Shape of the Panda Tracking Software (a staus report)

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1. Short Motivation
2. Software Status
   - PANDAroot
   - Detector Codes
   - Tracking Status
3. Conclusions & Outlook
4. Other issues on MVD+STT/TPC

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Panda Physics

A rich program has to be fulfilled which demands a lot of the detector setup.

- Charged particle tracking with good momentum resolution
- Neutral particle detection
- Particle identification
- Primary & secondary decay reconstruction
- Full event reconstruction

Tracking Issues

- Measure charged particles paths
- Good momentum reconstruction (bending radius)
- Good vertex reconstruction (position measurement)
- PID from energy loss / deceleration
- Material consideration necessary
- A highly complex magnetic field

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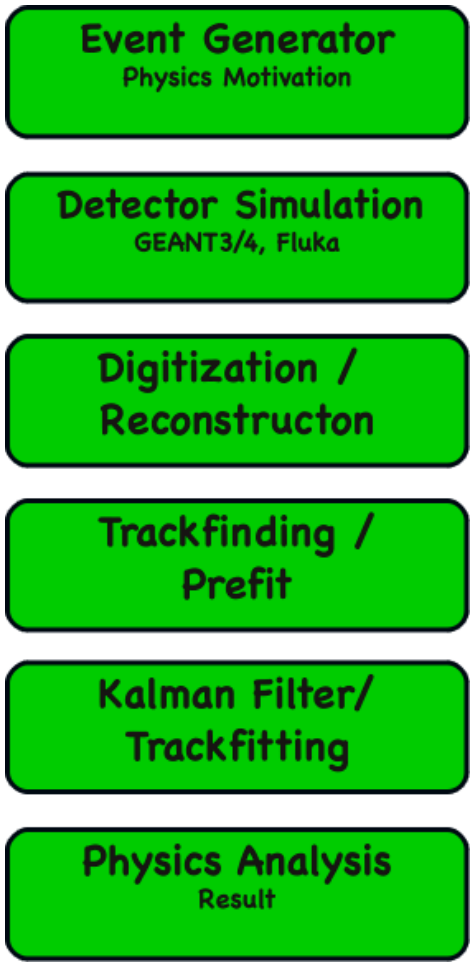
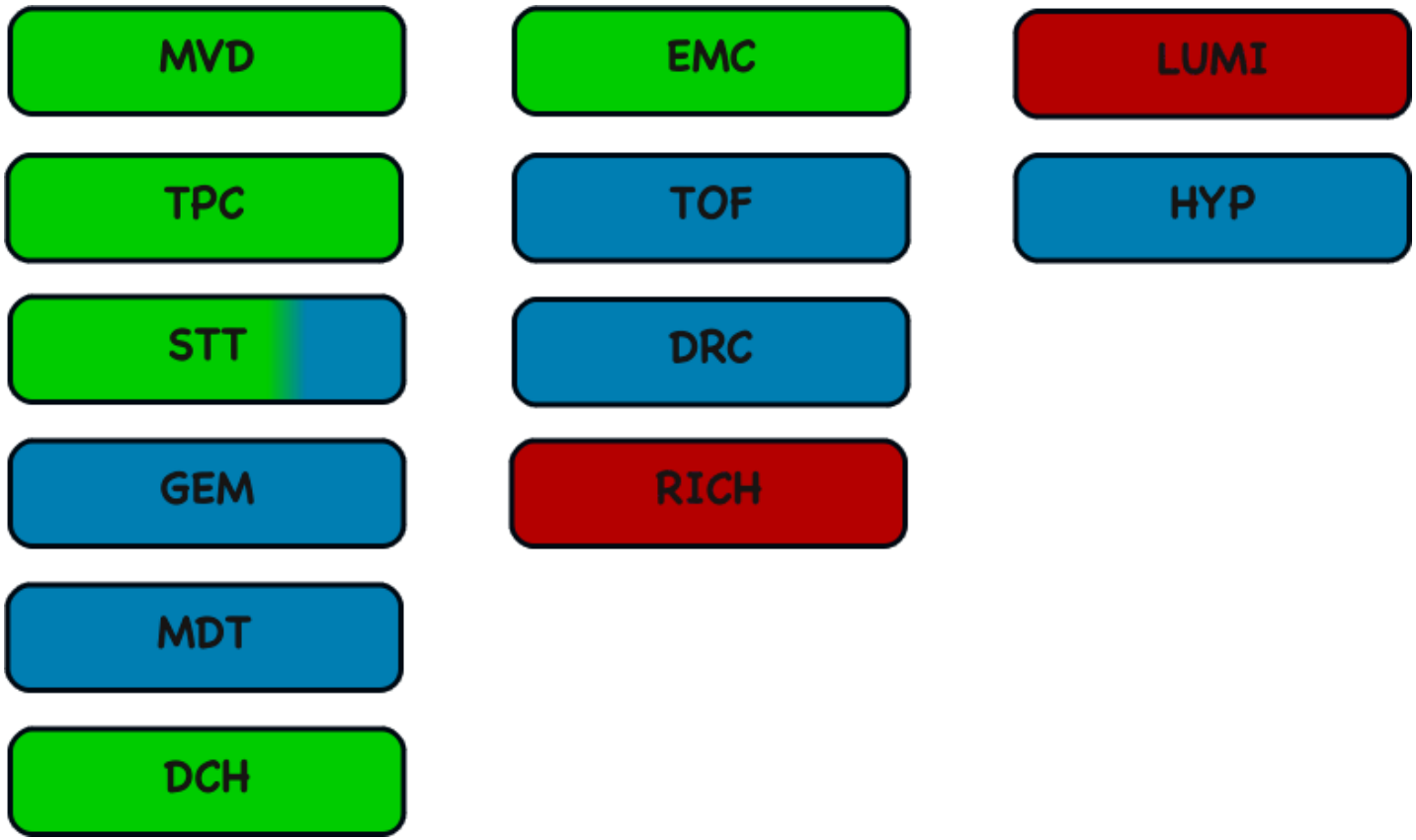


