

Detecting Protoclusters of Galaxies with the Multi-scaling Algorithm CARTHAGO

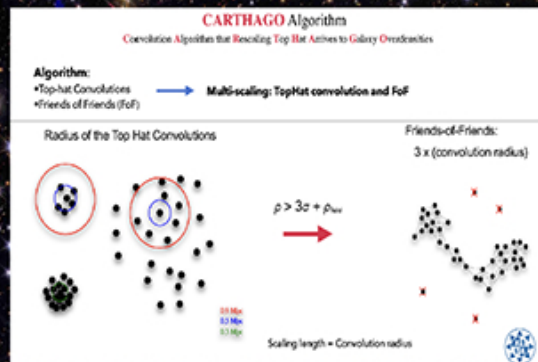
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ABSTRACT

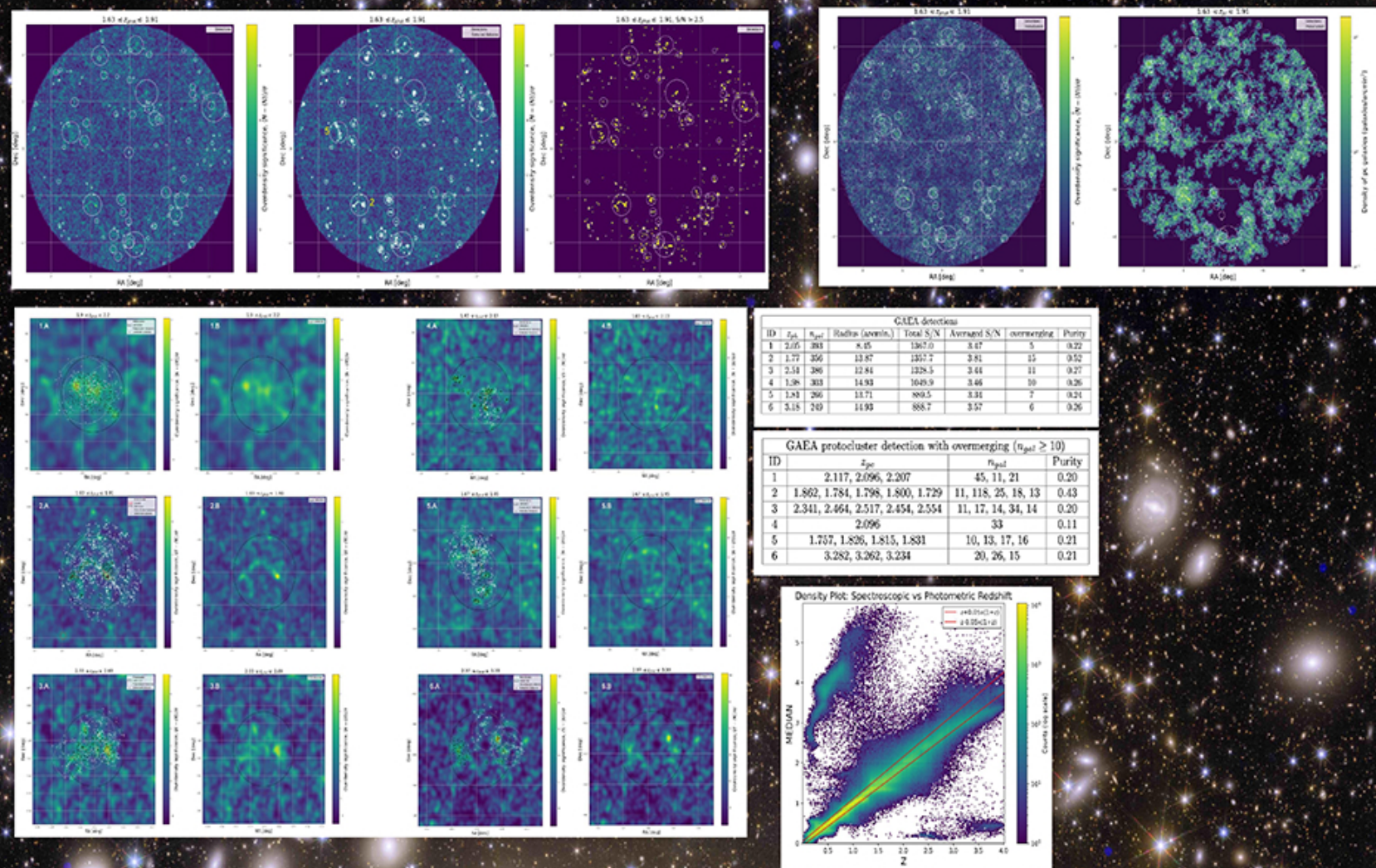
Protoclusters are extended overdensities of galaxies in the distant Universe that eventually collapse into massive galaxy clusters. The environments of these structures play a key role in shaping galaxy evolution. Moreover, the assembly and gravitational collapse of protoclusters provide valuable constraints on cosmological models. We have developed a novel algorithm, *CARTHAGO*, designed to detect galaxy protoclusters using a multi-scale approach. Thanks to this methodology, the algorithm can identify extended large-scale structures of varying sizes and morphologies. In this work, we apply *CARTHAGO* to the COSMOS2020 catalogue and compare the detected structures with those obtained in simulations, in order to better understand the nature of our findings. We also confront our detections in COSMOS2020 with previously reported protoclusters in the literature. From the simulations, we find that galaxy clusters act as tracers of protoclusters at redshifts $1 < z < 2$, and we detect extended structures surrounding several clusters. Finally, we apply our algorithm to the Euclid Q1 survey, where we identify several large-scale structures, one of which we present here.

