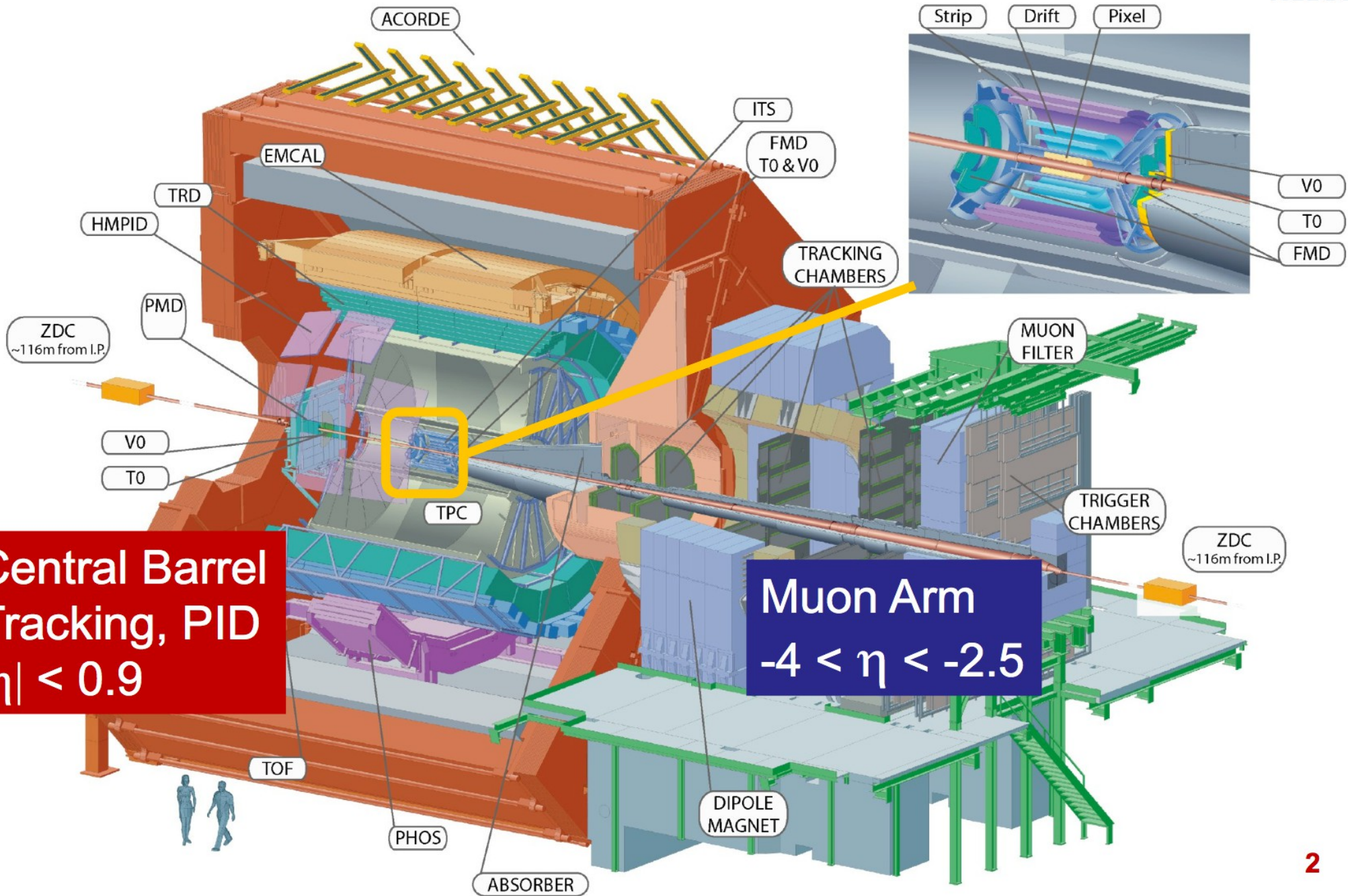


Fast Simulation Options in ALICE

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CERN

2nd Fast Monte Carlo Workshop in HEP
Zeuthen, 14 January 2014

ALICE at the LHC



Fast Simulations

- ALICE has implemented different procedures to speed up simulation
 - Specific stand-alone fast parametric simulations
 - acceptance, efficiency, resolution ..
 - “from 4-vector to histogram”
 - parameterization of covariance matrix for central tracking
 - Parametric simulation during digitization
 - Nuclear fragments in ZDC

