DARC Sample & Galaxy Clusters Formation

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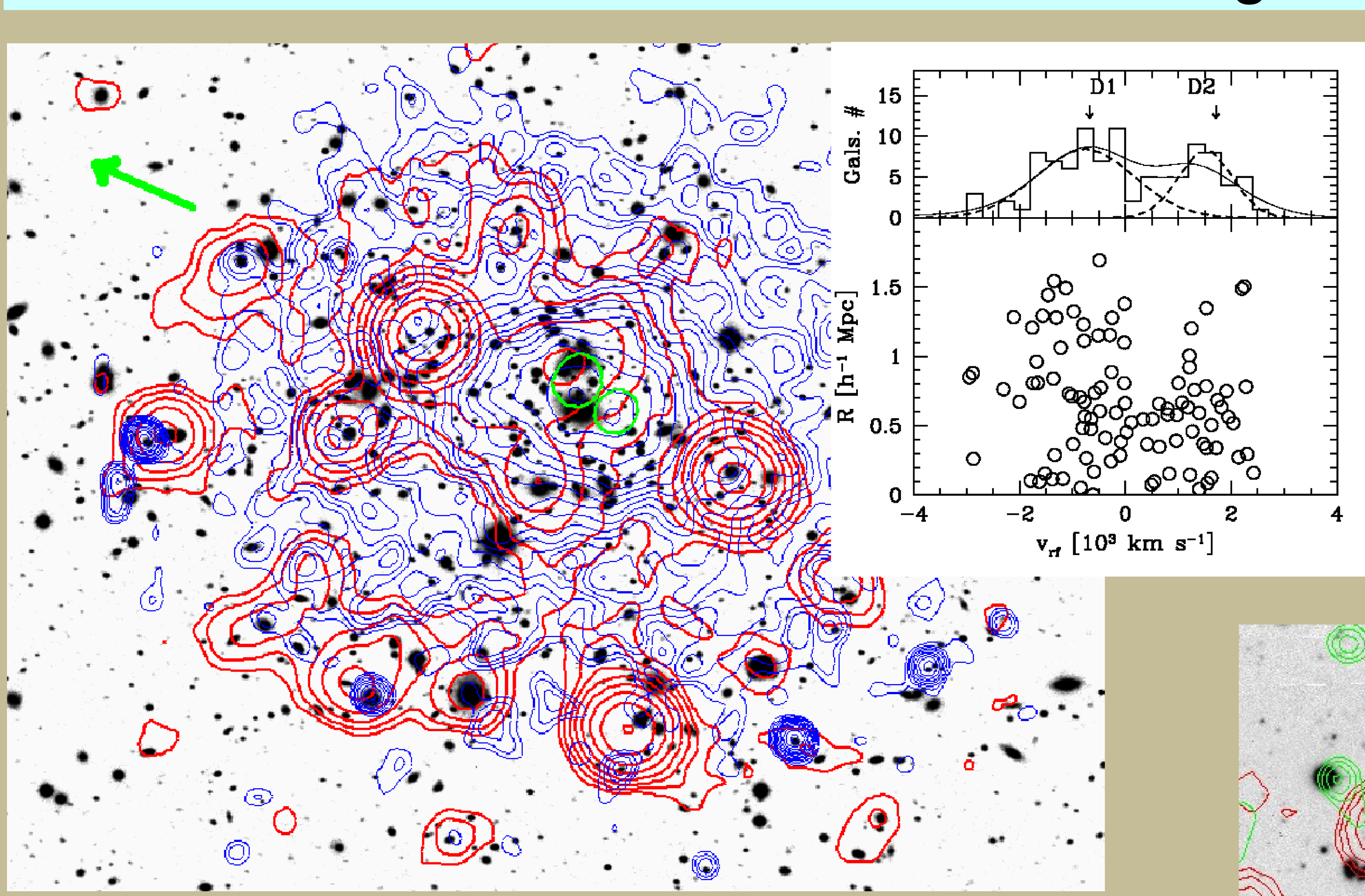
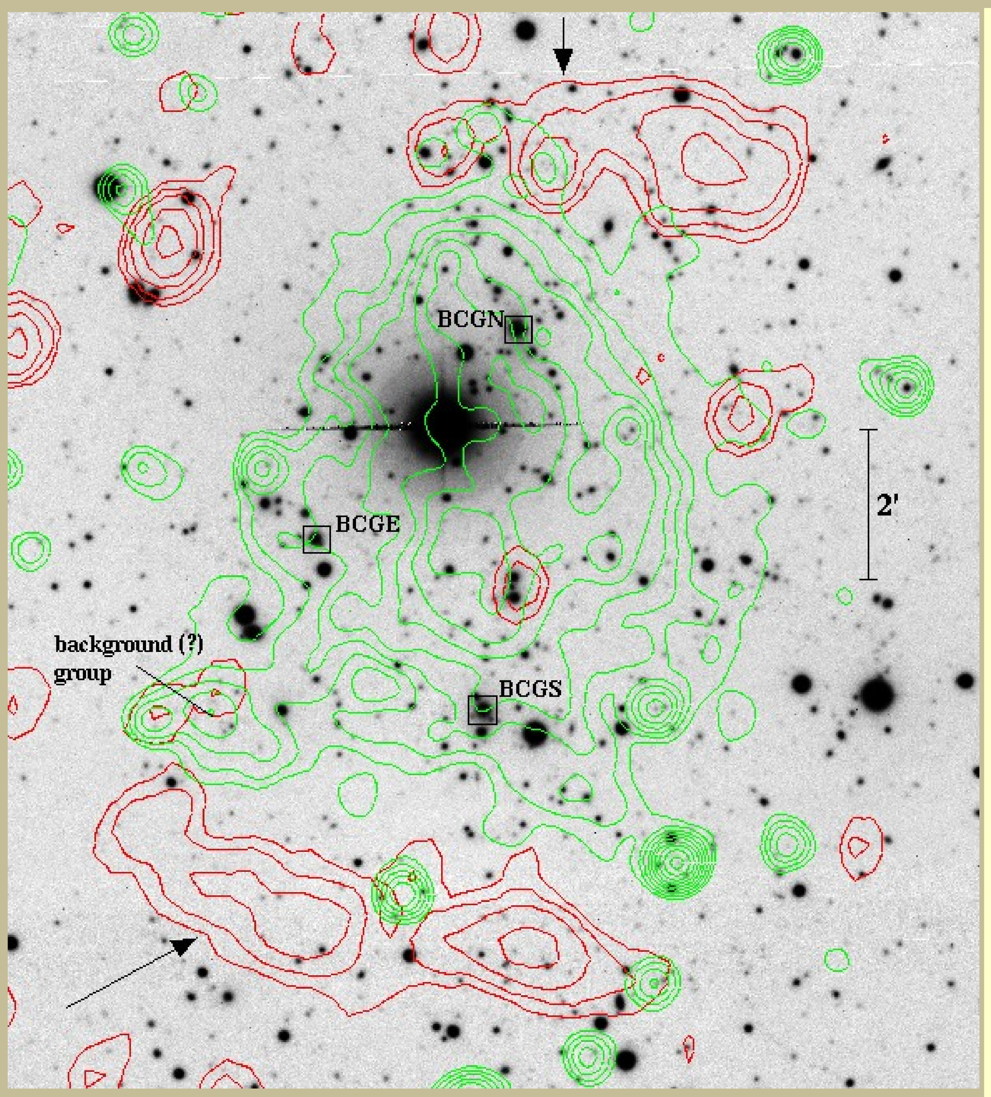
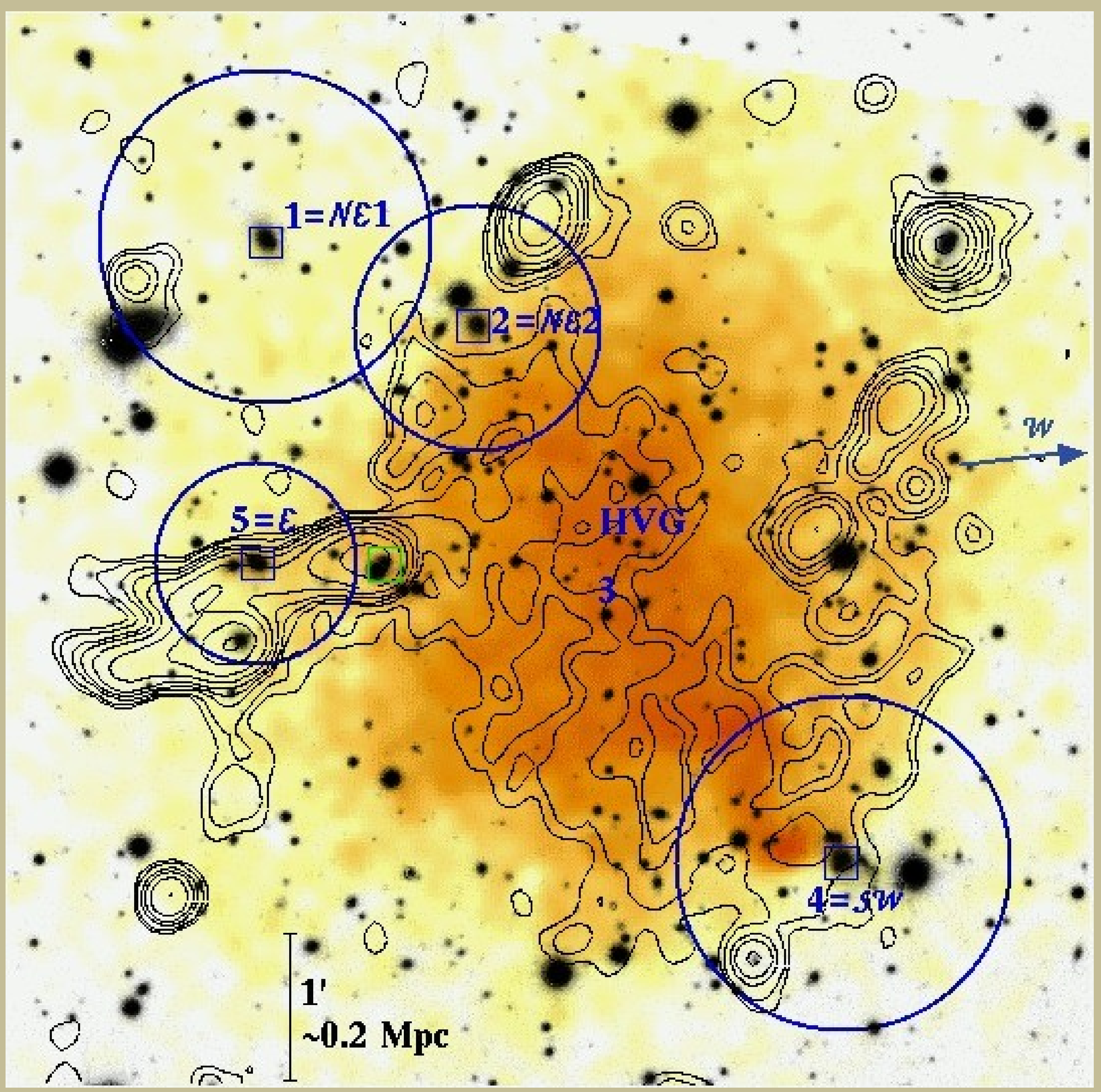
Context. Extended, diffuse radio emissions (halos and relics) embedded in galaxy clusters are rare phenomena. *Aims.* **The DARC program is aimed to study the internal Dynamics Analysis of "Radio"-Clusters.** *Methods.