SUN/260.1

Starlink Project
Starlink User Note 260.1

Brad Cavanagh
Joint Astronomy Centre

June 2008

ORAC-DR – Submm heterodyne pipeline data reduction 1.0 User Guide

---

Abstract

ORAC-DR is a general-purpose automatic data-reduction pipeline environment. This document describes its use to reduce heterodyne data collected at the James Clark Maxwell Telescope (JCMT).

Contents

1 Introduction 1

2 Running ORAC-DR 1

3 ACSIS Data 2

4 An overview of the reduction 3
- 4.1 Pointing observations . . . 3
- 4.2 Focus observations . . . 3
- 4.3 Flux calibrator observations . . . 3
- 4.4 Line source science observations . . . 3
- 4.5 Continuum source science observations . . . 3

5 Displaying reconstructed cubes and images 3

6 Variance propagation 4

7 Data files 4
- 7.1 Filenames and locations . . . 4
- 7.2 File suffixes . . . 4

A Recipes 5

B Main Recipes 5
- CADC_REDUCE_OBS . . . 6
- CONVERT_TO_FITS . . . 7
- GENERATE_CUBE . . . 8
- NO_OP . . . 9
- REDUCE_CUBE . . . 10
- REDUCE_DAS . . . 11
- REDUCE_FOCUS . . . 12
- REDUCE_PLANET_SAMPLE . . . 13
- REDUCE_POINTING . . . 14
- REDUCE_SCIENCE . . . 15
- REDUCE_SCIENCE_BROADLINE . . . 16
- REDUCE_SCIENCE_BROADLINE_CONTINUUM . . . 22
- REDUCE_SCIENCE_BROADLINE_POL . . . 23
- REDUCE_SCIENCE_BROADLINE_QA . . . 24
- REDUCE_SCIENCE_CONTINUUM . . . 25
- REDUCE_SCIENCE_CONTINUUM_POL . . . 26
- REDUCE_SCIENCE_CONTINUUM_QA . . . 27
- REDUCE_SCIENCE_FSW . . . 28
- REDUCE_SCIENCE_GRADIENT . . . 31
- REDUCE_SCIENCE_GRADIENT_POL . . . 40
- REDUCE_SCIENCE_LEGACY . . . 41
- REDUCE_SCIENCE_LINEFOREST . . . 42
- REDUCE_SCIENCE_LINEFOREST_POL . . . 49
- REDUCE_SCIENCE_NARROWLINE . . . 50

REDUCE_SCIENCE_NARROWLINE_CONTINUUM . . . 59
REDUCE_SCIENCE_NARROWLINE_POL . . . 60
REDUCE_SCIENCE_NARROWLINE_QA . . . 61
REDUCE_SCIENCE_POL . . . 62
REDUCE_SCIENCE_QA . . . 63
REDUCE_SCIENCE_SELFBL . . . 64
REDUCE_SKYDIP . . . 65
REDUCE_STANDARD . . . 66
REDUCE_STANDARD_POL . . . 67

C Quick Look Recipes 68
REDUCE_SCIENCE_BROADLINE_QL . . . 69
REDUCE_SCIENCE_CONTINUUM_QL . . . 70
REDUCE_SCIENCE_GRADIENT_QL . . . 71
REDUCE_SCIENCE_LINEFOREST_QL . . . 72
REDUCE_SCIENCE_NARROWLINE_QL . . . 73

D Summit Recipes 74
REDUCE_SCIENCE_BROADLINE_SUMMIT . . . 75
REDUCE_SCIENCE_CONTINUUM_SUMMIT . . . 76
REDUCE_SCIENCE_FSW_SUMMIT . . . 77
REDUCE_SCIENCE_GRADIENT_SUMMIT . . . 80
REDUCE_SCIENCE_LINEFOREST_SUMMIT . . . 81
REDUCE_SCIENCE_NARROWLINE_SUMMIT . . . 82

1 Introduction

Heterodyne data from the James Clerk Maxwell Telescope consists of data taken from a backend correlator such as ACSIS or the DAS and a frontend such as HARP (Buckle et al 2009, MNRAS, 399, 1026) or the single receptor instruments (RxA3, RXW etc). The pipeline system described here works with data taken in the ACSIS file format but can reduce data taken from the DAS if the data are first converted using the GSD2ACSIS SMURF command (SUN/258, SUN/259, SUN/229).

2 Running ORAC-DR

This is a very brief introduction to running ORAC-DR. More detailed information can be found in SUN/230. SUN/232 also includes a description of how to set up and run ORAC-DR.

You must first initialise ORAC-DR using `oracdr_acsis`. This will prepare ORAC-DR to reduce data taken that night. If you wish to reduce a previous nights data then you should specify the UT date on the command line, e.g. `oracdr_acsis 20080616`. If necessary, you should set the `$ORAC_DATA_IN` and `$ORAC_DATA_OUT` environment variables to the names of the directories from which the raw data should be read and to which reduced data should be written.

For example:

```
% oracdr_acsis 20080616
% setenv ORAC_DATA_IN /jcmtdata/raw/acsis/spectra/20080616
% setenv ORAC_DATA_OUT /home/bradc/data/oracdr/reduced/acsis/20080616
```

To reduce all data taken so far and then all data as it is stored you should run

```
oracdr -loop flag -skip
```

Several windows will (eventually) open: an ORAC-DR text display, GAIA windows and KAPVIEW windows (a collective term for various KAPPA display tasks). The pipeline will reduce the data as they are stored to disk, using the recipe name in the image header.

The pipeline is meant to run without interference from the observer. Thus, although you can use the various GAIA tools to examine images, the pipeline should not need to be stopped and/or restarted. If, however, you do need to restart the pipeline then this can be done using the `-from` option on the command line:

```
oracdr -loop flag -from 19 -skip
```

This will re-reduce frames from 19 onwards if they have previously been reduced, then continue to wait for new frames to arrive. The `-loop flag` tells it not to exit when it runs out of frames. When reducing data off-line this should be omitted. The `-skip` tells it to skip missing observations.

To re-reduce a group of previously stored frames you can use the `-list` option to specify a list of frames separated by commas or ranges separated by colons:

```
oracdr -list 15,18:20
```

You may choose to reduce your data with a recipe other than the one specified in the file headers. If you discover narrow-line data reduction produces better maps than the REDUCE_SCIENCE_GRADIENT recipe does, you may wish to specify the REDUCE_SCIENCE_NARROWLINE recipe on the command line, for example:

```
oracdr -loop flag -list 18:20 REDUCE\_SCIENCE\_NARROWLINE
```

Simplified recipes are available to perform a faster data reduction suitable to be carried out in real-time at the telescope. To use these recipes, supply the -recsuffix SUMMIT command-line option:

```
oracdr -list 18:20 -recsuffix SUMMIT
```

If ORAC-DR is initialised using oracdr_acsis_summit this option will be included automatically.

The chief advantage to using the -recsuffix SUMMIT option instead of supplying the full recipe on the command-line is if the summit recipe does not exist, the default standard recipe will be used instead. Thus you need not fear reducing pointing observations using a recipe designed for science targets.

To exit (or abort) ORAC-DR click on 'Exit' in the text log window, or type [ctrl]-c in the xterm. The command oracdr_nuke can be used to kill all DR-related processes, should you be having problems.

3 ACSIS Data

ACSIS data comes in two forms: time-series cubes and spatial/spectral cubes. Time-series cubes have frequency on the first axis, detector on the second, and time on the third. As data comes in off the telescope, the time slices are written to disk. Because data acquisition is asynchronous, time slices are not necessarily written in sequential order. Further, there is a 500-megabyte size limit for raw data files, more than one file can be written per observation. These files are called **subscans**.

ACSIS can be configured to take data at two (or more) frequencies or bandwidth modes at the same time in different **subsystems**. Subsystems are treated as individual and separate observations by ORAC-DR except for **hybrid mode** observations, where two (or four, for RxA, RxB, and RxW) subsystems are set up to overlap in frequency space in such a way that overlapping channels observe the same frequency.

Astronomers would rather deal with spatial/spectral cubes (heretofor referred to as **cubes** – when time-series cubes are discussed they will be called **time-series cubes** instead of time-series cubes. Time-series cubes are regridded onto a spatial grid, creating a cube with right ascension and declination on the first two axes and frequency on the third.

4 An overview of the reduction

The data reduction for ACSIS depends on the type of data being reduced. Calibration observations (pointings, focus, and flux calibrators) are reduced differently from science observations. Further, science observations are reduced differently based on what type of science is being done; planetary continuum observations have different processing steps from line sources.

4.1 Pointing observations

Pointing observations are used to ensure that the telescope is pointing in the correct location.

In reducing pointing observations, two different methods are done. The first assumes that a continuum source has been observed, and the second assumes that a line source has been observed.

In both modes, the time-series data are first regridded to form a cube. In continuum mode, the spectral regions lacking lines are collapsed to form an image, and in line mode the line regions are collapsed to form an image. If a five-position pointing is done, then a Gaussian is fit to horizontal and vertical cuts (which correspond to azimuth and elevation) to determine the location of the pointing source. Otherwise, centroiding is done on the source. The calculated pointing offset is then reported to the user.

4.2 Focus observations

Focus observations are used to ensure that the telescope is focussed.

ORAC-DR currently does not calculate any focus measurements. The time-series data are only regridded to form a cube.

4.3 Flux calibrator observations

4.4 Line source science observations

4.5 Continuum source science observations

5 Displaying reconstructed cubes and images

ORAC-DR automatically displays selected cubes, images, and spectra during its

6 Variance propagation

7 Data files

7.1 Filenames and locations

7.2 File suffixes

Frame suffixes

Suffix	Kept	Description
`_raw`	Y	The raw frame
`_adu`	Y	Scaled to ADUs
`_sbf`	N	Bias frame subtracted
`_pov`	N	Poisson variance added
`_rnv`	N	Readnoise variance added
`_bgl`	N	Shows which pixels are background limited
`_bp`	N	Bad pixels masked
`_ext`	Y	Slices extracted and approximately aligned
`_ff`	N	Flat fielded
`_nf`	Y	Normalised flat
`_bpf`	N	Pixels previously marked as bad filled with interpolated values
`_ss`	N	sky-subtracted
`_scr`	Y	All rows scrunched to common wavelength scale
`_cub`	Y	Formed into a datacube
`_dbsc`	N	All spectra in datacube divided by standard
`_im`	Y	Image extracted from datacube

Group suffixes

Suffix	Kept	Description
_scr	Y	All rows scrunched to common wavelength scale
_cub	Y	Formed into a datacube
_mos	Y	Mosaicked datacube
_dbsc	Y	All spectra in datacube divided by standard
_im	Y	Image extracted from datacube

A Recipes

These sections shows the reference documentation for each recipe. It is automatically generated from the POD written into the recipe file.

B Main Recipes

CADC_REDUCE_OBS
Reduce OBS products for CADC

Description:

Process individual observations to generate OBS products suitable for transfer to CADC.

Notes:

o No group processing. o Conversion to FITS occurs outside of the pipeline.

Author :

Tim Jenness <t.jenness@jach.hawaii.edu>

CONVERT_TO_FITS
Test recipe

Description:

Convert to FITS test recipe

GENERATE_CUBE
Generate a cube from raw data

Description:

Generate a cube from raw data.

NO_OP
No operation recipe

Description:

This recipe does not do anything.

REDUCE_CUBE
alias for REDUCE_SCIENCE

Description:

This recipe is an alias for the recipe REDUCE_SCIENCE.

REDUCE_DAS
reduce das files

Description:

Does something to das files.

REDUCE_FOCUS
Reduce a heterodyne focus observation

Description:

This recipe reduces a heterodyne focus observation.

Notes:

- This recipe is suitable for ACSIS (including DAS-converted) observations. It reduces hybrid focus observations too.
- This recipe previously only created a cube from the raw time-series data.

Related Recipes :

REDUCE_POINTING, REDUCE_SCIENCE.

