We describe a study of the relationships between the broadband spectral energy distribution in AGN and their emission and absorption line properties. The study combines *HST* FOS observations of a sample of 450 AGN with *ROSAT* PSPC observations that includes all classes of AGN. The *Hubble/ROSAT* Continuum and Ultraviolet Line Emission Study (**H/RCULES**) of AGN enables characterization of:

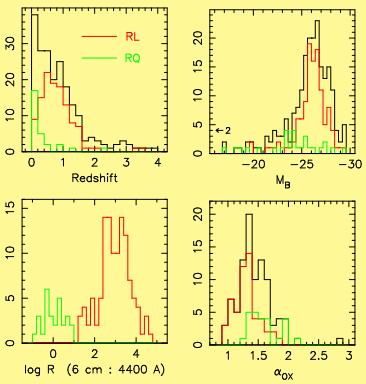
- Spectral energy distributions from X-ray to Radio.
  - The 'Big Blue Bump'.
  - The luminosity dependence of the SED.
  - The relationship between radio loudness and UV – X-ray characteristics in AGN.
- Emission line properties.
  - The Baldwin effect and its relation to the SED.
  - The primary source of variation in UV spectral properties of AGN (*cf* Boroson & Green (1992) primary eigenvector).
  - The link between the X-ray soft excess and the appearance of iron emission lines and coronal lines.
- Comparison between UV and X-ray absorption.
  - The frequency of occurrence of UV absorption.
  - The relationship to X-ray absorption (warm absorbers).
- Is there a luminosity dependence of absorption?

The FOS observations consist of both pre- and post-COSTAR spectra, the pre-COSTAR spectra will appear in a complete atlas of recalibrated *HST* FOS spectra of AGN (Evans, Koratkar, & Pesto 1999; Koratkar, et al. 1999). The challenge of analyzing such a large sample of AGN spectra is tackled using software developed for the **Chandra** mission. This also allows an analysis of the combined X-ray – UV – optical SED. Absorption lines in the UV spectra are identified and measured using FINDSL (Aldcroft 1995) and the iron emission features are fitted using a template generated from the UV spectrum of I Zw 1 (Vestergaard & Wilkes 1999).

Techniques used in the study of a sample of pre-COSTAR spectra are presented here. This sub-sample contains proportions of radio-loud (76%) and radio-quiet (24%) objects similar to the full FOS sample. *ROSAT* PSPC observations are available for approximately half of this sub-sample.

TABLE 1

	Total	*ROSAT* Detected
Sample	209	95
Radio Loud ...	116	54
Radio Quiet ..	28	25
BL Lac ..	9	7
BAL QSO	7	0
Sy 1	20	14
Sy 2	7	3
LINER ...	2	2



THE PRE-COSTAR SAMPLE

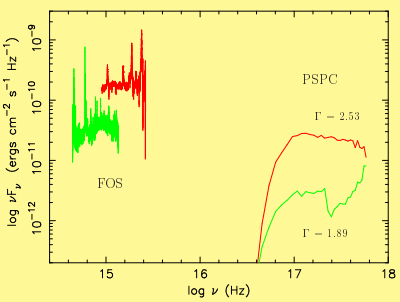
There are over 200 extragalactic objects observed with the FOS and, although the sample is heterogeneous, it allows an investigation of a large data set of high quality UV and optical spectra of AGN. Table 1 above gives the breakdown of the sample in terms of radio loudness and the availability of *ROSAT* PSPC measurements of the soft X-ray emission. We also list the number of objects of various AGN class. The histograms above show the distribution in the sample of redshift, absolute blue magnitude, radio loudness and the optical to soft X-ray spectral slope.

HST FOS AND *ROSAT* PSPC

The soft X-ray and UV – optical spectra of two AGN from the pre-COSTAR sample are presented below. The FOS spectra have be de-reddened using $N_H = N_H^{Gal}$ and $\Re = 3.1$. The PSPC observations are modeled using a power law continuum absorbed by a column with $N_H = N_H^{Gal}$. The PSPC spectrum of NGC 4151 is modified by the inclusion of a warm absorber with $N_H^{wa} = 4.3 \times 10^{21}$ cm^{-2} and $E_{edge} = 0.92$ keV.

