

The unified theory of Kuiper-belt and Oort-cloud formation: experiences from porting to EGEE

Jan Astalos

Institute of Informatics

Slovak Academy of Sciences

- **Application details**
- **Problems that needed to be solved**
- **Design and used technologies**
- **Conclusions**

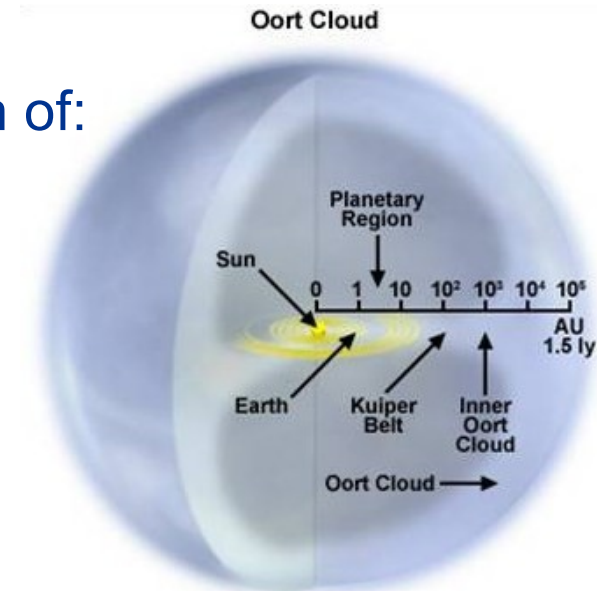
- **Collaboration**

- Slovakia: Astronomical institute, Slovak Academy of Sciences
- Italy: INAF-Catania Astrophysical Observatory
- Poland: Astronomical Observatory of the A.Mickiewicz University

- **Main goal**

- Working out unified theory of the formation of:

- Kuiper belt and Scattered Disc
 - *populations of small bodies beyond the Neptune's orbit*
- Oort cloud
 - *very distant cometary reservoir*



- **Method**

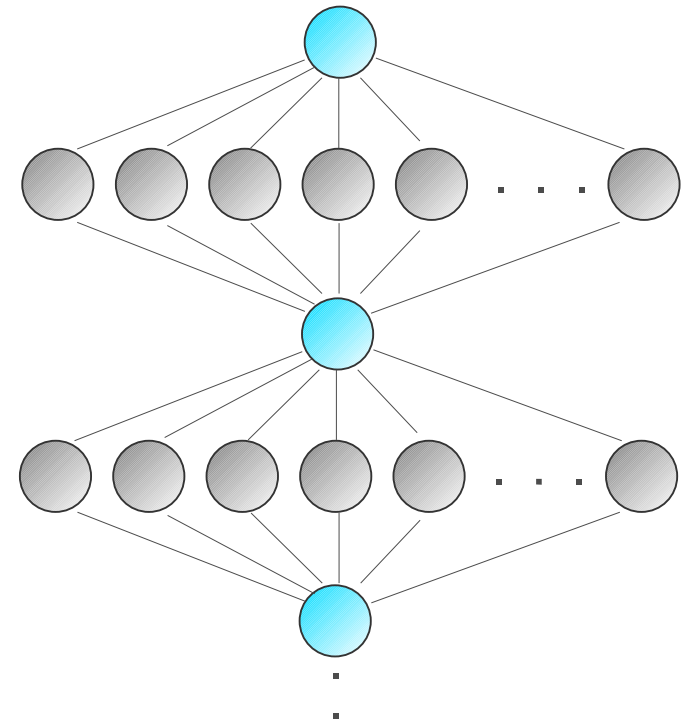
- simulation of the dynamical evolution of a large number (~10000) planetesimals (treated as test particles) in the proto-planetary disc; the trajectories of the particles are influenced by the perturbing forces from the giant planets, Galactic tide, and stars passing near or through the Oort cloud

- **Computational methods:**

- Numerical integration of orbits using RADAU integrator (included in public available package MERCURY developed by J.Chambers)
- Stellar perturbations – using advanced impulse approximation (proposed by P.A. Dybczynski)

