

# Vashra-T: Grid Ray Tracing for the Fusion Physics ASTRA Code

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- **Solves transport equations in magnetic fusion plasmas (Simulate the Displacements of particles and energy):**
  - Reduce transport → Improve confinement → Make reactors cheaper
  - Puts together models for transport, sinks and sources: Simulates a plasma discharge
  - **Improve plasma heating methods for a commercial reactor version!**
- **Now being executed on a shared memory machine**
  - Difficult to scale
  - **Idea:** Separated modules executed onto the Grid
    - Increasing parallelism

## ASTRA (Hindu mythology)

- Supernatural artifact
- Presided over by specific Deity



## Vajra (Hindu Mythology)

- Thunderbolt *Astra* from Indra Deity

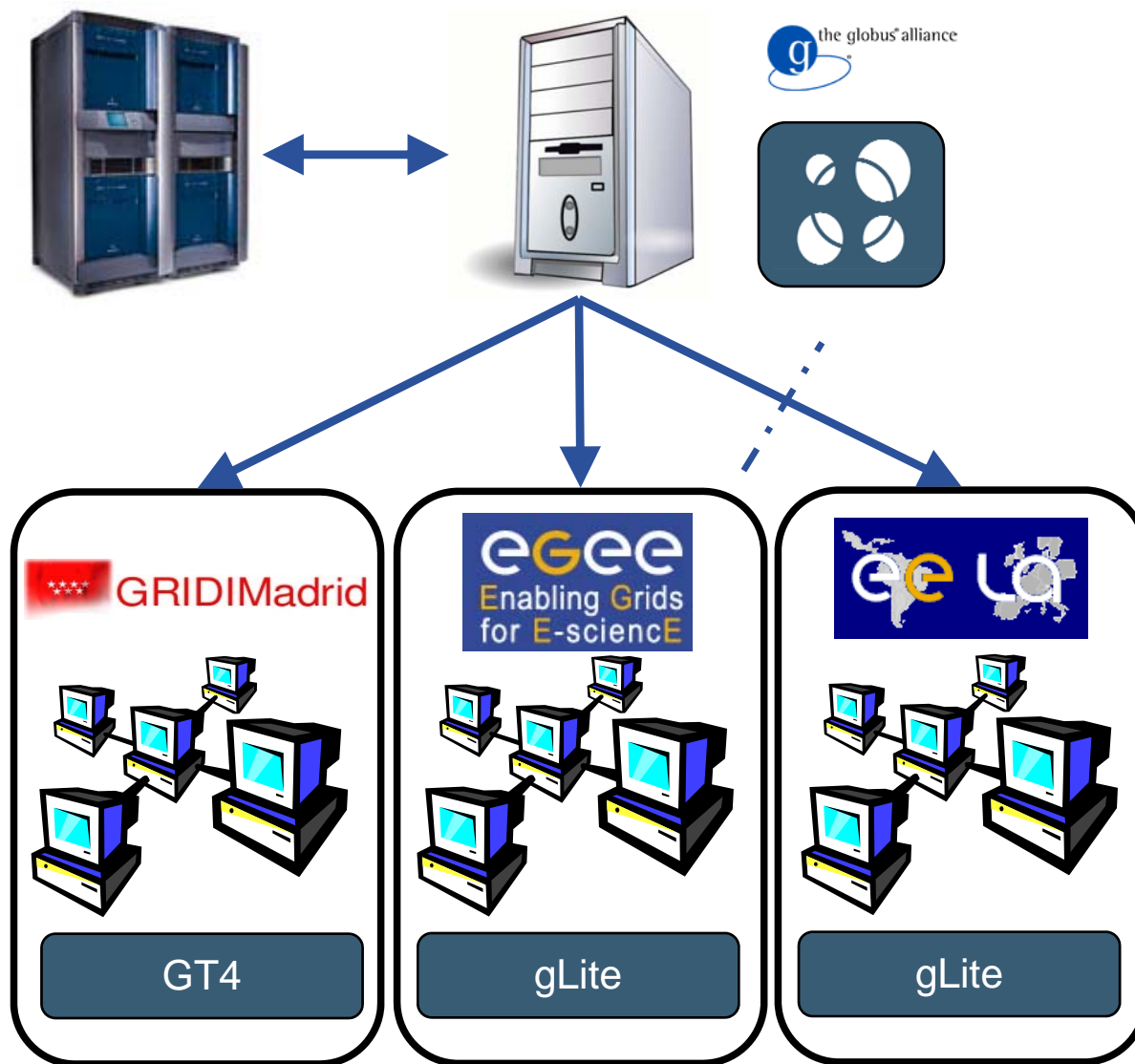
## Vashra (Fusion Physics on Grid)

- Each module invoked by ASTRA (transport coeff., sources, heating,...)

