Monte Carlo,
Recent issues and developments
Catalin Ristea, DPG

production's perspective view [i]

i. I don't take credit for any of presented developments,
other than faithful delivery of required productions and follow-up

Guideline to Geant4 Validation
minutes of PB on 02 Feb 2017

- *"CPU time for transport has decreased to **1.65x** Geant3 and doesn't impact significantly the overall CPU time for transport+digitization+rec (**x1.2**)*

- *The plan for 2017 is to have large scale tests involving several analyses, in particular those that are potentially more sensitive to the details of transport (calorimeters, electrons, low-pT protons)*

- *There is a preference to start with LHC10b (a minimum-bias sample and a sample with injected HF and J/psi → ee signals), with a modest sample size of about 10M events; the next candidates could be the pp and Pb-Pb samples at 5 TeV; other suggestions will be collected in a TWiki.*

- *Probably, for each sample, two parallel productions will be needed for the validation, one with G3 and one with G4"*

Phase 1

- Validation production already started in **Nov'15**, **ALIROOT-6439** and continuously maintained until **Mar'17** – was **LHC15k3*** (pass4 2010 data)

  – Many software issues were solved at that time: pi0 mass, latest VMC package, argument processing issue, running time optimizations

  – Main conclusions:

    - Detector QA was done for
      – ITS, TRD, EmCAL, PHOS, TPC
   - The agreement Data/G3-G4 was found satisfactory for all detectors

Phase 2

- Efforts ramped-up **Feb'17**

- Validation moved to **ALIROOT-7121**, production **LHC17c4***

  - Events fully validated by detector QA

  - Tracked in the Analysis QA sessions + PWG

  - Problems found:

