Porting ACTS Track Reconstruction to HIP for Multi-GPU Portability

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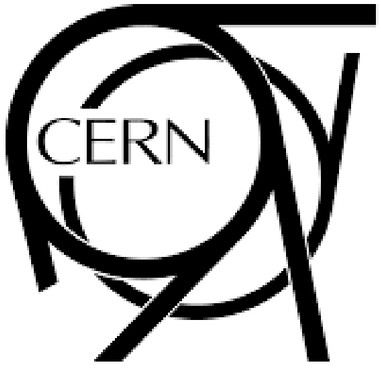
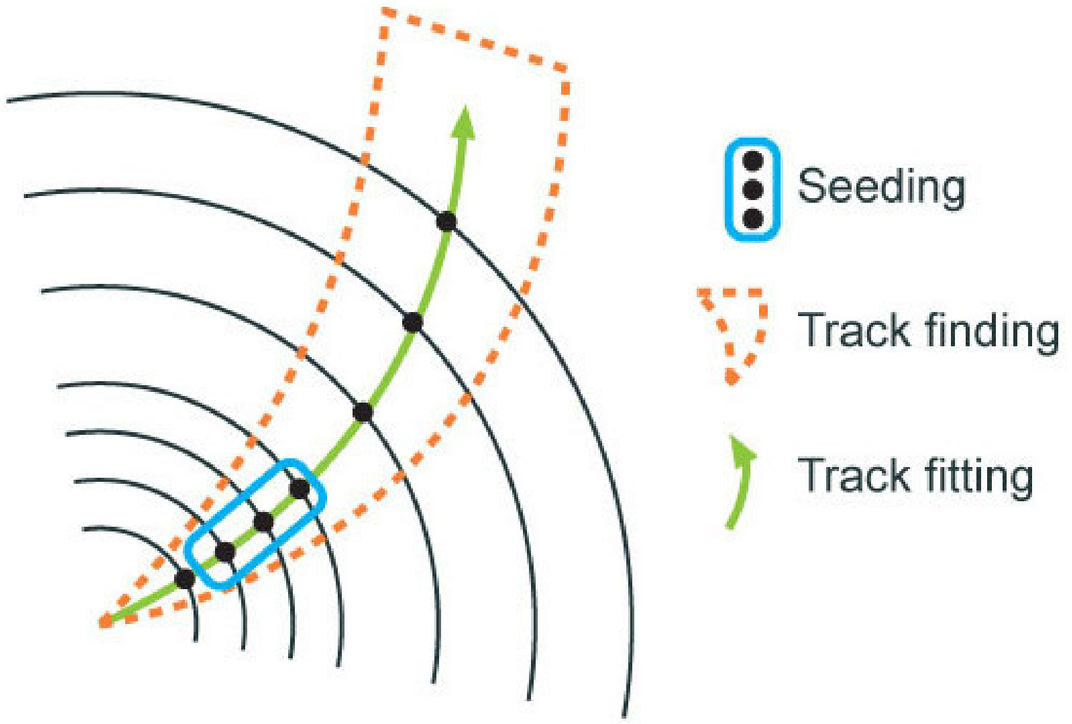
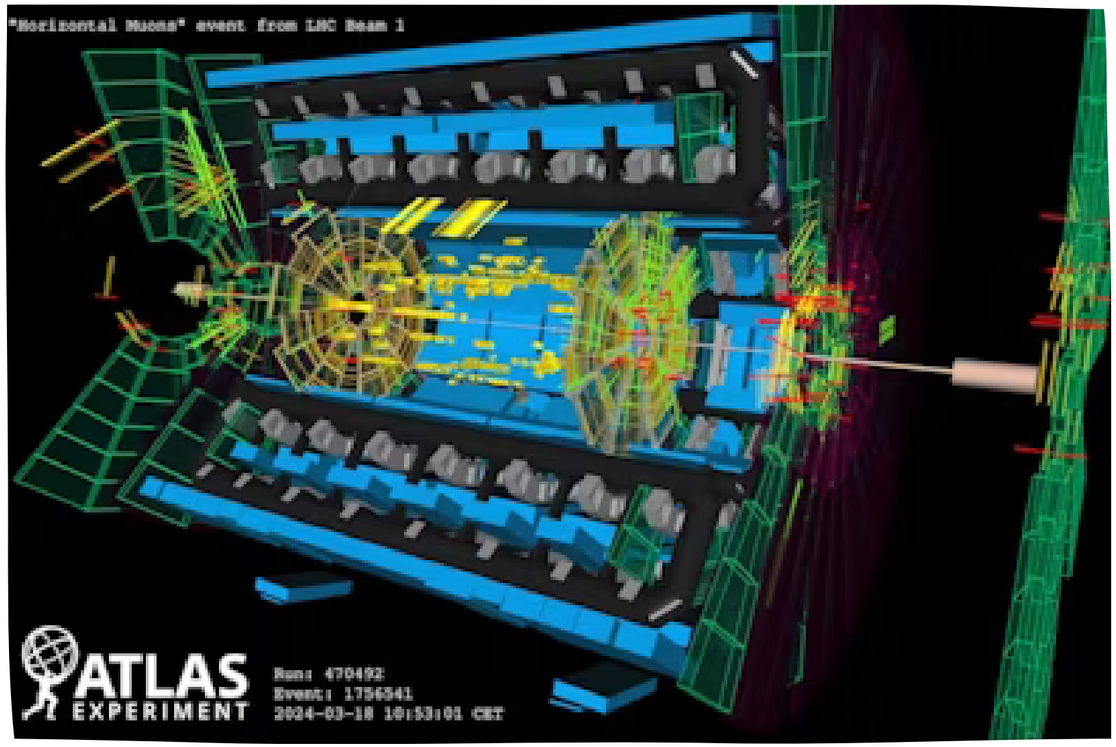