REDUCE_PLANET_SAMPLE
reduce a planetary calibrator

Description:

Reduce a planetary calibrator.

REDUCE_POINTING
Reduce an ACSIS pointing observation

Description:

This recipe reduces an ACSIS pointing observation. It does so by first converting a time-series cube (or more than one, as the case may be) as written by the ACSIS specwriter into a spatial/spectral cube. This cube is then median collapsed using the central 80% of the spectral range to avoid edge noise. The pointing target is then located and centroided to find the pointing offset in arcseconds.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP backends, or DAS data converted to ACSIS format. It reduces hybrid pointing observations too.
- By default the created cube has AzEl spatial co-ordinates.
- Image sideband data from sideband-separating (2SB) receivers is not processed. This is because only data from the pointing receptor is processed. As this receptor will be associated with the main sideband, it will not appear in subsystems associated with the image sideband.

Output Data :

- A spatial/spectral cube whose filename is of the form aYYYYMMDD_NNNNN_SS_MMMM_cube.sdf, where YYYYMMDD is the UT date, NNNNN is the zero-padded observation number, SS is the zero-padded subsystem number, and MMMM is the first zero-padded sub-scan number for the given observation and subsystem.
- A collapsed " white light" image whose filename is of the form aYYYYMMDD_NNNNN_SS_MMMM_ where YYYYMMDD, NNNNN, SS, and MMMM are as described above.

Related Recipes :

REDUCE_SCIENCE

REDUCE_SCIENCE
alias for REDUCE_SCIENCE_GRADIENT

Description:

This recipe is an alias for the recipe REDUCE_SCIENCE_GRADIENT.

REDUCE_SCIENCE_BROADLINE
Reduce a broadline ACSIS science observation

Description:

This recipe reduces a broadline ACSIS science observation.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP backends.

Available Parameters

The following parameters can be set via the -recpars option:

ALIGN_SIDE_BAND

Whether to enable or disable the alignment of data taken through different side bands when combining them to create spectral cubes. To combine such data, this parameter should be set true (1) to switch on the AlignSideBand WCS attribute. However, this is incompatible with some early ACSIS data, where various changes to some WCS attributes subvert the combination. Should reductions fail with " No usable spectral channels found" , reduce the two side bands independently. The default is not not to align sidebands, but 'raw' data may have had AlignSideBand enabled from earlier processing (where the default was to align). Likewise data taken on different epochs with the same sideband should not have AlignSideBand switched on. [0]

BASELINE_EDGES

Percentage of the full range to fit on either edge of the spectra for baselining purposes. If set to a non-positive value and BASELINE_REGIONS is undefined, then the baseline is derived after smoothing and automatic emission detection. If assigned a negative value, BASELINE_REGIONS, if it is defined, will be used instead to specify where to determine the baseline. [10]

BASELINE_ORDER

The polynomial order to use when baselining cubes. [1]

BASELINE_REGIONS

A comma-separated list of velocity ranges each in the format v1:v2, from where the baseline should be estimated. It is countermanded should EDGES be defined and non-negative. [undef]

CHUNKSIZE

The maximum sum of file sizes in megabytes of files to process simultaneously in MAKECUBE to avoid a timeout. The choice is affected by processor speed and memory. The minimum allowed value is 100. [5120]

CREATE_MOMENTS_USING_SNR
If set to true (1), moments maps will be created using a signal-to-noise map to find emission regions. This could be useful when observations were taken under differing sky conditions and thus have different noise levels. [0]

CUBE_MAXSIZE
The maximum size, in megabytes, of the output cubes. This value does not include extra information such as variance or weight arrays, FITS headers, or any other NDF extensions. [512]

CUBE_WCS
The coordinate system to regrid the cubes to. If undefined, the system is determined from the data. [undef]

DESPIKE
If set to 1 (true) despiking of spectra is enabled. [0]

DESPIKE_BOX
The size, in pixels, of the box used to both find the " background" and for cleaning spikes. This box should be slightly wider than the widest expected spike. Making this parameter too large will result in signal being identified as a spike and thus masked out. [9]

DESPIKE_CLIP
The clip standard deviations to use when finding spikes in the background-subtracted RMS spectrum. Multiple values result in multiple clip levels. A single clip level should be given verbatim, (e.g. 3). If supplying more than one level, enclose comma-separated levels within square brackets (e.g. [3,3,5]). [' [3,5]']

DESPIKE_PER_DETECTOR
Whether or not to treat each detector independently during despiking. If a spike is not seen in all detectors, consider setting this value to 1 (for true). [0]

FINAL_LOWER_VELOCITY
Set a lower velocity over which the final products, such as the reduced and binned spectral cubes, and noise and rms images, are to be created. Unlike RESTRICT_LOWER_VELOCITY, it permits the full baselines to be used during processing, yet greatly reduces the storage requirements of the final products by retaining only where the astronomical signals reside. It is typically used in conjunction with FINAL_UPPER_VELOCITY. If undefined, there is no lower limit. If FINAL_UPPER_VELOCITY is also undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

FINAL_UPPER_VELOCITY
Set an upper velocity over which the final products, such as the reduced and binned spectral cubes, and noise and rms images, are to be created. Unlike RESTRICT_UPPER_VELOCITY, it permits the full baselines to be used during processing, yet greatly reduces the storage requirements of the final products by retaining only where the astronomical signals reside. It is typically used in conjunction with FINAL_LOWER_VELOCITY. If undefined, there is no upper limit. If FINAL_LOWER_VELOCITY is also undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

FLATFIELD
Whether or not to perform flat-fielding. [0]

FLAT_LOWER_VELOCITY
The requested lower velocity for the flat-field estimations using the sum or ratio methods. It should be less than FLAT_LOWER_VELOCITY. [undef]

FLAT_METHOD
When flat-fielding is required (cf. FLATFIELD parameter) this selects the method used to derive the relative gains between receptors. The allowed selection comprises ' ratio' , which finds the histogram peaks of the ratio of voxel values; ' sum' , which finds the integrated flux; and ' index' , which searches and applies a calibration index of nightly flat-field ratios. The ratio method ought to work well using all the data, but for some data, especially early observations, it has broken down as the histogram mode is biased towards zero by noise and possible non-linearity effects. The sum method currently assumes that every receptor is sampling the same signal, which is only approximately true. [' sum']

FLAT_UPPER_VELOCITY
The requested upper velocity for the flat-field estimations using the the sum or ratio methods. It should be greater than FLAT_LOWER_VELOCITY. [undef]

FRACTION_BAD
The maximum fraction of bad values permitted in a receptor (or receptor' s subband for a hybrid observation) permitted before the a receptor is deemed to be bad. It must lie between 0.1 and 1.0 otherwise the default fraction is substituted. [0.9]

FREQUENCY_SMOOTH
The number of channels to smooth in the frequency axis when smoothing to determine baselines. This number should be small (∼10) for narrow-line observations and large (∼25) for broad-line observations. [25]

HIGHFREQ_INTERFERENCE
If set to true (1) the spectra for each receptor are analysed to detect high-frequency interference noise, and those spectra deemed too noisy are excluded from the reduced products. [1]

HIGHFREQ_INTERFERENCE_EDGE_CLIP
This is used to reject spectra with high-frequency noise. It is the standard deviation to clip the summed-edginess profile iteratively in order to measure the mean and standard deviation of the profile unaffected by bad spectra. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. [" 2.0,2.0,2.5,3.0"]

HIGHFREQ_INTERFERENCE_THRESH_CLIP
This is used to reject spectra with high-frequency noise. This is the number of standard deviations at which to threshold the noise profile above its median level. [4.0]

HIGHFREQ_RINGING
Whether or not to test for high-frequency ringing in the spectra. This is where a band of spectra in the time series have the same oscillation frequency and origin with smoothly varying amplitude over time. The amplitude is an order of magnitude or more lower than the regular high-frequency interference, but because it extends over tens to over 200 spectra, its affect can be as potent. Even if set to 1 (true), at least HIGHFREQ_RINGING_MIN_SPECTRA spectra are required to give a sufficient baseline against which to detect spectra with ringing. The HIGHFREQ_INTERFERENCE parameter must be true to apply this filter. [0]

HIGHFREQ_RINGING_MIN_SPECTRA
Minimum number of good spectra for ringing filtering to be attempted. See HIGHFREQ_RINGING. The filter needs to be able to discriminate between the normal unaffected spectra from those with ringing. The value should be at least a few times larger than the number of affected spectra. Hence there is a minimum allowed value of 100. The default is an empirical guess; for the worst cases it will be too small. If there are insufficient spectra the filtering may still work to some degree. [400]

LV_AXIS
The axis to collapse in the cube to form the LV image. Can be the axis' s index or its generic " skylat" or " skylon" . [" skylat"]

LV_ESTIMATOR
The statistic to use to collapse the spatial axis to form the LV image. See the KAPPA:COLLAPSE:ESTIMATOR documentation for a list of allowed statistics. [" mean"]

LV_IMAGE
A longitude-velocity map is made from the reduced group cube, if this parameter is set to true (1). The longitude here carries its generic meaning, so it could equally well be right ascension or galactic longitude; the actual axis derives from the chosen co-ordinate system (see CUBE_WCS). [undef]

MOMENTS
A comma-separated list of moments maps to create. [" integ,iwc"]

MOMENTS_LOWER_VELOCITY
Set a lower velocity over which the moments maps are to be created. It is typically used in conjunction with MOMENTS_UPPER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

MOMENTS_UPPER_VELOCITY
Set an upper velocity over which the moments maps are to be created. It is typically used in conjunction with MOMENTS_LOWER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

PIXEL_SCALE
Pixel scale, in arcseconds, of cubes. If undefined it is determined from the data. [undef]

REBIN
A comma-separated list of velocity resolutions to rebin the final cube to. If undefined, the observed resolution is used. [undef]

RESTRICT_LOWER_VELOCITY
Trim all data to this lower velocity. It is typically used in conjunction with RESTRICT_UPPER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

RESTRICT_UPPER_VELOCITY
Trim all data to this upper velocity. It is typically used in conjunction with RESTRICT_LOWER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

SPATIAL_SMOOTH
The number of pixels to smooth in both spatial axes when smoothing to determine baselines. [3]

SPREAD_FWHM_OR_ZERO
Depending on the spreading method, this parameter controls the number of arcseconds at which the envelope of the spreading function goes to zero, or the full-width at half-maximum for the Gaussian envelope. See the PARAMS parameter in SMURF/MAKECUBE for more information. [undef]

SPREAD_METHOD
The method to use when spreading each input pixel value out between a group of neighbouring output pixels when regridding cubes. See the SPREAD parameter in SMURF/MAKECUBE for available spreading methods. [" nearest"]

SPREAD_WIDTH
The number of arcseconds on either side of the output position which are to receive contributions from the input pixel. See the PARAMS parameter in SMURF/MAKECUBE for more information. [0]

TILE
Whether or not to make tiled spectral cubes. A true value (1) performs tiling so as to restrict the data-processing resource requirements. Such tiled cubes abut each other in pixel co-ordinates and may be pasted together to form the complete spectral cube. [1]

TRIM_MINIMUM_OVERLAP
The minimum number of desired channels that should overlap after trimming hybrid-mode observations. If the number of overlapping channels is fewer than this, then the fixed number of channels will be trimmed according to the TRIM_PERCENTAGE, TRIM_PERCENTAGE_LOWER, and TRIM_PERCENTAGE_UPPER parameters. [10]

TRIM_PERCENTAGE_LOWER = REAL (Given)
The percentage of the total frequency range to trim from the lower end of the frequency range. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from the lower end. If it and TRIM_PERCENTAGE are undefined, the lower-end trimming defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

TRIM_PERCENTAGE = REAL (Given)
The percentage of the total frequency range to trim from either end. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from either end. This parameter only takes effect if both TRIM_PERCENTAGE_LOWER and TRIM_PERCENTAGE_UPPER are undefined. If it too is undefined, the upper-frequency trimming defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

TRIM_PERCENTAGE_UPPER = REAL (Given)
The percentage of the total frequency range to trim from the higher end of the frequency range. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from the upper end. If it and TRIM_PERCENTAGE are undefined, it defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

VELOCITY_BIN_FACTOR
This is an integer factor by which the spectral axis may be compressed by averaging adjacent channels. The rationale is to make the reduced spectral cubes files substantially

smaller; processing much faster; and to reduce the noise so that, for example, emission features are more easily identified and masked while determining the baselines. It is intended for ACSIS modes, such as BW250, possessing high spectral resolution not warranted by the signal-to-noise. Note that this compression is applied after any filtering of high-frequency artefacts performed on adjacent channels. A typical factor is 4. There is no compression if this parameter is undefined. [undef]

Output Data :

- A spatial/spectral cube whose filename is of the form aYYYYMMDD_NNNNN_SS_MMMM_cube.sdf, where YYYYMMDD is the UT date, NNNNN is the zero-padded observation number, SS is the zero-padded subsystem number, and MMMM is the first zero-padded sub-scan number for the given observation and subsystem.
- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.

