# Clusterix 2.0: a virtual observatory tool to estimate cluster membership probability

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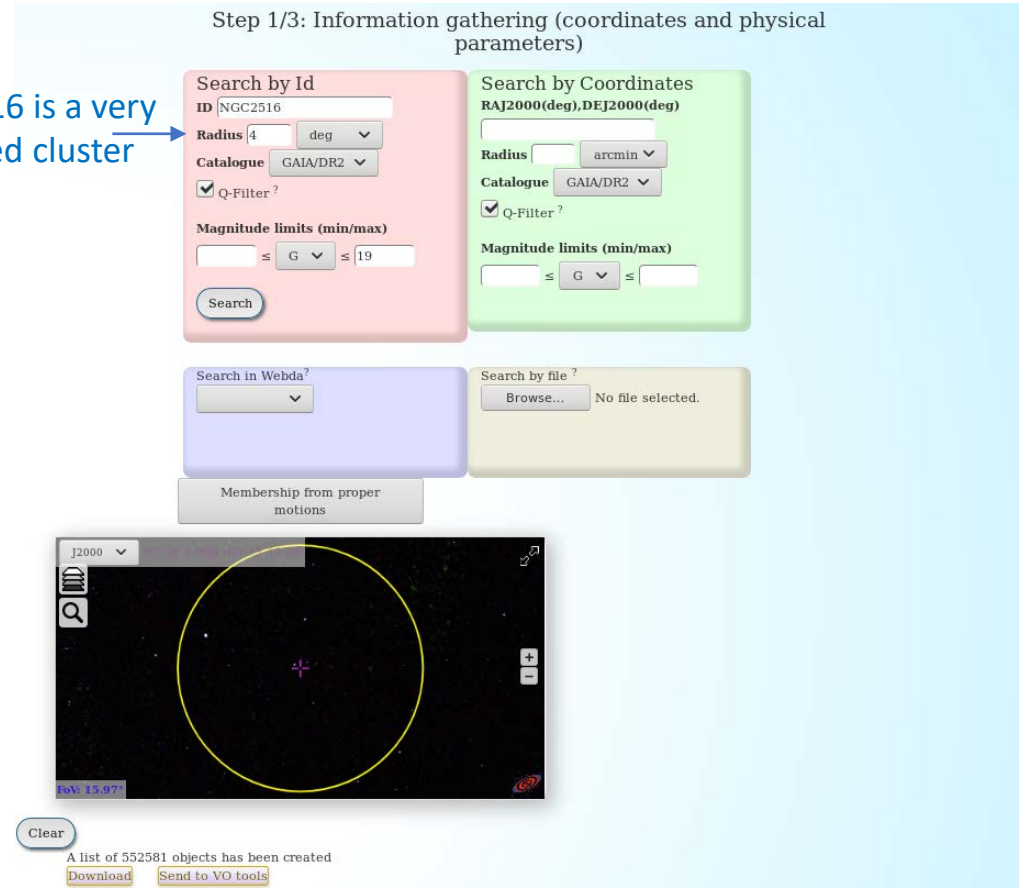
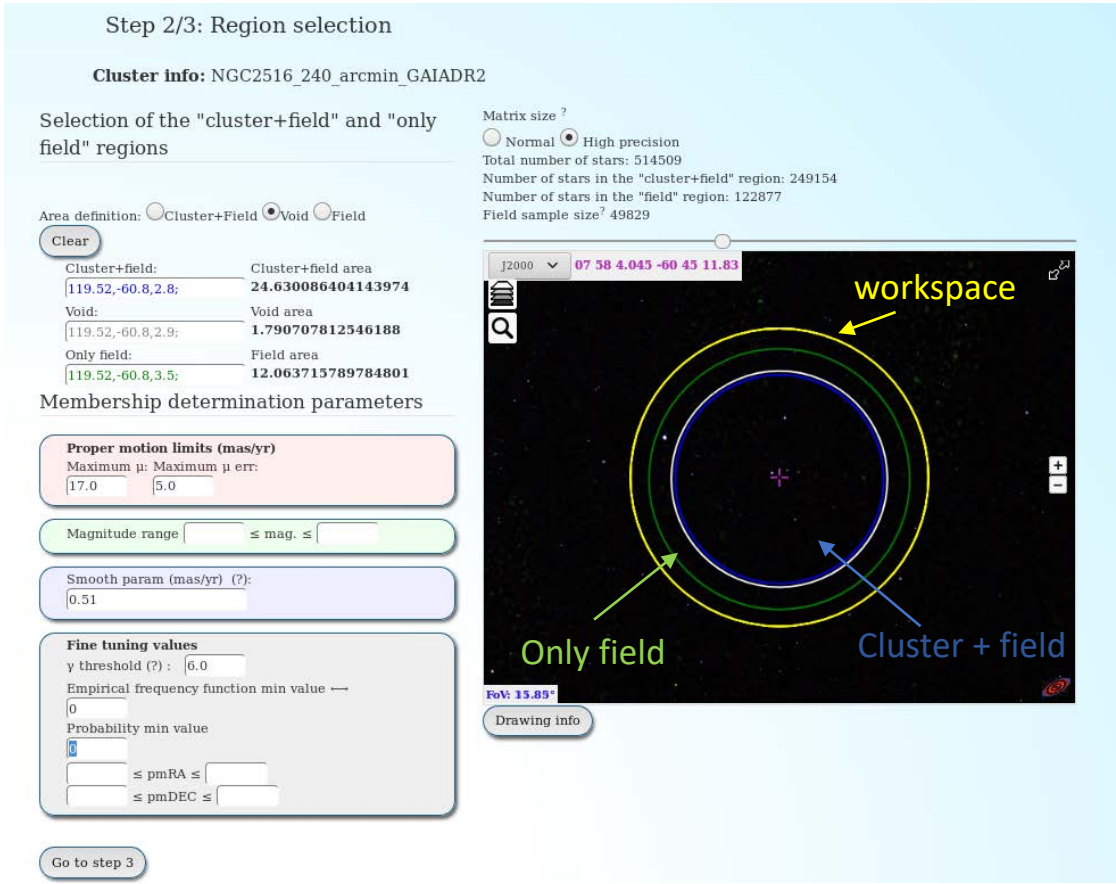
**Clusterix 2.0** is a web-based, Virtual Observatory compliant, interactive tool for the determination of **membership probabilities** in **stellar clusters** based on **proper-motion data** using a fully non-parametric method. In an area occupied by a cluster, the frequency function is made up of two contributions: cluster and field stars. The tool performs an empirical determination of the frequency functions from the vector point diagram without relying on any previous assumption about their profiles. **Clusterix 2.0** allows us to search the appropriate spatial areas in an interactive way until an optimal separation of the two populations is obtained. Several parameters can be adjusted to make the calculation computationally feasible without interfering with the quality of the results. The system offers the possibility to query different catalogues, such as ***Gaia***, or upload a user's own data. The results of the membership determination can be sent via SAMP to VO tools such as TOPCAT. *https://arxiv.org/abs/1910.07356*

