



A tidal dwarf galaxy in the interacting galaxy group NGC 3166/9?

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ABSTRACT: We have obtained high-resolution HI observations of the nearby, interacting galaxy group NGC 3166/9 using the Giant Metrewave Radio Telescope (GMRT). Previous Arecibo Legacy Fast ALFA survey (ALFALFA) maps of this region show an extended HI envelope around the main group members and reveal several putative dwarf galaxies. Our follow-up GMRT observations are an important probe of the membership, properties and nature of this dwarf galaxy population, which can constrain galaxy formation and evolution in a group environment. A thorough search of the GMRT datacube revealed eight low-mass objects, with gas masses ranging from 4×10^7 to $3 \times 10^8 M_{\odot}$, for which we computed stellar masses and star formation rates using ancillary SDSS and GALEX data respectively. One of these detections is clearly associated with a prominent tidal tail and is a probable tidal dwarf galaxy (TDG) with a dynamical to gas mass ratio close to unity.

OBSERVATIONS: Single-dish HI mapping, by Haynes (1981) and ALFALFA [1,2], of a nearby interacting galaxy group NGC 3166/9 showed extensive HI emission around the group's core region (Fig. 1). Follow-up higher resolution observations with the GMRT detected eight low-mass objects (Fig. 2). Most of these detections are either primordial dwarf irregular galaxies or short-lived tidally formed "knots"; however, one object, AGC 208457, is associated with a well-distinguished tidal tail and is likely to be a TDG [3].

