18.15
Hydrodynamics Near Black Holes

J. F. Hawley (Caltech)

The "central engine" of quasars and active galactic nuclei is most likely powered by accretion into a supermassive black hole. A Menagerie of steady state accretion flows have been developed, but short timescale variations in the observed properties of AGN's imply dynamic processes are at work. A promising technique is to study black hole accretion using numerical computer codes. Using the radial accretion equations as an analytic guide, intuitions into the behavior of inflowing matter with angular momentum can be obtained. Solution types can be characterized by angular momentum and energy. A systematic search of this solution space provides a means for understanding the resulting multi-dimensional hydrodynamic phenomena. Several examples from recent numerical calculations of axi-symmetric accretion flows are presented. From these models one can calculate plasma densitites and other values of interest for a range of accretion rates and black hole masses. These results can be compared with the well studied analytic accretion models.

A second important issue in accretion models is the existence of non-axisymmetric instabilities of the type recently discoverd by Papalouizou and Pringle (MNRAS 213, 799; 1985). This problem is amenable to numerical study and recent results are discussed.

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Session 19: Cosmology and Galactic Sources
9:20–6:00 (Exhibit Hall)
Display Session

19.01
Structure of the X-ray Background on Arc-minute Scales*

T.T. Hamilton and D.J. Helfand†, (Columbia University)

An analysis has been made of the arc-minute scale fluctuations in the extra-galactic diffuse X-ray background using the deep survey data gathered by the Einstein Observatory. These data provide a measure of the relative contributions to the unresolved X-ray background of point sources (such as quasars) and diffuse emission (such as an inter-cluster gas). A statistical measure of the granularity in each of several long exposure, high galactic latitude Einstein fields has been computed and compared to the granularity predicted by various models. It is demonstrated that the observed small scale anisotropy in the 1 to 3 keV band cannot be understood without invoking a log-N log-S relationship which extends down to sources with fluxes of $\lesssim 6\times10^{-15}$ ergs/sec/cm^2, a factor of four fainter than the Einstein deep survey sensitivity limit. For an $N^{-1.5}$ distribution, the most likely cutoff for faint point sources is found to be 3×10^{-15} ergs/s/cm^2, with a lower limit of 2×10^{-15}. These cutoffs correspond to integrated point-like fluxes ranging from 55% to 90% of the total nominal X-ray background. Owing to uncertainty in the absolute flux of the X-ray background in the particular directions surveyed, however, the possibility that the entire background originates from point sources cannot be excluded.

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19.02
An Estimate of the Total Space Density of Dwarf Galaxies

Neil D. Tyson, John M. Scalo, (Univ. of Texas at Austin)

If dwarf irregular and blue compact galaxies undergo episodes of star formation bursts, then it is likely that a large fraction of small galaxies remain undetected because of observational selection effects involving limiting magnitude and surface brightness. We have attempted to estimate this unobserved fraction by comparing simulated samples of bursting galaxies, constructed using the theoretical results of Gerola, Seiden and Schulman (1980, Ap. J., 242, 517) for burst amplitude and duty cycle as a function of galaxy size, with a distance-limited catalogue of real dwarf and blue compact galaxies. Assuming a frequency distribution of galaxy sizes of the form $f(r) \propto r^{\gamma}$, we find that after correction of the simulated catalogues for selection effects, a value $\gamma = -4.2 \pm 0.2$ gives good agreement with the observed frequency distributions of luminosity, radius, and angular size. The implications of this result for the true shape of the galaxy mass function, the nature of the absorbers in the Ly α forest, and the contribution to the cosmological density parameter will be discussed.

19.03
The Possible Protogalactic Role of Eddies in a Turbulent Early Universe

W. K. Brown (LANL)

Eddies present in a turbulent early universe can form excellent galaxies upon collapse of the eddies and a small amount of viscous evolution. The resulting model galaxies display realistically flat rotation curves, as well as exponential-like luminosity profiles. The dark mass can be baryonic or non-baryonic in this model.

19.04
Compton Scattering in Strong Magnetic Fields

A. K. Harding (NASA/Goddard) and J. K. Daugherty (UNC-Asheville)

The Compton scattering process in a magnetic field exhibits a variety of energy, angle and polarization dependent effects, which have been widely incorporated into models of X-ray and radio pulsars. In calculations of the scattering cross section, it is usually assumed that the the electron occupies the lowest Landau level in both initial and final states. Scattering events which leave the electron in an excited state involve recoil and thus, a relativistic treatment. Such events will result in a soft scattered photon, which may have $\nu \ll \nu_B$, and one or more cyclotron or synchrotron photons, produced as the electron immediately decays from its excited state. We will present calculations of the fully relativistic Compton scattering cross section in a strong magnetic field, which include excitations of the electron to an arbitrary Landau state. As in previous work, we assume that the electron is initially in the ground state, which is justified in view of the extremely rapid synchrotron transition rates from excited states. We find that the cross section for scattering into excited states becomes comparable to the cross section for scattering into the ground state at photon energies several times the cyclotron frequency in 10^{12} G fields. Thus, the comptonization of incident high energy photons could prove to be an important mechanism for maintaining a population of electrons in excited Landau levels as well as a significant source of soft photons. This process is likely to have interesting applications in models of gamma-ray bursts and X-ray pulsars.

19.05
A Slice of the Universe

Huchra, J. P., de Lapparent, V., Geller, M. J., Kurtz, M. J., Horine, E., Peters, J., and Tokarz, S., (CfA)

We recently completed a portion of the extension of the CfA