    - Analysis QA

      - Kaon kink issues
      - Secondary particles' production

PWG Validation

$J/\Psi \rightarrow e^+e^-$

- PWG-DQ

  - TPC PID (electron inclusion, p, π exclusion), tracking

  - No big problems spotted, some points that require double check

- PWG-HF

  - K, π PID TOF/TPC, secondary vtx reco, tracking

  - No big problems spotted so far

- PWG-LF

  - check TPC-ITS matching efficiency, pt resolution, absolute efficiency, matching probability to TOF
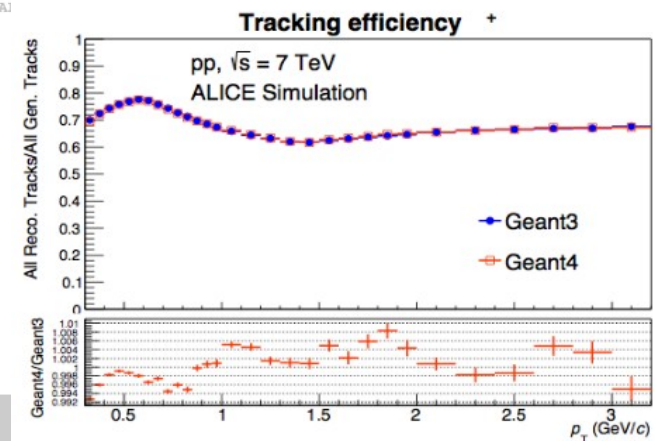
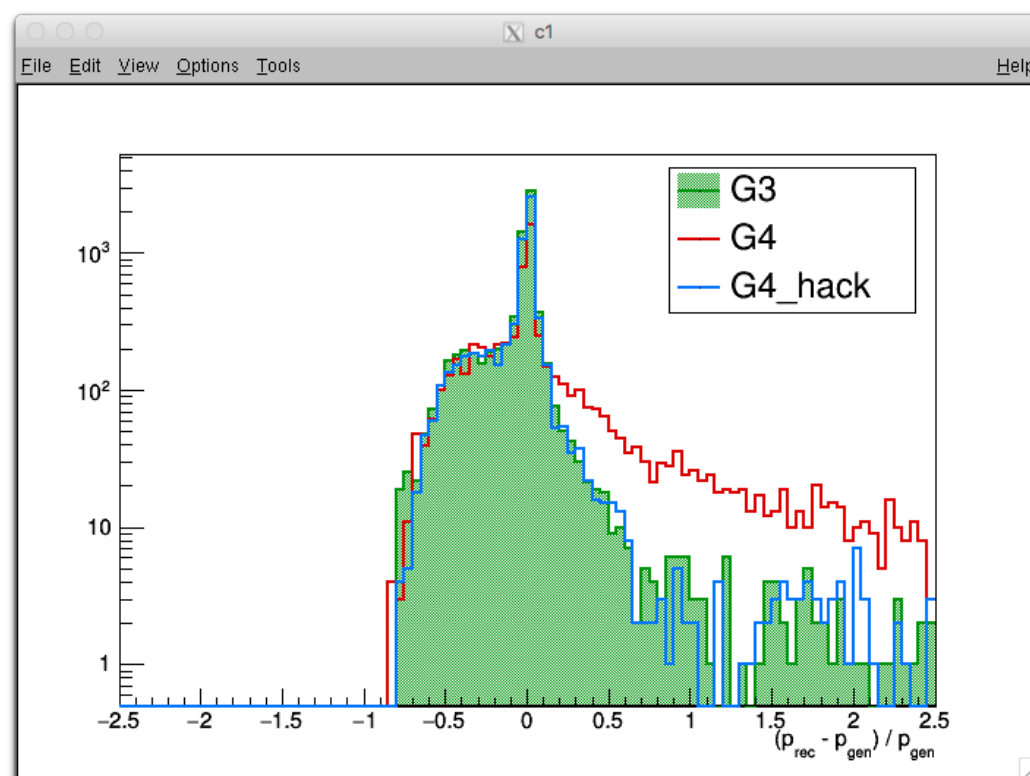- **Careful checks still to be done**
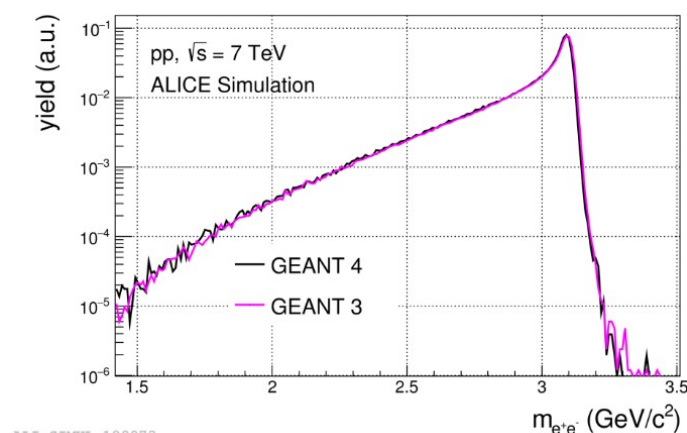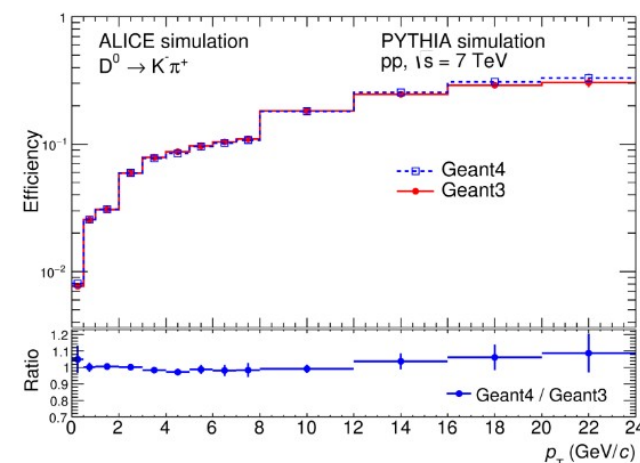
KAON Kink Issue

- **Geant4 bug fix**

  Momentum of decay particle was not correctly reconstructed by the NystromRK4 stepping (Ruben)

- It has been replaced by defaultRK4 stepping, with the drawback of 10-20% more running time (~2.5x more steps)