CARTHAGO ALGORITHM



The algorithm is based in Top-hat convolutions and FoF algorithms using a multi-scaling approach.

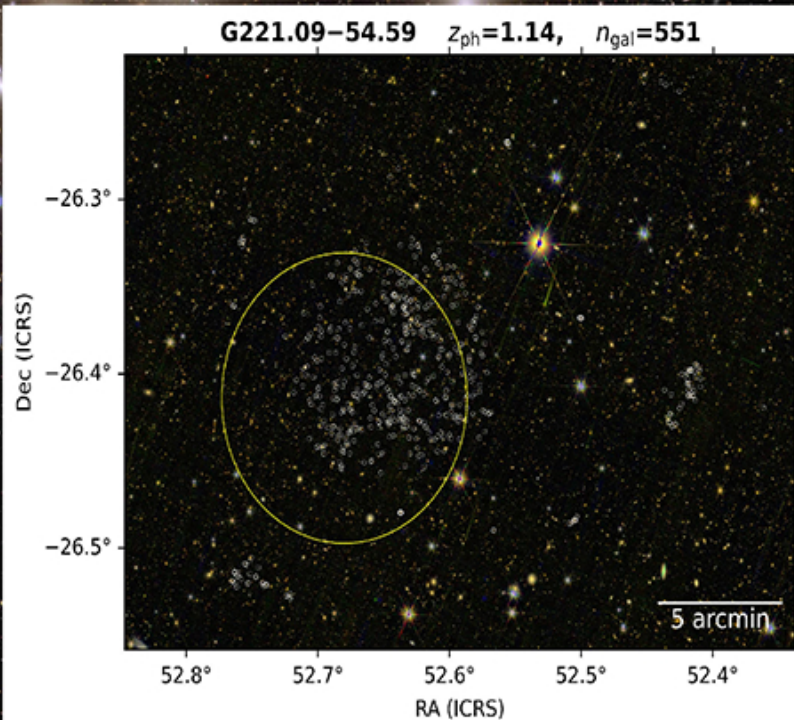
SIMULATIONS



COSMOS2020

ID	z_{ph}	Numb. of Gal.	Radius (arcmin)	Total S/N	Averaged S/N	Previously known
1	2.189	208	6.829	719.1	3.46	Yes
2	1.761	181	10.655	669.8	3.70	Yes
3	2.352	189	4.970	650.8	3.44	No
4	2.570	159	6.803	542.2	3.41	Yes
5	1.975	140	7.247	468.3	3.35	No
6	2.375	134	7.512	460.8	3.44	No

EUCLID Q1



Detection of an overdensity of galaxies in Euclid Q1, the yellow circle is a protocluster candidate from Planck observations.