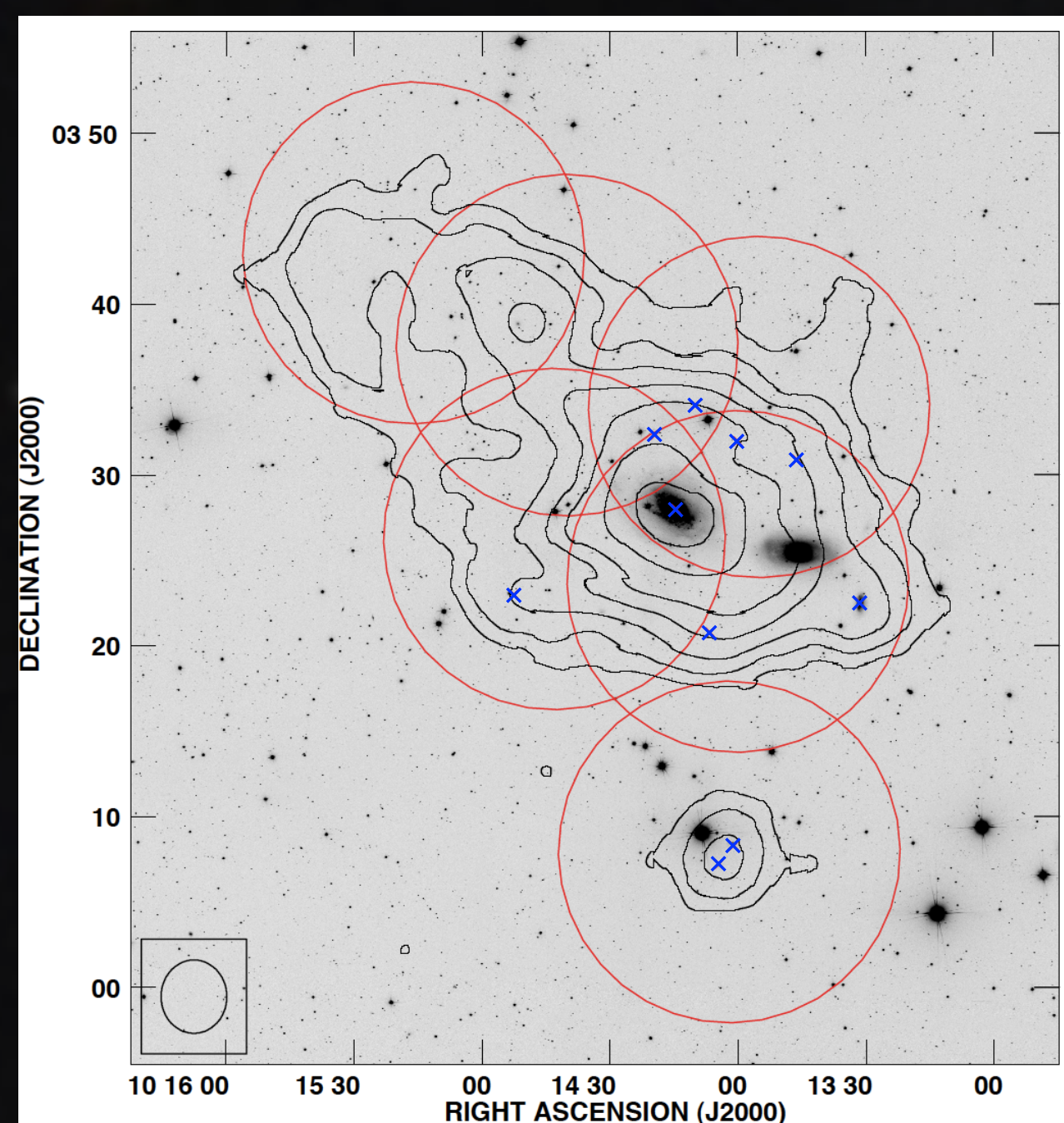


Figure 1: ALFALFA total HI intensity contours of the region around NGC 3166/9 superimposed on a SDSS *r*-band image. The red circles represent the GMRT follow-up pointings, blue X's are the locations of the GMRT detections.