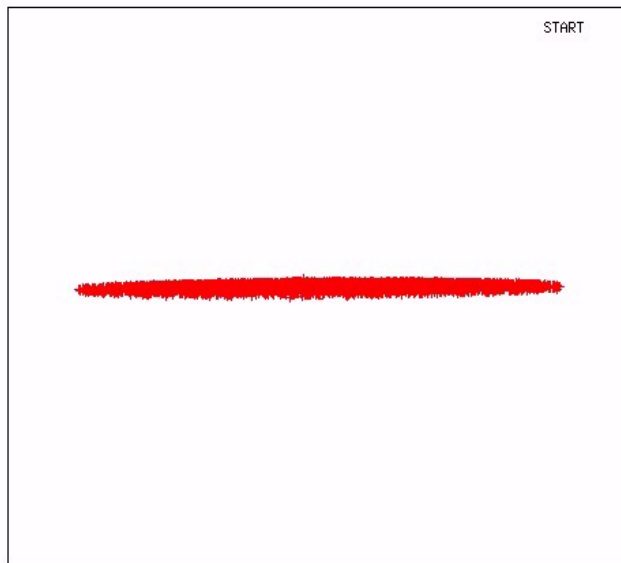
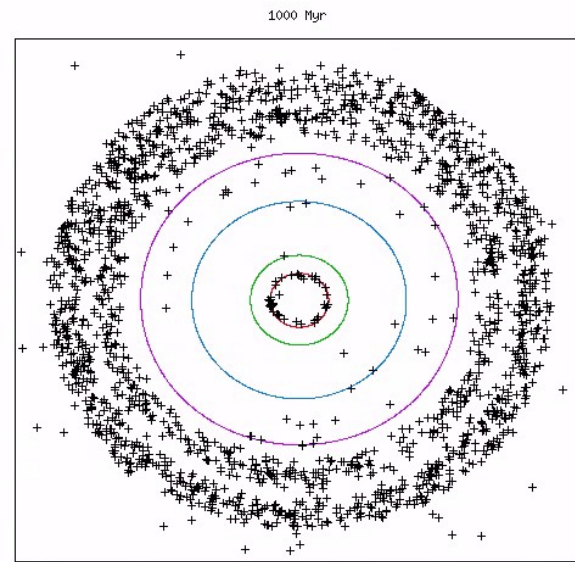
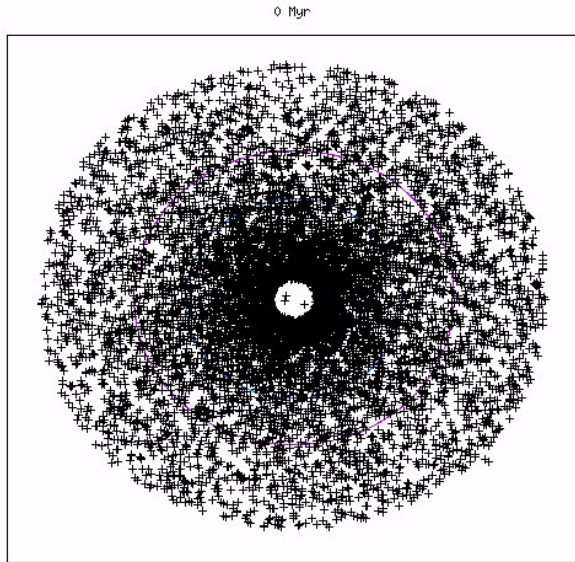
- **Structure**

- Sequence of sub-simulations
- Each sub-simulation consists of many independent tasks
- Output from all tasks is needed for preparation of next sub-simulation (requires user interaction)