Fast Simulations

- Embedding of rare signals into background events
 - Saves time of simulation of high-multiplicity background
 - “merging”: generated signal plus generated background
 - “embedding”: generated signal plus measured background
- No fast non-parametric simulation

Some benchmark numbers

MC Events per year

	2010	2011	2012	2013	
pp	876 M	331 M	589 M	557 M	
p-Pb				340 M	
Pb-Pb	1.1 M	26.4 M	44 M	74 M	

Typical pp minimum bias simulation on the Grid: 60 s / event

Transport and Generation: 70%
Digitization: 30%

Main consumers

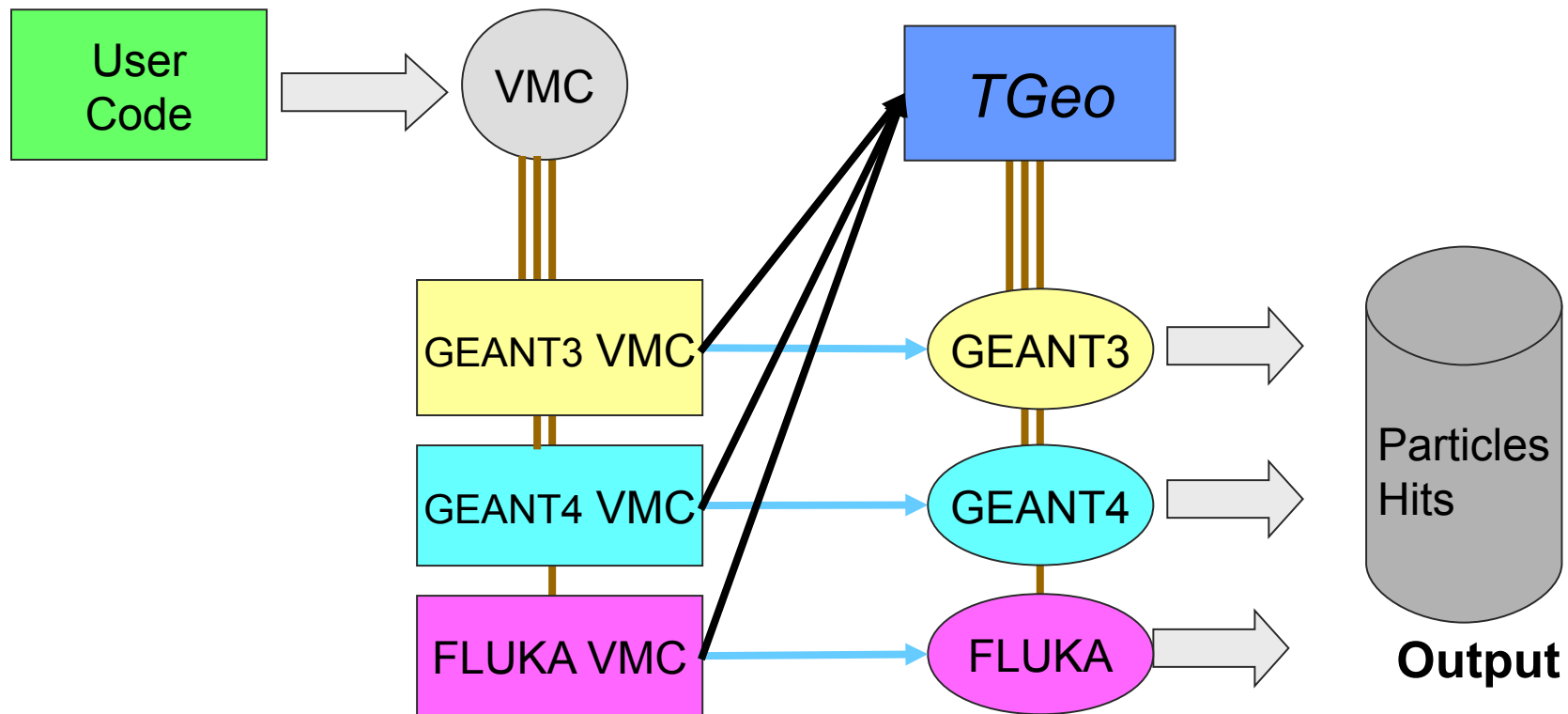
- Transport
 - ZDC (if included) 50%
 - ALIC (containing volume) 21%
 - inner structures 19%
 - TPC 5%
- Digitization
 - TPC (ExB, diffusion, signal generation ...) (90%)