* It is mainly based on spectroscopic data acquired at the TNG. The study of kinematics of member galaxies allow us to detect the intervening subclusters and obtain collision parameters. We have analyzed 20 clusters, each with ~100 galaxies, at z=0.1-0.3: Abell 115, 209, 520, 545, 610, 697, 725, 796, 773, 959, 1240, 1351, 1914, 1995, 2219, 2254, 2294, 2345, 2744, ZwCl2341. *Results.* DARC clusters have a high gravitational mass, 1-4x10^{15} M_{sol} within R_{200} and show presence of strong substructure. The observational scenario, reinforced by X-ray data too, agrees with the DARC clusters being in a post-merger phase, few Gyr after the core-core passage, and with the rest-frame velocity difference between the subclusters v=1000-4000 km/s. *Conclusions.* **Our conclusion supports the view of the connection between extended radio emission and energetic merging phenomena in galaxy clusters.**



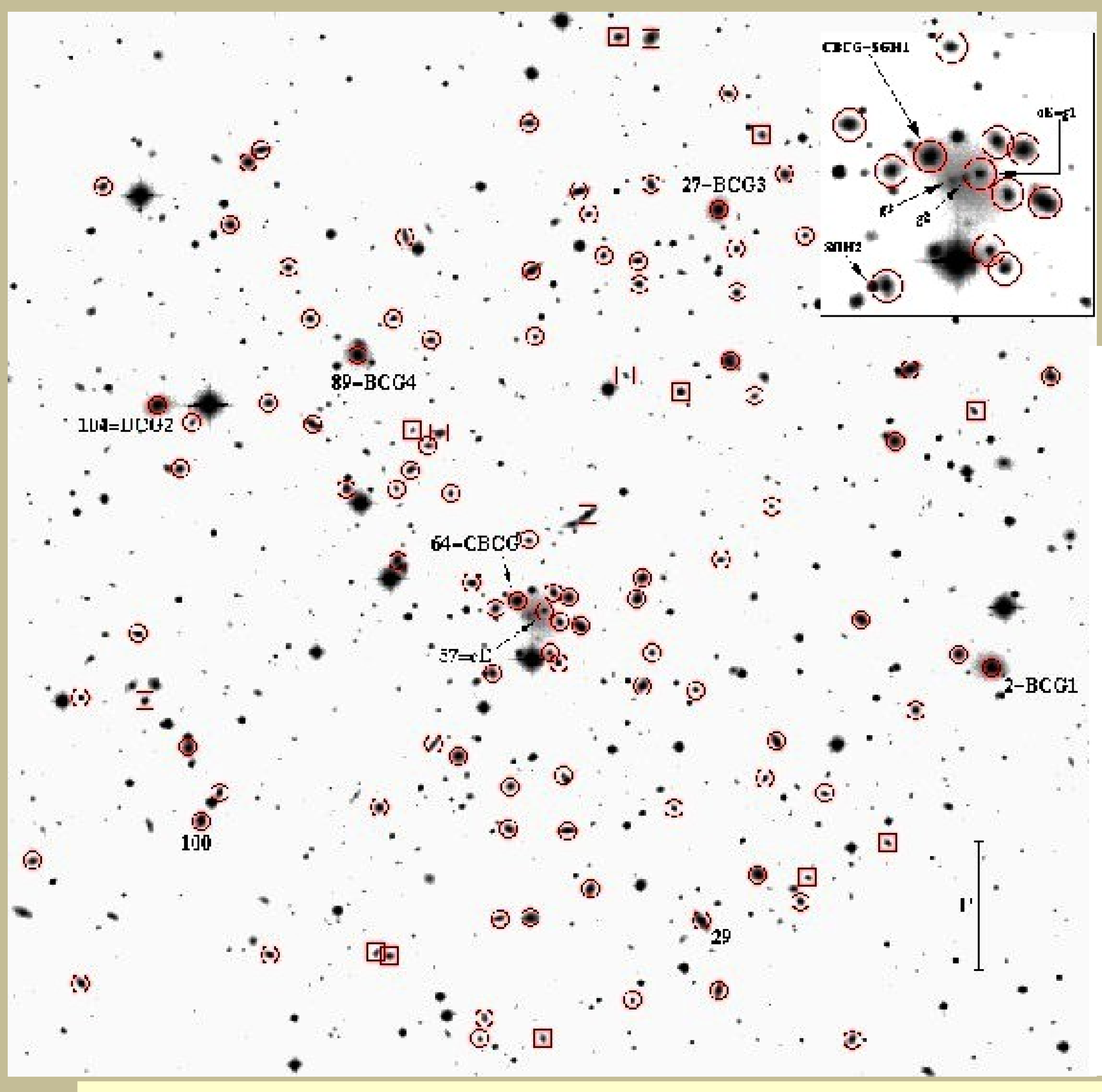
Abell 773: a LOS merging cluster with a radio halo. FIG.1: VLA Radio (Govoni et al. 2001) and Chandra X-ray Chandra contours with wavelet substructures. FIG.2: Velocity histogram and cluster and space phase plot. The velocity distribution of cluster galaxies shows two peaks at v~65000 and 67500 km/s, corresponding to the velocities of the two dominant galaxies D1 and D2. Our results suggest we are looking at a one, likely two groups in advanced phase of merging with a main cluster with an impact velocity of 2500 km/s. See Barrena et al. (2007, A&A, 467, 37).