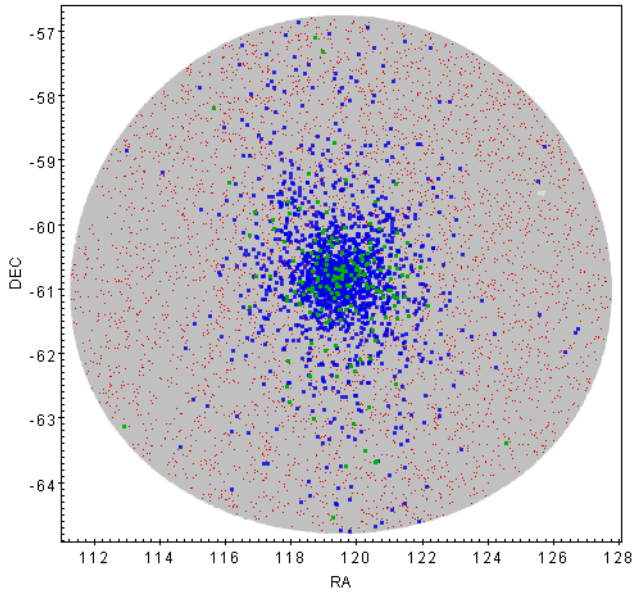
Clusterix 2.0

Many automatic tools have been developed in recent years to separate cluster members from the field (Castro-Guinard et al. 2018, Cantat-Gaudin et al. 2018, Sampedro & Alfaro, 2016). We present here an **open access web tool**, VO compliant, to facilitate membership studies from proper-motion data for any user that requires a **tailor-made study** on any specific data set.