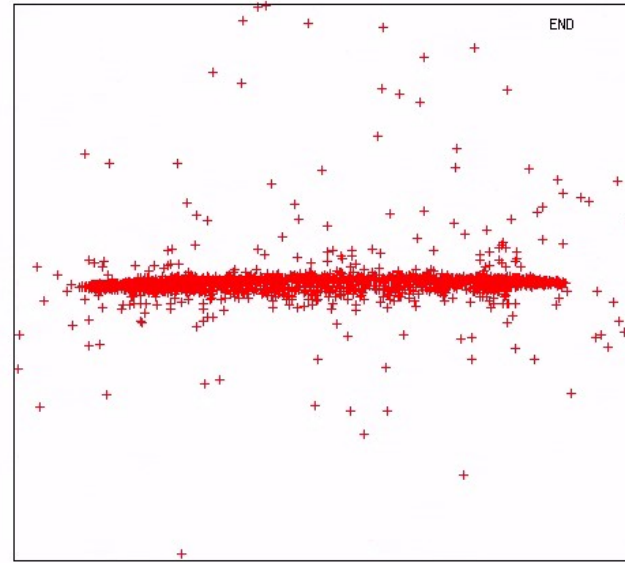


- **Demands for CPU time**
 - If a single 2.8GHz CPU was used, the computation of the orbits of 4 giant planets and 10038 test particles for 1 Gyr would last about 21 years
- **Running in Grid**
 - Tasks of each sub-simulation divided among 4 users and run in two Grids
 - EGEE: Virtual Organisation for Central Europe - 3/4
 - TriGrid (Trinacria Grid Virtual Laboratory) - 1/4
 - Simulation of 1Gyr was finished in ~ 5 months

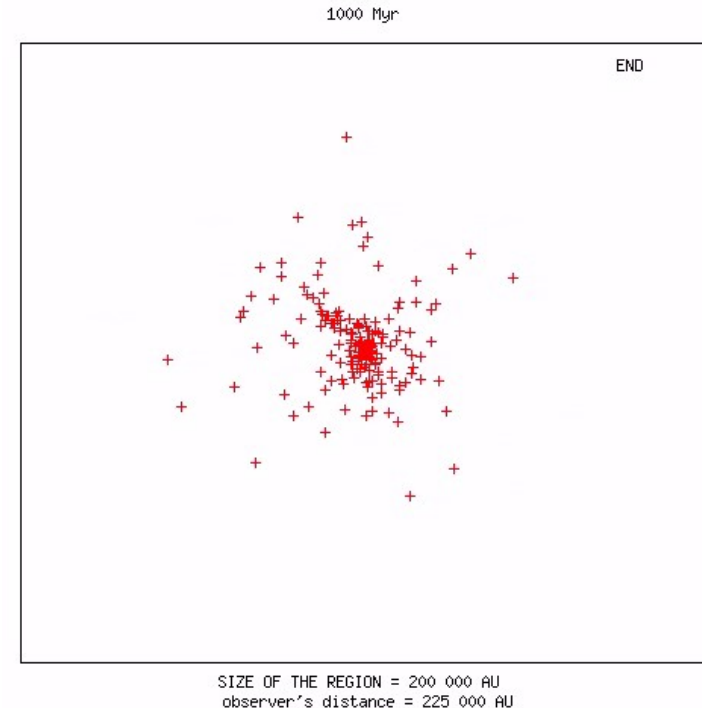
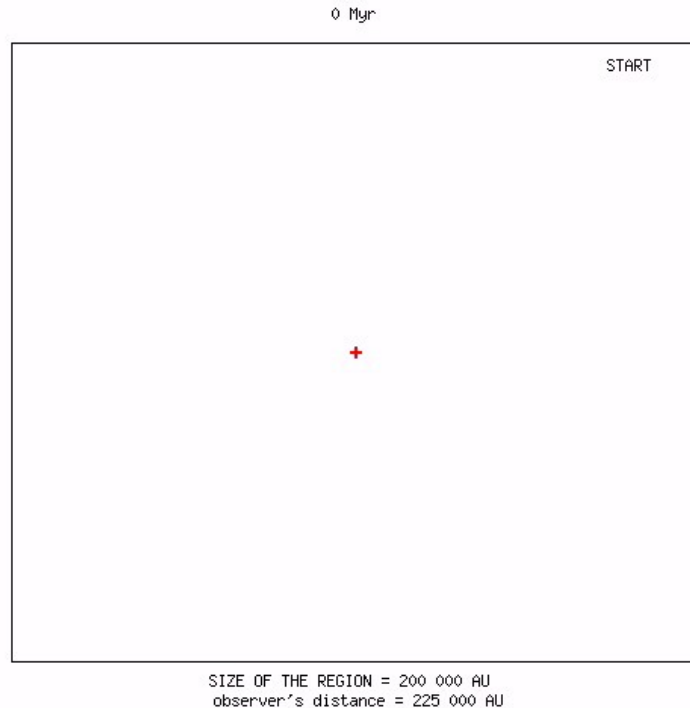
Enabling Grids for E-scienceE