PANDAroot main features

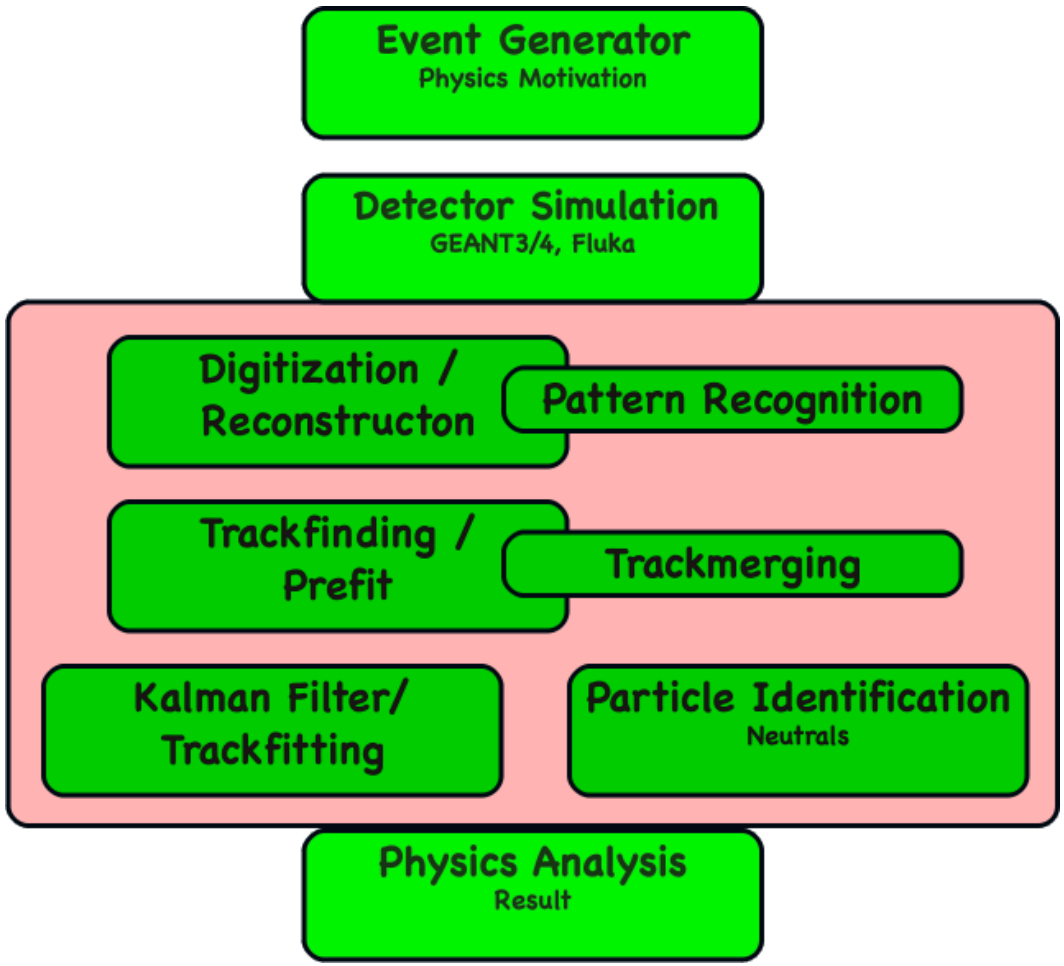
- Modular simulation framework: FAIRroot
- Different transport models available: GEANT3, GEANT4, FLUKA
- Event generators: Particle gun, EvtGen, DPM, UrQMD
- A root based geometry description for all simulation stages
- Task based organization of detector & reconstruction code $\rightarrow$ modular design
- Inclusion of root for histogramming, fitting etc.
- C++ as programming & macro language