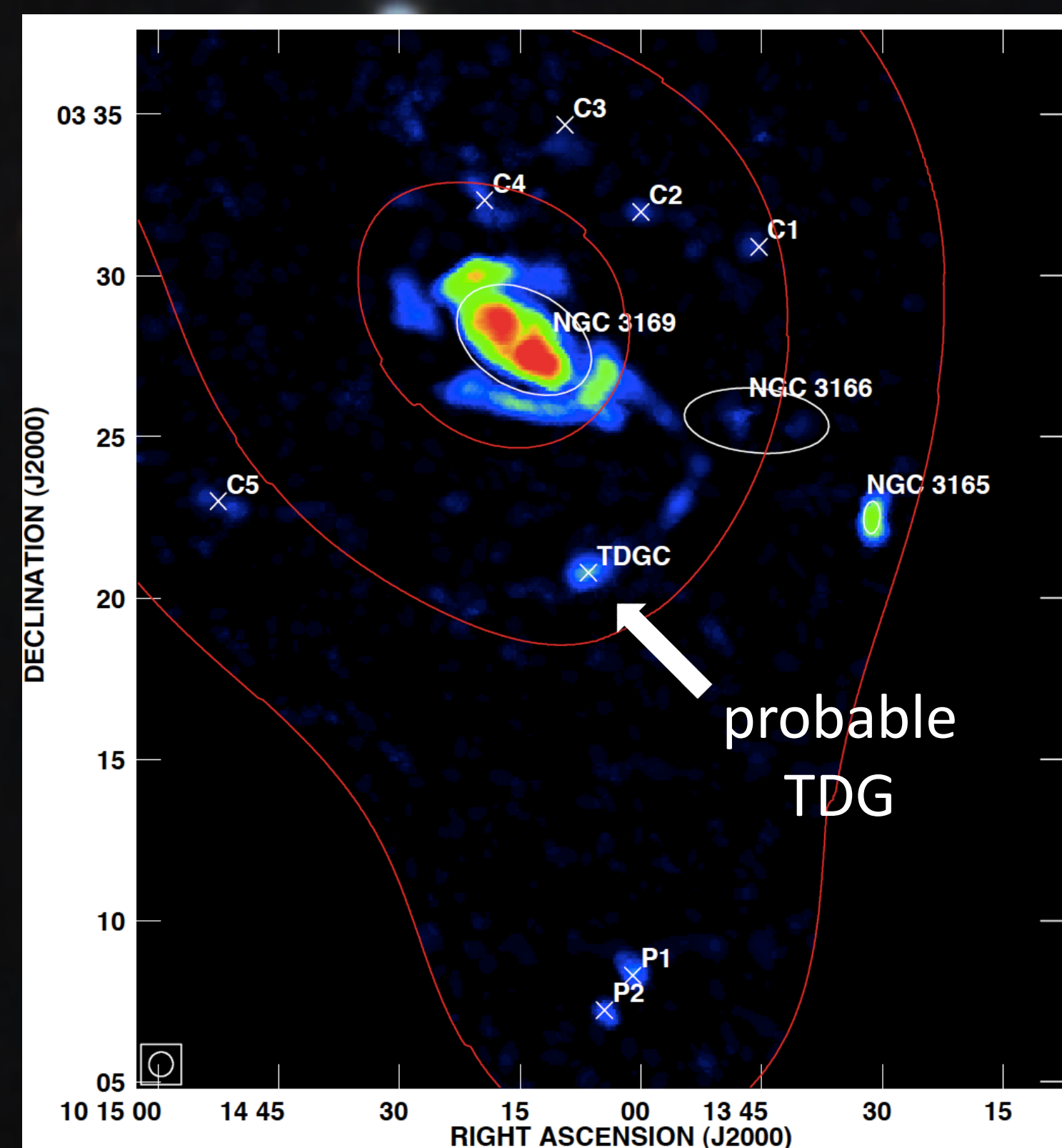


Figure 2: GMRT total intensity map of NGC 3166/9 at 45'' resolution. The X's are the GMRT detections and the ellipses represent the optical disks of the NGC galaxies. To remove spurious signals, regions outside of the outermost red noise contour ($\sigma = 2.8$ mJy/beam) were blanked.

PRESENT & FUTURE: This work is the start of a multi-resolution, multi-wavelength survey of gas-rich galaxy groups. We currently are interested in two gas-rich groups mapped by ALFALFA: NGC 871/7 and NGC 4725/47. We hope to obtain deeper optical imaging of NGC 3166/9, which will afford more reliable stellar and metallicity comparisons between the various group members.

TIDAL TAIL: We detect a prominent HI tail, which coincides with both optical and UV features (Figs. 3 & 4). It extends below NGC 3166 and ends at a probable TDG.

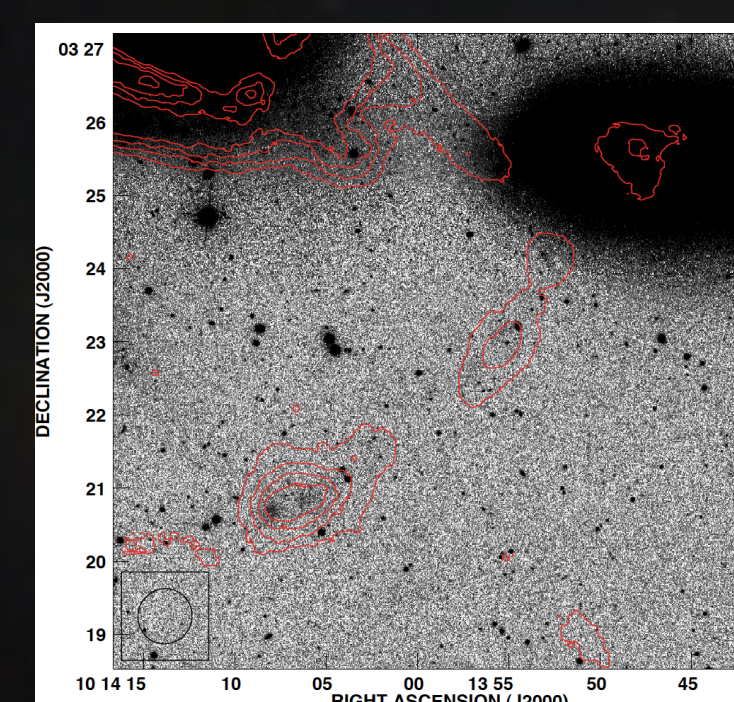


Figure 3: GMRT total HI intensity map of the tidal tail and the TDG candidate superimposed on an SDSS *r*-band image

