GERMAN ASTROPHYSICAL GAVO VIRTUAL OBSERVATORY

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Grid-based detection of Galaxy Clusters

using Virtual Observatory methods

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AIP

Detection of X-ray Galaxy-Clusters

„A new method for a simultaneous search for clusters of galaxies in X-ray photon maps and optical galaxy maps is described. The merging of X-ray and optical data improves the source identification so that a large amount of telescope time for spectroscopic follow-up can be saved. The method appears thus ideally suited for the analysis of the recently proposed wide-angle X-ray missions like DUO and ROSITA. As a first application, clusters are extracted from the 3rd version of the ROSAT All-Sky Survey and the Early Date Release of the Sloan Digital Sky Survey (SDSS). The time-consuming computations are performed within the German Astrophysical Virtual Observatory (GAVO). On a test area of 140 square degrees, 75 X-ray clusters are detected down to an X-ray flux limit of $3x10^{-13}$ erg s^{-1} cm^{-2} in the ROSAT energy band 0.1-2.4 keV. The clusters have redshifts $z \leq 0.5$. The survey thus fills the gap between traditional large-area X-ray surveys and serendipitous X-ray cluster searches based on pointed observations, and has the potential to yield about 4,000 X-ray clusters after completion of SDSS."
(P. Schücker et al. in ‘Astronomy & Astrophysics‘, A&A 420, 61-74 (2004))

Virtual Observatory Methods supporting Cluster Detection

This analysis method uses huge amounts of computing power, and needs access at runtime to catalog-data. Thus it is a good candidate for application of Virtual Observatory methods.
Towards the goal of running the ClusterFinder on the whole region of the sky covered by ROSAT and SDSS, we defined three necessary development tasks:

- **Accessing RASS and SDSS archives through VO methods**

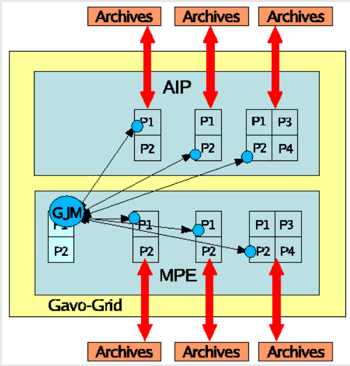
  The new access methods on RASS provided by GAVO e.g. enable access to the Photon-Event-Catalog with a Simple-ConeSearch query. For SDSS we now use the SDSS Data Release 1 and an improved sql-based query interface. We developped a wrapper application for the ClusterFinder, which retrieves catalog-data for a preselected area, and then starts the ClusterFinder to work on this area.

  You can access the same webservice via browser on
  http://www.g-vo.org, Products, RASS

- **Distributing the ClusterFinder on the GAVO-GRID**

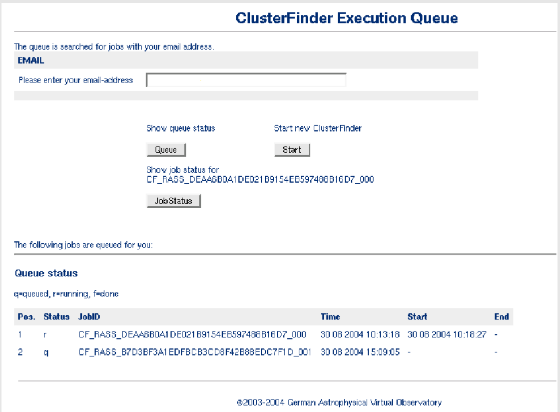
  Since the results of ClusterFinder for a given area are independent from the results of a neighbour-area, the division of the sky into suitable small chunks is possible. Each individual area can be scrutinized by ClusterFinder using another processor. The results can be fitted together like a mosaic afterwards.

  The GAVO-GRID currently connects AIP and MPE site. A total of 16 processors is available for GRID users. GAVO-GRID is build on the Globus-Toolkit.
  The ClusterFinder takes about a day on a single processor for a region the size of 8 square degrees. Distributing the task to the GRID thus speeds up the process significantly, currently by a factor of 16.
  Distributing the ClusterFinder also decreases the amount of data to be retrieved from the archives by each process.
  Runtime information on GAVO-GRID at
  http://gavo3.aip.de:8080/GAVOGRID



- **Developping a Webservice**

  Since the ClusterFinder can be used with different PointSpreadFunctions and other parameter variations, a Webservice to run the ClusterFinder is useful.
  The duration of a ClusterFinder run requires the Webservice to be asynchronous, since it may take a week to finish. The user is notified via email.
  All jobs started from the Webservice are placed in a Queue. The Webservice allows to query the status of the Queue and the status of a running job. Only an identified user can query and retrieve information from the Queue.
  The Webservice also creates contour graphs of the likelihood maps. For retrieval, all data, including retrieved catalog data and parameter sets, is packaged into a tarfile.
  Please visit the Demo-Version of the Clusterfinder:
  http://gavo1.aip.de:8080/clusterfinder
  The email-address cf-demo@aip.de provides access to the queue.



Poster for LNDS 2004, H. E., 08/2004