... space for optimization

Virtual Monte Carlo (VMC)

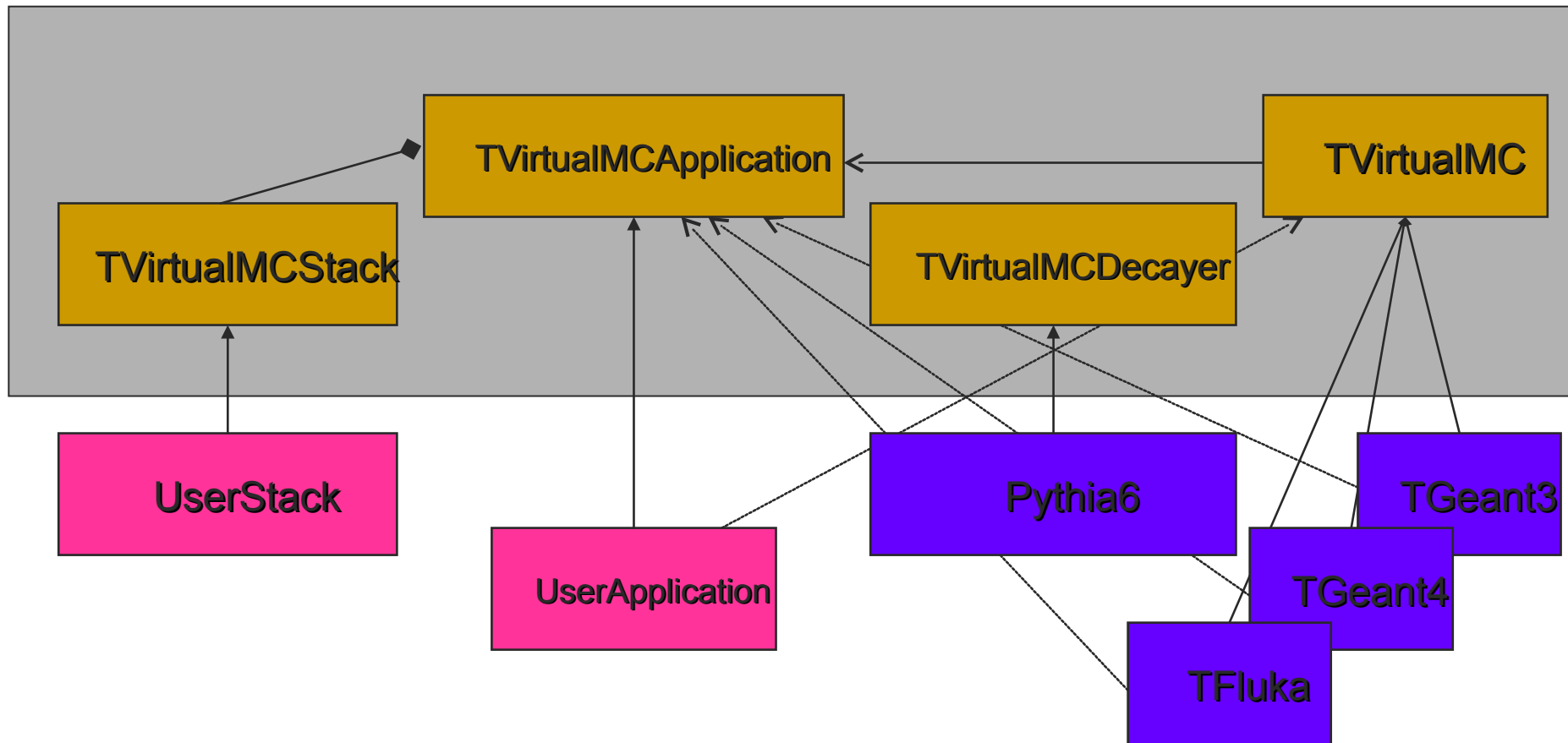
Transport MC transparent to the user application