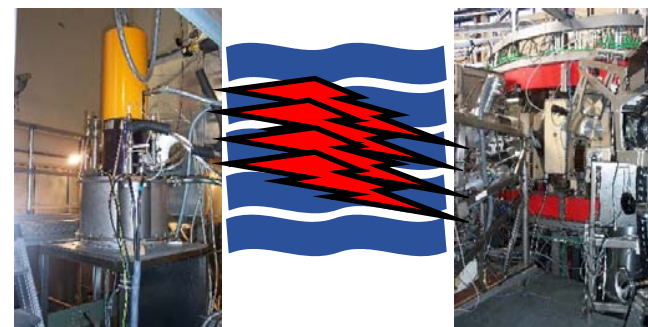
- **Vashra-T**

- Traces each ray contained in the simulation of a microwave beam which heats fusion plasma (Truba code)
- The properties of heating depend on the EVOLVING PLASMA: Interplay between transport and heating. A large number of rays to be run: **Needs to be executed as much as possible in less time**
- Fusion Physics (Fusion VO) – Proposed by CIEMAT (Spain)
- **Parameter Sweep (with pre and postprocess)**
- 1 ray = 1 job = 3' on a Pentium 4





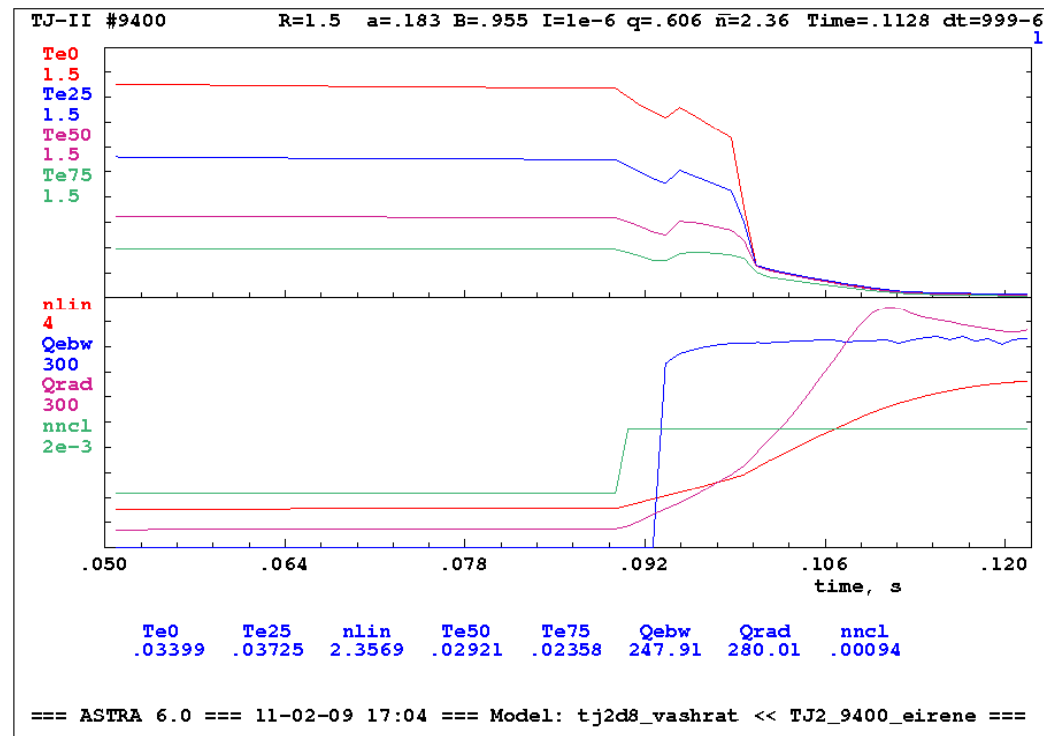
- **Local Machine**
  - SGI ALTIX 3700
  - 64 + 128 CPUs 64 bits
  - LSF
- **Local Communications**
  - scp and ssh
  - User ssh keys exported
- **Grid machine**
  - Globus Toolkit 4
  - Globus GridWay 4.2.1
  - Access to 30 sites



