58.05D

Spiral Structure and Global Star Formation Processes in M 51

Robert A. Gruendl (University of Maryland)

The nearby grand design spiral galaxy, M 51, is an obvious proving ground for studies of spiral structure and large scale star formation processes. New near-infrared observations of M 51 made with COB (Cryogenic Optical Bench) on the Kitt Peak 1.3m allow us to examine the stellar distribution and the young star formation regions as well as probe regions of high extinction such as dust lanes. We also present an analysis of the kinematics of the ionized gas observed with the Maryland-Caltech Imaging Fabry Perot.

The color information we derive from the near-infrared bands provides a more accurate tracer of extinction than optical observations. We find that the dust extinction and CO emission in the arms are well correlated. Our kinematic data show unambiguously that these dense gas concentrations are associated with kinematic perturbations. In the inner disk, these perturbations are seen to be consistent with the streaming motions predicted by classical density wave theory. The dust lanes, and presumably the molecular arms, form a narrow ridge that matches these velocity perturbations wherever the viewing angle is appropriate. This interpretation requires that the corotation radius be inward of the outer tidal arms. The outer tidal arms however show streaming velocities of the sign that would be expected interior to the corotation point. This can be reconciled if the outer arms are part of a second spiral pattern, most likely due to the interaction with the companion NGC 5195.

The near-infrared observations also show emission from the massive star forming regions. These observations are less affected by extinction than optical observations of H II regions and show clearly that the sites of massive star formation are correlated with but downstream from the concentrations of dense molecular material. This provides clear evidence that the ISM has been organized by the streaming motions which have in turn triggered massive star formation.

58.06

HI in M 81: Spiral Density Waves

David S. Adler (NRAO-VLA), David J. Westpfahl (NMIMT)

A high resolution HI image of M 81 taken with the VLA is used to study characteristics of spiral density waves in the disk. The two main spiral arms show different properties, consistent with previous surveys. The northeast arm shows strong signs of a classical density wave: a high concentration of gas along the inner (downstream) part of the arm (average arm-to-interarm intensity contrasts of up to 4:1), strong streaming motions (up to 30 km/sec) consistent with density-wave models; and velocity dispersions of up to 20 km/sec aligned with the intensity peaks. The southwest arm shows only minor signs of the presence of a density wave: the highest concentration of gas is aligned along the middle of the arm (contrasts up to 3:1); while streaming motions are present, they are inconsistent with density wave models; and velocity dispersions lower than in the northeast arm (8-12 km/sec). These inconsistencies lead us to believe that the density wave in the southwest arm may have been disrupted by an interaction with one of M 81's numerous companions.

The velocity profiles are not uniform as one moves along an arm; they show a high degree of small-scale structure. Much of this structure corresponds to features in the intensity maps - HI knots, clumps, and holes. While the density waves do a good job gathering the gas clouds into the spiral arm regions, accounting for the large-scale spiral structure in the disk, they cannot explain the small scale structure and anomalies in the velocity profiles. One must take into account mechanisms such as cloud-cloud interactions, star formation, and supernova events to explain the small-scale structure of the gas in the galaxy.

The integrated intensity along the spiral arms is seen to fluctuate as a function of galactocentric radius. The peaks along the arms are in rough agreement with those seen in the optical work of Elmegreen et al (1989, ApJ, 343, 602). These fluctuations are consistent with modal density wave theory, which describes these variations as regions where waves cross as they move inward and outward between the resonances in the galaxy.

Session 59: General Properties of AGN

Oral Session, 10:00am - 11:50am

Tucson Convention Center, Ballroom II

59.01D

Spectra and Luminosities of X-ray-selected Active Galactic Nuclei

W.A. Morgan, Jr. (Penn State/STScI)

We present results of the analysis of 112 X-ray-selected and fully optically-identified quasars in four sky fields in the southern hemisphere, detected by the Rosat Position Sensitive Proportional Counters. These fields were originally studied for the ultraviolet-excess properties of objects in the fields. This is one of the largest sets of fully-identified Rosat-observed quasars.

We determine the quasars' power-law spectral index $\alpha_x$ with three different methods: spectral "stacking," hardness ratios, and direct fitting, and discuss the differences between each of these methods. We derive monochromatic X-ray and optical luminosities $L_x$ and $L_{opt}$ and discuss the relationship between them, examine the optical-X-ray spectral slope $\alpha_{ox}$ and the related $L_x/L_{opt}$ ratio and their relationship to redshift, $L_x$, and $L_{opt}$, and finally present a model which could explain the observations.

59.02

X-ray Properties of a Thousand Quasars: ROSAT Observations of the LBQS

Paul J. Green (SAO), Norbert Schartel (MPE), Scott F. Anderson (UWa), Paul C. Hewett (IoA), Craig B. Foltz (UAz), Wolfgang Brinkmann, Henner Fink, Joachim Trümper (MPE), and Bruce Margon (UWa)

Ninety percent of the more than 1000 QSOs in the Large Bright Quasar Survey (LBQS), were observed in soft X-rays during the ROSAT All-Sky Survey (RASS). These data constitute among the largest, most homogeneous X-ray surveys of QSOs to date, and as such are well-suited to the study of the multiwavelength properties of QSOs. By stacking X-ray counts, we obtain effectively much more sensitive observations for an average QSO in bins of redshift or luminosity, and for several classes of QSOs. We confirm a correlation of $\alpha_{ox}$ with luminosity for the overall sample. For higher redshifts and optical luminosities, radio-loud QSOs appear to become progressively more luminous in X-rays than radio-quiet QSOs. The X-ray properties of a subsample of 36 BAL QSOs suggest that they may be unusually X-ray quiet, while a subsample of 22 FeII-strong QSOs is anomalously X-ray bright.

59.03

X-RAY PROPERTIES OF THE NUCLEAR SOURCE IN THE CYGNSUS A GALAXY

D.E. Harris (SAO), R.A. Perley (NRAO), C.L. Carilli (Leiden, NL)

From a ROSAT HRI observation of Cygnus A (66 ksec), we find a second X-ray component approximately 5.5" south-east of the nuclear source. We will discuss the relation of the source morphology to the optical and radio emission and evaluate the "obscured quasar" hypothesis for the nuclear emission on the basis of source intensity and limits to the variability.