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Frequency of Gas-Stellar Counterrotation

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Abstract. We search for bulk counterrotation of the gas and stars in 67 galaxies of all types and a wide range of luminosities. Bulk counterrotation characterizes ∼25–30% of E/S0's with extended gas, but at most a few percent of Sa–Sbc spirals. For S0's, the frequency of counterrotation we derive agrees with previous work, but we sample significantly fainter luminosities. Thus the agreement suggests that similar formation mechanisms may operate over a wide range of physical scales.

1. Sample

The survey sample (Figure 1) consists of 67 galaxies drawn from the Nearby Field Galaxy Survey (NFGS), a survey of ∼200 galaxies including all morphological types in their natural abundance and spanning luminosities from $\mathrm{M_B} \sim -23$ to -15 (Jansen et al. 2000). Our sample includes all of the NFGS E/S0's with extended gas emission, a representative majority of the Sa–Sbc spirals, and a few later types. Three S0's show minimal rotation with uncertain sense.

2. Results

Counterrotators are circled in Figure 1. Four are E/S0's, totalling 24(29)% of all sample E/S0's with(without) the 3 uncertain S0's. One is an Im, for which the confidence of our counterrotation claim is $\sim 2.2\sigma$. Full details appear in Kannappan & Fabricant (2000). We stress that our detections represent a lower limit, because we cannot separate multiple kinematic components.

3. Discussion

Bertola, Buson, & Zeilinger (1992) and Kuijken, Fisher, & Merrifield (1996), find gas-stellar counterrotation frequencies of ∼20–25% for emission line S0's. We find 14(18)% with(without) the 3 uncertain S0's. This agreement, despite a strong difference in sample luminosity distributions (Figure 1), suggests that similar mechanisms form gas rich S0's over a wide range of physical scales.

Among 38 Sa–Sbc spiral galaxies, we find no clear cases of bulk counterrotation, implying a counterrotation frequency of <8% (95% confidence). However, counterrotation cannot be ruled out in the inner parts of one Sa (NGC 4795). This galaxy shows clear evidence of gas-stellar decoupling at large radii (Figure 2), possibly related to satellite accretion. Jore (1997) finds a bulk counter-

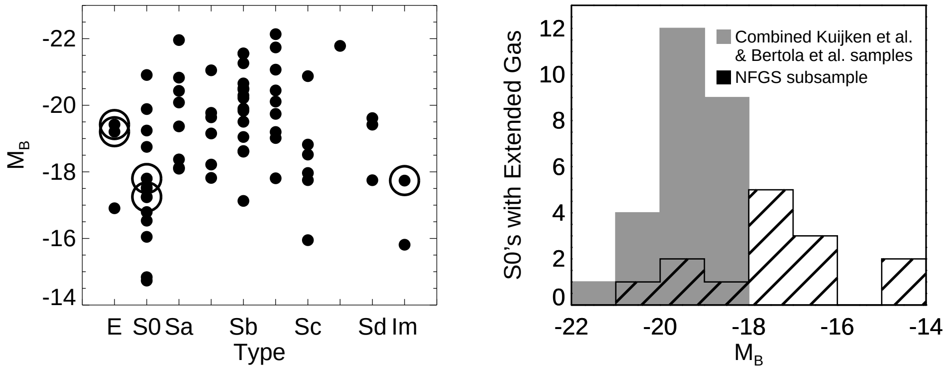

Figure 1. Left: The search sample, with counterrotators circled. Right: Luminosity distributions for the 14 S0's in our sample and for the Bertola et al. (1992) and Kuijken et al. (1996) studies.

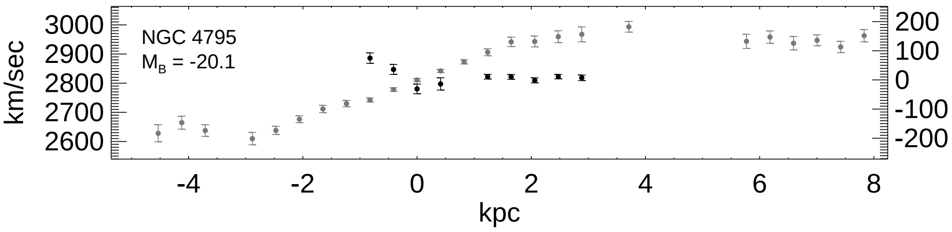

Figure 2. Gas (black) and stellar (grey) kinematics for NGC 4795.

rotation frequency of ∼17% in a sample of 23 bright Sa's, consistent with our results given our Sa sample size of 8 (see also Haynes et al. 2000).

As argued in Kannappan & Fabricant (2000), mergers and accretion provide the simplest explanation for the counterrotators' properties, particularly their early type morphologies, significant HI masses, and lack of obvious close neighbors. The signatures of minor retrograde accretion events may be washed out in gas rich spirals, while more substantial mergers are likely to produce E/S0/Sa galaxies. Dwarf-dwarf mergers may help to explain the faint S0 population.

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