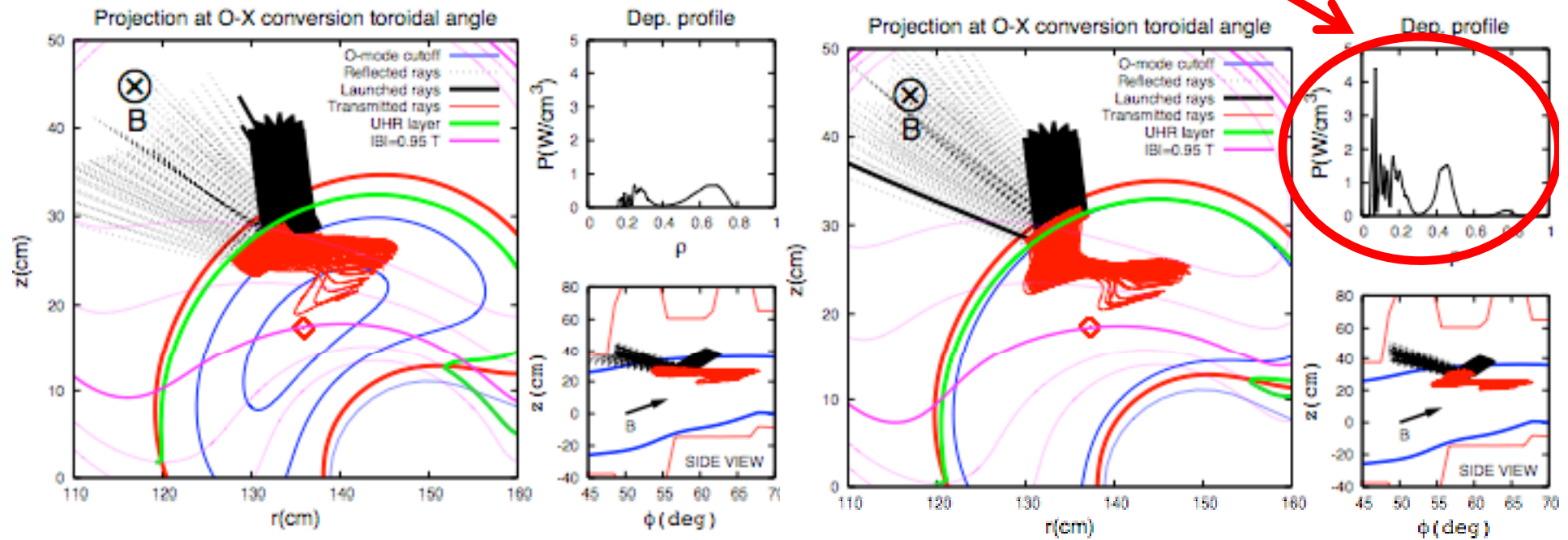
Plasma (n, T) → Heating properties → Plasma Evolution →  
 Heating properties → Evolution →...

- Heating estimated by the grid every 1 ms
  - Study of next ASTRA extensions to be gridified

- Evolution estimated by ASTRA.
- TRUBA results change.



- Results at  $t=100$  and  $t= 120$  ms
- **The Heating is much more centred!!!**



- **Walltime improvement**
  - Before Vashra-T: 40.5 hours (profile with 97 rays/beam)
  - With Vashra-T: 2.5 hours (same profile)
- **Module idea works!**
  - Study of next ASTRA extensions to be gridified
    - **FAFNER**: MC Code for Plasma Heating
    - **EIRENE**: particle source code
    - ...



# Grazie mille!

**Wait... want to see  
Vashra-T in action?**