Digitization, Reconstruction & Pattern Recognition

- Most important detector parts mainly complete: No MC information used
- Some parts miss a real reconstruction or are work in progress
- Only few detector parts missing



PANDAroot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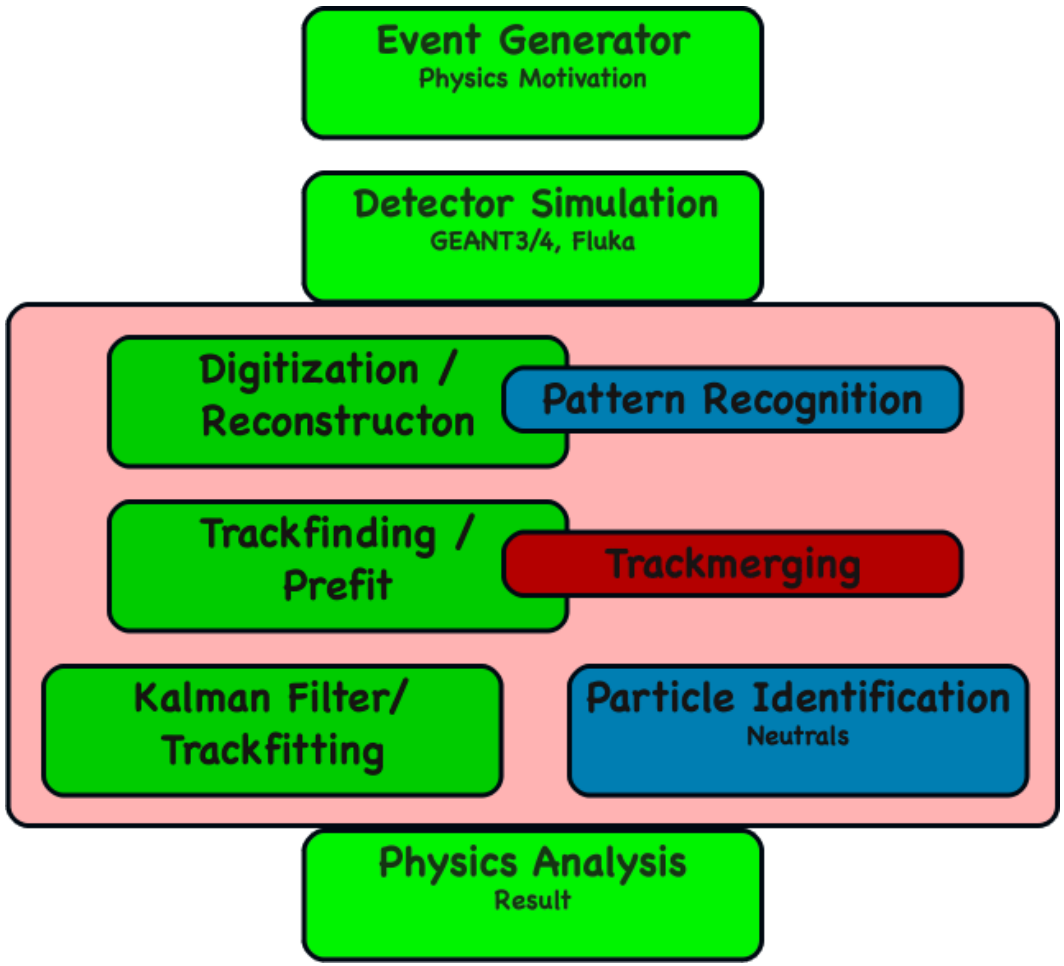
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Track Finding