ASCFIT will allow both the FOS and PSPC spectra to be modelled simultaneously without the need to create response matricies for the FOS observations.

Mkn 509 and NGC 4151



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CONTINUUM & EMISSION LINE MEASUREMENTS

ASCFIT is a generalized fitting engine designed primarily for spatially resolved spectroscopy of X-ray observations that will be provided by NASA's **Chandra** X-ray Observatory. ASCFIT enables data to be modeled using a variety of optimization methods and with a number of built-in statistical tests. The ease with which user-models can be created and the ability to simultaneously model a number of input data sets that may be in different formats (e.g. ASCII and PHA style FITS files) makes ASCFIT suitable for the goals of the H/RCULES project.

The flow chart above gives an overview of the procedure developed to measure the *HST* FOS spectra. The continuum and emission lines are measured within ASCFIT and absorption lines are detected and measured using FINDSL (see lower right). This is an iterative process; the results from the initial use of ASCFIT are supplied to FINDSL and the absorption line parameters are then fed back into ASCFIT to refine the emission line measurements.

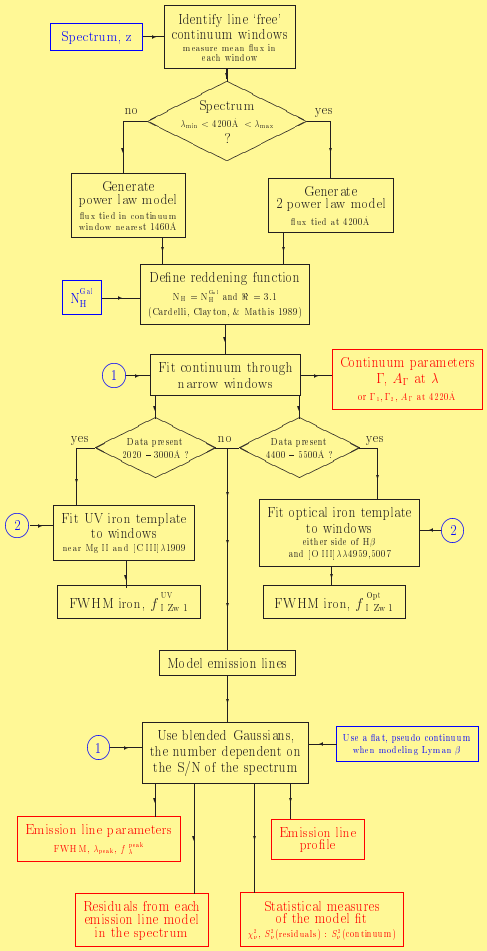
The flow chart below illustrates the procedure used in ASCFIT to measure the FOS spectra. There are three basic steps:

1) Measure the continuum, convolved with a reddening function.

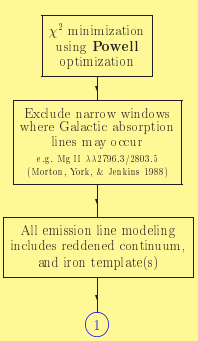
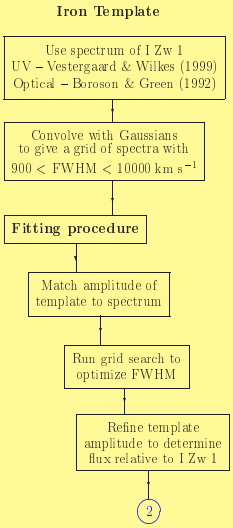
2) Measure the iron emission line blends using template spectra (see upper right of poster).

3) Measure the emission lines with Gaussian components.

As a first step the continuum is modeled as a power law or, where the spectral coverage is wide enough, two power law continua are used. To enable an accurate measurement of the emission line profiles and strengths the blended iron emission line complexes must be accounted for. This emission can be strong in the regions around Mg II and Hβ/[O III] and one of the goals of the H/RCULES project is to measure the strengths of iron emission in this large sample of AGN.



In all fitting procedures



Iron Template