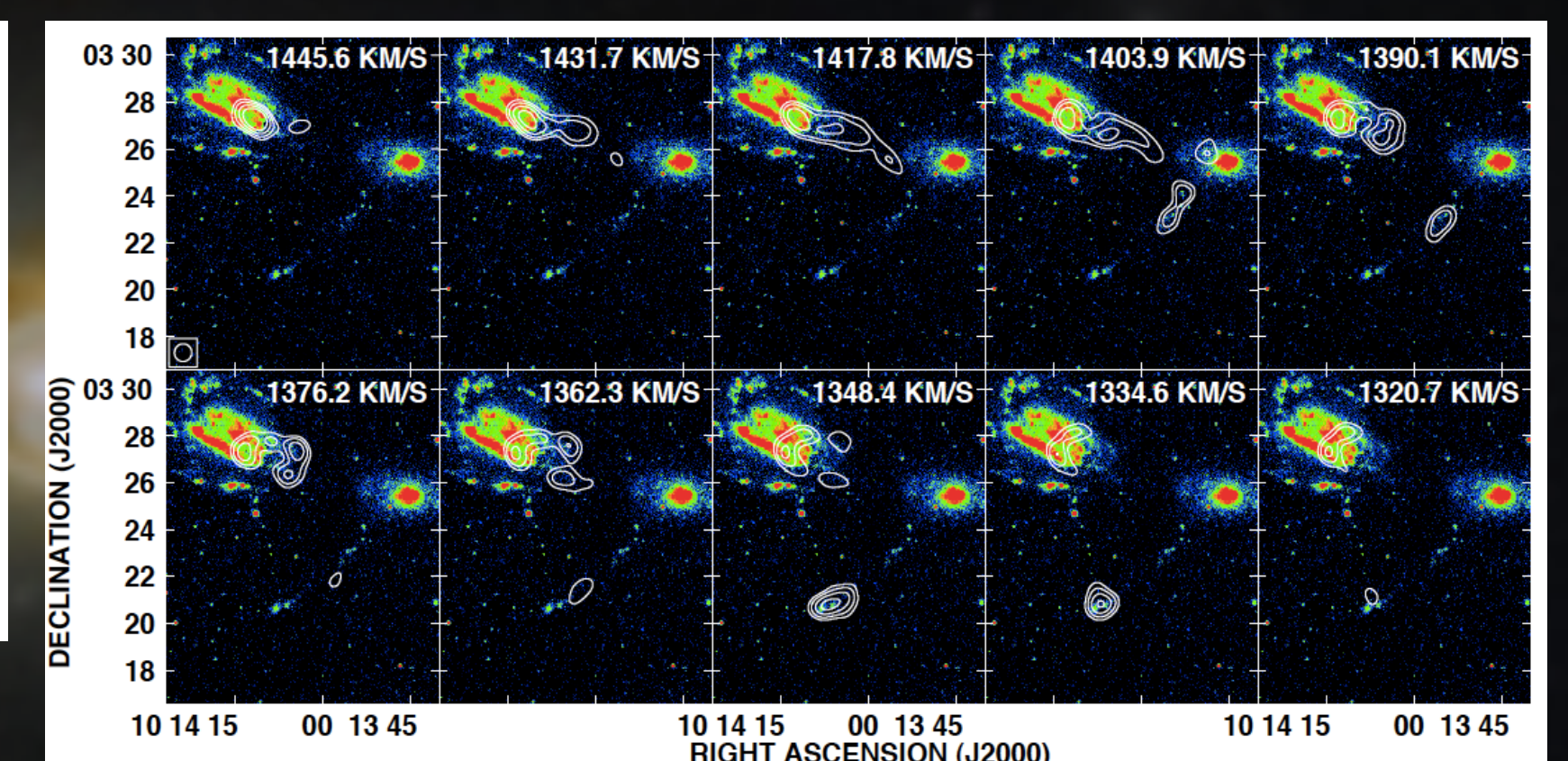


Figure 4: Channel maps of the GMRT HI contours at 45'' resolution showing the tidal tail superimposed on a GALEX NUV image. The bright NUV objects are NGC 3166 and NGC 3169.