- Necessary step to collect all hits belonging to a particle path
- Usually a pre-fit is available → reasonable starting values for the trackfit

Ideal Tracking:

- Takes MC track id
- Available for many sub-detectors for QA

Conformal Mapping:

- For barrel part: Transforms circles (xy projection) to lines
- Realized in LheTrack package

Riemann Tracking:

- For barrel part: Transforms helices on a plane
- Becomes slow for many points

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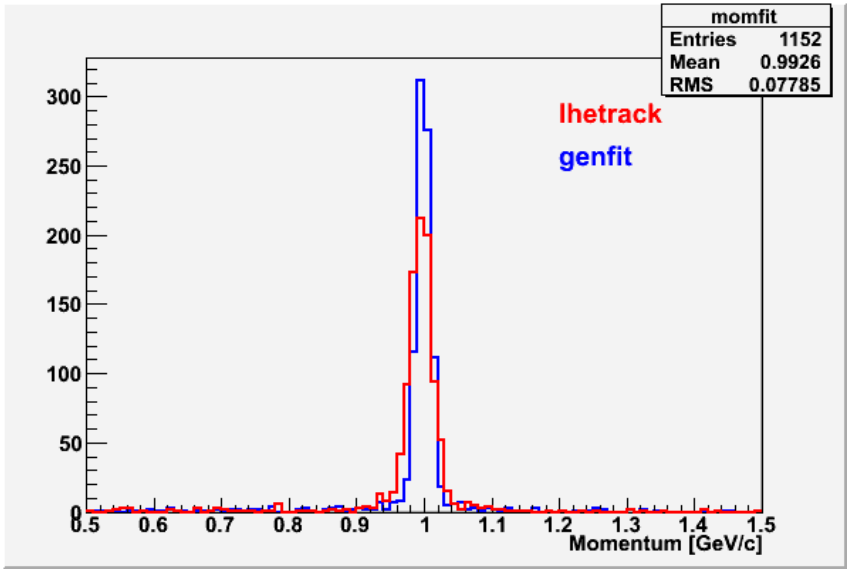
Kalman Filter & Track Fitting

Fitting (obtaining the track parameters) has to take into account:

- Different detector shapes (wires, planes, 3D points)
- Magnetic field: Solenoid, Dipole & area in between
- Scattering in material
- Energy loss in material