Base class *TVirtualMC*



VMC Class Design

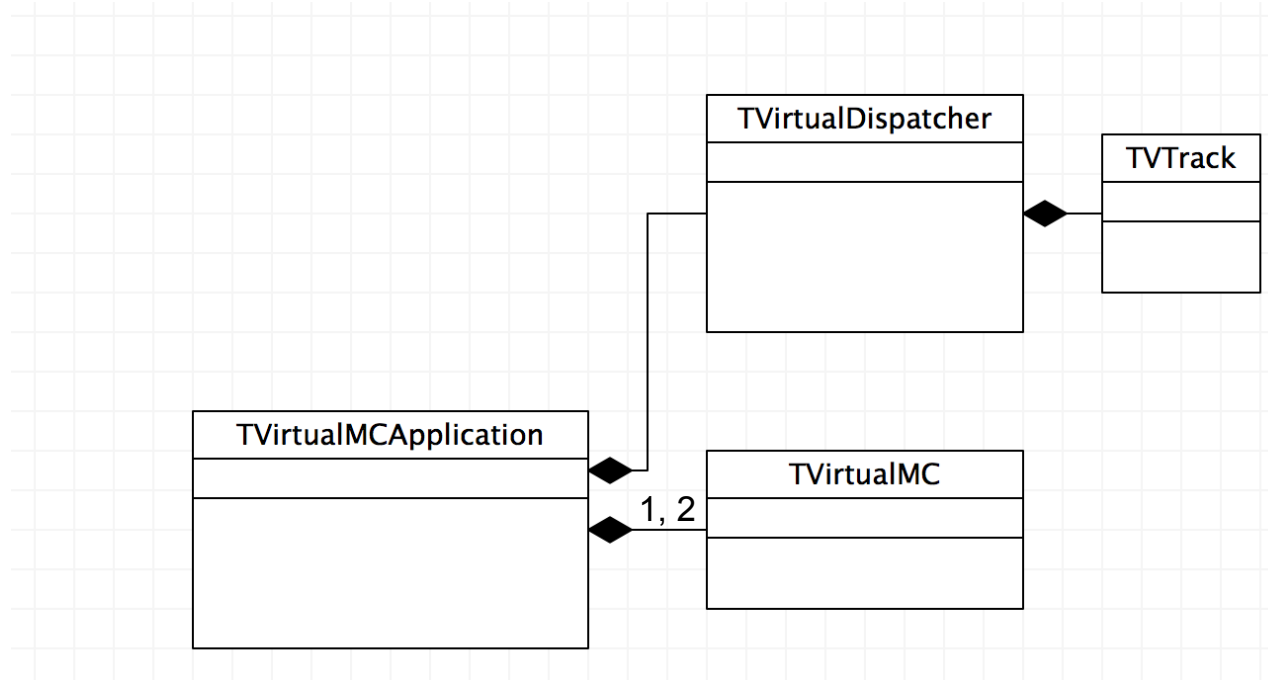
- But also the user application has to be transparent to the transport MC
 - Base classes *TVirtualMCApplication*, *TVirtualMCStack*, *TVirtualMCDecayer*



