

# Recent star formation in the H I dominated outer regions of early-type galaxies

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## Abstract.

**Context.** According to the ATLAS<sup>3D</sup> project, about 20 percent of all nearby early-type galaxies ( $D < 42$  Mpc;  $M_K < -21.5$  mag; stellar mass  $M_{stars} \gtrsim 6 \times 10^9 M_\odot$ ) outside clusters are surrounded by a disc or ring of low-column-density neutral hydrogen (H I) gas with typical radii of tens of kpc, much larger than the stellar body.

**Aims.** Our aim is to understand the impact of these gas systems on the host galaxies, in particular, whether there is any recent star formation related to the H I and effect of recent star formation on the host early-type galaxies.

**Methods and sample.** We analyse the distribution of star formation out to large radii by using resolved H I images together with UV and optical images. We calculate the UV-UV and UV-optical colours in two apertures, 1-3 and 3-10  $R_{eff}$ . Using FUV emission as a proxy for star formation, we also estimate the integrated star formation rate in the outer regions. Our sample consists of 18 H I-rich galaxies as well as 55 control galaxies where no H I has been detected. We select the control sample galaxies to match the H I-rich galaxies in stellar mass, environment, distance and stellar kinematics.

**Results.** In half of the H I-rich galaxies the radial UV profile changes slope at the position of the H I radial profile peak. We find that the FUV-NUV and UV-optical colours in the first and second apertures of the H I-rich galaxies are on average 0.5 and 0.8 mag bluer than the H I-poor ones, respectively. We also find that the H I-rich early-type galaxies have colour gradients that are almost 2 times stronger than the H I-poor ones. We estimate the integrated star formation rate in the outer regions ( $R > 1 R_{eff}$ ) to be on average  $\sim 6.1 \times 10^{-3} M_\odot \text{ yr}^{-1}$  for the H I-rich galaxies. We find that the gas depletion time in the outermost region (3-10  $R_{eff}$ ) is  $\sim 80$  Gyrs, which is similar to that estimated for the outskirts of spirals.

**Conclusions.** Studying the stellar populations in early type galaxies with and without H I, we find that galaxies with H I generally show UV and UV-Optical colours in the outer parts that are bluer than those of early-type galaxies without H I. This shows that the H I is actively involved in recent star formation. The star formation rate in the outer regions is too low to build a stellar disc, and therefore change the morphology of the host even when integrated over several Gyrs. Star formation in outermost regions does not depend on the type of the galaxies.

**Keywords.** galaxies: elliptical and lenticular, cD, galaxies: evolution, galaxies: ISM, galaxies: structure

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