

LHCb software (& us...)

- triggered by RTA request for our status & plans
 - but even *without* that request good to get an overview of
 - expectations & responsibilities,
 - necessities & wishes,
 - plans & opportunities,
 - capacity & availability
- both for LHCb, and (more importantly) ourselves: we do not need to solve *every* LHCb problem/challenge

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Expectations & Responsibilities

Responsibility	Institute
Management	All Institutes
Shifts	All Institutes
GPU HLT1 framework	LPNHE, NIKHEF, Maastricht, Marseille
Tracking	CERN, Heidelberg, LPNHE, AGH, USC Valencia, UFRJ, Milano, Tsinghua, Dortmund, Pisa
Track fit	NIKHEF, MIT
CALO reco/ID	IJC, Annecy, CERN, La Salle, Warsaw, HSE, YSDA
RICH reco/ID	Cambridge, HSE, YSDA
Muon reco/ID	HSE, YSDA
Fixed target	Firenze
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Upgrade Ib/II R&D	Milano, Pisa, Cagliari, Ferrara Bristol, Imperial, Manchester, CERN, HSE, YSDA NIKHEF, LPNHE, IJCLab

Expectations & Responsibilities

“What are we doing”

- RTA / WP1 (data structures)
 - HLT2 event model, functors & persistency (GR, MV)
- RTA / WP2 (reconstruction)
 - Convener (MV)
 - ML inference, global PID (MV),
 - Calo (MV,GR),
 - Track extrapolation (GS,MM), fit (MV, AU, WH)
- RTA / WP3 (Selections)
 - Framework, Configuration & Optimization (DM, GR)
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 - Alignment, B-field, “R&D / proof of principle” (WH)
- RTA / WP5 (Operations & QA)
 - Piquet shifts (DM)
 - Code reviews, maintenance (GR, MV)
- RTA / WP6 (Upgrade II)
 - Tracking (AU),
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- DPA / WP1 (sprucing)
 - Persistency, configuration (GR)
- DPA / WP2 (analysis productions)
- DPA / WP3 (Offline Analysis Tools)
 - FunTuple (PK, GR), Functors (GR), Flavour Tagging (XC, JV, MM)
- DPA / WP4 (Innovative Analysis Techniques)
 - Quantum Computing (DN,XC,JV,MM,GS)
- DPA / WP5 (Legacy)
- DPA / WP6 (Analysis Preservation & Open Data)
- DPA / WP7 (Training + Documentation)
 - Answer questions on Mattermost (GR)
- Simulation / Framework + New Technologies
- Simulation / Generators
- Simulation / MIB & Radiation
- Simulation / Detailed & Fast Simulations
- Simulation / MC Production
- Simulation / Detector Modeling
 - tracking detector resolutions (WM)

Necessities and wishes - *before* run4

Consolidation

- HLT2 continues from / builds upon HLT1
- Allen 2.0 / Gaudi framework integration
 - Reconstruction split between HLT1/HLT2 is (should be!) *an implementation detail, open for change depending on circumstances* (save/read vs. rerun)
- Better use of existing persistency & reconstruction in analysis
 - *eg. rerunning track fit (not patrec) during analysis should be considered routine use (for the right subset of trigger lines) — this includes eg. availability of improved alignments/calibrations.*
- Trigger Configuration Review
 - Are lines persisting the right information?
 - Ensure yields/fb⁻¹ meet expectations
 - More automated analysis / verification of configuration (“automate DM”)
 - Actively seek out (partial) overlaps, enforce ‘best practices’

Necessities - *before* run4

HLT1/HLT2 interop&integration; robustness; scaling

- Allen 2.0:
 - More “production-like” paranoia throughout the code base
 - Memory management + dependency tracking (towards integration with Gaudi)
 - Persistency: drop HltSelReports, use DstData
 - More standardized build setup
- Allen+Gaudi integration:
 - Remove separation/duplication of algorithms: re-use of GPU code in Gaudi (decoding, pattern recognition)
 - High-throughput scheduling of GPU algorithms in Gaudi, latency hiding (use C++26 std::execution::sender/receiver/task_graph)
 - Updated event store: no invasive inheritance (needs updated persistency!), dependency tracking, integrate events store with scheduling
- PyConf 2.0:
 - Allow ‘meta’ operations (manipulations of (partial) configurations as 1st class actions)
 - Split in generic (Gaudi) graph-based vs specific (LHCb) parts
- HLT2:
 - Use of Allen results: do not ‘start from scratch again’ and then ‘see whether it matches’
 - Improvements to configuration, persistency, functors, ... (utilizing C++26 reflection)
 - *Fix* MC persistency
 - More ML/AI use (utilizing GPUs)
- Simulation:
 - Faster / Better / ... more use of ML
 - Less invasive requirements (management decisions!)

Necessities - *post* run4

Starting from the lessons learned with (pre-)run 4 activities

- GPU first; CPU second - no duplication of functionality between GPU/CPU
- R&D for selections on GPU (may not work!)
- Full 4D reconstruction & *drastic* clean up of the “run 5 branch”
- Revisit Event Model (will break a lot of things - we *failed* this between run2 & run3!)
 - Use newly standardized C++26 features (reflection!)
 - Consider numerical accuracy and choice of parameterizations

Really figure out what it takes to process *and analyse* the expected data volume...

- GPU integration with online (farm, event builder, ...)
- Analysis model
- Scale the simulation