Related Recipes :

REDUCE_SCIENCE_GRADIENT

REDUCE_SCIENCE_BROADLINE_CONTINUUM alias for REDUCE_SCIENCE_CONTINUUM

Description:

This recipe is an alias for the recipe REDUCE_SCIENCE_CONTINUUM.

REDUCE_SCIENCE_BROADLINE_POL
Reduce an ACSIS science polarimetry observation

Description:

This recipe reduces an ACSIS science polarimetry observation. It is currently a no-op.

REDUCE_SCIENCE_BROADLINE_QA
Reduce a broadline ACSIS science observation

Description:

This recipe reduces a broadline ACSIS science observation.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP backends.

Output Data :

- A spatial/spectral cube whose filename is of the form aYYYYMMDD_NNNNN_SS_MMMM_cube.sdf, where YYYYMMDD is the UT date, NNNNN is the zero-padded observation number, SS is the zero-padded subsystem number, and MMMM is the first zero-padded sub-scan number for the given observation and subsystem.
- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.

Related Recipes :

REDUCE_SCIENCE_GRADIENT

REDUCE_SCIENCE_CONTINUUM
Reduce an ACSIS science observation, without baselining

Description:

This recipe reduces an ACSIS science observation. It does so by first converting a time-series cube (or more than one, as the case may be) as written by the ACSIS specwriter into a spatial/spectral cube. This cube is then coadded to other cubes in the same group to form a higher signal-to-noise ratio cube.

Notes:

- This recipe is suitable for ACSIS using either the RxA3, RxA3m or HARP backends.

Output Data :

- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.
- Spatial/spectral cubes whose filenames are of the form aYYYYMMDD_M, where YYYYMMDD is the UT date, and M is the observation number. These are created in case the data are not marked as good and so are reduced individually at CADC.
- log.efficiency, only if the object is a planet for which this is allowed (URANUS, MARS or JUPITER).

Related Recipes :

REDUCE_POINTING

REDUCE_SCIENCE_CONTINUUM_POL
Reduce an ACSIS science polarimetry observation

Description:

This recipe reduces an ACSIS science polarimetry observation. It is currently a no-op.

REDUCE_SCIENCE_CONTINUUM_QA
Reduce an ACSIS science observation, without baselining

Description:

This recipe reduces an ACSIS science observation. It does so by first converting a time-series cube (or more than one, as the case may be) as written by the ACSIS specwriter into a spatial/spectral cube. This cube is then coadded to other cubes in the same group to form a higher signal-to-noise ratio cube.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP backends.

Output Data :

- A spatial/spectral cube whose filename is of the form aYYYYMMDD_NNNNN_SS_MMMM_cube.sdf, where YYYYMMDD is the UT date, NNNNN is the zero-padded observation number, SS is the zero-padded subsystem number, and MMMM is the first zero-padded sub-scan number for the given observation and subsystem.
- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.

Related Recipes :

REDUCE_POINTING

REDUCE_SCIENCE_FSW
Reduce an ACSIS narrow-line science observation using advanced algorithms

Description:

This recipe is used for advanced narrow-line ACSIS data processing.

This recipe first creates a spatial cube from the raw time series data. Then, working on the raw time series data, it subtracts a median time-series signal, thresholds the data, then trims the ends of the frequency range to remove high-noise regions.

After the time-series manipulation has been done to every member of the current group, every member is run through MAKECUBE to create a group spatial cube. This cube then has its baseline removed through a smoothing process, and moments maps are created.

A baseline mask formed from the group cube is run through UNMAKECUBE to form baseline masks for the input time-series data, which are then baselined. The baselined time-series data are then run through MAKECUBE to create observation cubes, from which moments maps are created.

Notes:

- This recipe is suitable for ACSIS data.
- The 'nearest' method is used for creating cubes with MAKECUBE.
- A 10-pixel box smooth is used in the frequency domain. This may be too large for some narrow-line data.

Available Parameters

The following parameters can be set via the -recpars option:

BASELINE_ORDER

The polynomial order to use when baselining cubes.

CREATE_MOMENTS_USING_SNR

If set to true (1), moments maps will be created using a signal-to-noise map to find emission regions. This could be useful when observations were taken under differing sky conditions and thus have different noise levels.

CUBE_WCS

The coordinate system to regrid the cubes to.

FLATFIELD

Whether or not to perform flat-fielding.

MOMENTS
A comma-separated list of moments maps to create.

MOMENTS_LOWER_VELOCITY
Set a lower velocity over which the moments maps are to be created. Typically used in conjunction with MOMENTS_UPPER_VELOCITY. Must include at least one decimal place (i.e. " -50.0" for setting the limit to -50 km/s).

MOMENTS_UPPER_VELOCITY
Set an upper velocity over which the moments maps are to be created. Typically used in conjunction with MOMENTS_LOWER_VELOCITY. Must include at least one decimal place (i.e. " 50.0" for setting the limit to 50 km/s).

PIXEL_SCALE
Pixel scale, in arcseconds, of cubes.

REBIN
A comma-separated list of velocity resolutions to rebin the final cube to.

RESTRICT_LOWER_VELOCITY
Trim all data to this lower velocity. Must include at least one decimal place (i.e. " -50.0" for restricting to -50 km/s).

RESTRICT_UPPER_VELOCITY
Trim all data to this upper velocity. Must include at least one decimal place (i.e. " 100.0" for restricting to 100 km/s).

SPREAD_METHOD
The method to use when spreading each input pixel value out between a group of neighbouring output pixels when regridding cubes. See the SPREAD parameter in SMURF/MAKECUBE for available spreading methods.

SPREAD_WIDTH
The number of arcseconds on either side of the output position which are to receive contributions from the input pixel. See the PARAMS parameter in SMURF/MAKECUBE for more information.

SPREAD_FWHM_OR_ZERO
Depending on the spreading method, this parameter controls the number of arcseconds at which the envelope of the spreading function goes to zero, or the full-width at half-maximum for the Gaussian envelope. See the PARAMS parameter in SMURF/MAKECUBE for more information.

Output Data :

- For individual time-series data: median time-series removed with the _tss suffix; thresholded data with the _thr suffix; frequency ends removed with the _em suffix; baseline-only mask with the _tsmask suffix; non-baseline regions masked with the _msk suffix; baselined data with the _bl suffix.
- For individual spatial/spectral cubes: baselined cube with the _cube suffix; baseline region ma sk with the _blmask suffix.

- For group cubes: cube with the _cube suffix; baseline region mask with the _blmask suffix; baselined cube with the _bl suffix;
- For moments maps: integrated intensity map with the _integ suffix; velocity map with the _iwc suffix.

Related Recipes :

REDUCE_SCIENCE_GRADIENT.

REDUCE_SCIENCE_GRADIENT
Reduces an ACSIS science observation using advanced algorithms

Description:

This recipe is used for advanced generic ACSIS data processing. It has not been tuned for any specific type of data.

This recipe first creates a spatial cube from the raw time-series data. Then, working on the raw time-series data, it subtracts a median time-series signal, thresholds the data, then trims the ends of the frequency range to remove high-noise regions. There is optional masking of noise spikes. Receptors with non-linear baselines and spectra affected by transient high-frequency noise may be rejected.

After the time-series manipulation has been done to every member of the current group, every member is run through MAKECUBE to create a group spatial cube. This cube then has its baseline removed through a smoothing process, and moments maps are created.

A baseline mask formed from the group cube is run through UNMAKECUBE to form baseline masks for the input time-series data, which are then baselined. The baselined time-series data are then run through MAKECUBE to create observation cubes, from which moments maps are created.

Notes:

- This recipe is suitable for ACSIS data.
- The 'nearest' method is used for creating cubes with MAKECUBE.
- The spatial smoothing has a three-pixel kernel, while frequency smooths over 25 pixels. Both use block averaging.
- There are a number of ways to define the baseline regions:
- as a percentage of the spectrum width at either end of the spectrum (see " BASELINE_EDGES" in AVAILABLE PARAMETERS);
- as a set of velocity ranges expected or known to be free of emission lines (see " BASELINE_REGIONS" in AVAILABLE PARAMETERS); or if both of these arguments or their corresponding recipe parameters are undefined,
- use the whole spectrum smoothing spectrally and spatially (see " FREQUENCY_SMOOTH" and " SPATIAL_SMOOTH" in AVAILABLE PARAMETERS) with feature detection to mask lines. This can also be selected if " BASELINE_REGIONS" in AVAILABLE PARAMETERS is defined for other purposes, such as the rejection of bad spectra. by setting the " BASELINE_METHOD" in AVAILABLE PARAMETERS to " auto" .

Available Parameters

The following parameters can be set via the -recpars option:

ALIGN_SIDE_BAND

Whether to enable or disable the alignment of data taken through different side bands when combining them to create spectral cubes. To combine such data, this parameter should be set true (1) to switch on the AlignSideBand WCS attribute. However, this is incompatible with some early ACSIS data, where various changes to some WCS attributes subvert the combination. Should reductions fail with "No usable spectral channels found", reduce the two side bands independently. The default is not not to align sidebands, but 'raw' data may have had AlignSideBand enabled from earlier processing (where the default was to align). Likewise data taken on different epochs with the same sideband should not have AlignSideBand switched on. [0]

BASELINE_EDGES

Percentage of the full range to fit on either edge of the spectra for baselining purposes. If set to a non-positive value and BASELINE_REGIONS is undefined, then the baseline is derived after smoothing and automatic emission detection. If assigned a negative value, BASELINE_REGIONS, if it is defined, will be used instead to specify where to determine the baseline. [undef]

BASELINE_EMISSION_CLIP

This is a comma-separated list of standard deviations factors for progressive clipping of outlying binned (see BASELINE_NUMBIN) residuals to an initial linear fit to the baseline. This is used to determine the fitting ranges automatically. Its purpose is to exclude features that are not part of the trends. Pixels are rejected at the ith clipping cycle if they lie beyond plus or minus BASELINE_EMISSION_CLIP(i) times the dispersion about the median of the remaining good pixels. Thus lower clipping factors will reject more pixels. The normal approach is to start low and progressively increase the clipping factors, as the dispersion decreases after the exclusion of features. Between one and five values may be supplied. The minimum value is 1.0. If undefined, the default for MFITTREND's CLIP parameter is used, which is fine in most cases. Where the emission is intense and extends over a substantial fraction of the spectrum, harsher clipping is needed to avoid biasing the fits. [undef]

BASELINE_LINEARITY

If set to true (1) receptors with mostly or all non-linear baselines are excluded from the reduced products. [1]

BASELINE_LINEARITY_CLIP

This is used to reject receptors that have non-linear baselines. It is the maximum number of standard deviations above the median rms deviations for which a detector's non-linearity is regarded as acceptable. The minimum allowed is 2. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. ["2.0,2.3,3.0"]

BASELINE_LINEARITY_LINEWIDTH

This is used to reject receptors that have transient or mostly non-linear baselines. It specifies the location of spectral-line emission or the regions to analyse for bad baselines. Allowed values are:

- "auto", which requests that the emission be found automatically;

- " base" meaning test the portions of the spectrum defined by the BASELINE_REGIONS recipe parameter; or
- it is the extent(s) of the source spectral line(s) measured in km/s, supplied in a comma-separated list. For this last option, each range may be given as bounds separated by a colon; or as a single value being the width about zero. For instance " -20:50" would excise the region -20 to +50 km/s, and " 30" would exclude the -15 to +15 km/s range. [" auto"]

BASELINE_LINEARITY_MINRMS
This is used to retain receptors that have noisy or slightly non-linear baselines, or transient bad baselines (cf. LOWFREQ_INTERFERENCE). The parameter is the minimum rms deviation from linearity, measured in antenna temperature, for a receptor to be flagged as bad. The non-linearity identification intercompares the receptors and can reject an outlier that in practice is not a bad receptor; it is just worse than the other receptors in an observation. This parameter sets an absolute lower limit to prevent such receptors from being excluded. Values between 0.05 and 0.2 are normal. Most good receptors will be in 0.02 to 0.05 range. [0.1]

BASELINE_LINEARITY_SCALELENGTH
This is used to reject receptors that have non-linear baselines. It is the smoothing scale length in whole pixels. Features narrower than this are filtered out during the background-level determination. It should be should be odd (if an even value is supplied, the next higher odd value will be used) and sufficiently large to remove the noise while not removing the low-frequency patterns in the spectra. The minimum allowed is 51. It is also used to detect transient non-linear baselines (cf. LOWFREQ_INTERFERENCE). [101]

BASELINE_METHOD
This specifies how to define the baseline region. Currently only " auto" is recognised. This requests the automated mode where the emission is detected and masked before baseline fitting. If undefined or not " auto" , then BASELINE_EDGES or BASELINE_REGIONS (q.v.) will be used.

BASELINE_NUMBIN
The number of smoothing bins to used for the baseline determination and hence the emission masking. The default lets MFITTREND choose (currently 32 bins), and is normally sufficient for narrow lines. For line forests, more resolution is needed so as not to include emission in the majority of bins, and so a value that will provide a few bins across the a line' s width is better, typically 128, which is the default if the LINEFOREST_BASELINE recipe parameter is true. []

BASELINE_ORDER
The polynomial order to use when baselining cubes. [1]

BASELINE_REGIONS
A comma-separated list of velocity ranges each in the format v1:v2, from where the baseline should be estimated. It is countermanded should BASELINE_EDGES be defined and non-negative. These can also be used to define where to test baseline linearity if BASELINE_LINEARITY_LINEWIDTH is set to " base" . [undef]

CHUNKSIZE
The maximum sum of file sizes in megabytes of files to process simultaneously in MAKE-CUBE to avoid a timeout. The choice is affected by processor speed and memory. The minimum allowed value is 100. [5120]

CREATE_MOMENTS_USING_SNR
If set to true (1), moments maps will be created using a signal-to-noise map to find emission regions. This could be useful when observations were taken under differing sky conditions and thus have different noise levels. [0]

CUBE_MAXSIZE
The maximum size, in megabytes, of the output cubes. This value does not include extra information such as variance or weight arrays, FITS headers, or any other NDF extensions. [512]

CUBE_WCS
The coordinate system to regrid the cubes to. If undefined, the system is determined from the data. [undef]

DESPIKE
If set to 1 (true) despiking of spectra is enabled. [0]

DESPIKE_BOX
The size, in pixels, of the box used to both find the "background" and for cleaning spikes. This box should be slightly wider than the widest expected spike. Making this parameter too large will result in signal being identified as a spike and thus masked out. [7]

DESPIKE_CLIP
The clip standard deviations to use when finding spikes in the background-subtracted RMS spectrum. Multiple values result in multiple clip levels. A single clip level should be given verbatim, (e.g. 3). If supplying more than one level, enclose comma-separated levels within square brackets (e.g. [3,3,5]). [' [3,5]']

DESPIKE_PER_DETECTOR
Whether or not to treat each detector independently during despiking. If a spike is not seen in all detectors, consider setting this value to 1 (for true). [0]

FINAL_LOWER_VELOCITY
Set a lower velocity over which the final products, such as the reduced and binned spectral cubes, and noise and rms images, are to be created. Unlike RESTRICT_LOWER_VELOCITY, it permits the full baselines to be used during processing, yet greatly reduces the storage requirements of the final products by retaining only where the astronomical signals reside. It is typically used in conjunction with FINAL_UPPER_VELOCITY. If undefined, there is no lower limit. If FINAL_UPPER_VELOCITY is also undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

FINAL_UPPER_VELOCITY
Set an upper velocity over which the final products, such as the reduced and binned spectral cubes, and noise and rms images, are to be created. Unlike RESTRICT_UPPER_VELOCITY, it permits the full baselines to be used during processing, yet greatly reduces the storage requirements of the final products by retaining only where the astronomical signals reside.

It is typically used in conjunction with FINAL_LOWER_VELOCITY. If undefined, there is no upper limit. If FINAL_LOWER_VELOCITY is also undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

FLATFIELD
Whether or not to perform flat-fielding. [0]

FLAT_LOWER_VELOCITY
The requested lower velocity for the flat-field estimations using the sum or ratio methods. It should be less than FLAT_LOWER_VELOCITY. [undef]

FLAT_METHOD
When flat-fielding is required (cf. FLATFIELD parameter) this selects the method used to derive the relative gains between receptors. The allowed selection comprises 'ratio' , which finds the histogram peaks of the ratio of voxel values; 'sum' , which finds the integrated flux; and 'index' , which searches and applies a calibration index of nightly flat-field ratios. The ratio method ought to work well using all the data, but for some data, especially early observations, it has broken down as the histogram mode is biased towards zero by noise and possible non-linearity effects. The sum method currently assumes that every receptor is sampling the same signal, which is only approximately true. ['sum']

FLAT_UPPER_VELOCITY
The requested upper velocity for the flat-field estimations using the the sum or ratio methods. It should be greater than FLAT_LOWER_VELOCITY. [undef]

FRACTION_BAD
The maximum fraction of bad values permitted in a receptor (or receptor' s subband for a hybrid observation) permitted before the a receptor is deemed to be bad. It must lie between 0.1 and 1.0 otherwise the default fraction is substituted. [0.9]

FREQUENCY_SMOOTH
The number of channels to smooth in the frequency axis when smoothing to determine baselines. This number should be small (∼10) for narrow-line observations and large (∼25) for broad-line observations. [25]

HIGHFREQ_INTERFERENCE
If set to true (1) the spectra for each receptor are analysed to detect high-frequency interference noise, and those spectra deemed too noisy are excluded from the reduced products. [1]

HIGHFREQ_INTERFERENCE_EDGE_CLIP
This is used to reject spectra with high-frequency noise. It is the standard deviation to clip the summed-edginess profile iteratively in order to measure the mean and standard deviation of the profile unaffected by bad spectra. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. [" 2.0,2.0,2.5,3.0"]

HIGHFREQ_INTERFERENCE_THRESH_CLIP
This is used to reject spectra with high-frequency noise. This is the number of standard deviations at which to threshold the noise profile above its median level. [4.0]

HIGHFREQ_RINGING
Whether or not to test for high-frequency ringing in the spectra. This is where a band of spectra in the time series have the same oscillation frequency and origin with smoothly varying amplitude over time. The amplitude is an order of magnitude or more lower than the regular high-frequency interference, but because it extends over tens to over 200 spectra, its affect can be as potent. Even if set to 1 (true), at least HIGHFREQ_RINGING_MIN_SPECTRA spectra are required to give a sufficient baseline against which to detect spectra with ringing. The HIGHFREQ_INTERFERENCE parameter must be true to apply this filter. [0]

HIGHFREQ_RINGING_MIN_SPECTRA
Minimum number of good spectra for ringing filtering to be attempted. See HIGHFREQ_RINGING. The filter needs to be able to discriminate between the normal unaffected spectra from those with ringing. The value should be at least a few times larger than the number of affected spectra. Hence there is a minimum allowed value of 100. The default is an empirical guess; for the worst cases it will be too small. If there are insufficient spectra the filtering may still work to some degree. [400]

LOWFREQ_INTERFERENCE
If set to true (1) the spectra for each receptor are analysed to detect low-frequency interference ripples or bad baselines, and those spectra deemed too deviant from linearity are excluded from the reduced products. [1]

LOWFREQ_INTERFERENCE_EDGE_CLIP
This is used to reject spectra with low-frequency interference. It is the standard deviation to clip the profile of summed-deviations from linearity iteratively in order to measure the mean and standard deviation of the profile unaffected by bad spectra. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. ["2.0,2.0,2.5,3.0"]

LOW_FREQ_INTERFERENCE_THRESH_CLIP
This is used to reject spectra with low-frequency interference. This is the number of standard deviations at which to threshold the non-linearity profile above its median level. [3.0]

LV_AXIS
The axis to collapse in the cube to form the LV image. Can be the axis's index or its generic "skylat" or "skylon". ["skylat"]

LV_ESTIMATOR
The statistic to use to collapse the spatial axis to form the LV image. See the KAPPA:COLLAPSE:ESTIMATOR documentation for a list of allowed statistics. ["mean"]

LV_IMAGE
A longitude-velocity map is made from the reduced group cube, if this parameter is set to true (1). The longitude here carries its generic meaning, so it could equally well be right ascension or galactic longitude; the actual axis derives from the chosen co-ordinate system (see CUBE_WCS). [undef]

MOMENTS
A comma-separated list of moments maps to create. ["integ,iwc"]

MOMENTS_LOWER_VELOCITY
Set a lower velocity over which the moments maps are to be created. It is typically used in conjunction with MOMENTS_UPPER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

MOMENTS_UPPER_VELOCITY
Set an upper velocity over which the moments maps are to be created. It is typically used in conjunction with MOMENTS_LOWER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

PIXEL_SCALE
Pixel scale, in arcseconds, of cubes. If undefined it is determined from the data. [undef]

REBIN
A comma-separated list of velocity resolutions to rebin the final cube to. If undefined, the observed resolution is used. [undef]

RESTRICT_LOWER_VELOCITY
Trim all data to this lower velocity. It is typically used in conjunction with RESTRICT_UPPER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

RESTRICT_UPPER_VELOCITY
Trim all data to this upper velocity. It is typically used in conjunction with RESTRICT_LOWER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

SPATIAL_SMOOTH
The number of pixels to smooth in both spatial axes when smoothing to determine baselines. [3]

SPREAD_METHOD
The method to use when spreading each input pixel value out between a group of neighbouring output pixels when regridding cubes. See the SPREAD parameter in SMURF/MAKECUBE for available spreading methods. [" nearest"]

SPREAD_WIDTH
The number of arcseconds on either side of the output position which are to receive contributions from the input pixel. See the PARAMS parameter in SMURF/MAKECUBE for more information. [0]

SPREAD_FWHM_OR_ZERO
Depending on the spreading method, this parameter controls the number of arcseconds at which the envelope of the spreading function goes to zero, or the full-width at half-maximum for the Gaussian envelope. See the PARAMS parameter in SMURF/MAKECUBE for more information. [undef]

TILE
Whether or not to make tiled spectral cubes. A true value (1) performs tiling so as to restrict the data-processing resource requirements. Such tiled cubes abut each other in pixel co-ordinates and may be pasted together to form the complete spectral cube. [1]

TRIM_MINIMUM_OVERLAP
The minimum number of desired channels that should overlap after trimming hybrid-mode observations. If the number of overlapping channels is fewer than this, then

the fixed number of channels will be trimmed according to the TRIM_PERCENTAGE, TRIM_PERCENTAGE_LOWER, and TRIM_PERCENTAGE_UPPER parameters. [10]

TRIM_PERCENTAGE_LOWER
The percentage of the total frequency range to trim from the lower end of the frequency range. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from the lower end. If it and TRIM_PERCENTAGE are undefined, the lower-end trimming defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

TRIM_PERCENTAGE
The percentage of the total frequency range to trim from either end. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from either end. This parameter only takes effect if both TRIM_PERCENTAGE_LOWER and TRIM_PERCENTAGE_UPPER are undefined. If it too is undefined, the upper-frequency trimming defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

TRIM_PERCENTAGE_UPPER
The percentage of the total frequency range to trim from the higher end of the frequency range. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from the upper end. If it and TRIM_PERCENTAGE are undefined, it defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

VELOCITY_BIN_FACTOR
This is an integer factor by which the spectral axis may be compressed by averaging adjacent channels. The rationale is to make the reduced spectral cubes files substantially smaller; processing much faster; and to reduce the noise so that, for example, emission features are more easily identified and masked while determining the baselines. It is intended for ACSIS modes, such as BW250, possessing high spectral resolution not warranted by the signal-to-noise. Note that this compression is applied after any filtering of high-frequency artefacts performed on adjacent channels. A typical factor is 4. There is no compression if this parameter is undefined. [undef]

Output Data :

- For individual time-series data: median time-series removed with the _tss suffix; thresholded data with the _thr suffix; frequency ends removed with the _em suffix; baseline-only mask with the _tsmask suffix; non-baseline regions masked with the _msk suffix; baselined data with the _bl suffix.
- For individual spatial/spectral cubes: baselined cube with the _cube suffix; baseline region mask with the _blmask suffix.
- For group cubes: cube with the _cube suffix; baseline region mask with the _blmask suffix; baselined cube with the _bl suffix;
- For moments maps: integrated intensity map with the _integ suffix; velocity map with the _iwc suffix. An optional longitude-velocity image with the _lv suffix, derived from the group cube.