SIZE OF REGION - 145 AU
 observer's distance = 125 AU



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 observer's distance = 125 AU



- **More details about the application**
 - Neslušan L. (ne@ta3.sk), Jakubík M. (mjakubik@ta3.sk), Paulech T. (astrotom@savba.sk)

- **Previous experiment done by users**
 - parametric simulation with large number of short term tasks
- **Throughput**
 - Problems with failed jobs
 - Jobs stuck in queues at some sites
 - Low performance on some worker nodes
- **Productivity**
 - Too much effort needed for managing large number of jobs
 - Users needed easy-to-use tools for automatic job management
 - Use of Grid should be as simple as possible: prepare input data, start processing, download output
- **Fair resources sharing**
 - Users wanted to use only a subset of available resources

- **Goals**

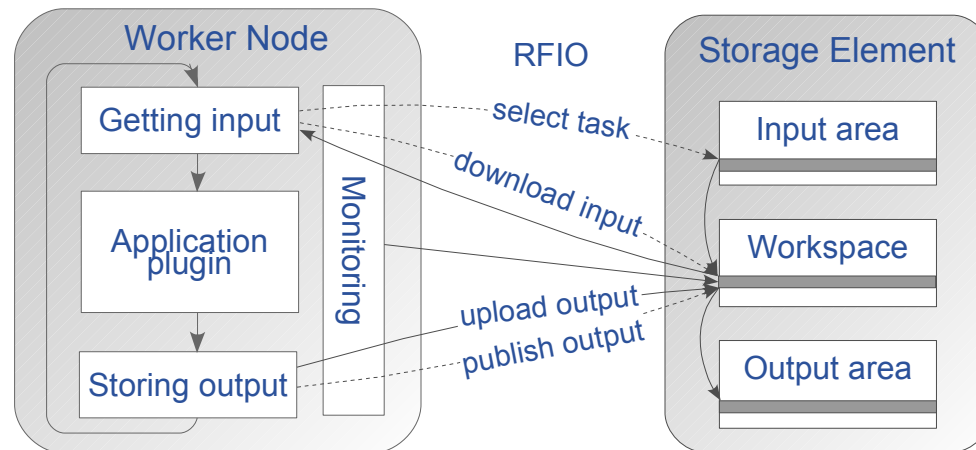
- The framework should be as generic as possible - reusability
- To avoid external services – only standard EGEE services
- Based only on technologies available in EGEE
- Automatic – with minimal user interaction
- As simple as possible – to minimise maintenance effort