Possible Extension for Fast Simulation

- Ideally Fast/Slow simulation engine transparent to user code
 - same StepManager, Hit and MC truth management
 - same or simplified geometry
- Need more than one TVirtualMC instance
- Need dispatcher component to decide which instance is active depending on
 - particle type
 - region
 - volume
 -

Possible Extension for Fast Simulation

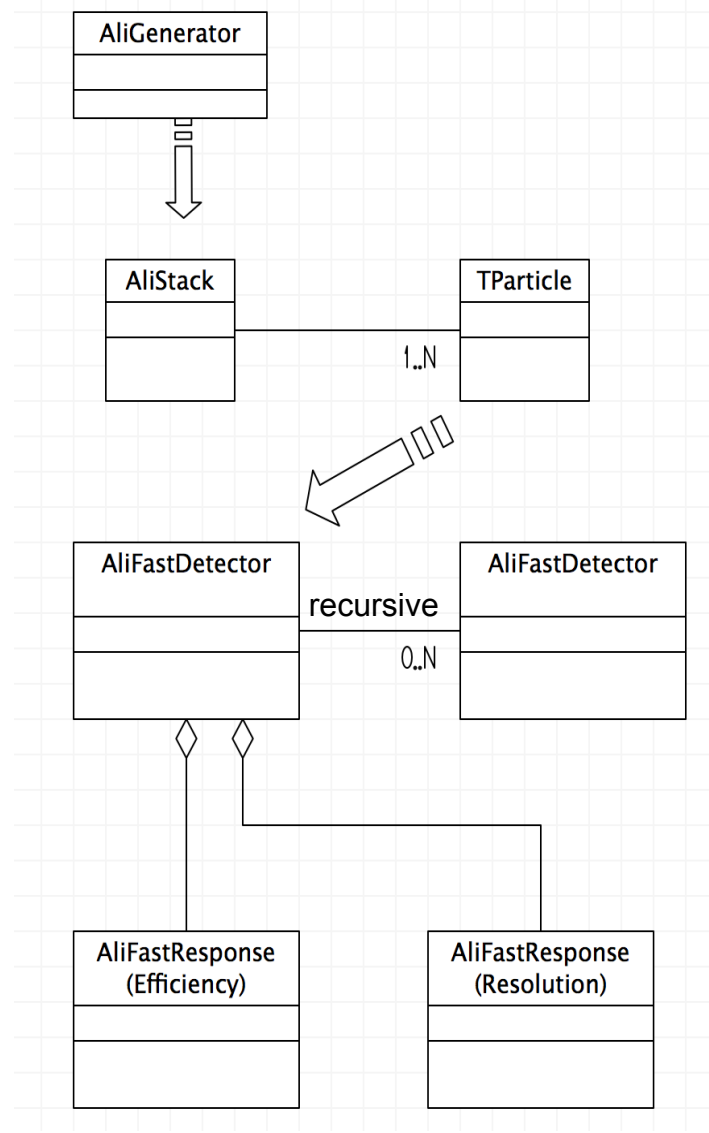


TAliceFastMC

- reuse of existing classes ?
- certainly use existing design/implementation ideas

How could parametric and slow simulation be combined using already existing components ?

