Contribution ID: **68** Type: **poster**

Grid Computing for Kinetic Transport in Magnetic Fusion Devices

Wednesday 9 May 2007 17:30 (20 minutes)

Describe the scientific/technical community and the scientific/technical activity using (planning to use) the EGEE infrastructure. A high-level description is needed (neither a detailed specialist report nor a list of references).

The study of ion trajectories in low collisionality plasmas is
very important
for understanding transport in tokamaks and stellarators. Several
issues make
this study useful to understand the confinement in those devices.
One of them
is the kinetic transport and the behaviour of particles in a
given magnetic
configuration. We make a transport estimate for the TJ-II device,
which is a
medium size flexible heliac characterized by a complex magnetic
configuration.

Report on the experience (or the proposed activity). It would be very important to mention key services which are essential for the success of your activity on the EGEE infrastructure.

We have developed a computer code, ISDEP, that solves the
guiding-centre
equations in the presence of collisions. One million particles
are followed
in a realistic TJ-II magnetic configuration for a time (for the
first time in
TJ-II) comparable to the discharge duration. The large number of
trajectories
as well as a careful data analysis allow us to obtain accurate
estimates of
the time evolution of several quantities of interest. The method
is specially
appropriated for a complex magnetic configuration like that of
TJ-II.
Global features of transport, not present in the customary
neoclassical
models, appear: a monotonic increasing of heat and particle
fluxes with
minor radius, the non-diffusive character of transport, the
appearance of
asymmetries on the magnetic surfaces and the non-Maxwellian
character of the
distribution function.

With a forward look to future evolution, discuss the issues you have encountered (or that you expect) in using the EGEE infrastructure. Wherever possible, point out the experience limitations (both in terms of existing services or missing functionality)

The next step will be to let the background plasma vary due to the evolution of the test particles followed by the code. The approach consisting on keeping constant the background does not allow the study of evolving plasmas and dissipates any perturbation. The application must, hence, be modified to be able to be run iteratively and self-consistently in the Grid.

Describe the added value of the Grid for the scientific/technical activity you (plan to) do on the Grid. This should include the scale of the activity and of the potential user community and the relevance for other scientific or business applications

The customary neoclassical transport estimates assume that the transport coefficients depend only on the local plasma characteristics. In TJ-II, the ion particle orbits include large radial excursions in a single collision time. The very same particle thus visit plasma regions of widely differing conditions, which invalidates the local approximation. Therefore, global plasma characteristics must be taken into account in more accurate transport estimates for TJ-II. With this in mind, one can find an equivalence between a Fokker-Planck equation (which in our case describes the evolution of the particle distribution a plasma in the presence of electric field and collisions) and a Langevin equation. This approach it is ideally suited for massive parallel computing in Grids. We expect the Langevin approach to be useful to study transport in devices where deviations from the local hypothesis are sizeable.

Author: Mr VELASCO, José Luis (Instituto de Biocomputación y Física de Sistemas Complejos / Departamento de Física Teórica, Universidad de Zaragoza)

Co-authors: Dr TARANCÓN, Alfonso (Instituto de Biocomputación y Física de Sistemas Complejos / Departamento de Física Teórica, Universidad de Zaragoza); Dr CASTEJON, Francisco (Instituto de Biocomputación y Física de Sistemas Complejos / Laboratorio Nacional de Fusión (Asociación Euratom/Ciemat)); Dr GUASP, José (Laboratorio Nacional de Fusión (Asociación Euratom/Ciemat)); Dr FERNÁNDEZ, Luis Antonio (Instituto de Biocomputación y Física de Sistemas Complejos / Departamento de Física Teórica I, Universidad Complutense de Madrid); Dr MARTIN-MAYOR, Víctor (Instituto de Biocomputación y Física de Sistemas Complejos / Departamento de Física Teórica I, Universidad Complutense de Madrid)

Presenter: Mr VELASCO, José Luis (Instituto de Biocomputación y Física de Sistemas Complejos / Departamento de Física Teórica, Universidad de Zaragoza)

Session Classification: Poster and Demo Session