have used a new instrument, the University of Texas Fabry Perot spectrometer, that is capable of observing previously undetected, extended low-surface brightness emission. The Orion A cloud is a known site of both shock and radiative excitation processes. Comparing the strengths of the three observed lines, we can probe the relative contribution of each excitation mechanism throughout the cloud and thereby study the energetics of star formation environments. Also, in Orion A, we see molecular hydrogen that extends > 2.5 parsecs (20 arcminutes) from the OB stars of the Trapezium region, the most likely source of exciting ultraviolet photons. Our maps of parsec-scale molecular hydrogen emission are consistent with recent [CII] 158 micron maps of the photodissociated boundaries of molecular clouds, which suggest that ultraviolet photons can penetrate large distances into the clouds through gaps in a clumpy structure (e.g., Howe et al. 1991, ApJ, 373, 158; Stacey et al. 1993, ApJ, 404, 219). The clumpiness of the material plays a role both in fragmentation to form stars and in allowing ultraviolet radiation to break up the cloud. Observations of ultraviolet-excited molecular hydrogen emission in the near-infrared provide a new tool for studies of the physics of cloud boundaries. Using near-infrared mapping of molecular hydrogen, we can address simultaneously the degree of clumping, the excitation processes, and physical conditions in the cloud.

HELIUM-LIKE IRON LINE TEMPERATURE DIAGNOSTICS IN CLUSTERS OF GALAXIES

Douglas A. Swartz and Martin E. Sulkanen
X-Ray Astronomy Branch
Marshall Space Flight Center, Huntsville

The emission complex around ~ 6.7 keV, arising from He-like Fe lines and their dielectronic satellites, has been observed at low resolution in a number of clusters of galaxies. With sufficient spectral resolution, the ratio, $G = (x+y+z)/w$, of the intercombination (x and y) and forbidden (z) to the resonance (w) lines arising from the $n = 2$ level of the He-like ion, is a sensitive temperature diagnostic. The temperature behavior of this ratio is strongly dependent on the spectral resolution. We introduce an alternative definition for G that includes the contribution of satellite lines and improves the temperature fidelity of this diagnostic; namely, along a line of sight, of projected radius b, through the cluster, $G(b) = W^{xyz}(b)/W^{w}(b)$, where W is an equivalent width, xyz denotes the energy band from 6635 to 6695 eV, and w that from 6695 to 6720 eV. We find that deprojection of the observed values of this ratio can yield accurate temperature profiles for temperatures in the range 10^7 to 10^8 K that do not suffer from the cluster model uncertainties inherent in deconvolution of broad-band X-ray surface brightness profiles.

In summary: (i) G must be defined as ratio of equivalent widths in the ~ 6635 to 6695 eV range to that in the 6695 to 6720 eV range in order to have a useful T_e diagnostic. As originally defined as the ratio of the individual x, y, and z lines to the w line, G is non-monotonic when the higher ($n > 3$) dielectronic satellite lines are properly included. (ii) $G(T_e)$ depends only on a relatively small set of atomic data and not on cluster model parameters (gravitational potential, abundances, etc.) as does the surface brightness method for deriving T_e. (iii) Only relative measurements are needed to define $G(b)$ eliminating the dependence on instrument systematics and the distance scale. (iv) G is a monotonic function of temperature for $T_e \leq 10^8$ K and G can be measured for $T_e \geq 10^7$ K. (v) G provides only T_e; other measurements or model assumptions must be used to obtain the density, abundances, etc. (vi) G requires high spectral resolution as is possible with the XRS detector to be flown on the AXAF-S mission (12 eV spectral, ~ 1 arcmin spatial resolution).

THE LINEAR THEORY OF CONVECTIVE INSTABILITIES IN ACCRETION DISKS.

E.T. Vishniac and S. Luo
University of Texas
and
P.H. Diamond
University of California, San Diego

Convective instabilities may arise in ionized or neutral accretion disks. In some cases (e.g., low mass protostellar disks) they are likely to be an important mechanism for angular momentum transfer. Unfortunately, there is some uncertainty regarding the *direction* of angular momentum transport in convectively unstable regions. Previous work, based on the