Stand-Alone Parametric Simulation



Event Loop
Particle Loop

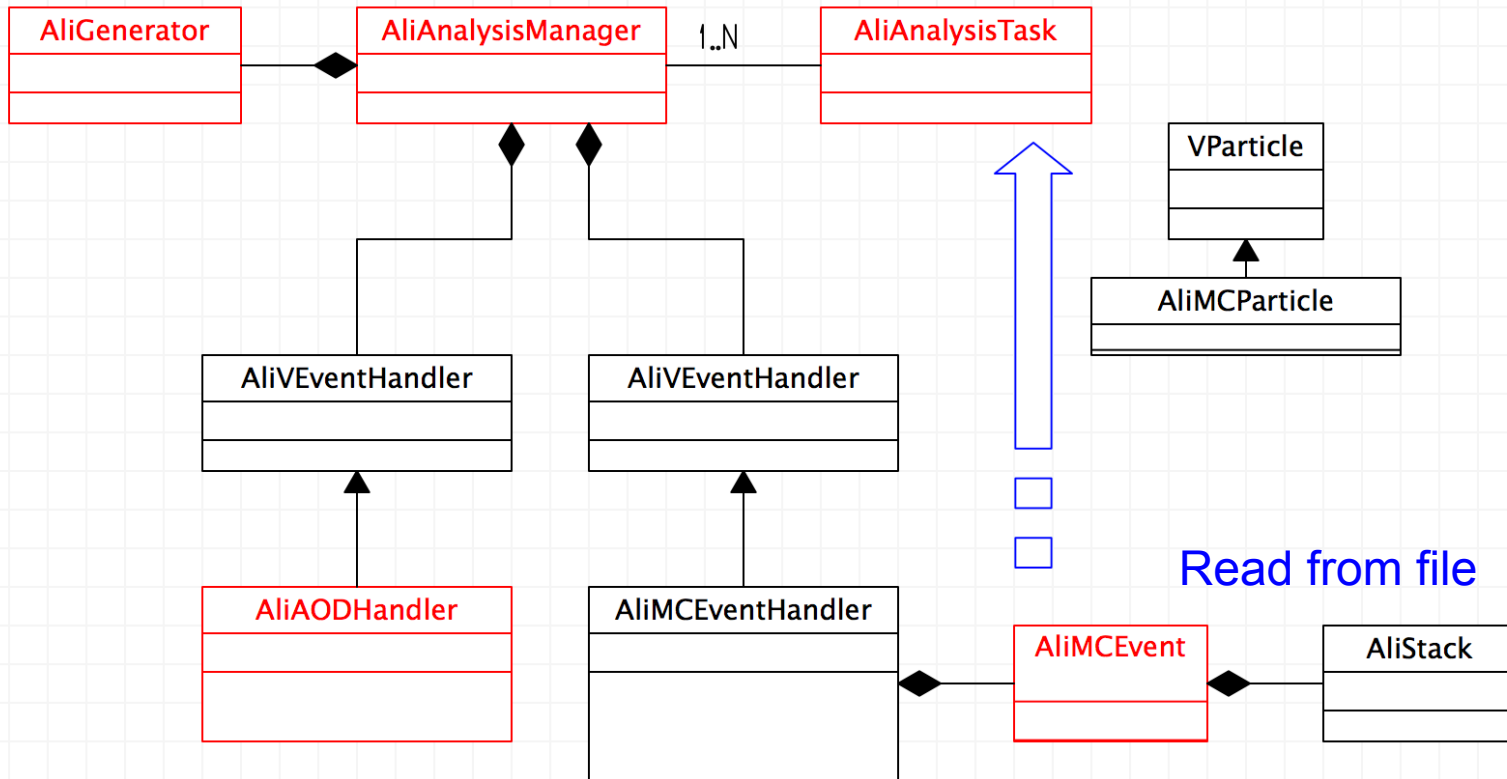
Apply efficiency, acceptance and resolution

Fill Histograms

- Has been used for physics performance studies (mainly muon spectrometer)
- Not used in production
- No writing of physics objects.

