INTERACTING VOID GALAXIES

BASED ON THE VOID GALAXY SURVEY

Kapteyn Institute
Department of Astronomy
RuG

B. Beygu[1] , K. Kreckel[2], R. van de Weygaert[1], J.M. van der Hulst[1], J. H. van Gorkom[2], P.J.E. Peebles[3], T. Jarret[4], G. Rhee[5]

beygu@astro.rug.nl

[1]Kapteyn Astronomical Institute, University of Groningen, [2]Departement of Astronomy, University of Columbia, [3]Joseph Henry Laboratories, Princeton University, [4] California Institute of Technology , [5]Physics Department, University of Nevada Las Vegas

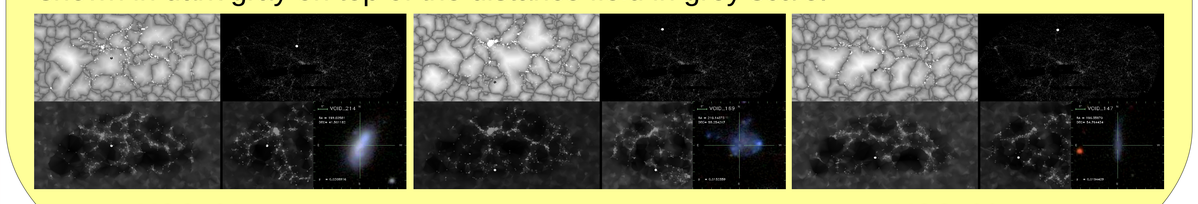
INTRODUCTION

The Void Galaxy Survey consists of a multiwavelength observational study of void galaxies. The goal of the project is to compare the physical intrinsic properties of void galaxies, to assess in how far they differ from the regular field population and infer how they are forming and evolving. Our galaxy sample consists of 60 *geometrically* selected galaxies (all in local voids d < 100 Mpc). A pilot survey for the HI imaging of 15 void galaxies is completed (see *Kreckel et al. 2011*). In this poster we present three interesting examples as candidates of interacting void galaxies: ***VGS_31***, ***VGS_38*** and ***VGS_30***.

SELECTION CRITERIA

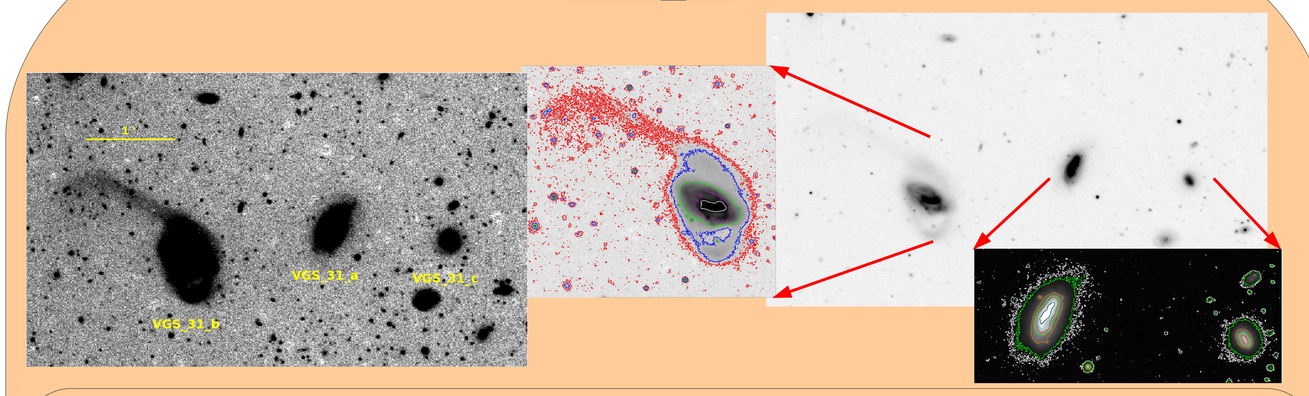
The identification of void galaxies in our survey is uniquely based on a pure (tessellation-based, DTFE) geometric procedure *independent* of the intrinsic properties of galaxies without any a priori assumption of the scale and the shaped of the voids (see *Platen et al. 2007*). A second criteria is done in order to deal with the redshift distortion effects.