Related Recipes :

REDUCE_SCIENCE_NARROWLINE.

REDUCE_SCIENCE_GRADIENT_POL
Reduce an ACSIS science polarimetry observation

Description:

This recipe reduces an ACSIS science polarimetry observation. It is currently a no-op.

REDUCE_SCIENCE_LEGACY
Reduces an ACSIS narrow-line science observation using advanced algorithms for the tiled public release

Description:

This recipe is used for advanced narrow-line ACSIS data processing forming spectral cubes for all JSA (HEALPix) tiles included within the sky region observed. Products are named to distinguish them from normal reduced cubes. (See OUTPUT DATA below.) Otherwise it performs the REDUCE_SCIENCE_NARROWLINE recipe. Please see the documentation for that recipe for further information.

Output Data :

- For individual spatial/spectral cubes: baselined cube with the _cube suffix; baseline region mask with the _blmask suffix.
- For group cubes: cube with the _healpix<n> suffix, where <n> is the HEALPix tile index.

Related Recipes :

REDUCE_SCIENCE_NARROWLINE

REDUCE_SCIENCE_LINEFOREST
Reduce an ACSIS lineforest science observation using advanced algorithms

Description:

This recipe is used for advanced lineforest ACSIS data processing.

This recipe first creates a spatial cube from the raw time series data. Then, working on the raw time series data, it subtracts a median time-series signal, thresholds the data, then trims the ends of the frequency range to remove high-noise regions. There is optional masking of noise spikes. Receptors with non-linear baselines and spectra affected by transient high-frequency noise may be rejected.

After the time-series manipulation has been done to every member of the current group, every member is run through MAKECUBE to create a group spatial cube. This cube then has its baseline removed through a smoothing process, and moments maps are created for the full cube and for each detected line.

A baseline mask formed from the group cube is run through UNMAKECUBE to form baseline masks for the input time-series data, which are then baselined. The baselined time-series data are then run through MAKECUBE to create observation cubes, from which moments maps are created.

Notes:

- This recipe is suitable for ACSIS data.
- The 'nearest' method is used for creating cubes with MAKECUBE.
- A 10-pixel box smooth is used in the frequency domain. This may be too large for some narrow-line data. The spatial smoothing has a five-pixel kernel.

Available Parameters

The following parameters can be set via the -recpars option:

ALIGN_SIDE_BAND

Whether to enable or disable the alignment of data taken through different side bands when combining them to create spectral cubes. To combine such data, this parameter should be set true (1) to switch on the AlignSideBand WCS attribute. However, this is incompatible with some early ACSIS data, where various changes to some WCS attributes subvert the combination. Should reductions fail with " No usable spectral channels found" , reduce the two side bands independently. The default is not not to align sidebands, but 'raw' data may have had AlignSideBand enabled from earlier processing (where the default was to align). Likewise data taken on different epochs with the same sideband should not have AlignSideBand switched on. [0]

BASELINE_LINEARITY
If set to true (1) receptors with mostly or all non-linear baselines are excluded from the reduced products. [1]

BASELINE_LINEARITY_CLIP
This is used to reject receptors that have non-linear baselines. It is the maximum number of standard deviations above the median rms deviations for which a detector's non-linearity is regarded as acceptable. The minimum allowed is 2. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. ["2.0,2.3,3.0"]

BASELINE_LINEARITY_LINEWIDTH
This is used to reject receptors that have transient or mostly non-linear baselines. It specifies the location of spectral-line emission or the regions to analyse for bad baselines. Allowed values are:

- "auto", which requests that the emission be found automatically;
- "base" meaning test the portions of the spectrum defined by recipe parameter BASELINE_REGIONS; or
- it is the extent(s) of the source spectral line(s) measured in km/s, supplied in a comma-separated list. For this last option, each range may be given as bounds separated by a colon; or as a single value being the width about zero. For instance "-20:50" would excise the region -20 to +50 km/s, and "30" would exclude the -15 to +15 km/s range. ["auto"]

BASELINE_LINEARITY_MINRMS
This is used to retain receptors that have noisy or slightly non-linear baselines, or transient bad baselines (cf. LOWFREQ_INTERFERENCE). The parameter is the minimum rms deviation from linearity, measured in antenna temperature, for a receptor to be flagged as bad. The non-linearity identification intercompares the receptors and can reject an outlier that in practice is not a bad receptor; it is just worse than the other receptors in an observation. This parameter sets an absolute lower limit to prevent such receptors from being excluded. Values between 0.05 and 0.2 are normal. Most good receptors will be in 0.02 to 0.05 range. [0.1]

BASELINE_LINEARITY_SCALELENGTH
This is used to reject receptors that have non-linear baselines. It is the smoothing scale length in whole pixels. Features narrower than this are filtered out during the background-level determination. It should be should be odd (if an even value is supplied, the next higher odd value will be used) and sufficiently large to remove the noise while not removing the low-frequency patterns in the spectra. The minimum allowed is 51. It is also used to detect transient non-linear baselines (cf. LOWFREQ_INTERFERENCE). [101]

BASELINE_ORDER
The polynomial order to use when baselining cubes. [1]

BASELINE_REGIONS
A comma-separated list of velocity ranges each in the format v1:v2, from where the baseline should be estimated. These can also be used to define where to test baseline linearity if BASELINE_LINEARITY_LINEWIDTH is set to "base". [undef]

CHUNKSIZE
The maximum sum of file sizes in megabytes of files to process simultaneously in MAKE-CUBE to avoid a timeout. The choice is affected by processor speed and memory. The minimum allowed value is 100. [5120]

CREATE_MOMENTS_USING_SNR
If set to true (1), moments maps will be created using a signal-to-noise map to find emission regions. This could be useful when observations were taken under differing sky conditions and thus have different noise levels. [0]

CUBE_MAXSIZE
The maximum size, in megabytes, of the output cubes. This value does not include extra information such as variance or weight arrays, FITS headers, or any other NDF extensions. [512]

CUBE_WCS
The coordinate system to regrid the cubes to. If undefined, the system is determined from the data. [undef]

DESPIKE
If set to 1 (true) despiking of spectra is enabled. [0]

DESPIKE_BOX
The size, in pixels, of the box used to both find the " background" and for cleaning spikes. This box should be slightly wider than the widest expected spike. Making this parameter too large will result in signal being identified as a spike and thus masked out. [5]

DESPIKE_CLIP
The clip standard deviations to use when finding spikes in the background-subtracted RMS spectrum. Multiple values result in multiple clip levels. A single clip level should be given verbatim, (e.g. 3). If supplying more than one level, enclose comma-separated levels within square brackets (e.g. [3,3,5]). [' [3,5]']

DESPIKE_PER_DETECTOR
Whether or not to treat each detector independently during despiking. If a spike is not seen in all detectors, consider setting this value to 1 (for true). [0]

FINAL_LOWER_VELOCITY
Set a lower velocity over which the final products, such as the reduced and binned spectral cubes, and noise and rms images, are to be created. Unlike RESTRICT_LOWER_VELOCITY, it permits the full baselines to be used during processing, yet greatly reduces the storage requirements of the final products by retaining only where the astronomical signals reside. It is typically used in conjunction with FINAL_UPPER_VELOCITY. If undefined, there is no lower limit. If FINAL_UPPER_VELOCITY is also undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

FINAL_UPPER_VELOCITY
Set an upper velocity over which the final products, such as the reduced and binned spectral cubes, and noise and rms images, are to be created. Unlike RESTRICT_UPPER_VELOCITY, it permits the full baselines to be used during processing, yet greatly reduces the storage requirements of the final products by retaining only where the astronomical signals reside.

It is typically used in conjunction with FINAL_LOWER_VELOCITY. If undefined, there is no upper limit. If FINAL_LOWER_VELOCITY is also undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

FLATFIELD
Whether or not to perform flat-fielding. [0]

FLAT_LOWER_VELOCITY
The requested lower velocity for the flat-field estimations using the sum or ratio methods. It should be less than FLAT_LOWER_VELOCITY. [undef]

FLAT_METHOD
When flat-fielding is required (cf. FLATFIELD parameter) this selects the method used to derive the relative gains between receptors. The allowed selection comprises 'ratio', which finds the histogram peaks of the ratio of voxel values; 'sum', which finds the integrated flux; and 'index', which searches and applies a calibration index of nightly flat-field ratios. The ratio method ought to work well using all the data, but for some data, especially early observations, it has broken down as the histogram mode is biased towards zero by noise and possible non-linearity effects. The sum method currently assumes that every receptor is sampling the same signal, which is only approximately true. ['sum']

FLAT_UPPER_VELOCITY
The requested upper velocity for the flat-field estimations using the the sum or ratio methods. It should be greater than FLAT_LOWER_VELOCITY. [undef]

FRACTION_BAD
The maximum fraction of bad values permitted in a receptor (or receptor's subband for a hybrid observation) permitted before the a receptor is deemed to be bad. It must lie between 0.1 and 1.0 otherwise the default fraction is substituted. [0.9]

FREQUENCY_SMOOTH
The number of channels to smooth in the frequency axis when smoothing to determine baselines. This number should be small (∼10) for narrow-line observations and large (∼25) for broad-line observations. [10]

HIGHFREQ_INTERFERENCE
If set to true (1) the spectra for each receptor are analysed to detect high-frequency interference noise, and those spectra deemed too noisy are excluded from the reduced products. [1]

HIGHFREQ_INTERFERENCE_EDGE_CLIP
This is used to reject spectra with high-frequency noise. It is the standard deviation to clip the summed-edginess profile iteratively in order to measure the mean and standard deviation of the profile unaffected by bad spectra. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. ["2.0,2.0,2.5,3.0"]

HIGHFREQ_INTERFERENCE_THRESH_CLIP
This is used to reject spectra with high-frequency noise. This is the number of standard deviations at which to threshold the noise profile above its median level. [4.0]

HIGHFREQ_RINGING
Whether or not to test for high-frequency ringing in the spectra. This is where a band of spectra in the time series have the same oscillation frequency and origin with smoothly varying amplitude over time. The amplitude is an order of magnitude or more lower than the regular high-frequency interference, but because it extends over tens to over 200 spectra, its affect can be as potent. Even if set to 1 (true), at least HIGHFREQ_RINGING_MIN_SPECTRA spectra are required to give a sufficient baseline against which to detect spectra with ringing. The HIGHFREQ_INTERFERENCE parameter must be true to apply this filter. [0]

HIGHFREQ_RINGING_MIN_SPECTRA
Minimum number of good spectra for ringing filtering to be attempted. See HIGHFREQ_RINGING. The filter needs to be able to discriminate between the normal unaffected spectra from those with ringing. The value should be at least a few times larger than the number of affected spectra. Hence there is a minimum allowed value of 100. The default is an empirical guess; for the worst cases it will be too small. If there are insufficient spectra the filtering may still work to some degree. [400]

LOWFREQ_INTERFERENCE
If set to true (1) the spectra for each receptor are analysed to detect low-frequency interference ripples or bad baselines, and those spectra deemed too deviant from linearity are excluded from the reduced products. [1]

LOWFREQ_INTERFERENCE_EDGE_CLIP
This is used to reject spectra with low-frequency interference. It is the standard deviation to clip the profile of summed-deviations from linearity iteratively in order to measure the mean and standard deviation of the profile unaffected by bad spectra. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. [" 2.0,2.0,2.5,3.0"]

LOW_FREQ_INTERFERENCE_THRESH_CLIP
This is used to reject spectra with low-frequency interference. This is the number of standard deviations at which to threshold the non-linearity profile above its median level. [3.0]

MINIMUM_LINE_WIDTH
The minimum line width, in channels, of automatically detected lines.