NGC2516 is a very extended cluster

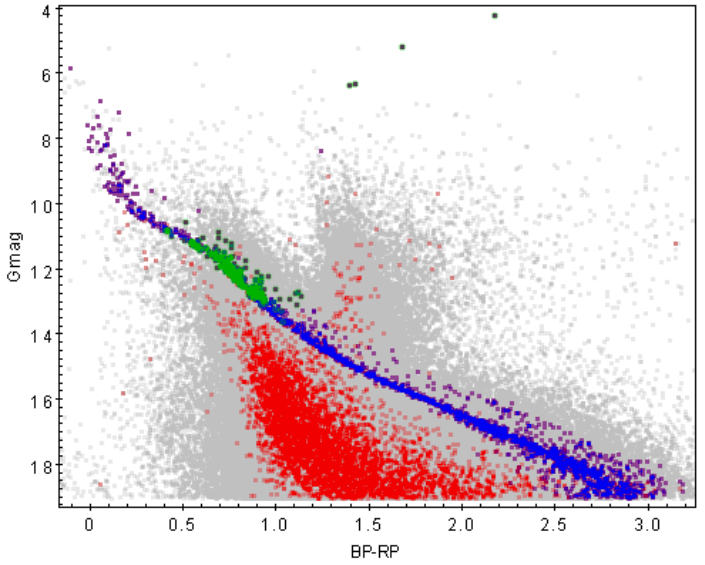





## NGC 2516

Translucent grey shows all stars in a 4 degree radius around the centre (552 583 stars). The selection made by Clusterix, 6 210 stars (in red and blue), is refined with parallax: 1 819 members (in blue), where 175 in green show compatible *Gaia* radial velocities.

