CONNECTIONS (COllaboratioN oN codE development for future Cosmological simulaTIONS)

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Aims:

1) To port our sub-resolution models in OpenGadget3 and continue their development;
2) To analyze the workflow of OpenGadget3 in the context of EUPEX, and perform modularization and optimization on it;
3) To investigate the possibility to improve our post-processing tools, especially sub-structures finders, making use of ML techniques, and possibly include them into OpenGadget to perform the task on-the-fly

https://schede.inaf.it/richiesta_consulta/mostra?selezione=62432ba930dccd67a5a7d018&anno=2022

Time-line

- **Month 4**: Complete the porting of MUPPI in OpenGadget. Completed; module included in OpenGadget3 repository

- **Month 6**: Complete the revision of the chemical enrichment module, including the new cabability of having different star formation modes depending upon physical characteristic of the ambient gas (task 2); complete the production of an ML-based tool for the identification of substructures in simulations, used in post-processing (preliminary name: "StructUnet", subStructures identification with U-net; task 3). Completed; writing of the paper in progress

- **Month 8**: Complete the porting of the dust formation and evolution model in OpenGadget (task 4); Completed; module included in OpenGadget3 repository

- **Month 10**: complete the study of feasibility of the use StructUnet, not only as post-processing, but also on-the-fly during the run (task 5). Postponed to after the publication of the paper

- **Month 12**: Complete a detailed analisys of SMBHs behaviour in the AGN feedback module (task 6). Completed

- **Month 14**: Revision of the AGN feedback module, possibly with the implementation of a dynamical friction sub-resolution prescription for SMBHs (task 7). In progress; writing of the paper also in progress

Activities

- **Workshop «Hydrosim 2023» (Sexten, July 2023): about 5000 euros as contribute for the organization, about 1000 euros for support of local researchers and of non-Italian collaborators**
  https://www.sexten-cfa.eu/event/hydrosim-2023-collaboration-meeting-designing-the-next-generation-of-cosmological-simulations/
- **Partecipation to the workshop «StEm65» : about 1600 euros for the partecipation of G. Murante**
  https://www.sexten-cfa.eu/event/stem65/
- We obtained computing time on CINECA G100 and PLEIADI systems through competitive calls
- We obtained disk space at CINECA through competitive calls

Project upgrades

We added two new sub-projects not present in the original proposal:

- High resolution of a Milky-Way like galaxy, in a cosmological context, using OpenGadget with our new modules
- Integration of Schroedinger-Poisson equations on Quantum Computers;
  comparison among Schroedinger-Poisson, Vlasov-Poisson and Particle-Mesh N-Body code