Here we show 3 examples of selecting our galaxies by geometry from SDSS using different visualizations of the density field. For each panel anti-clockwise: 1) SDSS DR7 sky map footprint, the void galaxy indicated by the heavy dot. 2) Galaxy image. 3) & 4) DTFE density grey scale maps in two perpendicular slices intersecting at the galaxy location. 5) The Spine / Web watershed contours of the density field are shown in dark gray on top of the distance field in grey scale.



VGS_31_a VGS_38_a VGS_30_a

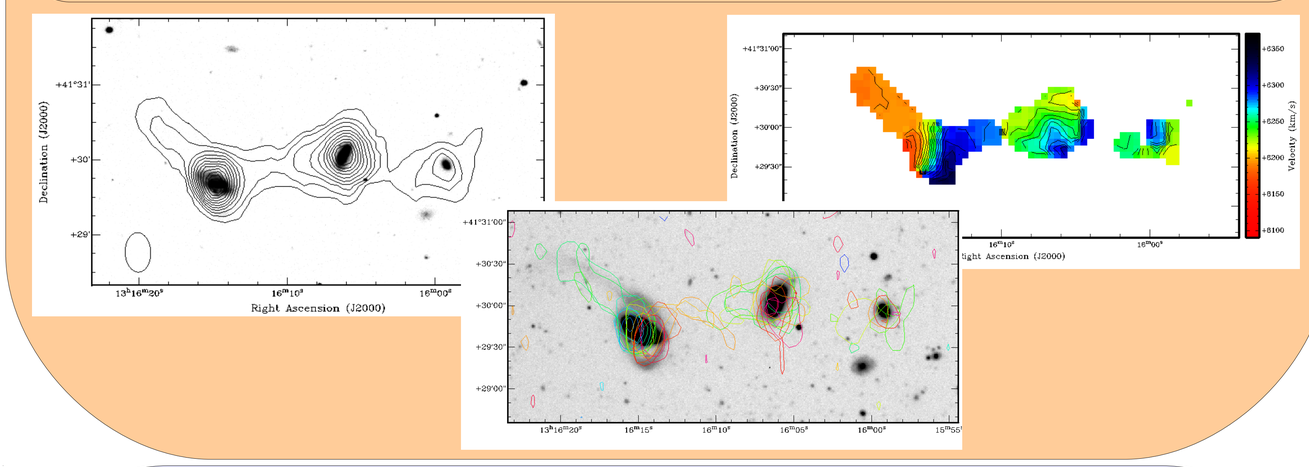
VGS_31



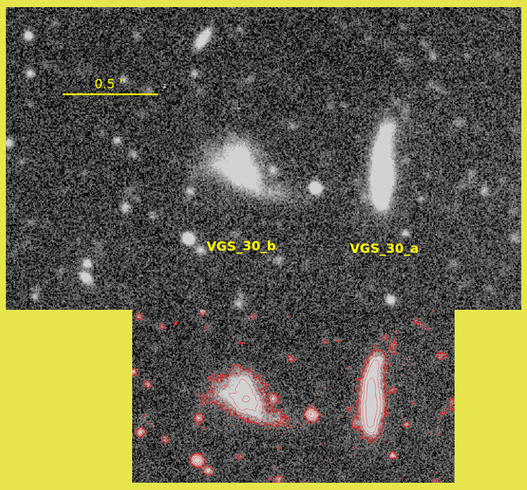
VGS_31 is a system of three galaxies (VGS_31_a, VGS_31_b and VGS_31_c) lying deep in a void; seemingly positioned along a filament bridging the void.

