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Neutral and ionized gas distribution in and around the radio galaxy Coma A

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Abstract.

H I absorption has been detected with the WSRT against *both lobes* of the radio galaxy Coma A. This radio galaxy could be expanding in a particularly gas rich environment, perhaps the result from interactions/mergers between the dominant giant galaxy (associated with the radio galaxy) and less massive galaxies in the same group.

Powerful radio galaxies are frequently associated with kpc-sized emission line nebulosities, extending up to tens of kpc from the nucleus. These nebulosities can be either lit up by interactions between the radio jet/lobe and the environment or photoionized by anisotropic UV radiation from the active nucleus. Little is known in radio galaxies to what extent this ionized gas is related to the overall ISM. A key element for studies of these extended emission line regions is to know the intrinsic distribution of the gas in and around the galaxy, i.e. to know the distribution of the neutral gas together with that of the ionized gas. Coma A is an ideal object for this study. It is a well-known radio galaxy ($z = 0.0857$) studied in detail by van Breugel et al. (1985). The radio structure is mainly formed by two lobes (see Fig. 1) and the total size is ~ 65 kpc (for $H_\circ = 75$ km s^{-1} Mpc^{-1}, 1.45 kpc/arcsec). A spectacular system of interlocking emission line arcs and filaments has been observed in Hα (see Fig. 1) using the Taurus Tunable Filter (on the WHT, Tadhunter et al. 2000). A striking match between the ionized gas and the radio structures (see Fig. 1) makes the origin of the ionized gas even more puzzling and *strongly suggests the presence of a complex interaction between the radio structure and the gas around Coma A.*

1. HI observations with the Westerbork Synthesis Radio Telescope

We have observed Coma A at the frequency of the redshifted H I line (1343 MHz) with the WSRT using 10 MHz bandwidth and a velocity resolution of ~ 20 km s^{-1}. At the resolution of our observations (about 13 arcsec), the radio structure of Coma A appears just resolved in two structures corresponding to the northern and southern lobes. The preliminary results show that we have detected H I in absorption against *both radio lobes*. In both lobes the peak of the absorption is at a very low optical depth (~ 0.4 %). This low optical depth is likely to be due (at least in part) to dilution. The velocity of the absorption is about 200 km s^{-1} redshifted for the northern lobe and between 100 and 150 km s^{-1} blueshifted for the southern lobe compared to the systemic velocity. The FWHM is between 150 and 200 km s^{-1}. Assuming a spin temperature of 100 K, this gives a column density of $5 \cdot 10^{19}$ atoms cm^{-2}. Velocities of the ionized gas derived from a slit aligned with the radio axis show the same trend with position. Thus, *the HI appears kinematically associated with the ionized gas*.

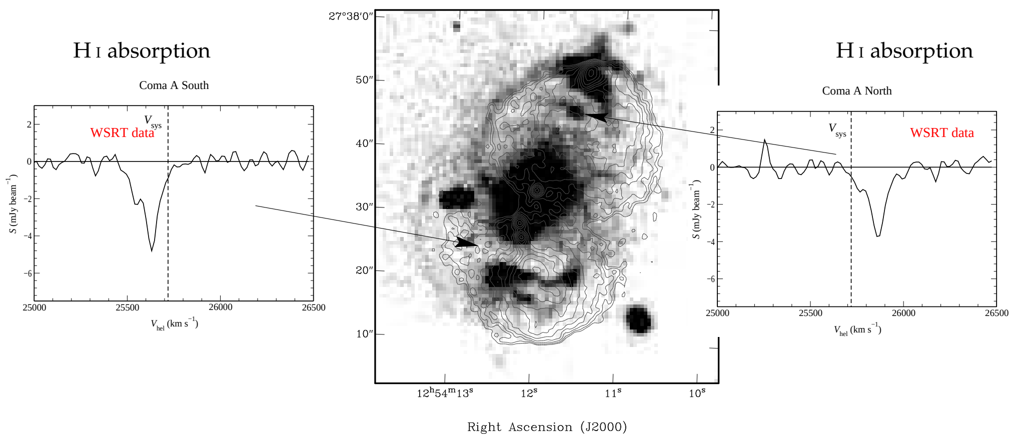

Fig.1 *Panel showing the approximate location of the H I absorption. In the plots, the dashed line represents the systemic velocity. In the middle, is the Hα image with superimposed the contours from a 20cm VLA image.*

1.1. Preliminary conclusions

One of the very few objects in which spatially extended 21-cm H I absorption has been detected against the radio lobes is the central radio galaxy in the cooling flow cluster Abell 2597 (O'Dea et al. 1994). This has been interpreted as indication that the radio lobes are surrounded by a collection of clouds containing both neutral and ionized gas. The same could apply to Coma A, with the main difference that *the scale of the phenomena is larger* (several tens of kpc instead of few kpc). Indeed, in the case of Coma A, the complicated Hα structure has been explained by a particularly gas rich environment surrounding the galaxy and that the close morphological association is due to the radio lobes expanding into this gas-rich environment (Tadhunter et al. 2000). The detected H I would just be part of this system.

Coma A could be the result of interactions/mergers between the dominant giant galaxy and less massive galaxies in the same group. Although we cannot yet say how spatially extended the observed absorption is, it is quite likely that Coma A indeed possesses extended H I structures.

References

Tadhunter C.N., Villar-Martin M., Morganti R., Axon D. 2000, MNRAS, 314, 849
van Breugel W., Miley G., Heckman T., Butcher H., Bridle A. 1985, ApJ, 290, 496
O'Dea C., Baum S., Gallimore J., 1994, ApJ, 436, 669