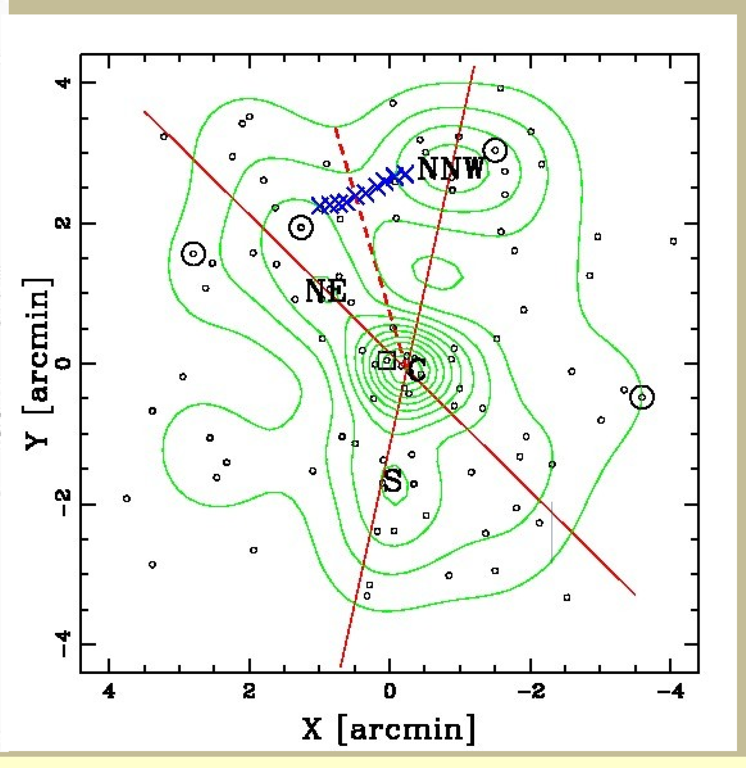


Abell 1240: a cluster with symmetric double radio relics (radio contours by Bonafede et al. 2009). Abell 1240 is shown to have a bimodal structure with two galaxy clumps, each dominated by a brightest cluster galaxy, BCGN and BCGS, roughly aligned along the N-S direction, the same as defined by the elongation of its **Chandra X-ray surface brightness** and the axis of symmetry of the relics. The two-body model agrees with the hypothesis that we are looking at a cluster merger that occurred largely in the plane of the sky, the two galaxy clumps being separated by a rest-frame velocity difference 2000 km/s at a time of 0.3 Gyr after the crossing core. The merging axis is perpendicular to the radio relics strongly supporting support the ``outgoing merger shocks" model. See Barrena et al. (2009, A&A, 503, 357).

