CDS QUICKLOOK DISPLAY SOFTWARE

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ABSTRACT

We present a software package designed to display and manipulate spectral data from the Coronal Diagnostic Spectrometer (CDS) on SOHO and also to make preliminary measurements of spectral properties from the displayed data. CDS is designed to observe selected extreme-ultraviolet emission lines useful for density and temperature diagnostics. The instrument will produce large amounts of data in the form of spectra from extended solar regions.

The software, which is written in IDL, is made user friendly by utilizing the IDL widget user interface allowing for interaction using pushbuttons, pull-down menus, and sliders. The main features of the CDS Quicklook Software includes displaying spectra from both the normal incidence spectrometer (NIS) and the grazing incidence spectrometer (GIS), measuring wavelengths and intensities, plotting of profiles, line fitting, line identification, and generating intensity and velocity maps. The data structure within IDL is described and examples of the main feature in the CDS Quicklook Software are given.

1. INTRODUCTION

The idea with the Quicklook software was to make available a software package that would make display and manipulation of CDS observations easy and user friendly. During the operations of the instrument it will be used for display and manipulation of recently received data from the CDS instrument and also for further planning of new observing sequences.

The software, as it exists today, has developed into something more than just a "quicklook" tool. A number of features are now included that makes it possible to measure and analyze different properties of the observed data, such as line widths, intensities, intensity maps etc. Also, the separate routines make a useful platform for further development of more specific analyzing software.

The CDS instrument consists of a Wolter-Schwartschild II grazing incidence telescope which has the focus at a slit assembly which lies beyond a flat scan mirror. After the slit, two components of the beam are fed into two spectrometers. One component feed a normal incidence spectrometer (NIS) with a twin toroidal grating assembly and a 2-D detector. Another part of the beam are fed to a grazing incidence spectrometer (GIS) with a spherical grating and an array of four 1-D detectors along the Rowland Circle.

The NIS detector consist of 1024 x 1024 pixels. Two spectra are focused into the central 1024x256 pixel area of the CCD. The spectral coverage is 310–380 Å and 517–633 Å In practice, it will be rare that CDS can return the full NIS detector. In most cases a selection of data will be used where a set of sub-windows or line-windows (since the sub-windows are centered around emission lines) will be extracted from the full detector.

The GIS spectrum is focused into four 1-D detectors and cover the wavelength ranges 155-244 Å, 261–346 Å, 395–496 Å, and 662–787 Å. As for the NIS detector a selection of line windows can be extracted from the four GIS detectors.

2. DATA FORMATS AND DATA STRUCTURE

The SOHO Science Operations Working Group (SWOG) has selected FITS as the standard file format for all the scientific data files generated by the PI teams. The reason for this are tow-fold: First of all, it provides compatibility with existing data sets and software used in the astronomical community, including ground-based solar data. Second, it facilitates interoperatbility between the various instrument teams at the SOHO Experimenters Operation Facility (EOF), since the file structure is independent of computer architecture and operating system. An analysis of the CDS requirements led to the conclusion that the best way to store the CDS data are stored in the FITS files as *binary tables.*

The Quicklook software for the CDS project will be used both menu-driven and directly from the IDL prompt (interactive mode). To simplify the last approach we felt the need to construct a simple an coherent internal data structure for the data in the FITS files.

From the users point of view, it will be very useful to have one variable containing all the data in a FITS file, instead of having, for instance, one variable for each of the detector windows. Also from the point of view of developing new routines, having a coherent way of storing and transferring data between functions or routines will be useful.

The IDL function READCDSFITS will return a single anonymous IDL structure variable containing all the science data and the auxiliary information that goes with the spectral data in the FITS file, which can then be sent as a parameter to the other Quicklook routines.

3. THE QUICKLOOK SOFTWARE

The CDS QL software is written in IDL and can be used both in an interactive and in a menu driven mode. In the interactive mode the user works from the IDL prompt and can utilize a number of routines to extract data or information from the IDL structure containing the observations. At the same time all private, as well as standard IDL library routines, can be used.

In the menu driven mode we utilize the IDL widget user interface allowing for interaction using pushbuttons, pull-down menus, and sliders. Thus, in this mode the user do not need to know anything about the calling syntax or any details of the routines itself. The only input to these routines when called are the structure variable containing all the data and header information from the FITS file. A main menu will appear where four different display modes can be selected and will be discussed separately below. From each display page the user can push a HELP button to activate a help widget where information about each single feature can be obtained. This includes information about how to use the different buttons and sliders etc. Hard copies of the display pages can easily be printed by just pressing a button.