Above: Various deep optical images of the system each of them indicating different features of the galaxies. *VGS_31_b* has a *tidal tail* which can be caused by *VGS_31_a* and a *wrap* or *ring* like structure possibly caused by a fall of a 4th object onto it. Besides it has an asymmetric bar wrt its disc.

Below: From left to right; HI intensity map, renzogram and the HI velocity map of the VGS_31. The three galaxies are embedded in the same HI cloud. The bridges between galaxies suggest an interaction. Systematic velocities imply that three of them are almost at same plane on the sky.

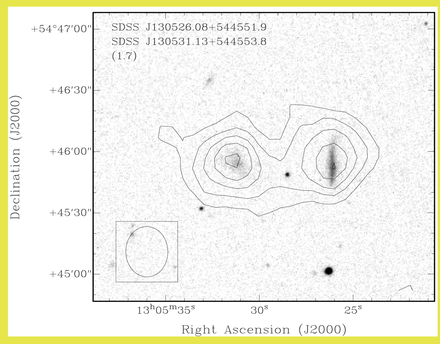


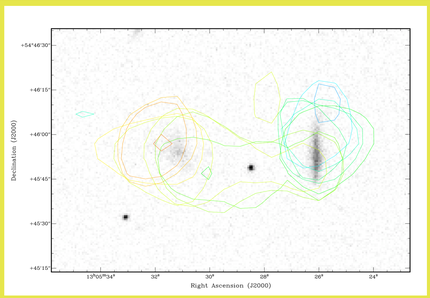
VGS_30



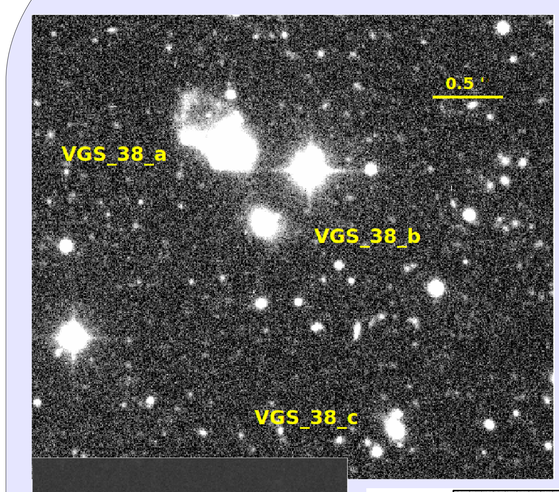
Left: *VGS_30* is a system of two galaxies located between a void wall between two large voids. The system is ~ 25 kpc across. *VGS_30_b is distorted and* has a tidal feature towards *VGS_30_a.*

Below: The renzogram shows how the two galaxies are kinematically connected. Each galaxy has its own gas envelop and share a bridge between them. It is hard to conclude weather the *VGS_30_b* was already in that position or moved from the other side of the *VGS_30_a* but from the brightness profile and the renzogram it is clear that there is a tidal interaction between the two galaxies.