→ Genfit

- Detector shapes
- Fitting

→ GEANE

- Track Propagation
- Field
- Material

Figure: 1000 reconstructed pions with $1GeV/c$

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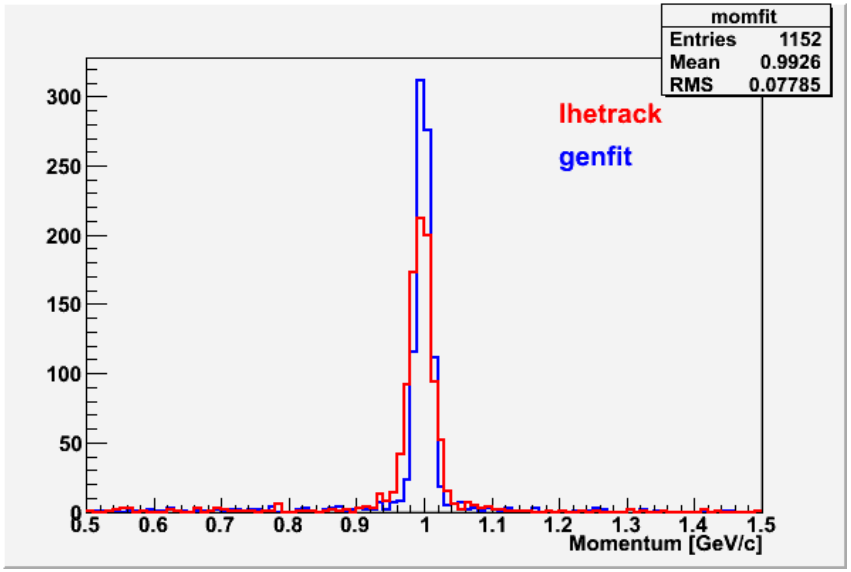

