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The Surface Brightness of the Cores of Elliptical Galaxies from Hubble Space Telescope High Resolution Imaging

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heating mechanism, ambipolar diffusion heating, which keeps the wind hot ($T_{\text{wind}} \sim$ a few thousand K) at large distances (several AU) from the central star. We compute the abundance of CO in the wind using a simplified chemical network that includes the destruction and formation of H_2 and the destruction of CO by endothermic reactions with H atoms. In addition, we do not assume that the populations of the vibrational levels of CO are in LTE (as assumed by other workers in the field), but carry a full NLTE calculation which includes IR radiative pumping and the "surprisal" cross sections for collisional excitation. The agreement of our results with the observed fluxes and line profiles for the $v = 2 \rightarrow 0$ and $v = 3 \rightarrow 1$ transitions is excellent, but because we compute the level population for only the lowest six vibrational levels, the computed fluxes for the $v = 4 \rightarrow 2$ and higher transitions do not match the data. A better fit to these transitions requires the inclusion of many more vibrational levels in the model molecule. We have under way calculations which include at least the lowest ten vibrational levels of the ground electronic state of CO.

Session 33: Galaxies II Oral Session, 2:15–3:45 pm Crystal Forum

33.01

Radio Spectra and Star Formation Histories in HII Galaxies

Hans-Jörg Deeg (Univ. of New Mexico/NRAO)

A sample of HII galaxies has been observed in several radio and optical bands. These galaxies are undergoing very active star formation; they have been selected on the basis of strong radio continuum emission. Radio continuum observations were obtained to determine their radio spectra. Several of the spectra were found to flatten towards lower frequencies, which is unusual. Surface and aperture photometry was obtained in the B,R, and I bands and in the $\text{H}\alpha$ emission line. Several mechanisms which could shape the radio spectra are reviewed towards their suitability to account for the spectral shapes and are fitted to the spectra. The equipartition magnetic field was found to be 10–30 μG , and the radiation density inside HII regions was found to be between 2 and 15 eV cm^{-3} . The spectra resulting from a time variable relativistic electron injection ('synchrotron aging') show variations of the injection rate within a few Myrs. A fit based on free-free absorption balances free-free absorption and thermal emission, constraining the maximum size of the HII region. This allows a direct comparison with $\text{H}\alpha$ observations, showing sizes of 0.5 – 1 kpc. The fits also gave the electron density of 10 – 60 cm^{-3} , and the emission measure of the order 10^5 pc cm^{-6} . A correlation between the galaxies' fraction of thermal emission and their size and radio luminosity was found. A model describing electron diffusion losses, dependent on a galaxies' size, can reproduce the correlation well. Radio and FIR emission indicate star formation rates which are enhanced during the last 10^{6-7} years. Star formation ages derived from 'synchrotron aging' are compared to those derived from optical colors and the radio-to-FIR ratio, establishing 'synchrotron aging' as a valid indicator for these ages. This allowed to sort the galaxies into an age sequence of their starbursts. The physical picture of a region in which star formation, SN explosions, and the resulting nonthermal radio emission takes place, can be accounted for well, by comparing the different star formation estimators which are based on a variety of radiative processes.

33.02

A Survey of a Complete Sample of HII Galaxies to Detect HI Companions

C.L. Taylor (University of Minnesota)

Title: A Complete Survey of HII Galaxies to Detect HI Companions

C.L. Taylor (U.Minnesota), E. Brinks (NRAO), E.D. Skillman (U.Minnesota)

HII Galaxies are HI rich galaxies which contain one or a few high surface brightness optical knots whose spectra resemble those of HII regions. These knots are areas of intense star formation. The current star formation rates are too high to last a Hubble time, leading to the hypothesis that HII galaxies undergo

star formation in discrete bursts. (Searle & Sargent, 1972, ApJ 173, p. 25) One possible explanation for this phenomenon is that a gravitational interaction triggers the burst of star formation in an otherwise quiescent galaxy.

Taylor, Brinks, & Skillman (1993, AJ 105, p. 128) mapped in HI 9 isolated HII galaxies with the VLA in its most compact configuration. Five HI companions were discovered near four of the HII galaxies. These HI companions were within a radius of 30 arcmin and within 240 km s^{-1} . The companions were typically one order of magnitude smaller than their parent galaxies in both neutral hydrogen and total mass.

Motivated by this success, we have obtained 21-cm VLA observations of a complete, volume limited sample of HII galaxies without obvious interaction partners. The current sample consists of nineteen members with velocities less than 2500 km s^{-1} . From our observations we have positively identified 10 companions around 8 galaxies, plus a further four sample members which are gravitationally interacting with nearby sample members, for a total of at least 12 interacting systems. A preliminary analysis of these objects and the statistical significance of the detection rate will be discussed.

33.03

The Distribution of Dark Matter in the Halo of M87

Benoit Tremblay and David Merritt (Rutgers University)

We investigate the constraints that can be placed on the distribution of dark matter around M87 using the 43 globular cluster velocities reported by Mould *et al.* (1990). If the globular cluster system is assumed to be spherical, with an isotropic velocity distribution, we find that the most likely dependence of the dark matter density on radius is $r^{-1.8}$ between about 3 and 30 kpc, where the exponent lies between 0.2 and 3 with 99 of roughly 200 velocities would be necessary to determine the exponent of the density falloff to ± 0.5 under the isotropic hypothesis. The minimum number of velocities required to detect the presence of velocity anisotropy in the M87 globular cluster system is of order one thousand.

33.04

The Surface Brightness of the Cores of Elliptical Galaxies from Hubble Space Telescope High Resolution Imaging

L. Ferrarese, H.C. Ford (JHU, STScI), W. Jaffe, F. van den Bosch (Leiden Observatory), R.W.O. Connell (University of Virginia)

High resolution studies of the cores of elliptical galaxies are needed in order to understand the mechanisms of galaxy formation and evolution. Because ground based imaging is severely impaired by atmospheric seeing, we have undertaken a program of high resolution Hubble Space Telescope (HST) imaging of a magnitude-limited sample of 12 elliptical galaxies in the Virgo cluster. The data has been obtained using the Planetary Camera (PC) and the F555W filter (very close to the Johnson V band). The plate scale of the PC is $0.043 \text{ arcsec/pixel} = 3.1 \text{ pc/pixel}$ at an assumed distance of 14.7 Mpc to the Virgo cluster. In spite of the spherical aberration affecting the HST primary mirror, our modelling shows that deconvolution techniques allow us to recover to surface brightness parameters up to 0.3 arcsec from the centre of the galaxy, an order of magnitude improvement with respect to ground based data. For each galaxy we have determined the ellipticity, position angle of the major axis, deviations of the isophotes from pure ellipses, and the brightness profile inside a 15 arcsec radius, by iteratively fitting the isophotes.

All of the galaxies studied show a unique morphology in the inner 10 arcsec. Five galaxies are found to harbour dust, in agreement with previous estimates (e.g. Lauer 1985b, Ebner *et al.* 1988), seven of the galaxies have isophotes deviating from pure ellipses more than 1% (cfr Pletier *et al.* 1990). For three galaxies, NGC4342, NGC4570, and NGC4623, we find the presence of a thin (less than 10 parsecs) elongated (≈ 150 parsecs) nuclear structure, resembling an edge-on disk, although kinematic data is needed to confirm the presence of a separate disk component. None of the galaxies shows an isothermal core. This may be the due to the presence of a large nuclear mass concentrations, such as a nuclear black hole, the occurrence of merging processes, or anisotropies in the velocity distribution.