Track Reconstruction in High-Energy Physics
ACTS & Detray

- Tracking: reconstructing paths of charged particles from detector hits
- ACTS: C++ toolkit for tracking algorithms used in HEP experiments
- Detray: GPU-friendly detector geometry + track propagation

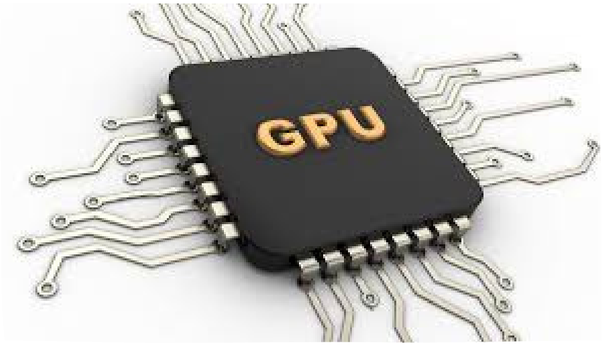


Detray: Detector Geometry & Track Propagation on GPUs



- Navigates tracks through detector layers
- Propagates track parameters in magnetic fields
- Accounts for material effects
- Optimized for massive parallel execution

Breaking the GPU Vendor Lock



GPUs : massive parallelis ideal for tracking

NVIDIA
CUDA

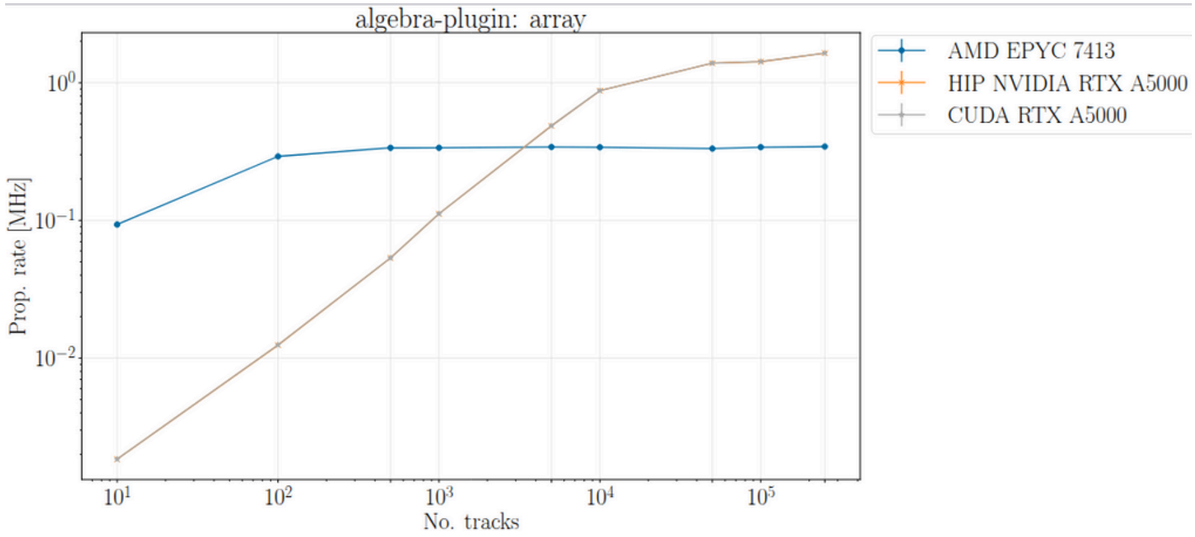
CUDA: NVIDIA only

HIP : portable to AMD & NVIDIA

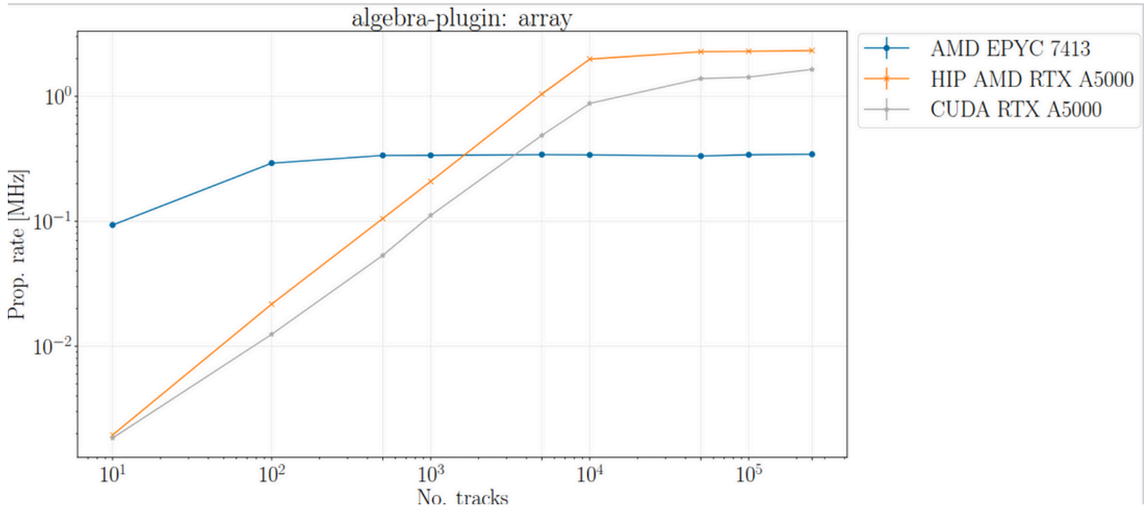
Implementation of HIP Support in Detray From Build to Benchmarks

- HIP config in CMake (detray build system)
- Ported Unit Tests (detector)
- Ported Integration Tests (propagator)
- Built Benchmarks for HIP
- performance plots **NVIDIA & AMD**