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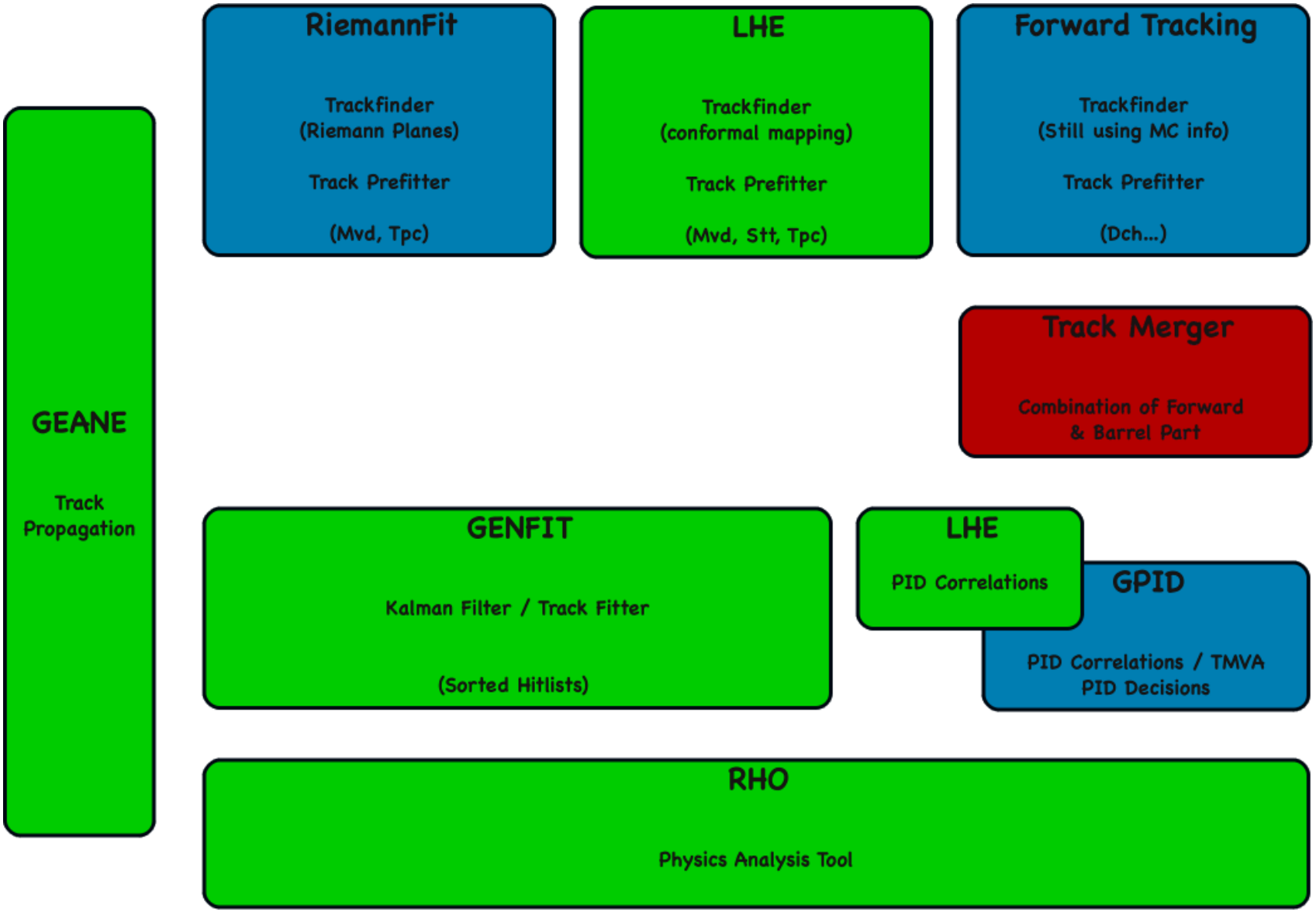
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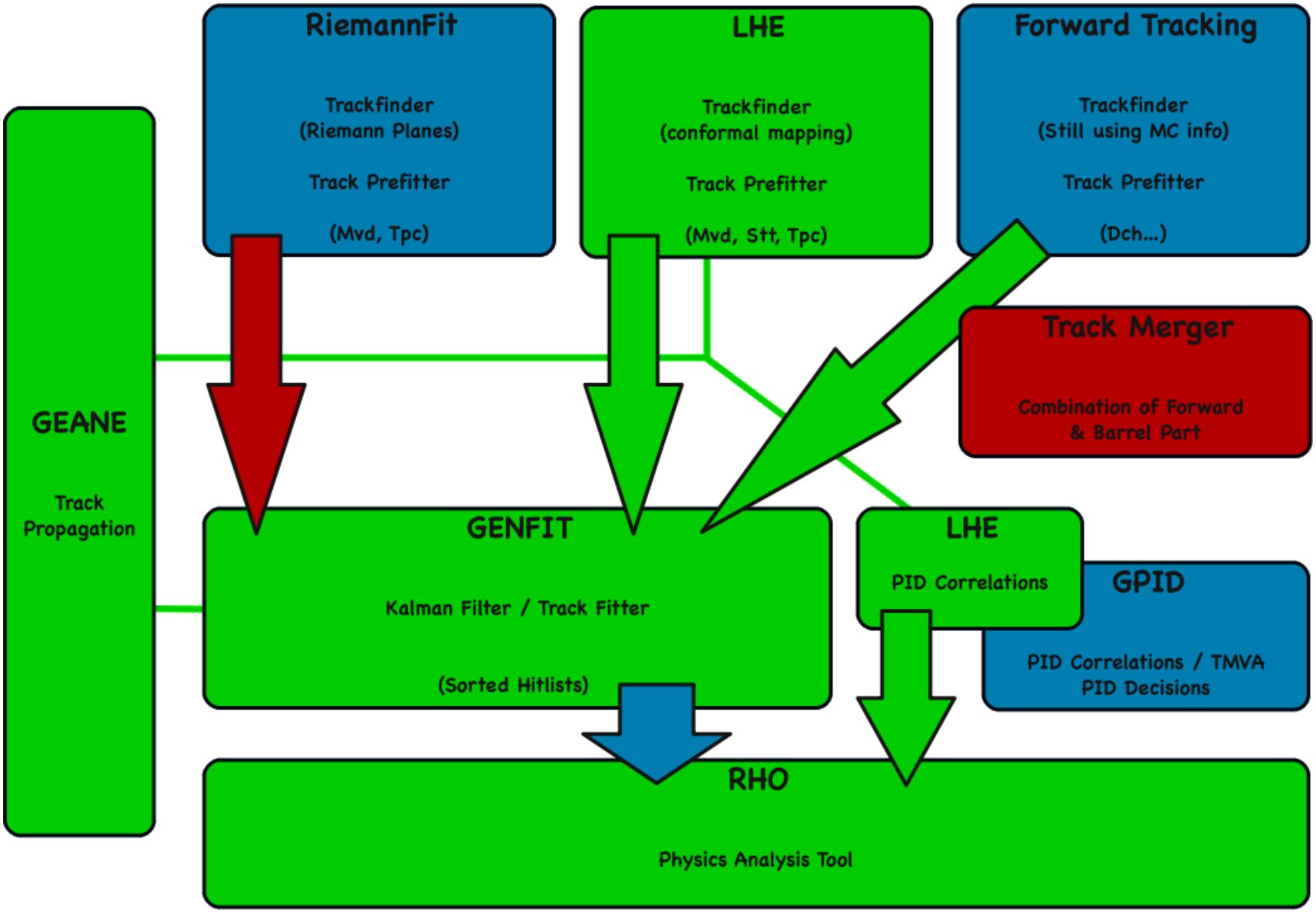
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Remarks on the software