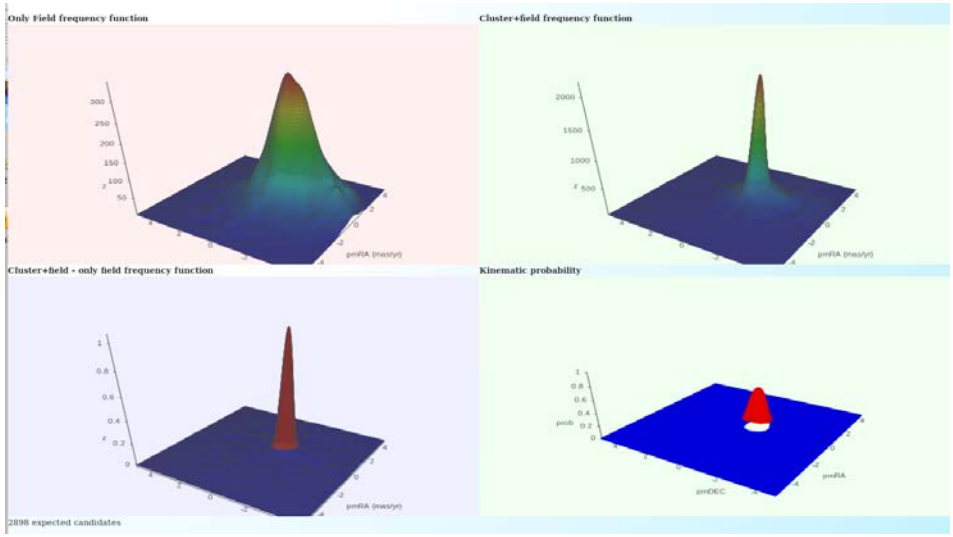


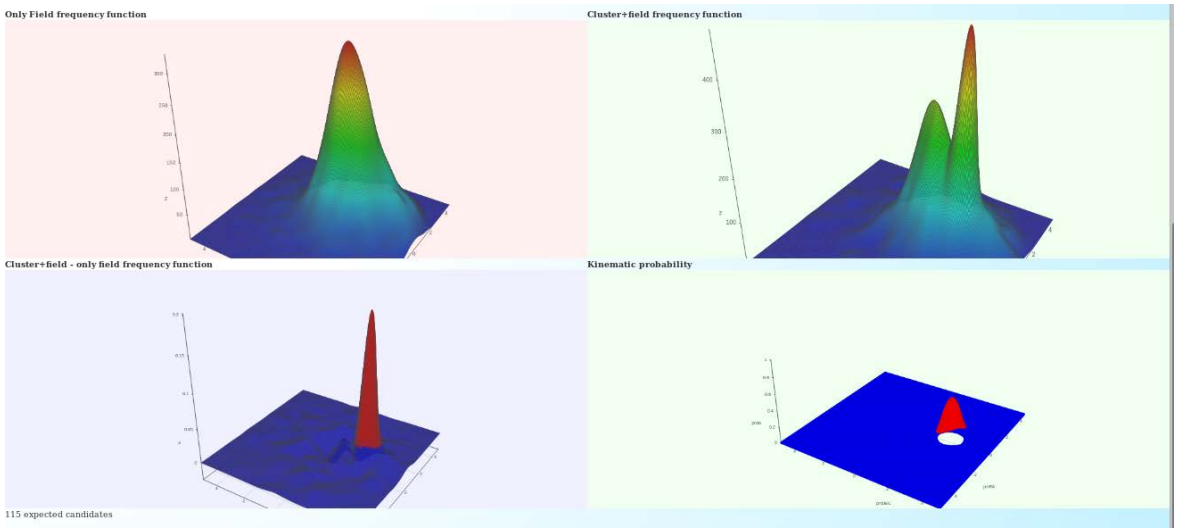

Different tools are best suited to different situations, but all of them have led to the discovery of new clusters. The census of open clusters seems far from complete (Castro-Guinard et al. 2020; Cantat-Gaudin et al. 2020) In Balaguer-Núñez et al. 2020 we apply **Clusterix 2.0** to several open clusters with different properties and environments to show the capabilities of the tool: an area of five degrees radius around an old, well-known cluster **NGC 2682** (M67, see Carrera et al. 2019); a pair of partly overlapping clusters **NGC 1750** and **NGC 1758** (see Balaguer-Núñez et al. 2019); a young cluster NGC 2516 with a striking elongated structure extended up to four degrees (see above); the area of **NGC 1817**, where we confirm a little-known cluster, **Juchert 23** (see below); and an area with many clusters, where we disentangle two overlapping clusters situated where only one was previously known: **Ruprecht 26** and the new **Clusterix 1** (see below).

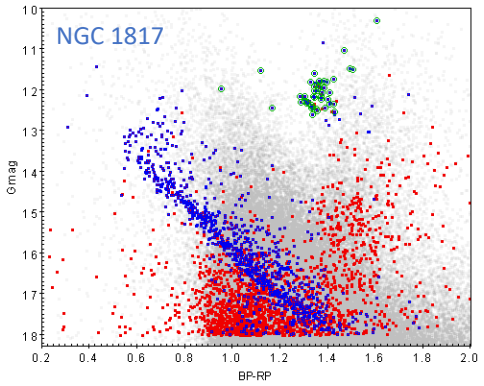
NGC 1817

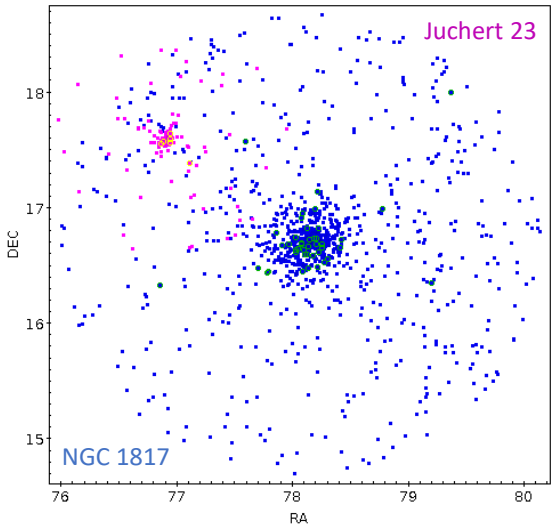
Two nearby clusters, but far enough to be studied separately

