DYNAMICAL CONSTRAINTS ON EARLY-TYPE GALAXY HALOS

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Much insight into the formation of early-type galaxies (ellipticals and S0s) can be gained through study of their halo properties (mass distribution, angular momenta, orbit structure). One of the most promising techniques for probing early-type halos is via the kinematics of planetary nebulae (PNe). We have pursued a multi-pronged program using several different techniques, old and new, to acquire PN velocities. This entails multi-fiber spectroscopy with WYFFOS+AUTOFIB2 on the 4.2-m WHT, masked counter-dispersed imaging with FORS2+MXU on UT2, and counter-dispersed imaging with ISIS and with the custom-built *Planetary Nebula Spectrograph (PN.S)* on the WHT (Douglas et al. 2002). We have now acquired 70-200 velocities to 3-6 $R_{\rm eff}$ in each of 7 galaxies: NGC 821, NGC 3379, NGC 4472, NGC 4486, NGC 4494, NGC 5866, and NGC 7457.

For the bright ellipticals NGC 4472 and NGC 4486, the kinematics of the PNe and the globular clusters (GCs: Zepf et al. 2000; Hanes et al. 2001) suggest that the circular velocity profile is constant or rising with radius at 4 $R_{\rm eff}$.

For the faint ellipticals NGC 821, NGC 3379, and NGC 4494, the projected velocity dispersion profile declines markedly with radius (see Figure 1). Together with the results for NGC 4697 (Mendéz et al. 2001), this suggests that sub-L^* ellipticals have much less dominant dark halos than brighter ellipticals.

More rigorous determination of the mass distributions will use orbit modeling techniques (Romanowsky & Kochanek 2001) and all available dynamical constraints (stars, PNe, GCs, X-ray gas).

Although elliptical galaxies rotate slowly in their inner parts, it is possible that their outer parts rotate rapidly, making their total specific angular momenta comparable to those of spiral galaxies (e.g., Arnaboldi et al. 1998). Full analysis of the PN data for our sample galaxies will test this. In NGC 4486, the outer GCs rotate rapidly ($\sim$250 km s^{-1} for $R > 20$ kpc; Côté et al. 2001), while our PN data indicate a lower rotational velocity for the stars ($\sim$100 km s^{-1}). This difference poses a challenge to models of this galaxy's formation.

Observations are planned with the PN.S for 10 more nearby ellipticals to fill out the current sample.

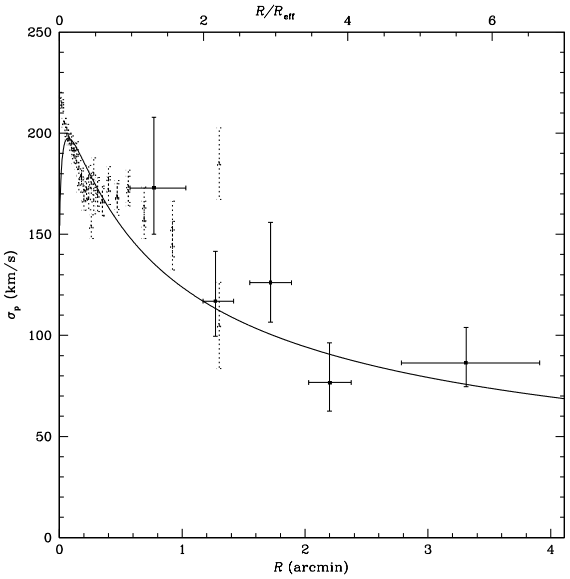

Fig. 1. Projected velocity dispersion profile around NGC 3379, as traced by the integrated stellar light (*dotted error bars*; Statler & Smecker-Hane 1999) and 110 PNe (*solid error bars*). The solid line shows an isotropic constant mass-to-light ratio Hernquist (1990) model.

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