LAL Expression of Interest for AIDA++ WP3

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WP3 F2F Meeting

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Local Context: Recent Evolution

- Hadrien Grasland will get a permanent position at the end of the year
  - Increased supervision capabilities
  - Became one of the ACTS core developers
- LAL (D. Rousseau) has been significantly involved in HEP ML efforts in the last years
  - TrackML challenge about ML potential for tracking
  - A PhD on GAN usage for detector simulation
- A new lab will start next January from the merge of 5 labs in Orsay
  - A larger Computing Department (~50)
  - Continuing with the focus on performance portability
  - At least one more person dedicated to ML
- LAL joined Belle II 18 months ago
  - Hadrien has some involvement in their computing

Aida++@LAL : PPP with SyCL in ACTS

- Why ?
  - **Performance Portability** and **Productivity** (PPP) is a major concern for long-term experiments.
  - **SyCL** is promoted by key players in the C++ standard committee (CodePlay, Xilinx) and recently gained strong attention/support from Intel.
- SyCL: what is it
  - A C++ extension for single source heterogeneous programming
  - OpenCL-based: allow using all the HW supported by OpenCL, including AMD GPUs
  - CUDA-like approach to allow using OpenCL through standard C++ constructs
  - Several implementations: recently Intel launched a proposal for a LLVM-Clang-based implementation
- Proposal
  - Evaluate PPP of SyCL with different hardwares
  - Using an **ACTS** use-case (ACTS is already compliant with Clang)
  - Potential for collaboration with industry (LAL has contacts with Xylinx)
- Risk analysis
  - Late availability of the Intel implementation
- References
  - https://p3hpc2018.lbl.gov/, https://performanceportability.org/
  - https://www.khronos.org/sycl/, https://www.codeplay.com/products/computesuite/computecpp
  - https://www.phoronix.com/scan.php?page=news_item&px=Intel-SYCL-For-LLVM-Clang

ACTS for Belle II

- Belle II experiencing the limitations of genfit2 tracking toolkit
  - Designed for maintainability rather than performance
  - Limited maintenance
- ACTS considered as a strong candidate for the future…
  - But additional manpower is needed to make it happening
  - A PoC built last January by KIT group, historical maintainers of the genfit codebase
- Hadrien did some profiling on genfit2
  - Currently the main issue for the performances is the G4-based geometry description: masking all the other performance problems, need to be solved
  - Start with ASCTS G4 importer? Explore the potential of DD4HEP?
- Preliminary contacts started recently with Belle II on this topic: need more time to refine what the AIDA++ contribution could be
  - A German project (Erum-Data-IDT?) started a few months ago with some actions around the same goal: potential for collaboration

Machine Learning in Tracking

- The TrackML Challenge demonstrated the potential of ML for tracking
  - TrackML co-organised by D. Rousseau: final workshop on July 1-2 @CERN
  - ML to assist traditional algorithms rather than replace them
- Proposal : contribute ML-assisted tracking algorithms in ACTS
  - Focused on pattern recognition
  - Already some preliminary discussions around this with one of the ACTS architect, A. Salzburger
- The (permanent) person of the new lab with a strong ML experience interested by this topic

Machine Learning in Simulation

- PoC of ATLAS detector simulation with GANs done recently: ATL-SOFT-PUB-2018-001
  - Contributions by D. Rousseau and Aishik Ghosh (PhD)
  - Simulation restricted to the homogeneous part of the detector
  - Performance gain over G4 full simulation: 3 orders of magnitude (but G4 still needed for training)
  - Less hand-made parametrisation than other fast simulation approaches
- Challenges for reaching a production-quality simulation will require a more sophisticated an larger network
  - Deal with peculiarities of a full calorimeter, edges and granularity changes
  - Maintain a sufficiently accurate simulation over a wide range of energies (several orders of magnitude)
- Proposal: study new network architectures on a variety of open data realistic detector simulations
  - Data needed is the output of the G4 full detector simulation
  - No need for geometry: the network will learn it from the G4 simulation
  - Need to discuss with experiments (ATLAS, CMS…) to get access to detector simulations
- Will benefit from access to new Orsay Jean Zay super computer for parallel training