DESELECTED SPECTRUM: Displays a full spectrum or spectral windows from specific exposures within a raster sequence. The individual spectral windows are *DESELECTED* into their corresponding positions on the detector. Measurements of wavelengths and positions on the detector is possible together with line identification. Very user friendly widgets for extraction of profiles or to zoom in on areas of interest are provided. The layout of this display page is shown in Figure 1.

WAVELENGTH SLICE/PROFILE: Display data slices at specific wavelengths + line profiles. A window is created with two types of display of the data in four selected spectral windows (see Figure 2). The upper display is is a cross section of the data at a specific wavelength, giving a spatial view of the region that has been scanned by the CDS NIS/GIS slits. The lower display is the intensity profile along the dispersion direction (line profile), at a selected point in the two-dimensional image displayed in the window above.

SPECTRAL WINDOW EXPOSURE: A window is created to show all the exposures of a selected spectral window, spread out one after another, and to report the identity of the Spectral Window/exposure number that is clicked on by the user. Zoom and extraction of profiles are available.

RASTER MOVIE: Shows a full raster sequence of a selected line window as a continuous animation. A very useful tool to identify for events within a serie of exposures.

In addition to the above mentioned features there are options that allow the user to display all the header information describing details about the observation and the data itself. For a detailed description of the CDS Quicklook Software we refer to the Quicklook Software User Manual (Ref. 1).

ACKNOWLEDGMENTS

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REFERENCES

1. Brekke P. and Haugan S V H. 1994, CDS Quicklook Software User Manual, CDS Internal Software Note.

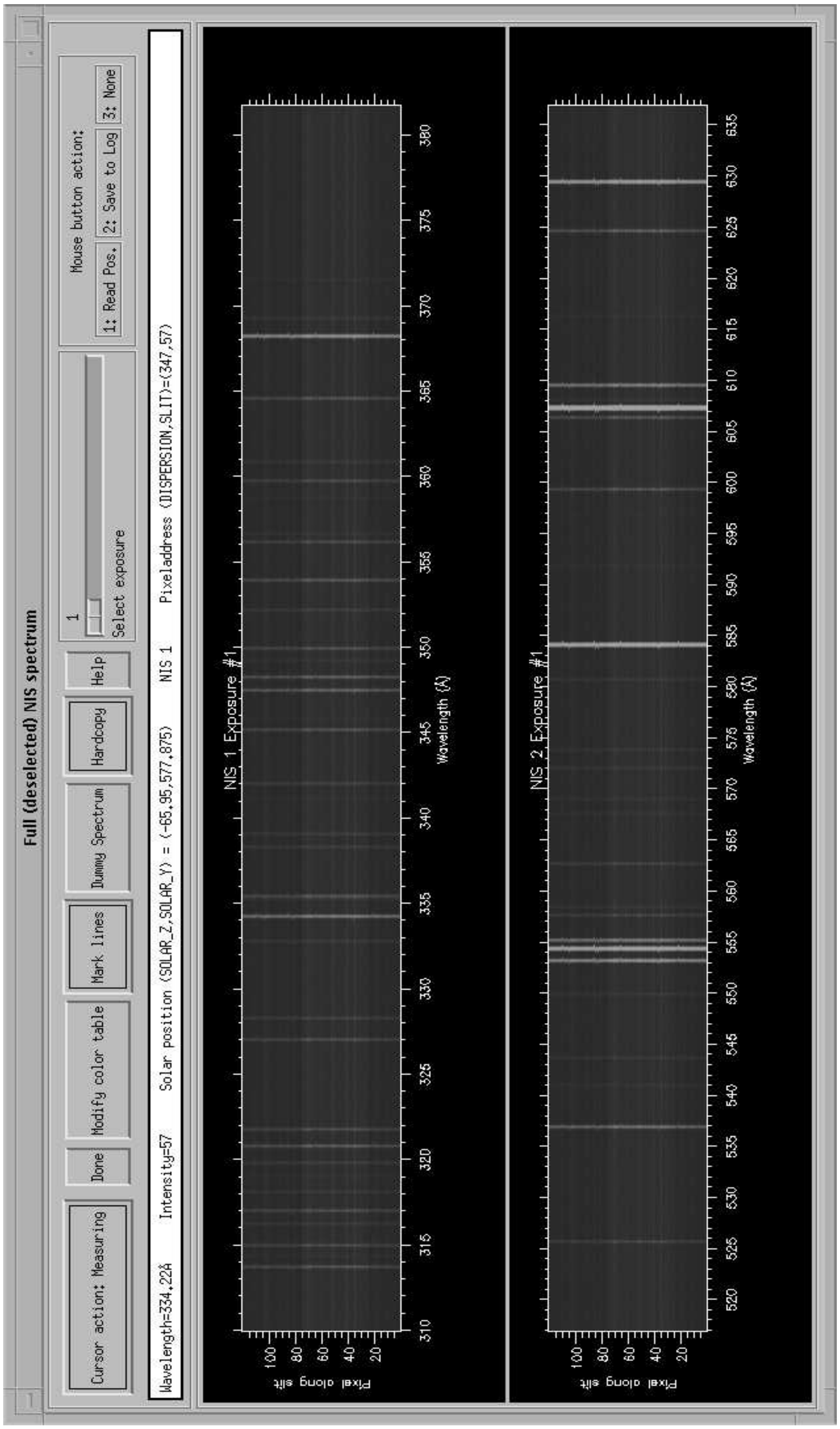

Figure 1: Layout of the Deselected Spectrum page showing the entire NIS spectral range.

