On The Interpretation Of Oxygen Line Emission In Comets And In SN 1987A
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Present interpretations of neutral oxygen spectra in various astrophysical sources often invoke the H Ly-β/O I fluorescent process to explain the presence of lines originating in higher levels. A basic analysis of the cascade populations and emissions to be expected from the process is carried out and applied to an ultraviolet spectrum of Comet Austin and to near-infrared spectra of the supernova SN 1987A, in which lines are present which have been interpreted as O I fluorescent lines. Some inconsistencies and consequences are pointed out including an interesting reversal of the usual roles of allowed and forbidden lines under optically thick conditions. It is concluded that the fluorescent mechanism probably did not operate in Comet Austin, nor in other comets; and that it has also not operated in SN 1987A. For Comet Austin in particular this raises questions concerning the origin of the observed high-excitation lines in the vicinity of 1042 and 1128 Å. In case of SN 1987A the apparent presence of lines of the O I quintet system appear to suggest a selective excitation mechanism.

A white light coronagraph was launched into orbit aboard the space shuttle OV 103 (Discovery) on 7 April 1993. This device was one of two instruments included in the SPARTAN 201-1 payload, a completely autonomous sub-satellite deployed from the shuttle for a period of about 47 hours. During this period of deployment data were collected by the white light coronagraph (WLC) and the SAO-supplied Ultraviolet Coronagraph (UVC) for investigations of the density, temperature, mass and bulk velocity distributions found in large scale coronal structures.

The WLC system is an externally occulted coronagraph system which incorporates a rotating half-wave plate polarimeter, and the image data is used to infer the brightness, the polarized brightness and degree of polarization of the white light emission from the solar corona. These data are in turn used to infer estimates of the K- and F-coronal brightness and density distributions.

A High-Resolution Solar Spectrum in the EUVE Bandpass
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The Solar EUV Rocket Telescope and Spectrograph (SERTS) obtains imaged spectra of solar features with resolution around 0.04 Å and high sensitivity. Its spectral range of 170 – 450 Å overlaps large portions of the Medium Wavelength and Long Wavelength Spectrographs on EUVE, and so may provide help in interpreting the lower resolution EUVE spectra of late-type stellar sources. As an example, we compare SERTS observations averaged over a typical solar active region with EUVE calibration spectra of Capella, a G6 + G2 binary. The Capella spectra include prominent spectral features at 256.5, 284.7, 304.2, 335.4, and 360.0 Å. The SERTS spectrum indicates that, although these features are generally dominated by a single emission line, they may also be contaminated to some degree by blends of other lines at the resolutions of the EUVE spectrographs, which are approximately 1.0 and 2.0 Å. This high-resolution solar active region spectrum from SERTS is now available electronically by request to thomas@jet.gsc.nasa.gov, as are emission line catalogs derived from it.

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Results from the First Flight of the High Energy Imaging Device (HEIDI) Balloon Payload

Imaging solar flares in hard X rays and gamma rays is the current scientific frontier for solar flare physics. The objectives of the HEIDI Project are to develop the Fourier-transform imaging technique using rotating modulation collimators (RMCs) and to obtain hard X-ray and gamma-ray images of solar flares and non-solar, cosmic X-ray sources such as the Crab Nebula. As currently configured, the HEIDI payload has two RMCs with 25-arcsecond and 11-arcsecond angular resolution, respectively; sensitivity to photon energies as high as 700 keV, and time resolution for individual photon events of 100 microseconds. It flew for the first time on June 22, 1993, and was pointed at the Crab Nebula and at the Sun throughout the six-hour flight. The HEIDI effort is envisioned as part of a long-term growth plan in which HEIDI will serve not only as a vehicle for testing grids and associated alignment techniques being developed for the High Energy Solar Physics (HESP) mission, but also as a hard X-ray and gamma-ray imager, ready to fly during the next solar maximum should HESP not come to fruition. Results from the first flight and a description of plans for the future of HEIDI will be presented.

Comparison of Deconvolution Methods for HESP and HEIDI X-Ray Images
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The use of rotation modulation collimators for hard X-ray imaging has been proposed for the High Energy Solar Physics (HESP) mission and for the balloon-borne High Energy Imaging Device (HEIDI). For this sort of telescope, considerable processing of the data is required in order to get useful images. In order to test the processing methods, we have made simulated images of solar hard X-ray bursts based on prototype Yohkoh SXI flares. For our purposes, we believe that it is more straightforward to use the initial kernels of the soft X-ray flares, instead of SXI images of hard X-ray sources, since the SXI images are already highly processed themselves. Our basic assumption is that the hard X-rays come from the same points where the initial soft X-rays are emitted.

These artificial hard X-ray images, when passed through the HESP simulator, produce "dirty" maps, which have to be deconvolved to produce "clean" maps. We have applied several different deconvolution techniques, among them a specialized CLEAN algorithm (based on the radio astronomy procedure), the Richardson-Lucy algorithm (well-known for its use on HST images), and the Maximum Entropy Method. We will discuss the advantages and disadvantages of each technique, with examples of different flares, levels of noise, and photon-counting statistics.

An Optical Method for Quantitatively Characterizing Rotating Modulation Collimators (RMC)

We have developed a method for quantitatively characterizing bi-grid Rotating Modulation Collimators that are used in a Fourier-transform X-ray imager. This method uses a beam-expanded HeNe laser to simulate the plane wave produced by a point source at infinity even though the grids are diffraction limited at 6010 angstroms. This expanded beam passes through the grids at a small angle relative to their axis of rotation and the modulated signal that is produced as the RMCs rotate is detected using a photomultiplier tube. In addition to providing a quantitative characterization of the RMCs, this method will also provide a measured point response function for the imaging system. Detailed analysis of this modulated signal to determine the effect of grid imperfections, relative twist of the grids, and other instrumental effects on the imaging capabilities of the instrument will be described.