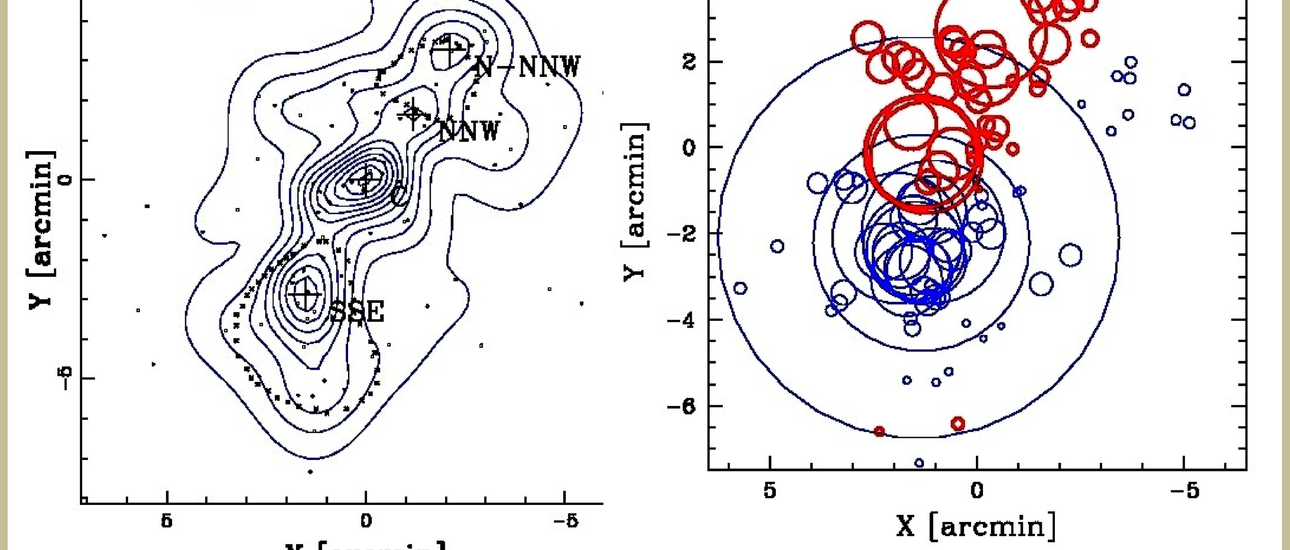


Abell 520: a cluster at the crossing of three LSS filaments. FIG.1: Radio contours (Govoni et al. 2001) and smoothed Chandra X-ray image (Markevitch et al. 2005). Our analysis is based on redshift data for 293 galaxies in the cluster field. We detect the presence of a high velocity group (***HVG***) with a rest-frame relative LOS velocity of v~2000 km/s with respect to the main system (MS). We also find that the MS shows evidence of subclumps along two preferred directions. The main, complex structure ***NE1+NE2*** and the ***SW*** structure (separated by v~1100 km/s) define the NE-SW direction, the same of the merger suggested by X-ray and radio data. The ***E*** and ***W*** structures define the E-W direction. Our results suggest that we are looking at a cluster forming at the crossing of three filaments of the LSS, each intervening subclump having its BCG. See Girardi et al. (2008, A&A, 491, 379).





Abell 545: a merging cluster with a forming BCG? FIG.1: opical image & intracluster light (ICL). FIG.2: galaxy distribution isodensity contours. Blue crosses indicate the sharp discontinuity detected in the X-ray surface brightness. Optical data reveal three main galaxy clumps (one at the center hosting the peak of X-ray emission; one at NNW, and one at NE); and possibly a fourth clump at South. There is not a dominant galaxy. The analysis of the X-ray surface brightness distribution provides us evidence of a disturbed dynamical phase. We show that the ICL, which has a previously determined redshift (Salinas et al. 2007), has a similar redshift to that of the cluster. The emerging picture of Abell 545 is that of a massive, very complex cluster with merging occurring along two directions. The ICL, likely due to the process of a brightest galaxy forming in the cluster core, is related to the accretion along the NE direction. See Barrena et al. (2011, A&A, 529, A128).



ZwCl 2341.1+0000, a very elongated galaxy structure with a complex radio emission: a cluster forming along a LLS filament? FIG.1: galaxy distribution contours with the two possible radio relics (here schematized using small crosses, Giovannini et al. 2010, see also Bagchi et al. 2002 and van Weeren et al. 2009). FIG.2: Dressler-Schectman bubble-plot, large blue circles highlights the SSE low velocity subcluster. See Boschin et al. (2013, MNRAS, accepted).