- A full chain ready: MVD+TPC/STT+EMC → LheTrack → Genfit
- STT: Ideal pattern recognition for z-coordinates
- TPC: No event mixing up to now
- Fast simulation available: Event generator → Fsim → Analysis
- Tutorial on Thursday

Outlook

- Real STT pattern recognition in progress
- Common Panda Track object & better connection to Rho analysis
- Better integration of Riemann Tracking in the chain
- Forward tracking & track merging to be developed

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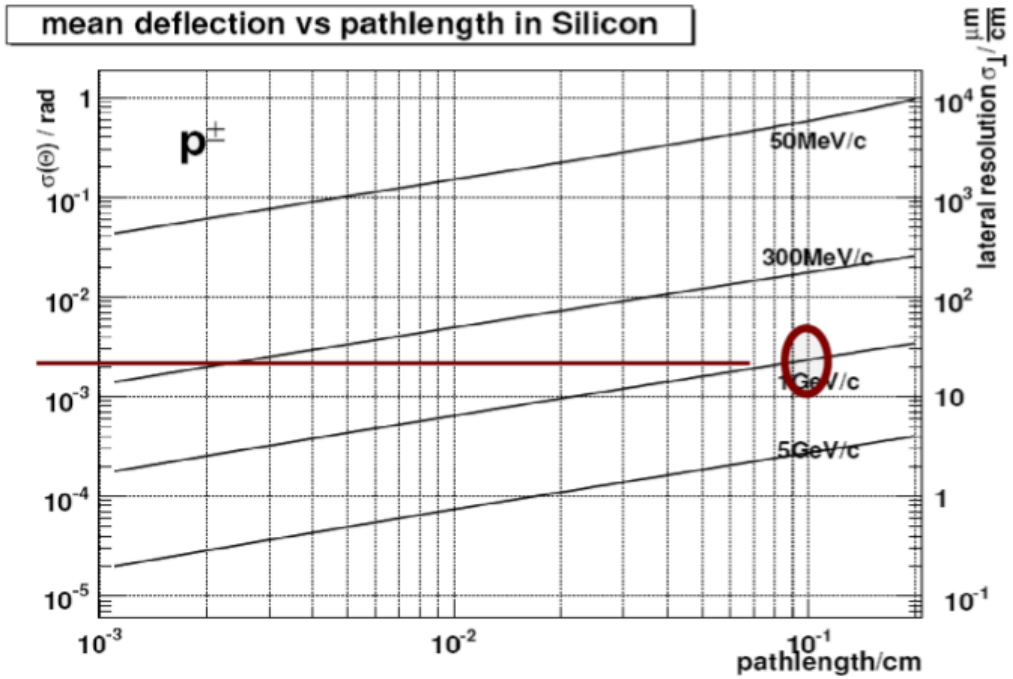

plot by H.G. Zaunick

$1 GeV/c$ proton: mean deflection of $\approx 2 mrad$ in $1 mm$ of silicon
$\rightarrow \approx 20 \frac{\mu m}{cm}$ flight distance