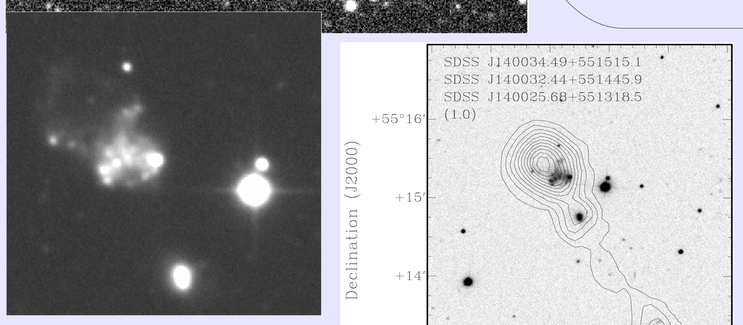
VGS_38

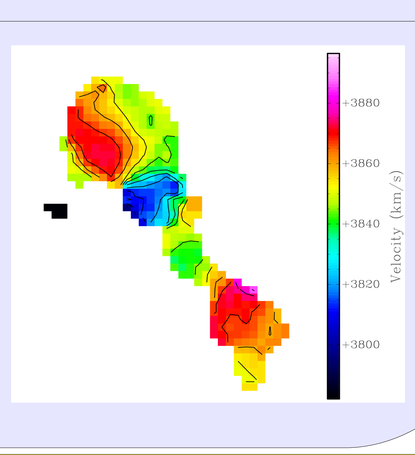


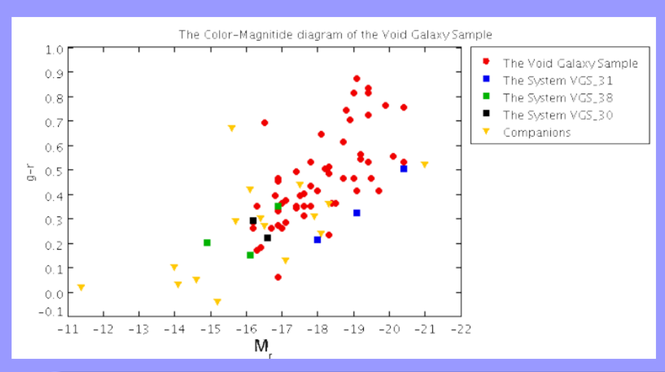
VGS_38 is a system of three aligned galaxies like VGS_31.

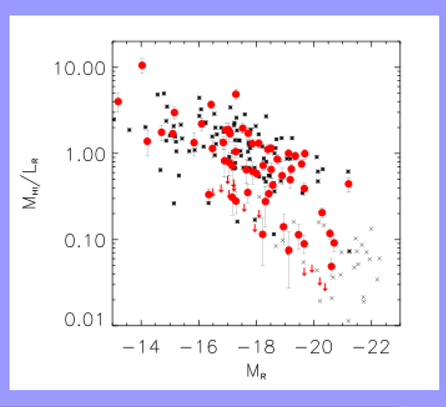
Left: Deep optical images reveals clearly the disturbed morphology of the *VGS_38_a.* located at the edge of its void. The whole system is about ~ 50 kpc across, galaxies being close enough to each other to be in interaction.

Below: The system is connected by a HI bridge. It has a very complicated gas dynamics as seen from its HI velocity map.









Top Left: Color-magnitude diagram of the whole sample of 60 galaxies including the companions. Our void galaxies are mostly blues and span variety of luminosities. *VGS_31* lie at the bright part of the diagram looking like as if it is evolved towards that way. Could it be a manifestation of star formation triggered by interaction?

Top Right: HI mass to light ratio as a function of R-band absolute magnitude for the VGS and companion galaxies (circles) compared with WHISP galaxies (stars, Swaters et al. 2002) and Ursa Major galaxies (crosses, Verheijen & Sancisi 2001). Upper limits on the VGS non-detections are also indicated (arrows). Our VGS follows the trend for fainter galaxies to have relatively higher HI mass to light ratios, and we note that particularly for galaxies with MR > −19, the VGS contains very few galaxies that have large H i mass to light ratios.

Bottom: Table showing the density and the redshifts of the galaxies.

	Density δ	z
VGS_31	-0.64	0.0209
VGS_38	-0.58	0.0138
VGS_30	-0.85	0.0194

DISCUSSION & PROSPECTS

- VGS_31 and VGS_38 appear to be elongated systems that are building up along a filament stretched along a void.
- The interacting void systems presented here are young dynamical systems, showing the hierarchical assembly of galaxies in action.

References:

Platen, van Weygaert, Jones, 2007, MNRAS, 380, 551P
Kreckel et al., 2011, AJ, 141, 4K
Van de Weygaert et al., 2011 arXiv1101.4187V
Beygu et al., 2011, in prep.
Kerckel et al., 2011 in prep.