Scientific report for the Lorentz Center

GREAT School on the Science and Techniques of Gaia

January 23 - 27, 2012

Gaia is the European Space Agency mission, scheduled for launch in 2013, which will provide a stereoscopic census of our Galaxy through the measurement of very high accuracy astrometry, radial velocities and multi-colour photometry for over 1 billion stars, galaxies, and solar system objects. The GREAT ITN is a Marie-Curie Initial Training Network (ITN) which aims at preparing a generation of young researchers for the scientific exploitation of the Gaia catalogue data. A major aim of this school was to stimulate collaborations within the network by providing the PhD students (and their supervisors) with a broad overview of the science topics covered by the network.

Because the lecture programme would be of general interest to anyone interested in the Gaia mission the school was also open to participants from outside the GREAT network. In total 33 students (including a few postdocs) participated in the school which was also attended by the scientists in charge of the network nodes. Including the lecturers there were 53 participants in total.

The programme consisted of two 90 minute lectures in the morning followed in the afternoon by exercises that the students had to carry out in groups. The lectures covered the following topics: Galactic dynamics, formation and evolution of the Galaxy, chemical elements in stars, open clusters, exoplanets, physical properties of asteroids, variable stars, asteroseismology, the distance scale of the universe, and the transient sky. There were also two afternoon lectures on the Gaia mission and spacecraft in order to familiarize the students with the details of the Gaia project.

During the first two afternoons each of the participating students had 5 minutes and one slide in which to present their research. The slides were handed in to the organizers before the workshop. These sessions served the double purpose of learning how to present one's research in this very short format and introducing the students to the senior workshop participants. This very much facilitated subsequent corridor discussions.

The rest of the afternoons were used to let the students work in 10 groups on an exercise which involved interrogating a simulated Gaia catalogue in order to research various aspects of the structure and dynamics of the Milky Way. The simulated catalogue contains 2 billion stars and represents a non-trivial data set to work with. For these exercises the students used a custom developed Java framework based on Hadoop, provided to them on a virtual machine (containing a small subset of the simulated catalogue) which they installed on their notebooks. The aim was to programme a short piece of code that extracted the relevant quantities and then produce a plot. On the Friday the students had to present their plots and interpret them. The senior participants provided comments and background information during the presentation session.

Remarkably some of the groups were able to run their code on the full catalogue which was stored in the `cloud' on Amazon. This represents an important first test of the concept of `bringing the processing to the data', which the Gaia community is planning to implement as a means of providing access to the real Gaia catalogue.

The exercise sessions ensured that the students worked together and got to know each other well. At the same time they sought help from the senior workshop participants and from the coding experts that were present. The hectic yet friendly atmosphere helped foster contact between the students and very much lowered the threshold for approaching the senior scientists. This ensured that one of the main goals of the workshop was attained, ensuring a successful future collaboration within the research network.

The GREAT school was very successful, providing the students with a broad introduction to the science of Gaia and giving them a first taste of working with the future Gaia catalogue. Having the students present their research in the beginning of the week worked very well, as it meant that they were not worrying about their presentations the rest of the time. The exercises were deliberately kept simple in terms of the astronomical problems in order to make sure that all groups could obtain a result. In view of the time that was available in practice this was a good decision. In the future we would like to organize a workshop fully dedicated to experimenting with advanced catalogue access techniques and a venue such as the Lorentz Center would be ideal.

The Lorentz Center facilities were very much appreciated by all those who attended the school and we would like to thank the staff (especially Gerda Filippo) for helping to make this school a real success.

All the lectures have been made available on-line through the following website: http://great.ast.cam.ac.uk/Greatwiki/GreatItn/ItnSchoolJan2012

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