- Improvement of track momentum resolution with MVD

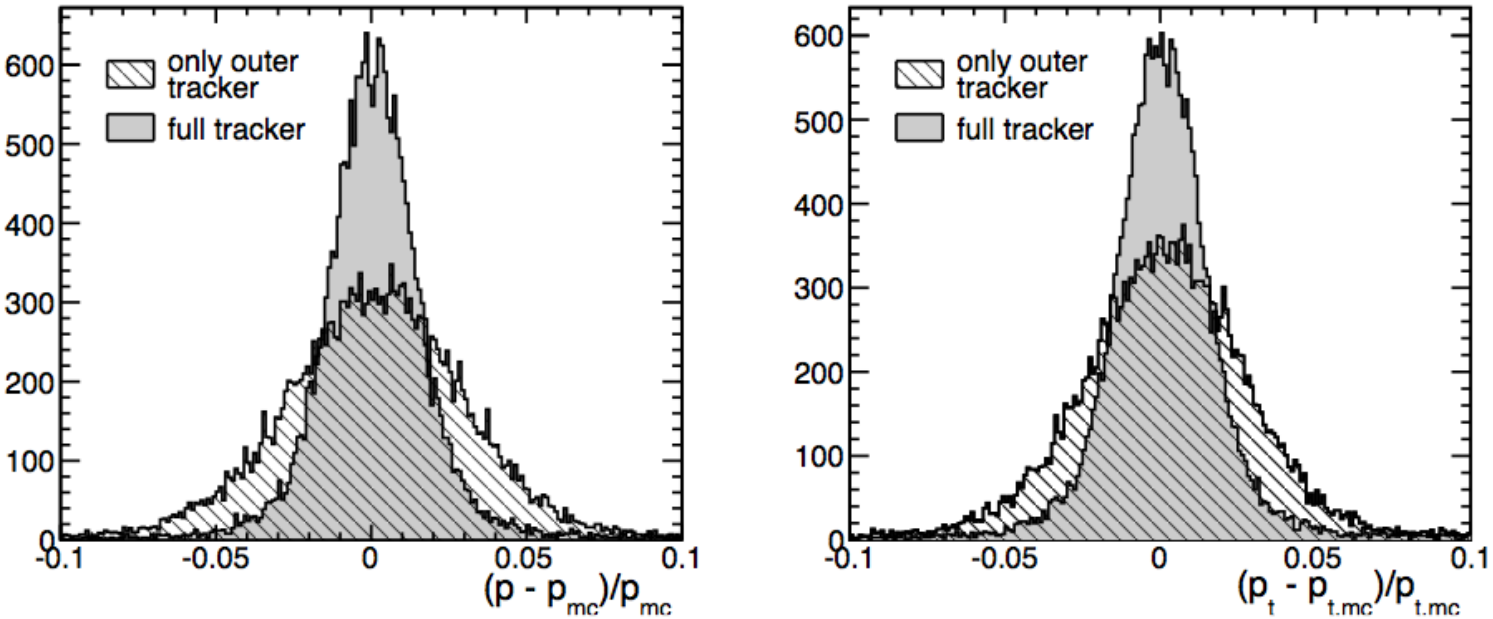

Figure 4.1: Comparison of the momentum error obtained by the full $\overline{\text{P}}$ANDA track fit (grey) and without MVD in the fit procedure (hatched). The right frame shows the deviation of the fitted transverse momentum from the Monte Carlo value and the left frame shows the corresponding total momentum distribution.

Figure: Taken from René Jäkels PhD thesis. Done with the old framework.

Pre Tracking

MVD standalone pre-tracking?

- Minimal 3-4 hits in the MVD form a tracklet
- Probably fast algorithm on hardware needed

Candidate uses:

- STT: Help the pattern recognition
- TPC: Seeding for event deconvolution
- Online decision on event shape

Thanks for listening.