ÆGIS:
An Astrophysics Experiment for Grating and Imaging Spectroscopy— a Soft X-ray, High-resolution Spectrometer

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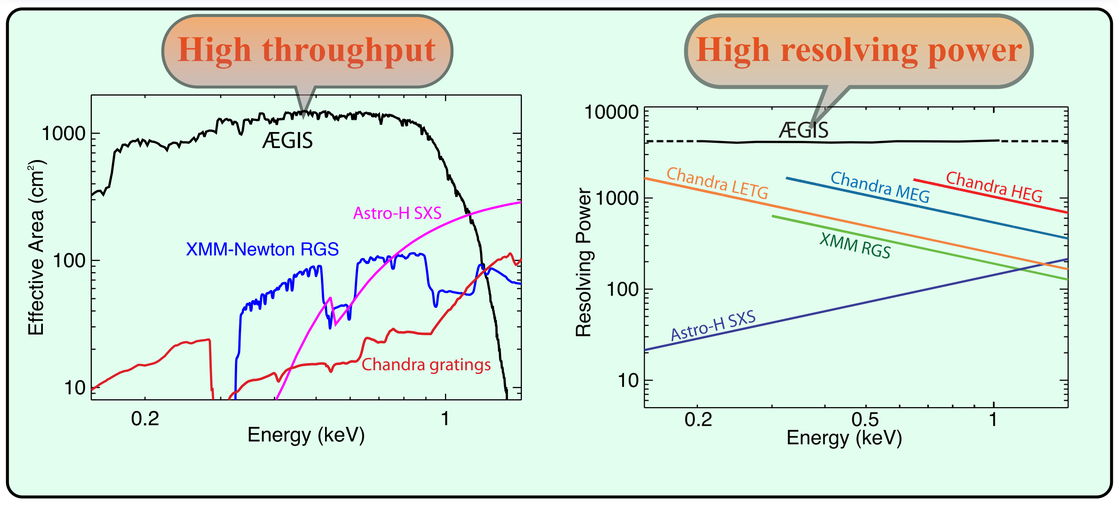
Abstract: ÆGIS is a concept for a high-resolution soft X-ray spectroscopic observatory developed in response to NASA's request for definitions of the next X-ray astronomy mission. At a small fraction of the cost of the once-planned International X-ray Observatory (IXO), ÆGIS has capabilities that surpass IXO grating spectrometer requirements, and which are far superior to those of existing soft X-ray spectrometers. ÆGIS incorporates innovative technology in X-ray optics, diffraction gratings and detectors. The mirror uses high area-to-mass ratio segmented glass architecture developed for IXO, but with smaller aperture and larger graze angles optimized for high-throughput grating spectroscopy with low mass and cost. The unique Critical Angle Transmission gratings combine low mass and relaxed figure and alignment tolerances of Chandra transmission gratings but with high diffraction efficiency and resolving power of blazed reflection gratings. With more than an order of magnitude better performance over Chandra and XMM grating spectrometers, ÆGIS can obtain high quality spectra of bright AGN in a few hours rather than 10 days. Such high resolving power allows detailed kinematic studies of galactic outflows, hot gas in galactic haloes, and stellar accretion flows. Absorption line spectroscopy will be used to study large scale structure, cosmic feedback, and growth of black holes in thousands of sources to great distances. ÆGIS will enable powerful multi-wavelength investigations, for example with Hubble/COS in the UV to characterize the intergalactic medium. ÆGIS will be the first observatory with sufficient resolution below 1 keV to resolve thermally-broadened lines in hot (~10 MK) plasmas. Here we describe key science investigations enabled by ÆGIS, its scientific payload and mission plan.

Performance



30 to 100 times better performance than anything we have now.

Meets many goals defined by the Decadal Survey and formerly planned for IXO:

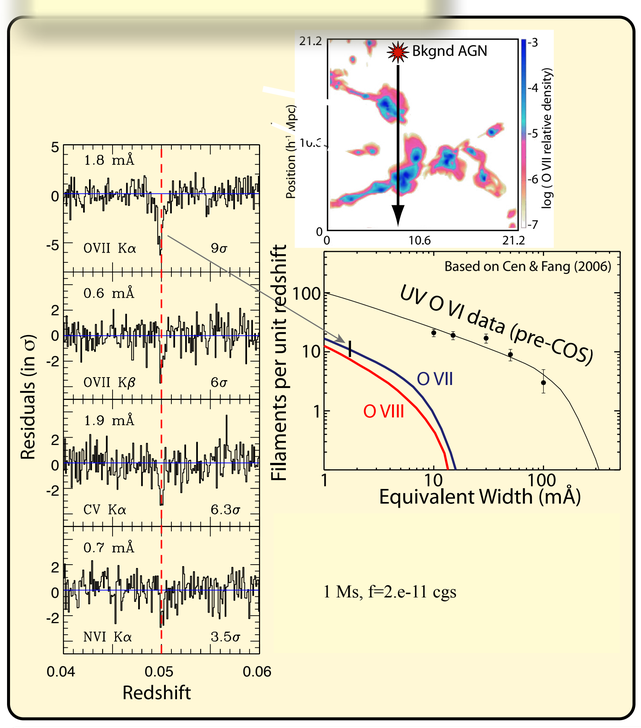
- How does ***large scale structure*** evolve? What is the connection between black hole formation and evolution of large-scale structure (***cosmic feedback***)? How does matter behave at ***very high density***?

Also addresses areas of broad astrophysical importance:

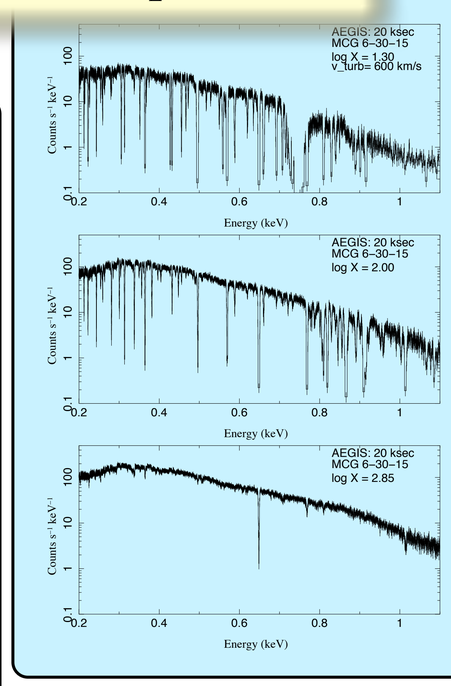
- Kinematics & composition of ***gas & dust in the ISM***; Accretion kinematics in ***young stars & proto-planetary disks***; Physics of ***stellar coronae***; Accretion, jets & winds in ***X-ray binary systems***; Nature & physics of ***neutron star atmospheres***; ***Distribution of metals*** in the Milky Way & other galaxies.