TDG CANDIDATE: AGC208457 appears to have all the hallmarks of a young TDG [4]:

- located at the tip of a tidal tail
- $M_{\text{gas}} = 3.1 \pm 0.4 \times 10^8 M_{\odot}$ (sufficient mass to evolve into a long-lived, self-gravitating system [5])
- shows evidence of active star formation
- $M_{\text{dyn}}/M_{\text{baryon}} = 1.4 \pm 0.4$ (contains little dark matter)

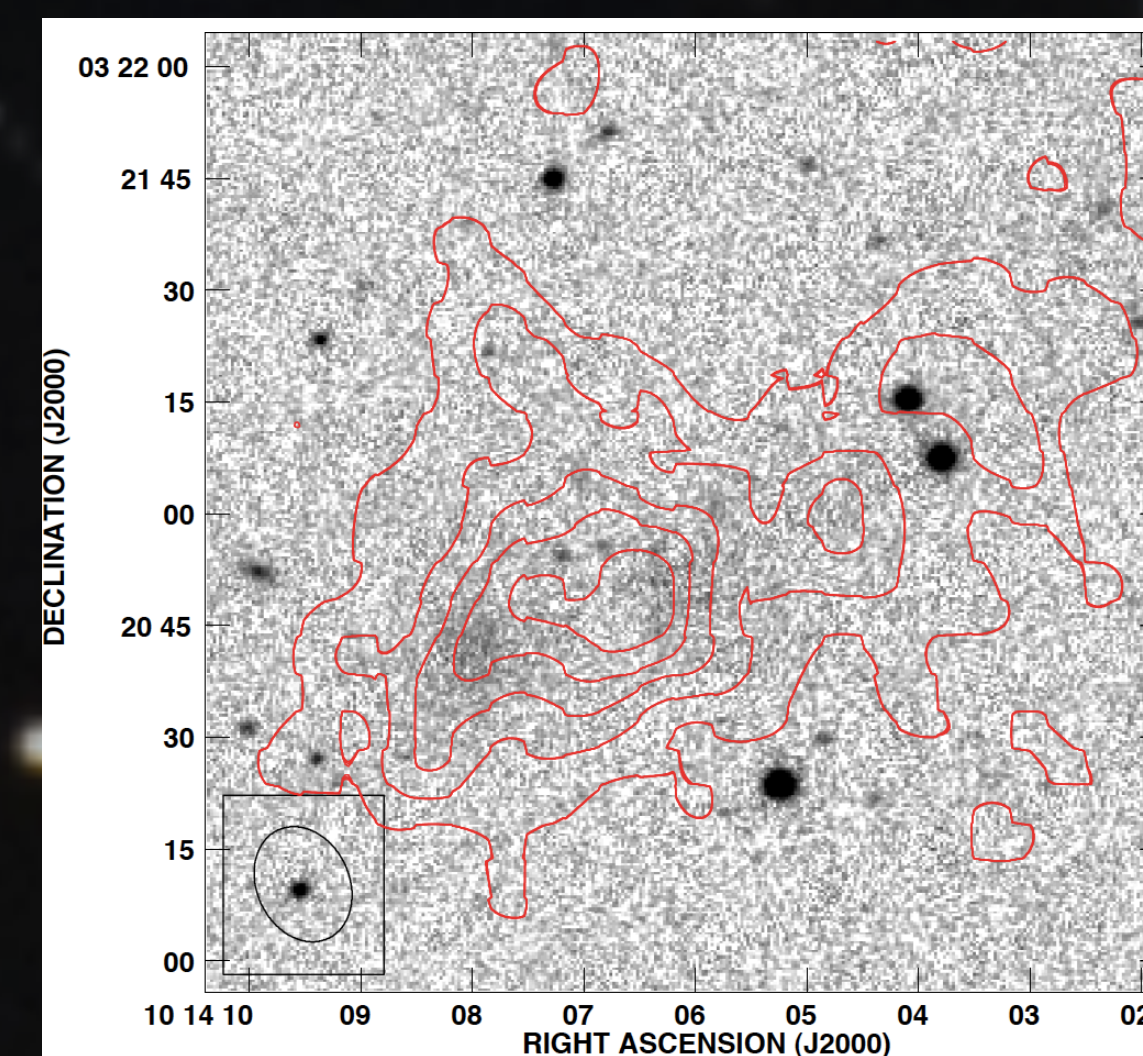


Figure 5: GMRT total intensity map of the TDG candidate at 15'' resolution superimposed on an SDSS *r*-band image.