Testing Detray
Benchmarking for Multi-Backend Speed

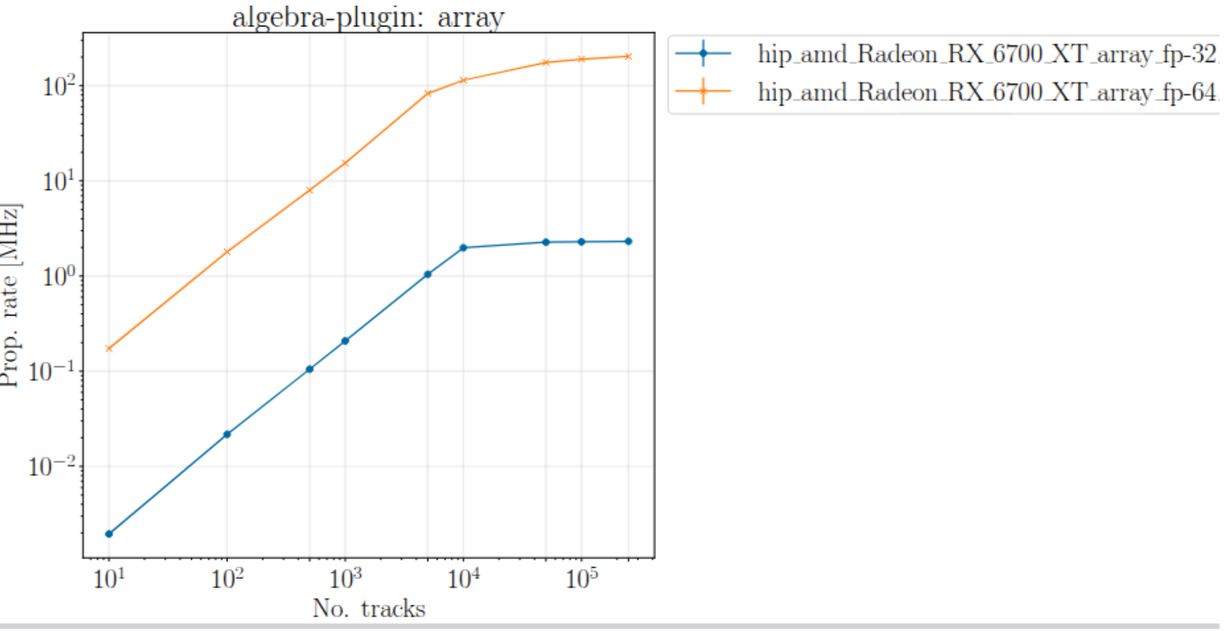


Throughput : CPU vs CUDA vs HIP - nvidia

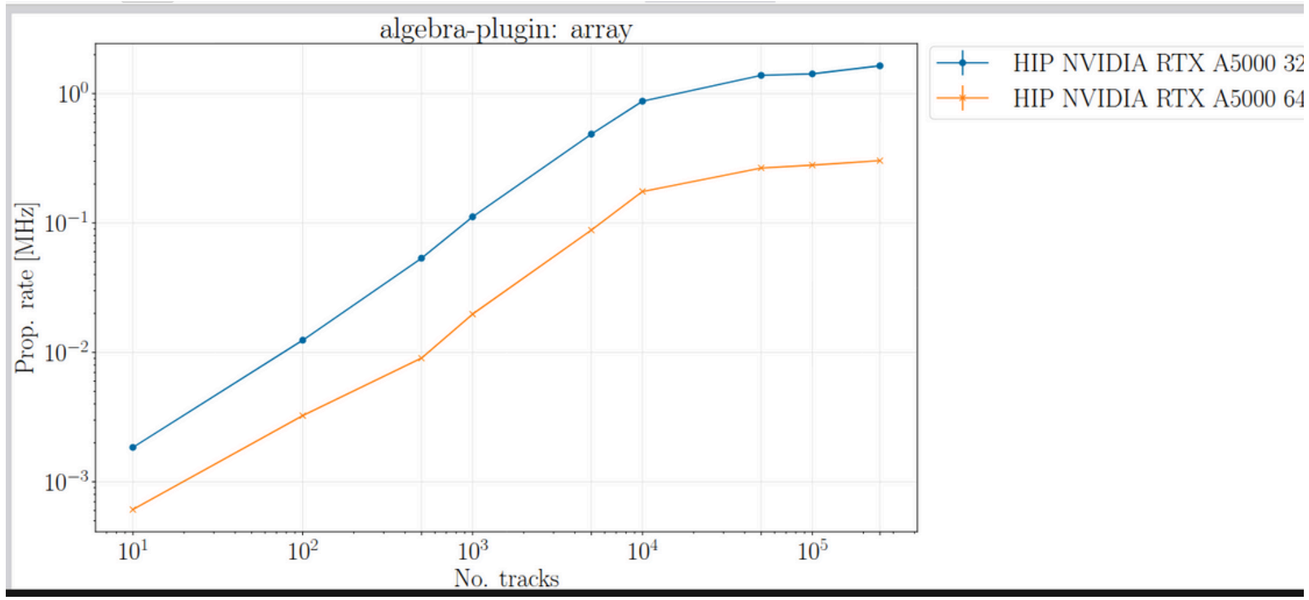


Throughput : HIP AMD & CUDA NVIDIA

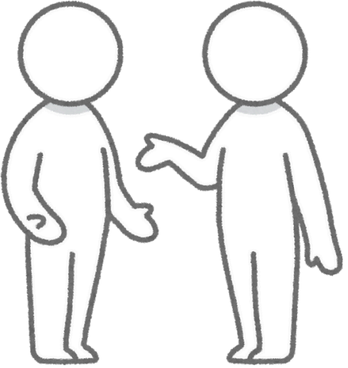
ODD Benchmark: Single vs Double Precision AMD and NVIDIA GPUs



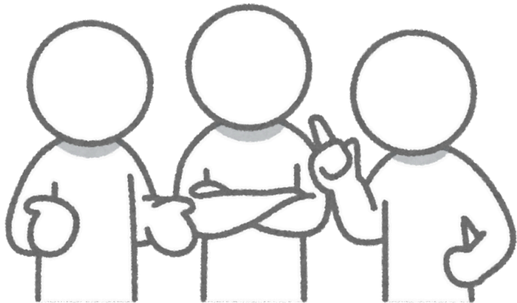
Throughput : HIP AMD 32 vs AMD 64



Throughput : HIP NVIDIA 32 vsNVIDIA 64



Comparative Performance Analysis
HIP & CUDA & CPU Backends



Next Step
HIP in ACTS Software Ecosystem

- Extend HIP to all ACTS components
- Verify propagation on AMD GPUs (validation tests)
- Reduce code duplication between CUDA & HIP tests
- Run benchmarks on different AMD GPUs (when available)
- Optimize for AMD ROCm stack

Thank you for your attention