Proposal for end-of-studies internship (engineering or M2 internship)

Optimisation of an astrophysics simulation code written in C++

Supervisor: Alice Faure (alice.faure@umontpellier.fr)
Host laboratory: Montpellier Universe and Particles Laboratory (LUPM), CNRS UMR 5299

Start date: beginning of march
Duration : 4 to 6 months

Context

The person recruited will be working on the CORSIKA software, an atmospheric particle cascades simulation code, and more specifically on its new version in C++17: CORSIKA 8. Previous versions of this code are currently used in several astrophysics experiments to adjust the physical models and design the telescopes as effectively as possible.

The new version of the code, which is still under development, is significantly slower than previous versions. Work is underway to improve its performance, on a CPU architecture without multi-threading or parallelization. Profiling has identified a few avenues: adapting precision, optimising the use of intelligent pointers, and modifying interpolation routines. Depending on the preferences of the person recruited as a trainee, one or other of these avenues may be pursued.

This optimisation work is part of LUPM's contribution to the international Cherenkov Telescope Array Observatory (CTAO), a grid of telescopes designed to detect gamma rays. CTAO uses CORSIKA to simulate atmospheric particle cascades, at a rate of around 200 million HS06 CPU hours per year. Reducing the computing time required for simulations is therefore of prime importance to CTAO.

The person recruited will be part of the LUPM's IT department and will be supervised by a research engineer in scientific computing. They will work in collaboration with the CORSIKA 8 developers as part of an international, open-source project.

Missions and schedule

1. Initial phase:

- Getting familiar with the computing infrastructure
- Getting familiar with the CORSIKA 8 code

2. Optimisation:
- In-depth profiling depending on the issue chosen
- Reduction of the issue to a simple case
- Optimisation of the simple case
- Modification of CORSIKA 8 based on the results obtained

3. Validation:

- Benchmarking

Curriculum we're looking for

Engineering school or Masters in computer science, scientific computing or astrophysics.

Skills we're looking for

- Knowledge compiled language (C, C++ or Fortran)
- Knowledge of Linux.

Compensation

The stipend for an internship in a CNRS research laboratory is €659.76 per month.

We welcome applications from people of all genders, backgrounds and experience. Even if you feel you do not meet all the criteria, we invite you to apply.