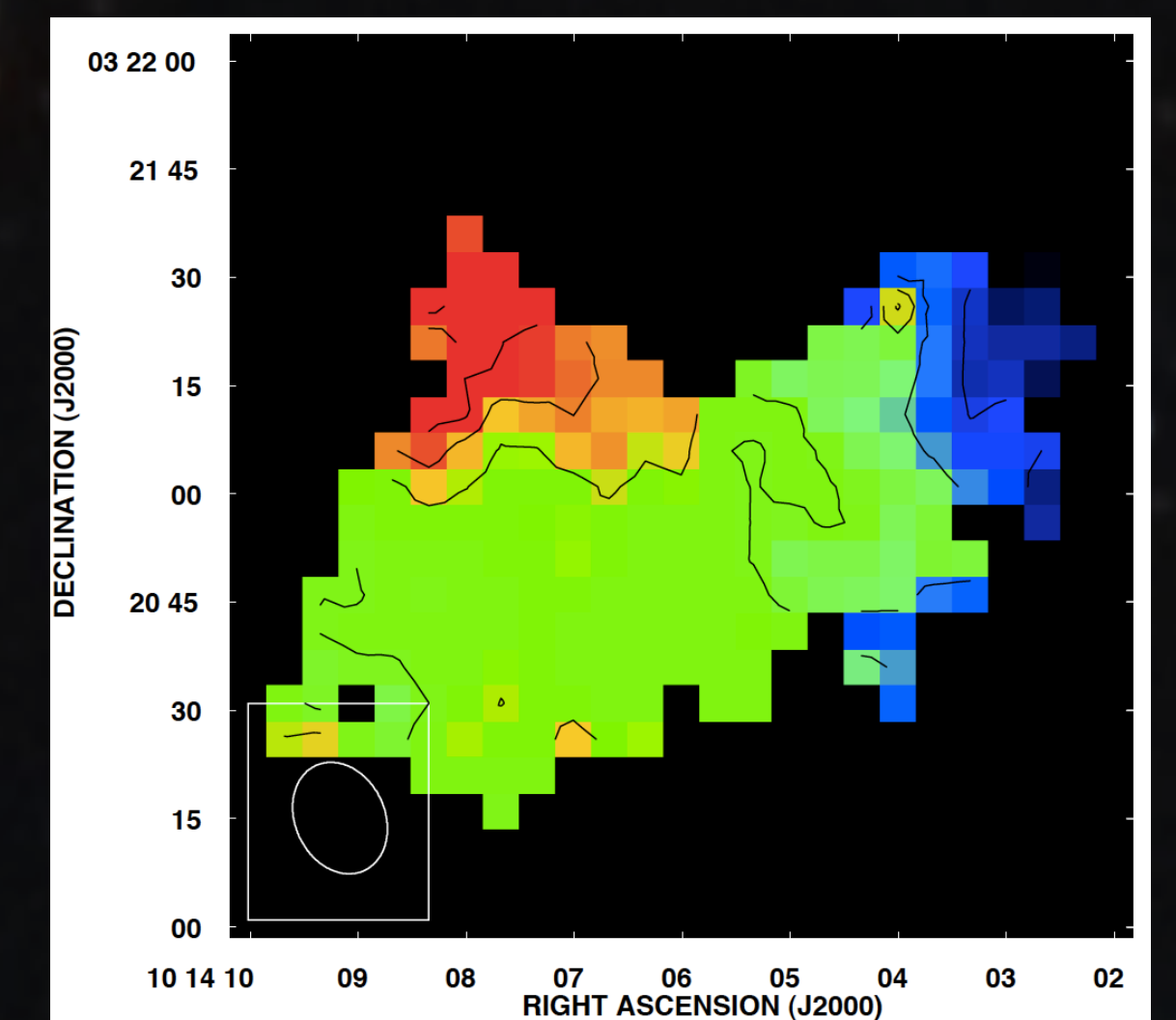


Figure 6: GMRT intensity-weighted velocity map. Contours are at (1325, 1330, 1335, 1340, 1345, 1350, 1355) km/s.

REFERENCES: [1] Haynes, M. P., 1981, AJ, 86, 1126. [2] Giovanelli, R., et al., 2005, AJ, 130, 2598. [3] Lee-Waddell, K., et al. 2012, MNRAS, submitted.

[4] Duc, P., 2011, arXiv:1101.4834. [5] Bournaud, F., Duc, P., 2006, A&A 456, 418.

Background: NGC 3166/9 group, image credit: Jon Talbot, Stark Bayou Observatory