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GAS CONTENT IN EARLY TYPE GALAXIES

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The interstellar medium of early type galaxies has attracted a great deal of interest ever since Faber & Gallagher (1976) showed that a considerable amount of mass ejected by evolved stars could pile up over the lifetime of the galaxy ($10^8 - 10^9$ M$_\odot$). Surprisingly though, high resolution and sensitive HI observations demonstrated that in general much less gas is detected and that most of it seems to have been accreted (van Gorkom et al 1986; Wiklind & Henkel 1990). We have started a project, mapping a few early-type galaxies in detail, in order to shed light on the origin of the ISM in these objects.

NGC 404 and NGC 3593 were observed with the NRAO Very Large Array (VLA) on 1996. For the global profiles we derived a total HI flux of 59.3 Jy km s^{-1} and a systemic velocity of -57 km s^{-1} for NGC 404, and 14.57 Jy km s^{-1} and 650 km s^{-1} for NGC 3593. The total HI masses derived for these galaxies were 1.52×10^8 M$_\odot$ and 1.03×10^8 M$_\odot$, respectively.

The HI is distributed in NGC 404 as a bright doughnut with an inner diameter of $\sim 3'$ and an outer diameter of $\sim 13'$. At considerably lower signal-to-noise level an outer ring can be discerned. The ellipticity of that ring is higher than that of the disc, suggesting a different inclination. Our HI data imply a mass of $M_{HI} \sim 1.14 \times 10^8$ M$_\odot$ in the "galaxy" ($R < 400''$) and $M_{HI} \sim 0.38 \times 10^8$ M$_\odot$ in the "annulus" ($R > 400''$). There is considerable fine-scale structure visible, but no large scale pattern such as spiral arms. The "galaxy" is very nearly circular, suggesting an almost face-on orientation.

The HI distribution in NGC 3593 is very irregular, in contrast with the optical image of this galaxy. NGC 3593 is well known to have a stellar disc which is counterrotating with respect to the main stellar body of the galaxy. The ionized, molecular and neutral gas corotate with this smaller innermost stellar disc (Bertola et al 1996; Corsini et al. 1998; García-Burillo et al 2000). The HI mass found is in very good agreement with measures with single dishes (eg. Sage 1993). We have detected also HI emission in an otherwise inconspicuous companion, with $M_{HI} \sim 7.7 \times 10^6$ M$_\odot$ and a systemic velocity of ~ 625 km s^{-1}, which puts it at the same distance as NGC 3593.

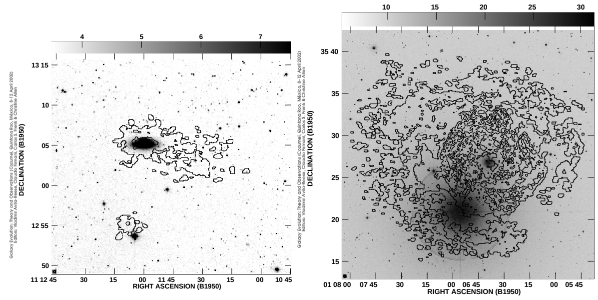

Fig. 1. NGC 404 (left) and NGC 3593 (right); both are displays of an optical image taken from the DSS with the HI distribution superposed as contours. The bright stellar object to the south-east of NGC 404 is βAnd.

Based on our HI data, an external origin for the HI, both in NGC 404 and NGC 3593 is the most likely explanation. The HI distribution of the latter shows what seems to be remnant tidal material, possibly still falling towards the galaxy. The amount of HI is compatible with that of a dwarf irregular galaxy (del Río et al 2002). In due course the small companion to the south east might await a similar fate! Although the evidence in the case of NGC 404 is less clear cut, it is difficult to explain the origin and orientation of the annulus other than in terms of an accretion event. Hence, we subscribe to the picture in which most, if not all the ISM in early type galaxies is external in origin.

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