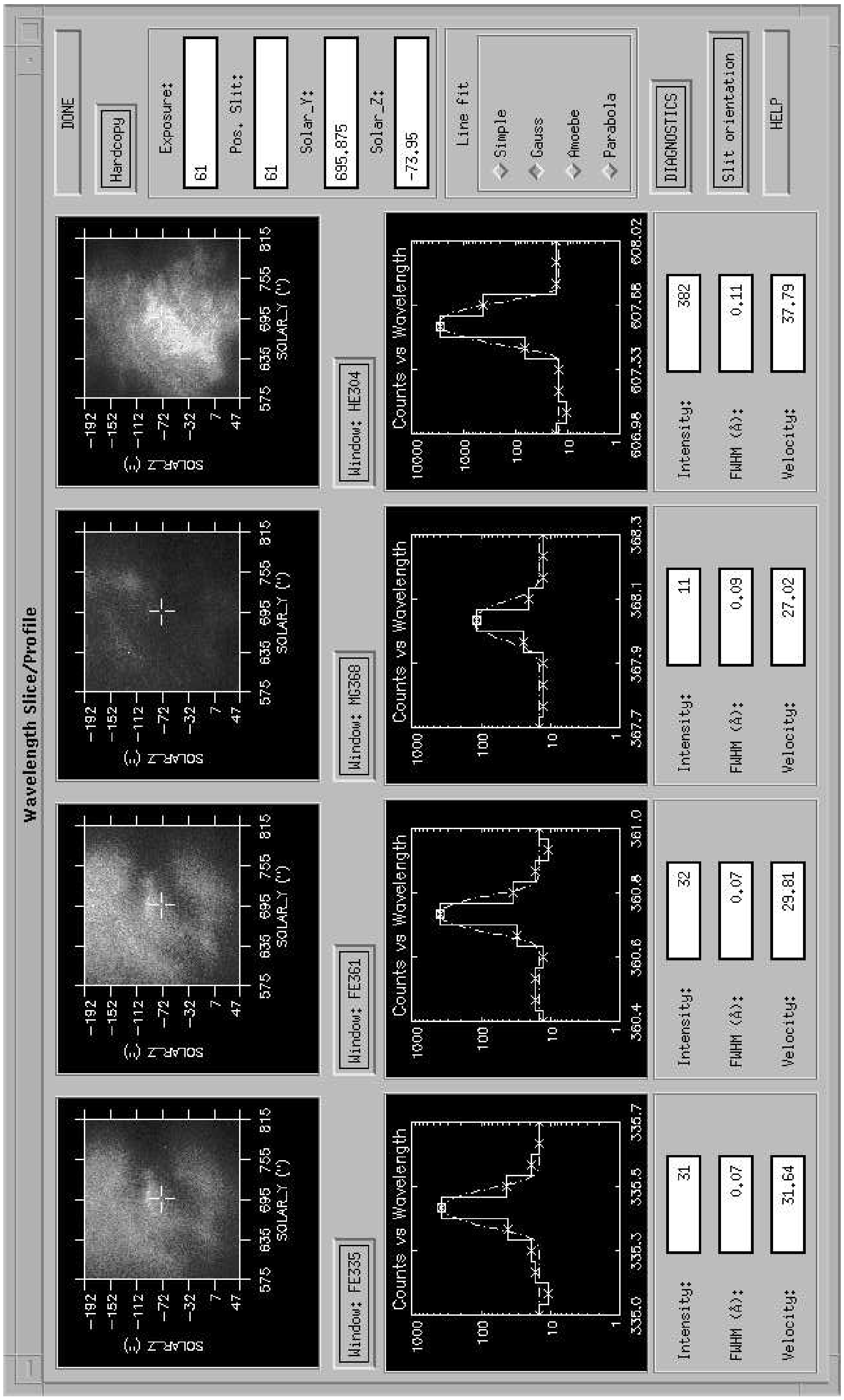

Figure 2: Layout of the Wavelength Slice/Profile page showing a spatial view of the region that has been scanned by the CDS NIS/GIS slits at a specific wavelength. The line profiles at the location of the cross hair are shown in the lower panels.