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PIANO NAZIONALE
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Centro Nazionale di Ricerca in HPC,
Big Data and Quantum Computing

Boost OpenGadget

Giuseppe Piero Brandino, eXact lab

Spoke 3 Progetti Bandi a Cascata, 24/09, 2024

exact lab



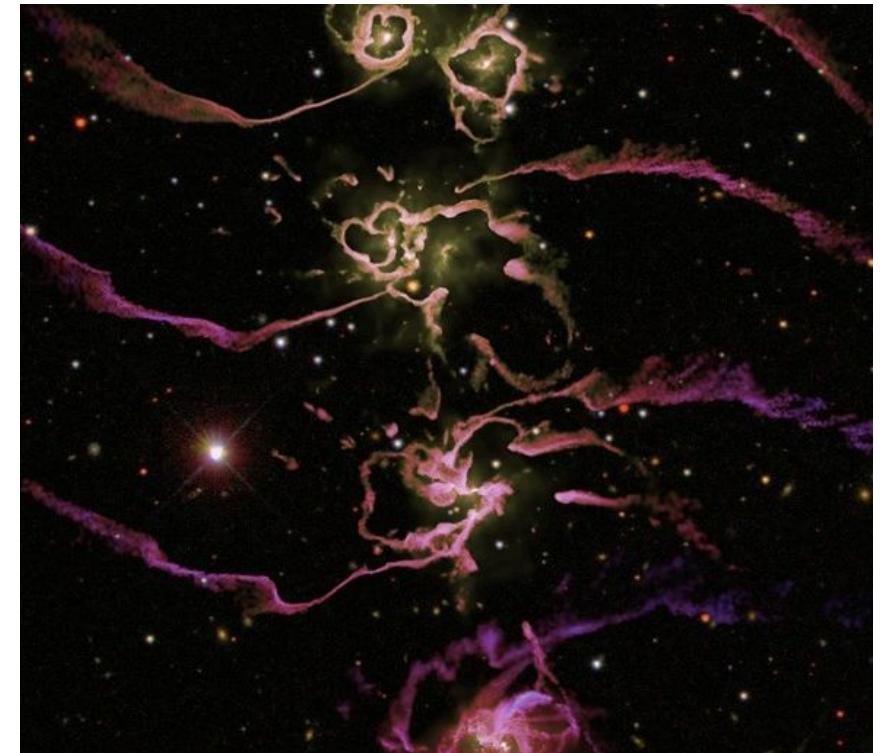
**BOOST
OPENGADGET**

OpenGadget

Cosmological N-body/SPH simulations on massively parallel computers

Allows the computation of

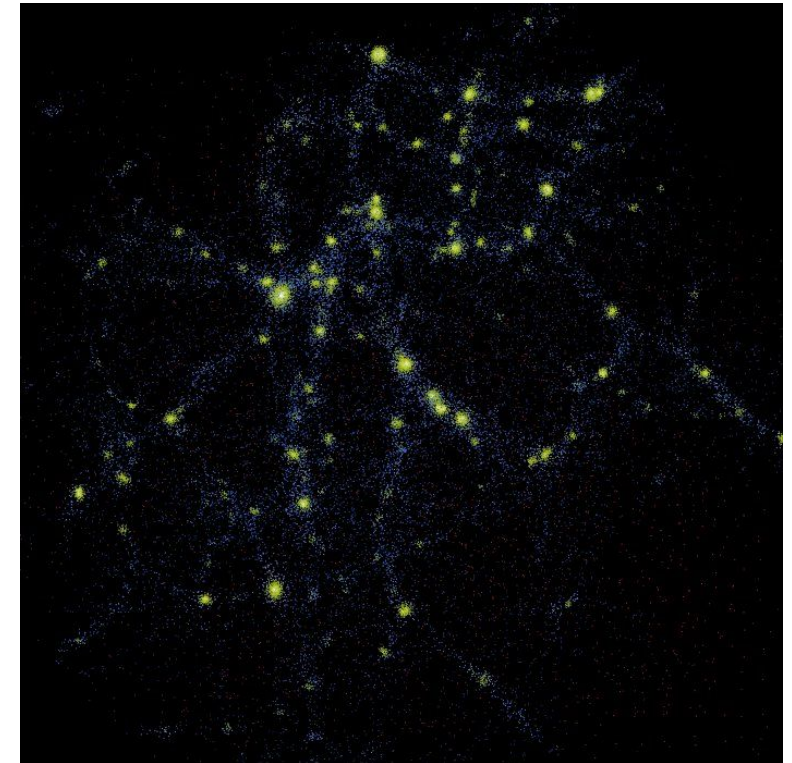
- Gravity
- Magneto-hydrodynamics
- Stellar evolution
- Treatment of supermassive black holes
- ..and more



Project overview

Re-engineering of OpenGadget core routines in order to

- Enhance performance and resource utilization efficiency
- Increase codebase maintainability
- Have a vendor-agnostic GPU codebase



Technical Objectives, Methodologies and Solutions

Technical objectives

- **Algorithmic optimization: tree-transversal on GPU, gravity simulation (CPU and GPU)**
- **Data structure optimization**
- **Vendor-agnostic development/optimization of GPU kernel (OpenACC/OpenMP)**
- **Increase readability and maintainability of the code base through refactoring**

Methodology

- **Test-driven development**
- **Detailed benchmark suite**

Involved Staff and new recruitments

The team has a multiple years experience in GPU e multi-GPU computing

- **Giuseppe Piero Brandino - Project leader: Ph.D. in Physics**
- **Matteo Poggi - Senior developer: Ph.D. in Physics**
- **Matteo Barnaba - Senior developer: Ph.D. in earthquake engineering**
- **Tommaso Tarchi - Junior developer: B.S. in Physics, M.Sc. in Data Science**

Timescale, Milestones, SAL

12 months duration, 3 phases

- **M1-M2: Performance assessment and activity plan**
- **M3-M10: Data structure and algorithms optimization**
- **M11-M12: Stakeholder validation and refinement**

Milestones

- **MS1 (M3): Performance assessment completed**
- **MS2 (M6): First optimization phase**
- **MS3 (M10): Second optimization phase**

3-months work progress report (SAL)