radio continuum emission, HI, colors, and Hα emission in M31. The Westerbork array has been used to obtain 24" x 36" resolution maps of the 21cm line (Brinks) and continuum emission (Walterboss), and combined with an earlier 49cm survey to separate the thermal and non-thermal sources. We have also obtained photographic surface photometry in UBVR and in Hα, using the Burrell Schmidt telescope at Kitt Peak and the Palomar Schmidt.

An early goal is to study the relationships between the different Pop I components of the galaxy. At low resolution, all components are concentrated in a ~10 kpc ring structure, coincident with the well-known HI ring. The improved spatial and kinematic resolution of the new radio surveys (~100 pc and 8 km $s^{-1}$), reveals a more complex structure, however. The locations of star forming regions, thermal radio sources, and nonthermal sources generally coincide, but are distinct from the HI. The HI, on the other hand, is very strongly correlated with the dust distribution. None of the components exhibits a pronounced spiral structure. The velocity structure is also complex, with most of the profiles showing a foreground "warp" (Bajaja and Shane 1982) superimposed on the main disk.

Our current efforts are concentrated on mapping the surface brightness, color, and Hα distributions in order to investigate several questions, including the nature of the radio sources, the relationship between the star formation rate and conditions in the interstellar gas, the recent star formation history, and the nature of the warps in the gaseous and stellar disks.

12.14 Stellar Dynamics in Late-Type Spiral Galaxies, D.B. MCELROY, U. MINN. Some bright spiral galaxies of types Sa-Sd are surveyed in absorption-line spectra to investigate stellar rotation and velocity dispersion as functions of radius. The spectra were obtained using the KPNO White Spectrograph on the 0.9m telescope, and analyzed with the Fourier quotient technique.

Consistent with the results of Kormendy and Illingworth (1982) on SO galaxies, and McElroy (1983) on M31, it is shown that these spirals are rotationally dominant except in the innermost regions, have higher V/σ ratios than ellipticals, and have low mass-to-light ratios. Mass estimates are obtained with a dynamic model using rotation, dispersion, and gradients in both.

Kormendy, J. and Illingworth, G.D., 1982, Ap.J., 256, 460.
McElroy, D.B., 1982, Ap.J., to appear in 15 July issue.

12.15 Resonance Rings in NGC 1433, R. BUTA, U. Tex. at Austin. Recent models of barred spirals (Schwarz 1979) have indicated that dynamical resonances with the bar can lead in time to the formation of structures in the gas distribution that bear a remarkable resemblance to the rings observed in real galaxies. The principal resonances where rings form are the inner Lindblad resonance (ILR), the outer Lindblad resonance (OLR), and the second harmonic resonance (UHR). The major axis position angle of each ring depends on the orientation of the dominant family of periodic orbits, which changes by 90° across a resonance. Schwarz suggested that the inner rings in barred spirals could be UHR rings aligned parallel to the bar, with outer rings near OLR and nuclear rings near ILR having the possibility of being aligned nearly perpendicular to the bar.

The nearly face-on southern barred galaxy NGC 1433, which is probably the nearest example of a "theta" (or SB(r)) spiral, includes three ring structures (an inner (r), outer (R'), and nuclear ring) whose characteristics are consistent with these resonance interpretations. The link is suggested by (1) the major axis orientation differences between the rings ($\theta_{R'}$=17°, $\theta_r$=93°, $\theta_{nr}$=34°); (2) the young stellar population in each ring as determined from UBVR surface photometry; (3) the four part structure of the inner ring with breaks near the minor axis; (4) the elliptical shape of the nuclear ring; (5) the "returning" arms of the outer R' to near the ends of the bar; and (6) the striking concentrations of HII regions in the nuclear and inner rings. Furthermore, new kinematic evidence reveals a dynamical line of nodes $\theta_o$ ≈15°, indicating that the inner ring is intrinsically elongated parallel to the bar ($\theta_b$=96°).

The rings of other theta spirals have similar features. Inner rings in some SA spirals are similar in having a young stellar population, but may not be UHR. The strength of the features suggests that resonances may play a major role in the structuring of some galaxies.

Ref. M. P. Schwarz, PhD thesis, Australian Nat'l Univ.

12.16 New Low-Frequency Observations of Giant Radio Galaxies, R.J. HANISCH, U. Md./NFRA.

Recent modifications of the University of Maryland's Clark Lake Telescope (Erickson, Mahoney, and Erb, 1982, Ap. J. Suppl. 50, 403) have made it possible to operate the "T" shaped array of 720 conical-spiral antennas as an interferometer with 512 non-redundant baselines. The telescope operates at frequencies between 15 and 125 MHz with a resolution of 330/ν (MHz) arcmin. Recent observations show that the sensitivity and confusion levels are less than 1 Jy at all frequencies.

A program of observations of the known giant radio galaxies and large head-tail sources is currently in progress and this program includes such objects as 3C129, DA240, 3C236, 3C326, and NGC315. The object of this work is to study the spectral index distribution and total extent of these sources. The results of recent observations will be presented, and the implications for such problems as source confinement, particle reacceleration, and radio source evolution will be discussed.

12.17 Temporal Variations of Extragalactic Radio Sources between 0.3 and 1.4 GHz, S. L. O'DELL, J. J. BRODERICK, B. DENNISON and K. J. MITCHELL, VPI&SU, D. R. ALTSCHULER, UPR (Rio Piedras), and J. J. CONDON and H. E. PAYNE, NRAO. The VPI sub-GHz-variability program monitors approximately 30 extragalactic radio sources, at five low radio frequencies (318, 430, 606, 880, and 1400 MHz). Data taken over the first three years of this program show significant variations in several sources, including AO 0235+164, NRAO 140, PKS 1117+14, DA 406, CTA 102, and 3C 454.3. The multi-frequency light curves for the more variable sources seem to exhibit two distinct types of behavior. For most of these sources, nearly simultaneous temporal variations which are strong at the lower frequencies (0.3-06 GHz) are noticeably weaker (or absent) at the higher frequencies (0.9-1.4 GHz). In contrast, the blazar AO 0235+164 underwent a "delayed" outburst qualitatively reminiscent of the expanding-cloud model,