Using EIS Gaussian fitting routines for IRIS data

Peter Young (GMU), 21-April-2014

The IRIS level-2 format is very similar to the EIS data format, and thus potentially allows EIS software to be used on IRIS data. This document describes how the EIS_AUTO_FIT suite of routines can be used with IRIS data.

Note that it is necessary for the user to have the EIS branch of Solarsoft in their personal Solarsoft distribution.

Introduction

The basic input for EIS_AUTO_FIT is a 'windata' structure that is returned by the routine EIS_GETWINDATA. The structure contains the intensity array for a specific EIS data window, along with an error array and various metadata. By creating a windata structure of the same format for IRIS data, the EIS_AUTO_FIT routine can then work with IRIS data.

IRIS_GETWINDATA

This routine is called as, e.g.,

```
IDL> wd=iris_getwindata(filename, 1402)
```

where 'filename' is the name of an IRIS level-2 raster file, and '1402' is the wavelength used to identify which wavelength window is required.

The routine has been written in order to return all the necessary structure tags that are required by EIS_AUTO_FIT and its associated routines.

A key difference is that the intensity tag '.int' contains the intensity in DN units rather than calibrated intensity units. Also the error tag '.err' is computed within the routine by converting the DN values to photons, computing the photon noise error, and then computing the errors as a fraction of the original DN signal.

EIS_AUTO_FIT

In the simplest form this routine is called as

```
IDL> eis_auto_fit, windata, fitdata
```

where 'fitdata' is a structure containing the fit details. The routine has been modified from the original EIS version by adjusting allowed parameter ranges to values more suitable for IRIS.

Full details about EIS_AUTO_FIT are available in EIS Software Note #16:

ftp://sohoftp.nascom.nasa.gov/solarsoft/hinode/eis/doc/eis_notes/16_AUTO_FIT/eis_swnote_16.pdf

Note that some aspects of this document do not apply to IRIS data. For example, thermal orbit variations are removed from level-2 IRIS files, whereas they are retained in EIS level-1 files.

Studying the fit results

The fit results can be studied graphically using the widget-based routine 'eis_fit_viewer.pro':

IDL> eis_fit_viewer, windata, fitdata

To extract intensity, velocity and line width arrays from the 'fitdata' structure, do:

IDL> int=eis_get_fitdata(fitdata,/int)
IDL> vel=eis_get_fitdata(fitdata,/vel)
IDL> wid=eis_get_fitdata(fitdata,/wid)

Note that giving the keyword /map will return the array into an IDL map.

For more details see EIS Software Note #16.

Usage notes

Trimming the windata structures

The IRIS data windows are often quite large and so it is recommended to 'trim' them. An example for the Si IV 1402 line is:

IDL> wdnew=eis_trim_windata(wd, [1401.77,1403.77])

Binning the windata structures

Some data-sets may be too noisy to fit accurately (e.g., weak lines, or quiet Sun data-sets with low exposure times). In this case it is beneficial to bin the data:

IDL> wdnew=eis_bin_windata(wd, xbin=xbin, ybin=ybin)

where 'xbin' and 'ybin' denote the number of pixels to be binned. Note that the error values are re-computed to take account of the binning.

Wavelength calibration

The output structure of EIS_AUTO_FIT contains the tag 'refwvl' that defines the zero velocity from which velocity maps are created. The tag value is set by EIS_AUTO_FIT to be the average wavelength across the raster. If the user is to study velocity maps, it is critical that 'refwvl' is modified. A first step is to replace the refwvl value with the laboratory wavelength of the transition.

For example, if the Si IV λ1402 line has been fit, then the laboratory wavelength is 1402.769 (e.g., Brekke et al., 1997, Sol. Phys. 175, 349), so the user would do:

IDL> fitdata.refwvl=1402.769

This assumes, however, that the absolute IRIS wavelength calibration is accurate. To be safer, the user should measure a photospheric line in the spectrum and base the absolute calibration off this. A suitable candidate is S I 1401.5136. If the user measures the wavelength of this line from the same raster, and adjusts it to the laboratory wavelength then this will fix the absolute

calibration. Suppose the S I line, was measured to be 1401.5040, then ‘refwvl’ will be modified to:

IDL> fitdata.refwvl=1402.769 – (1401.5136-1401.5040)