Simulations

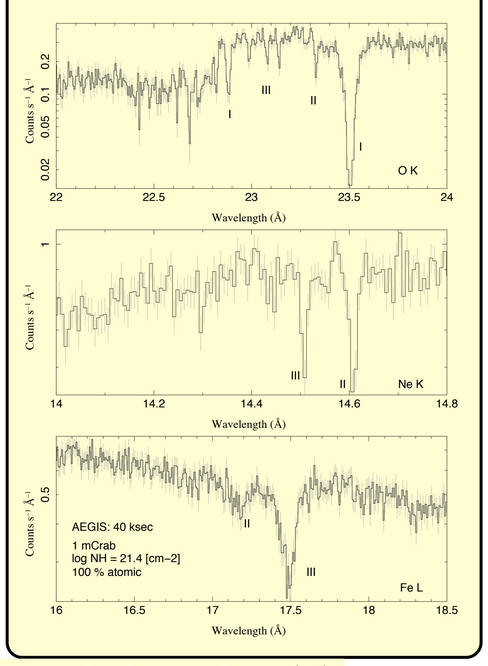
The WHIM



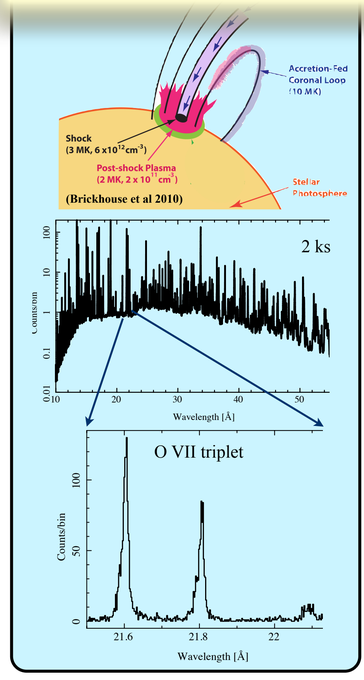
AGN Absorption lines



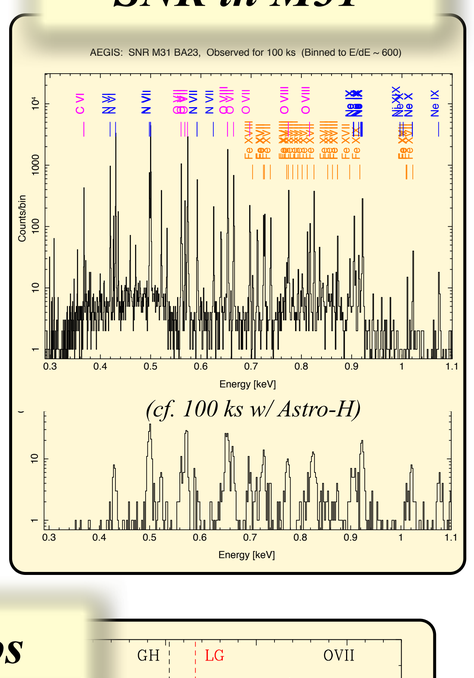
Interstellar Dust



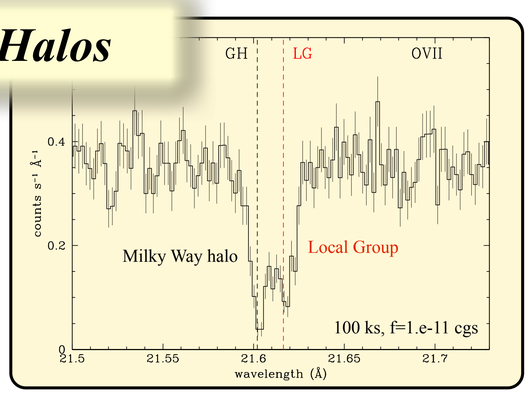
Stellar Accretion

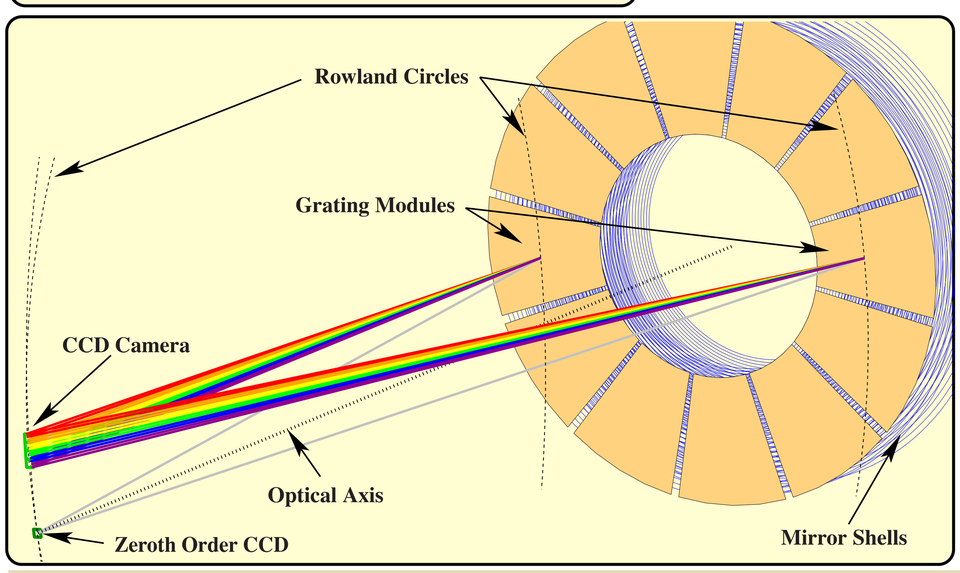


SNR in M31



Galaxy Halos





Spectrometer design: 6 module pairs of mirrors and **Critical Angle Transmission** grating arrays, each with a CCD readout array. "Sub-apertured" spectra provide higher resolution than a full-shell's image. Lightweight mirror: segmented, slumped glass, f=4.4m, 10" HPD. Blazed transmission gratings, low mass, relaxed alignment; CCD focal plane: high QE, fast readout, 6 arrays.

(For more information about ÆGIS see <http://pcos.gsfc.nasa.gov/studies/rfi/Bautz-Marshall-RFINNH11ZDA018L.pdf>.)

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