Astrophysics Applications Ported on SHIWA Simulation Platform (SSP) within ER-Flow

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The Astrophysics community involved in the first year of the ER-Flow project has selected six scenarios to be used as pilots to demonstrate how to develop, deploy and share workflows. These pilot workflows are ported to SSP and published in the SHIWA workflow repository. We have thus demonstrated how to exploit the simulation platform, as well as how researchers can use these workflows in their scientific work, and how they can modify them to create customized workflows.
Within the ER-Flow project the Astrophysics community is represented by the Istituto Nazionale di Astrofisica (INAF), Italy, that coordinates activities. The six pilot workflows are:

- **COMCAPT** (Capture of comets from the interstellar space by the Galactic tide), provided by the Astronomical Institute of Slovak Academy of Sciences (Figure 3).

- **FRANEC** (Frascati Raphson Newton Evolutionary Code) / BaSTI (Bag of Stellar Tracks and Isochrones), provided by INAF - Osservatorio Astronomico di Teramo (Figure 1).

- **LaSMoG** (Large Simulation for Modified Gravity), provided by the University of Portsmouth (UK) (Figure 5).
Astrophysics Workflows

- MESTREAM (Modelling the dynamical Evolution of meteoroid stream), provided by Astronomical Institute of Slovak Academy of Sciences (Figure 4).

- Planck (Simulations of the ESA Planck satellite mission), provided by INAF - Osservatorio Astronomico di Trieste (Figure 2).

- VisIVO (Visualization Interface for the Virtual Observatory), provided by INAF - Osservatorio Astrofisico di Catania (Figure 5).
Technical Implementation

The six workflows have been ported on SPP using WS-PGRADE/gUSE (Web Services Parallel Grid Runtime and Developer Environment / Grid User Support Environment). Some of them are meta-workflows, i.e. compositions of smaller workflows that can be used as building blocks for creating new workflows.

Through SSP the resources belonging to the following Virtual Organizations (VOs) can be exploited:

- astro.vo.eu-egee.org (European astronomical VO)
- INAF (Italian national VO for astronomy)
- Planck (VO dedicated to the ESA Planck satellite mission)
- VOCE (Virtual Organisation for Central Europe)

All these first year ER-Flow astrophysics workflows employ gLite as Grid middleware.
Future Plans

For the second year of ER-Flow Astrophysics workflows new communities have already been contacted, namely from France and Spain:

- **France:**
  - Astronomical Observatories of Strasbourg and Paris;
  - Seven new research groups could potentially contribute with new workflows.

- **Spain:**
  - Astronomical Institute of Andalucia (IAA);
  - Institute for Astrophysics of Cantabria (IFCA).

For these new workflows it is envisaged to have them (entirely or in part) coded not only in WS-PGRADE, but also using other developer environments, so as to guarantee interoperability among them.
Future Plans

The University of Portsmouth (UK), which have already contributed during the first year, will provide new workflows for rapid discovery of supernovae light curve anomalies and validation of models reconstructing the large scale structure of the universe.
Conclusions

- We have established an expanding international Astro Community interested in workflow technologies;

- We have demonstrated through SSP sharing of workflows and using resources belonging to different VOs;
Conclusions

- We have increased the numbers of meta-workflows and building block workflows and can exploit interoperability among them.

- We have gained a lot of expertise in terms of deploying such advanced technologies not only for developers but also for end users.
FRANEC simulation workflow which produces the models of stellar evolution starting from the output of the two modules EOS and OPACITY and a set of input parameters such as the mass of the structure and the initial chemical components.
Figure 2

The Planck satellite.
The trajectory of an interstellar comet during the period of its quasi capture by the Sun obtained with the COMCAPT workflow.
The ecliptic-toroidal structure of the meteoroid stream associated with asteroid 2003 EH1 produced by the MESTREAM workflow. The positions of the radiants of particles observable from the Earth are shown in the Hammer projection of sky in the modified ecliptical coordinate frame, with the longitude accounted from the Earth’s apex. The latter is in the origin of the frame.
Studying the acceleration of the Universe with the LaSMoG workflow: visual comparison of a standard gravity model and a modified gravity model (i.e. without introducing dark energy) taking advantage of the VisIVO tools.