WKB approximation (Goodman & Ryu), has been used to suggest that angular momentum transport is usually *inward* which is incompatible with a self-consistent accretion disk model. Here we examine the linear modes of convective instability in thin, low mass, accretion disks including the full radial structure of such modes. We have calculated the Eulerian angular momentum transport since this allows us to include the effects of mixing regions with different specific angular momenta. Our results can be summarized as follows. First, we find that linear modes exist for only a discrete set of k_z/k_θ. These values are roughly equally spaced. The minimum value and spacing are both monotonic functions of the maximum convective growth rate, Γ_c, and increase linearly with Γ_c for $\Gamma_c > \Omega$. Second, for any allowed value of k_z/k_θ there are solutions for all growth rates between 0 and Γ_c. Solutions with Γ close to Γ_c have large radial gradients. As Γ increases within this range the direction of angular momentum transport goes from positive to negative. Third, for a given Γ_c solutions with negative angular momentum transport tend to dominate as k_z/k_θ increases. Fourth, if we characterize modes by their ability to resist dissipation, then inward angular momentum transport appears to be slightly favored. Finally, including MHD effects will substantially modify this conclusion and may lead to outward angular momentum transport in conducting (ionized) disks.

McDONALD OBSERVATORY – *HUBBLE SPACE TELESCOPE* SPECTROSCOPY OF THE NARROW LINE REGION OF HIGH LUMINOSITY ACTIVE GALACTIC NUCLEI

Beverley J. Wills [1], H. Netzer [2], M.S. Brotherton [1], Mingsheng Han [1], D. Wills [1], J.A. Baldwin [3], G.J. Ferland [4], and I.W.A. Browne [5]

We have made high signal-to-noise spectroscopic observations of 7 radio-loud quasars with the Faint Object Spectrograph on the *Hubble Space Telescope* and from the ground at McDonald Observatory and at Kitt Peak National Observatory. The resolution is 300 - 400 km s^{-1} over the wavelength range 1000 - 8500 Å, enabling us to separate the broad and narrow components of the emission lines. This is the first study of the optical and UV narrow lines in such high luminosity AGNs.

The most important and striking observational result is the relative weakness of the narrow ultraviolet lines, assuming that they have the same widths as the narrow [OIII] λ5007 emission lines. We do not have a single definite detection of a narrow UV line in any of the 7 quasars.

We have measured all the strong optical narrow lines

[1] University of Texas.
[2] Tel Aviv University.
[3] IOA Cambridge & Univ. of Kentucky, Lexington.
[4] Jodrell Bank, Univ. of Manchester.

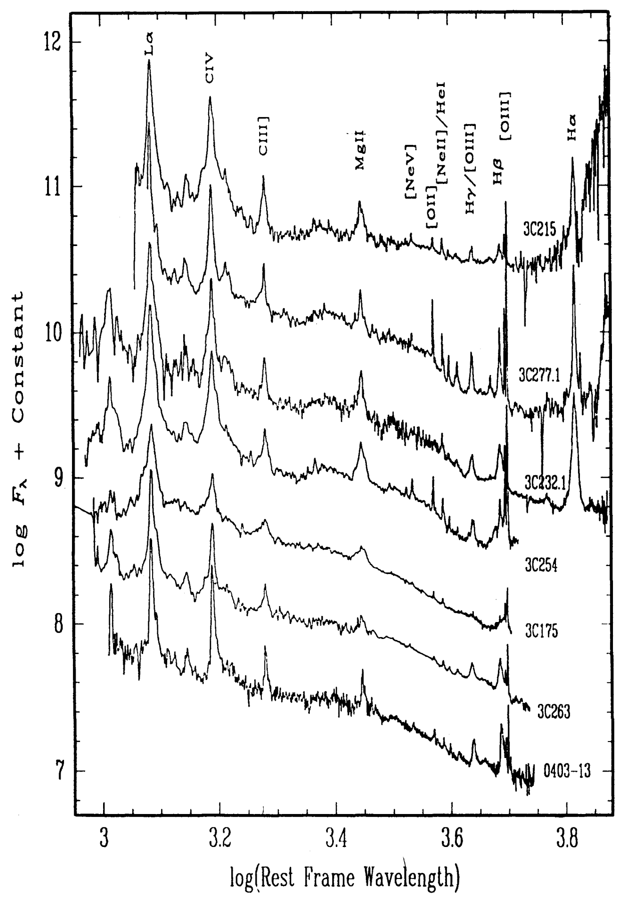

FIG. 1.— Sample *HST*-McDonald-KPNO spectra illustrating the wide wavelength coverage. The ordinate is plotted on displaced scales, and data have been smoothed for display. The vertical bars indicate positions of atmospheric A- and B-band absorption that have been divided out in the McDonald data, and omitted from the long-wavelength spectra of 3C 215, 277.1, and 323.1 (A-, A-, and B-band respectively).