- **Existing tools**

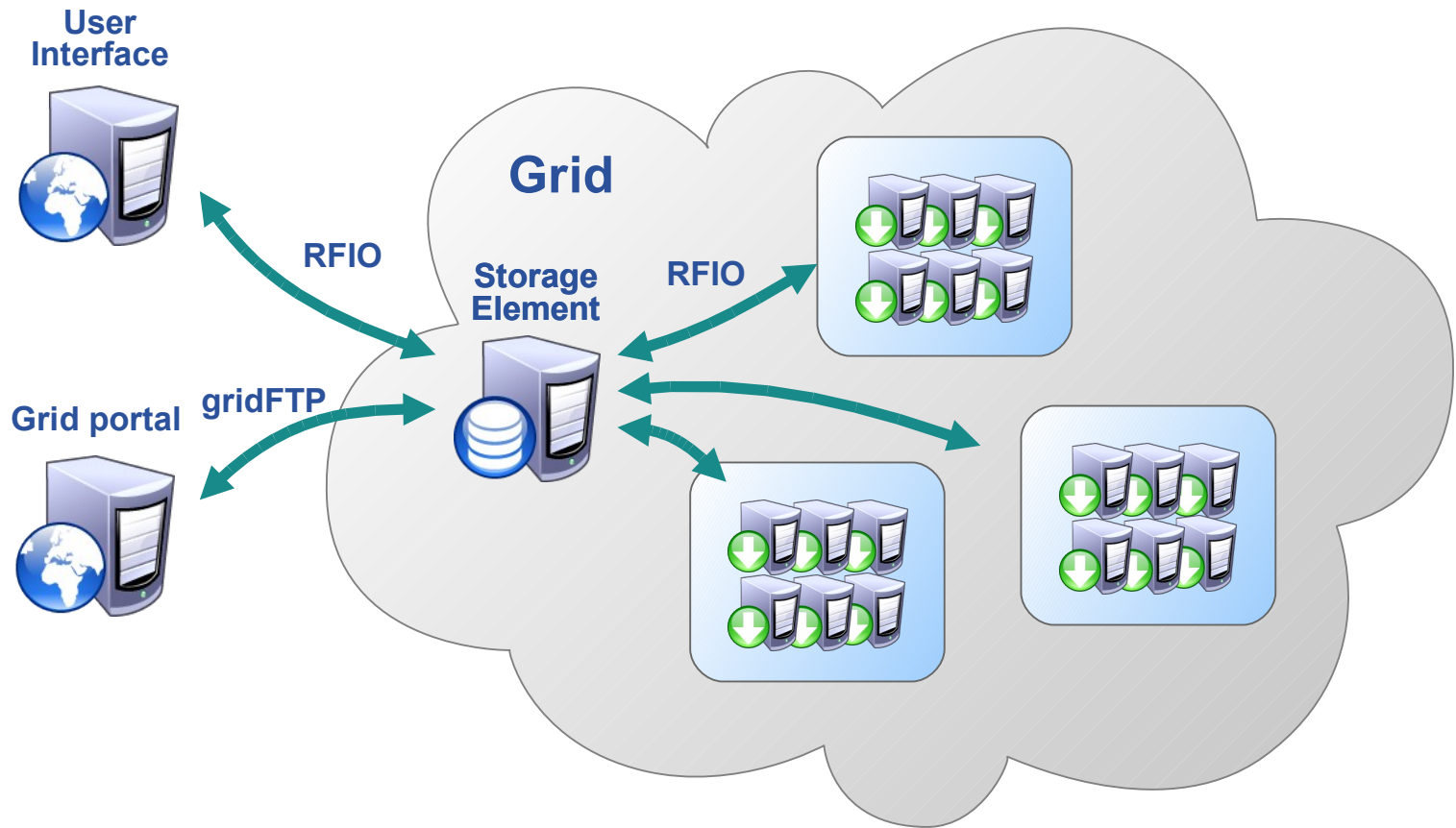
- not easy-to-use or too much application specific

- **Solution used: pilot jobs**

- Concept used in production by some of the virtual organisations in EGEE
- Input data are not associated with job, downloaded when pilot job starts running on worker node
- Failed and waiting jobs do not enter processing – they can be simply discarded



- Pilot jobs on worker nodes are running simulation model in cycle with input datasets obtained from Storage Element
- Monitoring information - periodically uploaded to Storage Element – heartbeat + progress monitoring



- User prepares input data on User Interface and copies them to working directory on Storage Element
- Status can be easily seen from contents of input and output area – by gridFTP also from Grid portals

- **Job management script**
 - Running in background on User Interface
 - Maintaining configured number of active workers
 - Failed and waiting workers are cancelled and sites are added to blacklist
- **Implementation**
 - Bourne Shell script – easy to modify and customize
 - Using job collections - it allows to speed up the start-up phase
 - Uses lightweight access to files on Storage Element – RFIO (Remote File IO Access), with secure authentication using grid certificates
- **Interactive access**
 - Users needed to identify causes of unexpected behaviour of some jobs, „log in“ to worker nodes
 - Using tool from Interactive EU Grid project „glogin“ - interactive session established by worker (works also if WN is on private IP)

- Users expect that their jobs sent to Grid will succeed – failures at the site and middleware level need to be automatically detected and solved by the higher level tools
- It is possible to perform lots of tasks in parameter studies successfully with minimal effort on user side
- Yet another success story for pilot job concept
- Support for porting the application to EGEE was done in the scope of EGEE NA4 activity.

- **Contact:**
 - astalos.ui@savba.sk
- **URL:**
 - <http://cvs.ui.sav.sk/twiki/bin/view/EGEE/NA4ParametricSimulations>