Kinematics level analysis

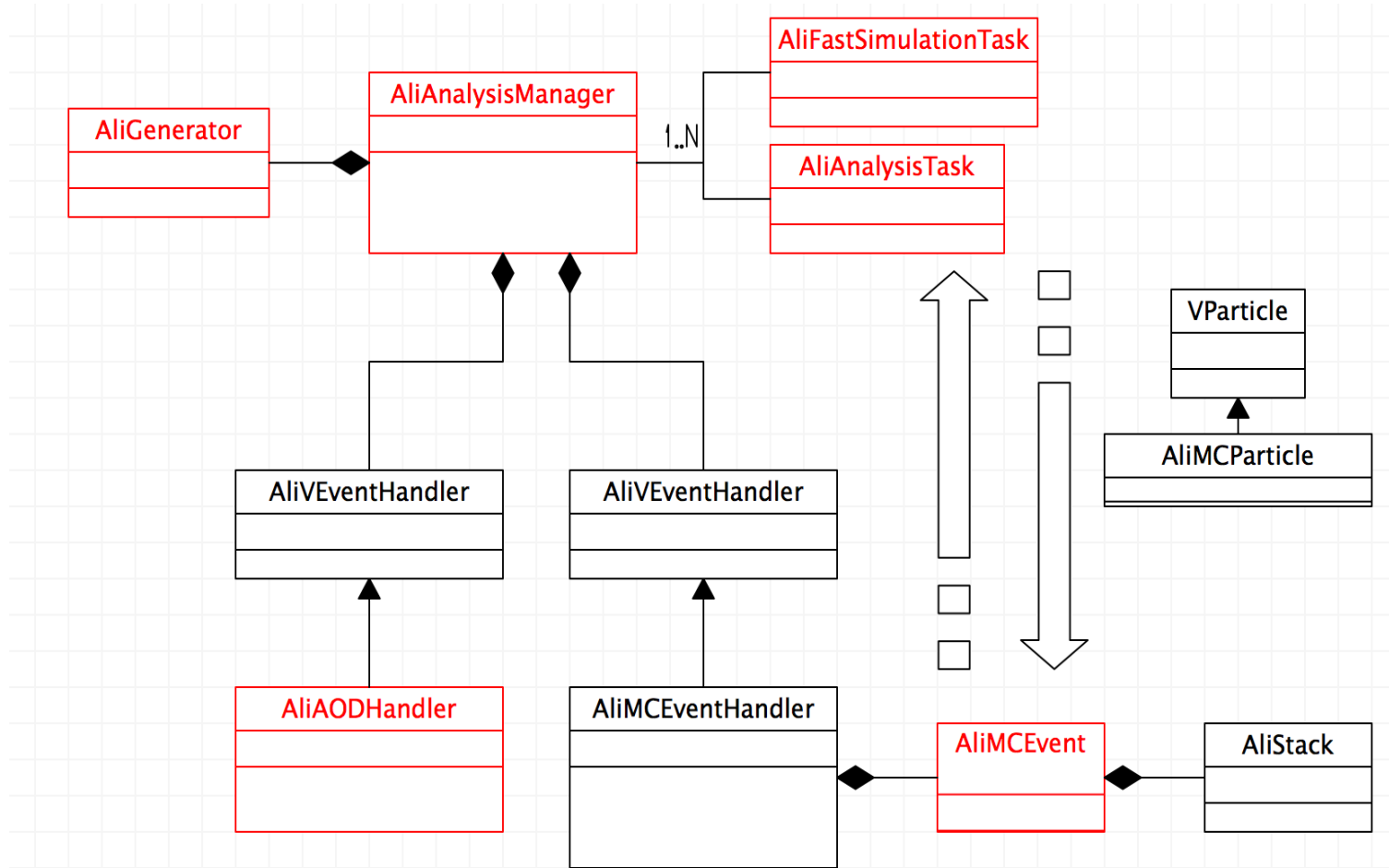
On the flight generation (fast because of reduced I/O)



Can be extended by using AnalysisTasks performing fast simulation

- updating the MCEvent for subsequent analysis
- and/or producing standard AOD events
- Interesting option since Analysis Framework well integrated in production system (analysis train)