MOMENTS
A comma-separated list of moments maps to create. [" integ,iwc"]

MOMENTS_LOWER_VELOCITY
Set a lower velocity over which the moments maps are to be created. It is typically used in conjunction with MOMENTS_UPPER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

MOMENTS_UPPER_VELOCITY
Set an upper velocity over which the moments maps are to be created. It is typically used in conjunction with MOMENTS_LOWER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

PIXEL_SCALE
Pixel scale, in arcseconds, of cubes. If undefined it is determined from the data. [undef]

REBIN
A comma-separated list of velocity resolutions to rebin the final cube to. If undefined, the observed resolution is used. [undef]

RESTRICT_LOWER_VELOCITY
Trim all data to this lower velocity. It is typically used in conjunction with RESTRICT_UPPER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

RESTRICT_UPPER_VELOCITY
Trim all data to this upper velocity. It is typically used in conjunction with RESTRICT_LOWER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

SPATIAL_SMOOTH
The number of pixels to smooth in both spatial axes when smoothing to determine baselines. [1]

SPREAD_METHOD
The method to use when spreading each input pixel value out between a group of neighbouring output pixels when regridding cubes. See the SPREAD parameter in SMURF/MAKECUBE for available spreading methods. [" nearest"]

SPREAD_WIDTH
The number of arcseconds on either side of the output position which are to receive contributions from the input pixel. See the PARAMS parameter in SMURF/MAKECUBE for more information. [0]

SPREAD_FWHM_OR_ZERO
Depending on the spreading method, this parameter controls the number of arcseconds at which the envelope of the spreading function goes to zero, or the full-width at half-maximum for the Gaussian envelope. See the PARAMS parameter in SMURF/MAKECUBE for more information. [undef]

TILE
Whether or not to make tiled spectral cubes. A true value (1) performs tiling so as to restrict the data-processing resource requirements. Such tiled cubes abut each other in pixel co-ordinates and may be pasted together to form the complete spectral cube. [1]

TRIM_MINIMUM_OVERLAP
The minimum number of desired channels that should overlap after trimming hybrid-mode observations. If the number of overlapping channels is fewer than this, then the fixed number of channels will be trimmed according to the TRIM_PERCENTAGE, TRIM_PERCENTAGE_LOWER, and TRIM_PERCENTAGE_UPPER parameters. [10]

TRIM_PERCENTAGE_LOWER
The percentage of the total frequency range to trim from the lower end of the frequency range. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from the lower end. If it and TRIM_PERCENTAGE are undefined, the lower-end trimming defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

TRIM_PERCENTAGE
The percentage of the total frequency range to trim from either end. For example,

if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from either end. This parameter only takes effect if both TRIM_PERCENTAGE_LOWER and TRIM_PERCENTAGE_UPPER are undefined. If it too is undefined, the upper-frequency trimming defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

TRIM_PERCENTAGE_UPPER
The percentage of the total frequency range to trim from the higher end of the frequency range. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from the upper end. If it and TRIM_PERCENTAGE are undefined, it defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

VELOCITY_BIN_FACTOR
This is an integer factor by which the spectral axis may be compressed by averaging adjacent channels. The rationale is to make the reduced spectral cubes files substantially smaller; processing much faster; and to reduce the noise so that, for example, emission features are more easily identified and masked while determining the baselines. It is intended for ACSIS modes, such as BW250, possessing high spectral resolution not warranted by the signal-to-noise. Note that this compression is applied after any filtering of high-frequency artefacts performed on adjacent channels. A typical factor is 4. There is no compression if this parameter is undefined. [undef]

Output Data :

- For individual time-series data: median time-series removed with the _tss suffix; thresholded data with the _thr suffix; frequency ends removed with the _em suffix; baseline-only mask with the _tsmask suffix; non-baseline regions masked with the _msk suffix; baselined data with the _bl suffix.
- For individual spatial/spectral cubes: baselined cube with the _cube suffix; baseline region mask with the _blmask suffix.
- For group cubes: cube with the _cube suffix; baseline region mask with the _blmask suffix; baselined cube with the _bl suffix;
- For moments maps: integrated intensity map with the _integ suffix; velocity map with the _iwc suffix.

Related Recipes :

REDUCE_SCIENCE_GRADIENT, REDUCE_SCIENCE_NARROWLINE.

REDUCE_SCIENCE_LINEFOREST_POL
Reduce an ACSIS science polarimetry observation

Description:

This recipe reduces an ACSIS science polarimetry observation. It is currently a no-op.

REDUCE_SCIENCE_NARROWLINE
Reduces an ACSIS narrow-line science observation using advanced algorithms

Description:

This recipe is used for advanced narrow-line ACSIS data processing.

This recipe first creates a spatial cube from the raw time-series data. Then, working on the raw time-series data, it subtracts a median time-series signal, thresholds the data, then trims the ends of the frequency range to remove high-noise regions. There is optional masking of noise spikes. Receptors with non-linear baselines and spectra affected by transient high-frequency noise may be rejected.

After the time-series manipulation has been done to every member of the current group, every member is run through MAKECUBE to create a group spatial cube. This cube then has its baseline removed through a smoothing process, and moments maps are created.

A baseline mask formed from the group cube is run through UNMAKECUBE to form baseline masks for the input time-series data, which are then baselined. The baselined time-series data are then run through MAKECUBE to create observation cubes, from which moments maps are created.

Notes:

- This recipe is suitable for ACSIS data.
- The 'nearest' method is used for creating cubes with MAKECUBE.
- A 10-pixel box smooth is used in the frequency domain. This may be too large for some narrow-line data. The spatial smoothing has a five-pixel kernel.
- There are a number of ways to define the baseline regions:
- as a percentage of the spectrum width at either end of the spectrum (see " BASELINE_EDGES" in AVAILABLE PARAMETERS);
- as a set of velocity ranges expected or known to be free of emission lines (see " BASELINE_REGIONS" in AVAILABLE PARAMETERS); or if both of these arguments or their corresponding recipe parameters are undefined,
- use the whole spectrum smoothing spectrally and spatially (see " FREQUENCY_SMOOTH" and " SPATIAL_SMOOTH" in AVAILABLE PARAMETERS) with feature detection to mask lines. This can also be selected if " BASELINE_REGIONS" in AVAILABLE PARAMETERS is defined for other purposes, such as the rejection of bad spectra. by setting the " BASELINE_METHOD" in AVAILABLE PARAMETERS to " auto" .

Available Parameters

The following parameters can be set via the -recpars option:

ALIGN_SIDE_BAND
Whether to enable or disable the alignment of data taken through different side bands when combining them to create spectral cubes. To combine such data, this parameter should be set true (1) to switch on the AlignSideBand WCS attribute. However, this is incompatible with some early ACSIS data, where various changes to some WCS attributes subvert the combination. Should reductions fail with " No usable spectral channels found" , reduce the two side bands independently. The default is not not to align sidebands, but 'raw' data may have had AlignSideBand enabled from earlier processing (where the default was to align). Likewise data taken on different epochs with the same sideband should not have AlignSideBand switched on. [0]

BASELINE_EDGES
Percentage of the full range to fit on either edge of the spectra for baselining purposes. If set to a non-positive value and BASELINE_REGIONS is undefined, then the baseline is derived after smoothing and automatic emission detection. If assigned a negative value, BASELINE_REGIONS, if it is defined, will be used instead to specify where to determine the baseline. [undef]

BASELINE_EMISSION_CLIP
This is a comma-separated list of standard deviations factors for progressive clipping of outlying binned (see BASELINE_NUMBIN) residuals to an initial linear fit to the baseline. This is used to determine the fitting ranges automatically. Its purpose is to exclude features that are not part of the trends. Pixels are rejected at the ith clipping cycle if they lie beyond plus or minus BASELINE_EMISSION_CLIP(i) times the dispersion about the median of the remaining good pixels. Thus lower clipping factors will reject more pixels. The normal approach is to start low and progressively increase the clipping factors, as the dispersion decreases after the exclusion of features. Between one and five values may be supplied. The minimum value is 1.0. If undefined, the default for MFITTREND' s CLIP parameter is used, which is fine in most cases. Where the emission is intense and extends over a substantial fraction of the spectrum, harsher clipping is needed to avoid biasing the fits. [undef]

BASELINE_LINEARITY
If set to true (1) receptors with mostly or all non-linear baselines are excluded from the reduced products. [1]

BASELINE_LINEARITY_CLIP
This is used to reject receptors that have non-linear baselines. It is the maximum number of standard deviations above the median rms deviations for which a detector' s non-linearity is regarded as acceptable. The minimum allowed is 2. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. [" 2.0,2.3,3.0"]

BASELINE_LINEARITY_LINEWIDTH
This is used to reject receptors that have transient or mostly non-linear baselines. It specifies the location of spectral-line emission or the regions to analyse for bad baselines. Allowed values are:

- " auto" , which requests that the emission be found automatically;

- " base" meaning test the portions of the spectrum defined by the BASELINE_REGIONS recipe parameter; or
- it is the extent(s) of the source spectral line(s) measured in km/s, supplied in a comma-separated list. For this last option, each range may be given as bounds separated by a colon; or as a single value being the width about zero. For instance " -20:50" would excise the region -20 to +50 km/s, and " 30" would exclude the -15 to +15 km/s range. [" auto"]

BASELINE_LINEARITY_MINRMS
This is used to retain receptors that have noisy or slightly non-linear baselines, or transient bad baselines (cf. LOWFREQ_INTERFERENCE). The parameter is the minimum rms deviation from linearity, measured in antenna temperature, for a receptor to be flagged as bad. The non-linearity identification intercompares the receptors and can reject an outlier that in practice is not a bad receptor; it is just worse than the other receptors in an observation. This parameter sets an absolute lower limit to prevent such receptors from being excluded. Values between 0.05 and 0.2 are normal. Most good receptors will be in 0.02 to 0.05 range. [0.1]

BASELINE_LINEARITY_SCALELENGTH
This is used to reject receptors that have non-linear baselines. It is the smoothing scale length in whole pixels. Features narrower than this are filtered out during the background-level determination. It should be should be odd (if an even value is supplied, the next higher odd value will be used) and sufficiently large to remove the noise while not removing the low-frequency patterns in the spectra. The minimum allowed is 51. It is also used to detect transient non-linear baselines (cf. LOWFREQ_INTERFERENCE). [101]

BASELINE_METHOD
This specifies how to define the baseline region. Currently only " auto" is recognised. This requests the automated mode where the emission is detected and masked before baseline fitting. If undefined or not " auto" , then BASELINE_EDGES or BASELINE_REGIONS (q.v.) will be used.