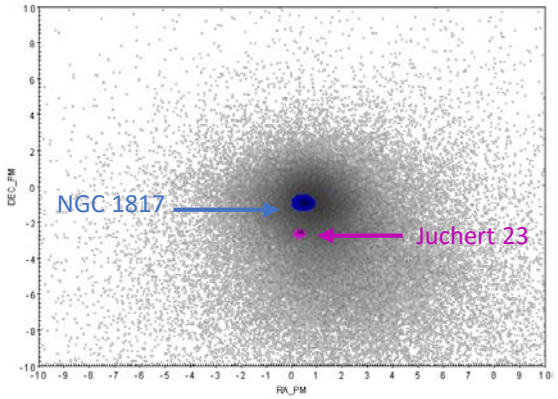
Juchert 23

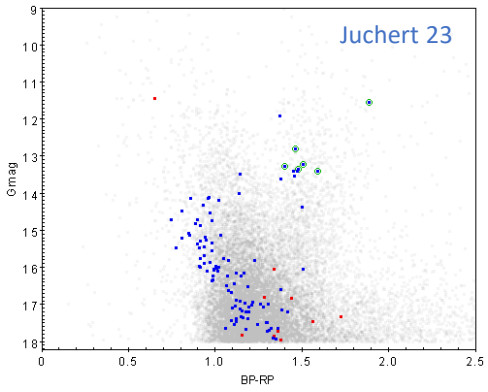


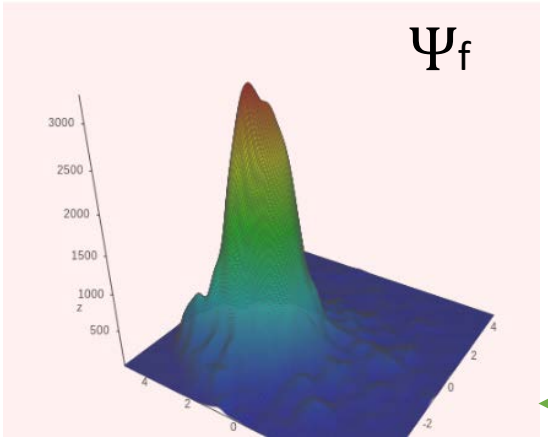



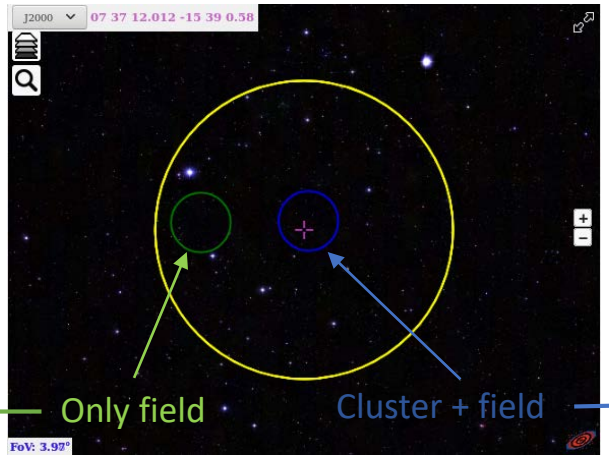



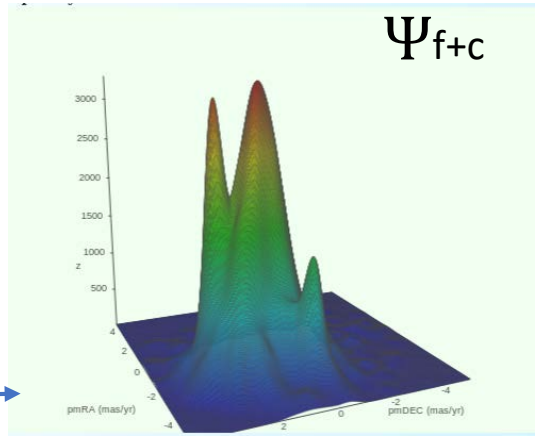



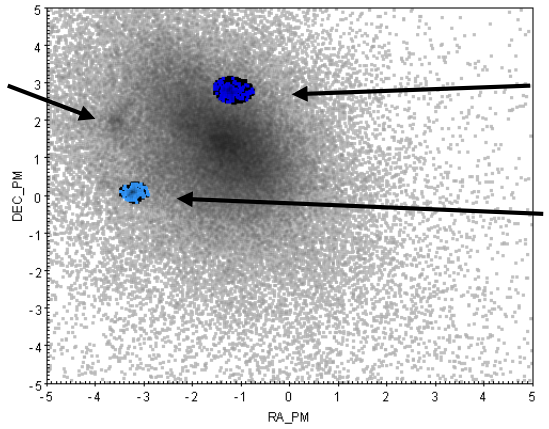
In an area full of clusters, we can play with the selection of spatial regions to maximize the contrast with the field.




**NGC 2425**




**Clusterix 1**

**Ruprecht 26**