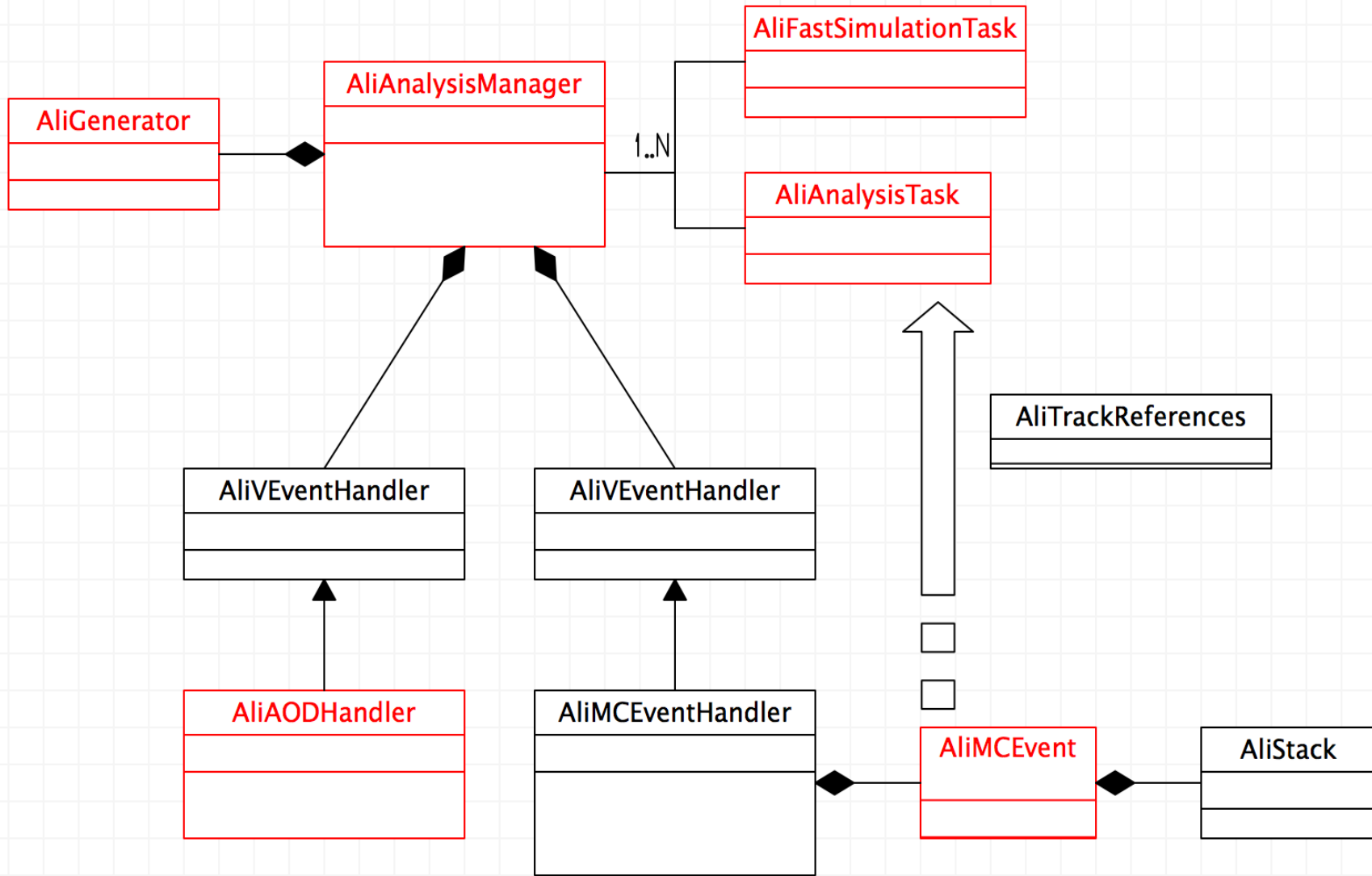
Full after Fast



Write Physics Objects
AOD

- Possibility to update MCEvent
- Possibility to chain with slow simulation
 - transport
- AODs from fast and slow simulation have to be merged

Fast after Full



TrackReferences (4-vectors on reference planes) as input for fast simulation.
 Tracks have to be stopped and flagged for fast simulation

Summary

- Still investigating the use cases and options for fast simulation in ALICE
 - fast performance studies
 - better planning of full simulation requirements
 - ...
- Learn from other experiments