BASELINE_NUMBIN
The number of smoothing bins to used for the baseline determination and hence the emission masking. The default lets MFITTREND choose (currently 32 bins), and is normally sufficient for narrow lines. For line forests, more resolution is needed so as not to include emission in the majority of bins, and so a value that will provide a few bins across the a line’ s width is better, typically 128, which is the default if the LINEFOREST_BASELINE recipe parameter is true. []

BASELINE_ORDER
The polynomial order to use when baselining cubes. [1]

BASELINE_REGIONS
A comma-separated list of velocity ranges each in the format v1:v2, from where the baseline should be estimated. It is countermanded should BASELINE_EDGES be defined and non-negative. These can also be used to define where to test baseline linearity if BASELINE_LINEARITY_LINEWIDTH is set to " base" . [undef]

CHUNKSIZE
The maximum sum of file sizes in megabytes of files to process simultaneously in MAKE-CUBE to avoid a timeout. The choice is affected by processor speed and memory. The minimum allowed value is 100. [5120]

CREATE_MOMENTS_USING_SNR
If set to true (1), moments maps will be created using a signal-to-noise map to find emission regions. This could be useful when observations were taken under differing sky conditions and thus have different noise levels. [0]

CUBE_MAXSIZE
The maximum size, in megabytes, of the output cubes. This value does not include extra information such as variance or weight arrays, FITS headers, or any other NDF extensions. [512]

CUBE_WCS
The coordinate system to regrid the cubes to. If undefined, the system is determined from the data. [undef]

DESPIKE
If set to 1 (true) despiking of spectra is enabled. [0]

DESPIKE_BOX
The size, in pixels, of the box used to both find the "background" and for cleaning spikes. This box should be slightly wider than the widest expected spike. Making this parameter too large will result in signal being identified as a spike and thus masked out. [5]

DESPIKE_CLIP
The clip standard deviations to use when finding spikes in the background-subtracted RMS spectrum. Multiple values result in multiple clip levels. A single clip level should be given verbatim, (e.g. 3). If supplying more than one level, enclose comma-separated levels within square brackets (e.g. [3,3,5]). ['[3,5]']

DESPIKE_PER_DETECTOR
Whether or not to treat each detector independently during despiking. If a spike is not seen in all detectors, consider setting this value to 1 (for true). [0]

FINAL_LOWER_VELOCITY
Set a lower velocity over which the final products, such as the reduced and binned spectral cubes, and noise and rms images, are to be created. Unlike RESTRICT_LOWER_VELOCITY, it permits the full baselines to be used during processing, yet greatly reduces the storage requirements of the final products by retaining only where the astronomical signals reside. It is typically used in conjunction with FINAL_UPPER_VELOCITY. If undefined, there is no lower limit. If FINAL_UPPER_VELOCITY is also undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

FINAL_UPPER_VELOCITY
Set an upper velocity over which the final products, such as the reduced and binned spectral cubes, and noise and rms images, are to be created. Unlike RESTRICT_UPPER_VELOCITY, it permits the full baselines to be used during processing, yet greatly reduces the storage requirements of the final products by retaining only where the astronomical signals reside.

It is typically used in conjunction with FINAL_LOWER_VELOCITY. If undefined, there is no upper limit. If FINAL_LOWER_VELOCITY is also undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

FLATFIELD
Whether or not to perform flat-fielding. [0]

FLAT_LOWER_VELOCITY
The requested lower velocity for the flat-field estimations using the sum or ratio methods. It should be less than FLAT_LOWER_VELOCITY. [undef]

FLAT_METHOD
When flat-fielding is required (cf. FLATFIELD parameter) this selects the method used to derive the relative gains between receptors. The allowed selection comprises 'ratio' , which finds the histogram peaks of the ratio of voxel values; 'sum' , which finds the integrated flux; and 'index' , which searches and applies a calibration index of nightly flat-field ratios. The ratio method ought to work well using all the data, but for some data, especially early observations, it has broken down as the histogram mode is biased towards zero by noise and possible non-linearity effects. The sum method currently assumes that every receptor is sampling the same signal, which is only approximately true. ['sum']

FLAT_UPPER_VELOCITY
The requested upper velocity for the flat-field estimations using the the sum or ratio methods. It should be greater than FLAT_LOWER_VELOCITY. [undef]

FRACTION_BAD
The maximum fraction of bad values permitted in a receptor (or receptor' s subband for a hybrid observation) permitted before the a receptor is deemed to be bad. It must lie between 0.1 and 1.0 otherwise the default fraction is substituted. [0.9]

FREQUENCY_SMOOTH
The number of channels to smooth in the frequency axis when smoothing to determine baselines. This number should be small (∼10) for narrow-line observations and large (∼25) for broad-line observations. [10]

HIGHFREQ_INTERFERENCE
If set to true (1) the spectra for each receptor are analysed to detect high-frequency interference noise, and those spectra deemed too noisy are excluded from the reduced products. [1]

HIGHFREQ_INTERFERENCE_EDGE_CLIP
This is used to reject spectra with high-frequency noise. It is the standard deviation to clip the summed-edginess profile iteratively in order to measure the mean and standard deviation of the profile unaffected by bad spectra. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. [" 2.0,2.0,2.5,3.0"]

HIGHFREQ_INTERFERENCE_THRESH_CLIP
This is used to reject spectra with high-frequency noise. This is the number of standard deviations at which to threshold the noise profile above its median level. [4.0]

HIGHFREQ_RINGING
Whether or not to test for high-frequency ringing in the spectra. This is where a band of spectra in the time series have the same oscillation frequency and origin with smoothly varying amplitude over time. The amplitude is an order of magnitude or more lower than the regular high-frequency interference, but because it extends over tens to over 200 spectra, its affect can be as potent. Even if set to 1 (true), at least HIGHFREQ_RINGING_MIN_SPECTRA spectra are required to give a sufficient baseline against which to detect spectra with ringing. The HIGHFREQ_INTERFERENCE parameter must be true to apply this filter. [0]

HIGHFREQ_RINGING_MIN_SPECTRA
Minimum number of good spectra for ringing filtering to be attempted. See HIGHFREQ_RINGING. The filter needs to be able to discriminate between the normal unaffected spectra from those with ringing. The value should be at least a few times larger than the number of affected spectra. Hence there is a minimum allowed value of 100. The default is an empirical guess; for the worst cases it will be too small. If there are insufficient spectra the filtering may still work to some degree. [400]

LOWFREQ_INTERFERENCE
If set to true (1) the spectra for each receptor are analysed to detect low-frequency interference ripples or bad baselines, and those spectra deemed too deviant from linearity are excluded from the reduced products. [1]

LOWFREQ_INTERFERENCE_EDGE_CLIP
This is used to reject spectra with low-frequency interference. It is the standard deviation to clip the profile of summed-deviations from linearity iteratively in order to measure the mean and standard deviation of the profile unaffected by bad spectra. A comma-separated list will perform iterative sigma clipping of outliers, but standard deviations in the list should not decrease. [" 2.0,2.0,2.5,3.0"]

LOW_FREQ_INTERFERENCE_THRESH_CLIP
This is used to reject spectra with low-frequency interference. This is the number of standard deviations at which to threshold the non-linearity profile above its median level. [3.0]

LV_AXIS
The axis to collapse in the cube to form the LV image. Can be the axis' s index or its generic " skylat" or " skylon" . [" skylat"]

LV_ESTIMATOR
The statistic to use to collapse the spatial axis to form the LV image. See the KAPPA:COLLAPSE:ESTIMATOR documentation for a list of allowed statistics. [" mean"]

LV_IMAGE
A longitude-velocity map is made from the reduced group cube, if this parameter is set to true (1). The longitude here carries its generic meaning, so it could equally well be right ascension or galactic longitude; the actual axis derives from the chosen co-ordinate system (see CUBE_WCS). [undef]

MOMENTS
A comma-separated list of moments maps to create. [" integ,iwc"]

MOMENTS_LOWER_VELOCITY
Set a lower velocity over which the moments maps are to be created. It is typically used in conjunction with MOMENTS_UPPER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

MOMENTS_UPPER_VELOCITY
Set an upper velocity over which the moments maps are to be created. It is typically used in conjunction with MOMENTS_LOWER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

PIXEL_SCALE
Pixel scale, in arcseconds, of cubes. If undefined it is determined from the data. [undef]

REBIN
A comma-separated list of velocity resolutions to rebin the final cube to. If undefined, the observed resolution is used. [undef]

RESTRICT_LOWER_VELOCITY
Trim all data to this lower velocity. It is typically used in conjunction with RESTRICT_UPPER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

RESTRICT_UPPER_VELOCITY
Trim all data to this upper velocity. It is typically used in conjunction with RESTRICT_LOWER_VELOCITY. If undefined, the full velocity range, less trimming of the noisy ends, is used. [undef]

SPATIAL_SMOOTH
The number of pixels to smooth in both spatial axes when smoothing to determine baselines. [5]

SPREAD_METHOD
The method to use when spreading each input pixel value out between a group of neighbouring output pixels when regridding cubes. See the SPREAD parameter in SMURF/MAKECUBE for available spreading methods. [" nearest"]

SPREAD_WIDTH
The number of arcseconds on either side of the output position which are to receive contributions from the input pixel. See the PARAMS parameter in SMURF/MAKECUBE for more information. [0]

SPREAD_FWHM_OR_ZERO
Depending on the spreading method, this parameter controls the number of arcseconds at which the envelope of the spreading function goes to zero, or the full-width at half-maximum for the Gaussian envelope. See the PARAMS parameter in SMURF/MAKECUBE for more information. [undef]

TILE
Whether or not to make tiled spectral cubes. A true value (1) performs tiling so as to restrict the data-processing resource requirements. Such tiled cubes abut each other in pixel co-ordinates and may be pasted together to form the complete spectral cube. [1]

TRIM_MINIMUM_OVERLAP
The minimum number of desired channels that should overlap after trimming hybrid-mode observations. If the number of overlapping channels is fewer than this, then

the fixed number of channels will be trimmed according to the TRIM_PERCENTAGE, TRIM_PERCENTAGE_LOWER, and TRIM_PERCENTAGE_UPPER parameters. [10]

TRIM_PERCENTAGE_LOWER
The percentage of the total frequency range to trim from the lower end of the frequency range. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from the lower end. If it and TRIM_PERCENTAGE are undefined, the lower-end trimming defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

TRIM_PERCENTAGE
The percentage of the total frequency range to trim from either end. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from either end. This parameter only takes effect if both TRIM_PERCENTAGE_LOWER and TRIM_PERCENTAGE_UPPER are undefined. If it too is undefined, the upper-frequency trimming defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

TRIM_PERCENTAGE_UPPER
The percentage of the total frequency range to trim from the higher end of the frequency range. For example, if a cube has 1024 frequency channels, and the percentage to trim is 10%, then 102 channels will be trimmed from the upper end. If it and TRIM_PERCENTAGE are undefined, it defaults to 2.75% for ACSIS and 7.5% for DAS observations. [undef]

VELOCITY_BIN_FACTOR
This is an integer factor by which the spectral axis may be compressed by averaging adjacent channels. The rationale is to make the reduced spectral cubes files substantially smaller; processing much faster; and to reduce the noise so that, for example, emission features are more easily identified and masked while determining the baselines. It is intended for ACSIS modes, such as BW250, possessing high spectral resolution not warranted by the signal-to-noise. Note that this compression is applied after any filtering of high-frequency artefacts performed on adjacent channels. A typical factor is 4. There is no compression if this parameter is undefined. [undef]

Output Data :

- For individual time-series data: median time-series removed with the _tss suffix; thresholded data with the _thr suffix; frequency ends removed with the _em suffix; baseline-only mask with the _tsmask suffix; non-baseline regions masked with the _msk suffix; baselined data with the _bl suffix.
- For individual spatial/spectral cubes: baselined cube with the _cube suffix; baseline region mask with the _blmask suffix.
- For group cubes: cube with the _cube suffix; baseline region mask with the _blmask suffix; baselined cube with the _bl suffix;
- For moments maps: integrated intensity map with the _integ suffix; velocity map with the _iwc suffix. An optional longitude-velocity image with the _lv suffix, derived from the group cube.

Related Recipes :

REDUCE_SCIENCE_GRADIENT.

REDUCE_SCIENCE_NARROWLINE_CONTINUUM
alias for REDUCE_SCIENCE_CONTINUUM

Description:

This recipe is an alias for the recipe REDUCE_SCIENCE_CONTINUUM.

REDUCE_SCIENCE_NARROWLINE_POL
Reduce an ACSIS science polarimetry observation

Description:

This recipe reduces an ACSIS science polarimetry observation. It is currently a no-op.

REDUCE_SCIENCE_NARROWLINE_QA
Reduce a narrowline ACSIS science observation

Description:

This recipe reduces an ACSIS science observation. It does so by first converting a time-series cube (or more than one, as the case may be) as written by the ACSIS specwriter into a spatial/spectral cube. This cube is then coadded to other cubes in the same group to form a higher signal-to-noise ratio cube.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP backends.
- This recipe differs from REDUCE_SCIENCE in that it uses a [5,5,10] box smooth when finding baselines.

Output Data :

- A spatial/spectral cube whose filename is of the form aYYYYMMDD_NNNNN_SS_MMMM_cube.sdf, where YYYYMMDD is the UT date, NNNNN is the zero-padded observation number, SS is the zero-padded subsystem number, and MMMM is the first zero-padded sub-scan number for the given observation and subsystem.
- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.

Related Recipes :

REDUCE_SCIENCE

REDUCE_SCIENCE_POL
Reduce an ACSIS science polarimetry observation

Description:

This recipe reduces an ACSIS science polarimetry observation. It is currently a no-op.

REDUCE_SCIENCE_QA
Reduce an ACSIS science observation

Description:

This recipe reduces an ACSIS science observation. It does so by first converting a time-series cube (or more than one, as the case may be) as written by the ACSIS specwriter into a spatial/spectral cube. This cube is then coadded to other cubes in the same group to form a higher signal-to-noise ratio cube.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP backends.

Output Data :

- A spatial/spectral cube whose filename is of the form aYYYYMMDD_NNNNN_SS_MMMM_cube.sdf, where YYYYMMDD is the UT date, NNNNN is the zero-padded observation number, SS is the zero-padded subsystem number, and MMMM is the first zero-padded sub-scan number for the given observation and subsystem.
- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.

Related Recipes :

REDUCE_POINTING

REDUCE_SCIENCE_SELFBL
Reduce an ACSIS science observation using user-defined baseline regions

Description:

This recipe is used for advanced generic ACSIS data processing. It has not been tuned for any specific type of data.

This recipe first creates a spatial cube from the raw time series data. Then, working on the raw time series data, it subtracts a median time-series signal, thresholds the data, then trims the ends of the frequency range to remove high-noise regions.

After the time-series manipulation has been done to every member of the current group, every member is run through MAKECUBE to create a group spatial cube. This cube then has its baseline removed and moments maps are created.

Notes:

- This recipe is suitable for ACSIS data.

Output Data :

- For individual time-series data: median time-series removed with the _tss suffix; thresholded data with the _thr suffix; frequency ends removed with the _em suffix; baseline-only mask with the _tsmask suffix; non-baseline regions masked with the _msk suffix; baselined data with the _bl suffix.
- For individual spatial/spectral cubes: baselined cube with the _cube suffix.
- For group cubes: cube with the _cube suffix; baselined cube with the _bl suffix;
- For moments maps: integrated intensity map with the _integ suffix; velocity map with the _iwc suffix.

Related Recipes :

REDUCE_SCIENCE

REDUCE_SKYDIP
not yet implemented

Description:

Currently no SKYDIP recipe exists for ACSIS obs

REDUCE_STANDARD
reduce a flux standard

Description:

This recipe reduces a flux standard. It first performs quality assurance tests, ascertaining whether the condition of the instrument is suitable for any of the three HARP-based JCMT Legacy Surveys. It then removes noisy frequency ends, merges hybrid-mode observations, thresholds extreme signals, and removes any gross signal common to all receptors. It then creates a cube, and removes a linear baseline. Integrated and peak flux are then measured and compared with a standard list.

Notes:

This recipe is suitable for ACSIS data.

Related Recipes :

REDUCE_SCIENCE.

REDUCE_STANDARD_POL
Reduce a standard calibration polarimetry observation

Description:

This recipe reduces an ACSIS standard calibration polarimetry observation. It is currently a no-op.

C Quick Look Recipes

These are intended for real-time display of data during observing.

REDUCE_SCIENCE_BROADLINE_QL
alias for REDUCE_SCIENCE_GRADIENT_QL

Description:

This recipe is an alias for the recipe REDUCE_SCIENCE_GRADIENT_QL.

REDUCE_SCIENCE_CONTINUUM_QL
alias for REDUCE_SCIENCE_GRADIENT_QL

Description:

This recipe is an alias for the recipe REDUCE_SCIENCE_GRADIENT_QL.

REDUCE_SCIENCE_GRADIENT_QL
QuickLook reduction of an ACSIS obs

Description:

This recipe provides quick-look functionality for ACSIS. For all observing modes other than scans it creates a cube from the raw data and finishes processing. For scans it does nothing.

Notes:

- This recipe is suitable for all ACSIS data.

Output Data :

- The regridded cube with _cube suffix.

Related Recipes :

REDUCE_SCIENCE_GRADIENT, REDUCE_SCIENCE_GRADIENT_SUMMIT.

REDUCE_SCIENCE_LINEFOREST_QL
alias for REDUCE_SCIENCE_GRADIENT_QL

Description:

This recipe is an alias for the recipe REDUCE_SCIENCE_GRADIENT_QL.

REDUCE_SCIENCE_NARROWLINE_QL
alias for REDUCE_SCIENCE_GRADIENT_QL

Description:

This recipe is an alias for the recipe REDUCE_SCIENCE_GRADIENT_QL.

D Summit Recipes

These are intended for reduction of data at the summit during observation. Not recommended for offline reduction.

REDUCE_SCIENCE_BROADLINE_SUMMIT
Reduce a broadline ACSIS science observation

Description:

This recipe reduces a broadline ACSIS science observation.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP backends.

Output Data :

- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.

Related Recipes :

REDUCE_SCIENCE_GRADIENT

REDUCE_SCIENCE_CONTINUUM_SUMMIT
Reduce an ACSIS science observation, without baselining

Description:

This recipe reduces an ACSIS science observation. It does so by first converting a time-series cube (or more than one, as the case may be) as written by the ACSIS specwriter into a spatial/spectral cube. This cube is then coadded to other cubes in the same group to form a higher signal-to-noise ratio cube.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP or DAS backends.

Output Data :

- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.

Related Recipes :

REDUCE_POINTING

REDUCE_SCIENCE_FSW_SUMMIT
for unknown purposes

Description:

This description appears to be copied from REDUCE_SCIENCE_NARROWLINE. It may not be correct for this recipe.

This recipe is used for advanced narrow-line ACSIS data processing.

This recipe first creates a spatial cube from the raw time series data. Then, working on the raw time series data, it subtracts a median time-series signal, thresholds the data, then trims the ends of the frequency range to remove high-noise regions.

After the time-series manipulation has been done to every member of the current group, every member is run through MAKECUBE to create a group spatial cube. This cube then has its baseline removed through a smoothing process, and moments maps are created.

A baseline mask formed from the group cube is run through UNMAKECUBE to form baseline masks for the input time-series data, which are then baselined. The baselined time-series data are then run through MAKECUBE to create observation cubes, from which moments maps are created.

Notes:

- This recipe is suitable for ACSIS data.
- The 'nearest' method is used for creating cubes with MAKECUBE.
- A 10-pixel box smooth is used in the frequency domain. This may be too large for some narrow-line data.

Available Parameters

The following parameters can be set via the -recpars option:

BASELINE_ORDER
The polynomial order to use when baselining cubes.

CREATE_MOMENTS_USING_SNR
If set to true (1), moments maps will be created using a signal-to-noise map to find emission regions. This could be useful when observations were taken under differing sky conditions and thus have different noise levels.

CUBE_WCS
The coordinate system to regrid the cubes to.

FLATFIELD
Whether or not to perform flat-fielding.

MOMENTS
A comma-separated list of moments maps to create.

MOMENTS_LOWER_VELOCITY
Set a lower velocity over which the moments maps are to be created. Typically used in conjunction with MOMENTS_UPPER_VELOCITY. Must include at least one decimal place (i.e. " -50.0" for setting the limit to -50 km/s).

MOMENTS_UPPER_VELOCITY
Set an upper velocity over which the moments maps are to be created. Typically used in conjunction with MOMENTS_LOWER_VELOCITY. Must include at least one decimal place (i.e. " 50.0" for setting the limit to 50 km/s).

PIXEL_SCALE
Pixel scale, in arcseconds, of cubes.

REBIN
A comma-separated list of velocity resolutions to rebin the final cube to.

RESTRICT_LOWER_VELOCITY
Trim all data to this lower velocity. Must include at least one decimal place (i.e. " -50.0" for restricting to -50 km/s).

RESTRICT_UPPER_VELOCITY
Trim all data to this upper velocity. Must include at least one decimal place (i.e. " 100.0" for restricting to 100 km/s).

SPREAD_METHOD
The method to use when spreading each input pixel value out between a group of neighbouring output pixels when regridding cubes. See the SPREAD parameter in SMURF/MAKECUBE for available spreading methods.

SPREAD_WIDTH
The number of arcseconds on either side of the output position which are to receive contributions from the input pixel. See the PARAMS parameter in SMURF/MAKECUBE for more information.

SPREAD_FWHM_OR_ZERO
Depending on the spreading method, this parameter controls the number of arcseconds at which the envelope of the spreading function goes to zero, or the full-width at half-maximum for the Gaussian envelope. See the PARAMS parameter in SMURF/MAKECUBE for more information.

Output Data :

- For individual time-series data: median time-series removed with the _tss suffix; thresholded data with the _thr suffix; frequency ends removed with the _em suffix; baseline-only mask with the _tsmask suffix; non-baseline regions masked with the _msk suffix; baselined data with the _bl suffix.
- For individual spatial/spectral cubes: baselined cube with the _cube suffix; baseline region ma sk with the _blmask suffix.

- For group cubes: cube with the _cube suffix; baseline region mask with the _blmask suffix; baselined cube with the _bl suffix;
- For moments maps: integrated intensity map with the _integ suffix; velocity map with the _iwc suffix.

Related Recipes :

REDUCE_SCIENCE_GRADIENT.

REDUCE_SCIENCE_GRADIENT_SUMMIT
Reduce an ACSIS science observation

Description:

This recipe reduces an ACSIS science observation. It does so by first converting a time-series cube (or more than one, as the case may be) as written by the ACSIS specwriter into a spatial/spectral cube. This cube is then coadded to other cubes in the same group to form a higher signal-to-noise ratio cube.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP backends.

Output Data :

- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.

Related Recipes :

REDUCE_POINTING

REDUCE_SCIENCE_LINEFOREST_SUMMIT alias for REDUCE_SCIENCE_GRADIENT_SUMMIT

Description:

This recipe is an alias for the recipe REDUCE_SCIENCE_GRADIENT_SUMMIT.

REDUCE_SCIENCE_NARROWLINE_SUMMIT
Reduce an ACSIS science observation

Description:

This recipe reduces an ACSIS science observation. It does so by first converting a time-series cube (or more than one, as the case may be) as written by the ACSIS specwriter into a spatial/spectral cube. This cube is then coadded to other cubes in the same group to form a higher signal-to-noise ratio cube.

Notes:

- This recipe is suitable for ACSIS using either the RxA3i or HARP backends.

Output Data :

- A spatial/spectral cube whose filename is of the form gaYYYYMMDD_N, where YYYYMMDD is the UT date, and N is the group number. This is the coadded group file.

Related Recipes :

REDUCE_POINTING