- Fix would be available in Geant4 master, to take back the time

Roberto, Andreas, comment in ALIROOT-7121

G4 dE/dx parametrization

- From: DPG & BTG Calibration & Tracking meetings,
  - P. Christiansen & J. Wiechula Jun'17, Jul'17
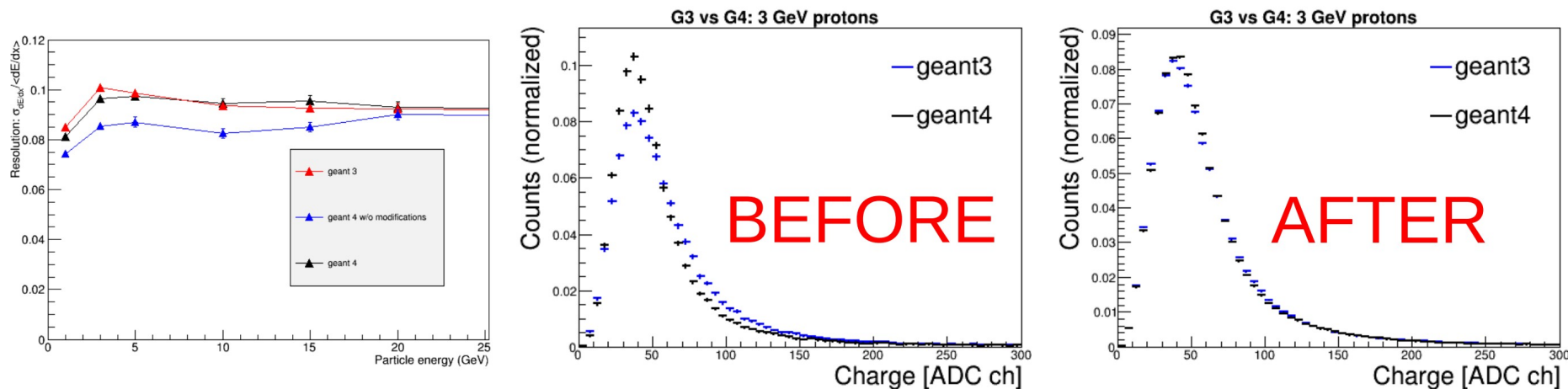
- New parametrization for TPC energy loss
  - Available starting with AliPhysics v5-09-17-01-1
- Data produced and validated into **LHC17c4_**hack

Production of Secondaries

ALIROOT-7427
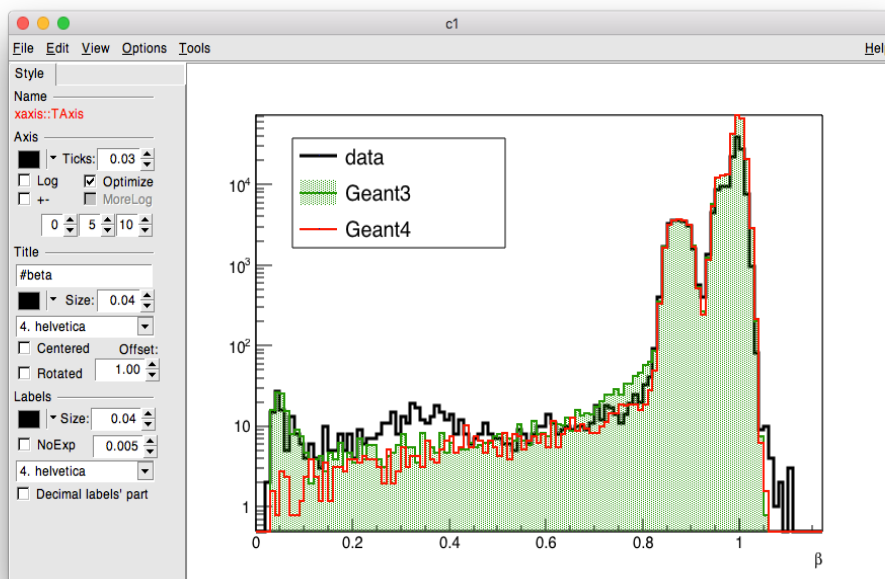
- Differences between G3/G4 signal in the TOF time signal tail, and also near the proton peak, where G4 is close to the data (Roberto)

- TOF tail might be related to low energy neutron capture and emission, G3 agreement to data could be accidental (Andreas)

- Investigations ongoing, issue not a show-stopper

Conclusions

- Many contributors to prepare Geant4 for production

- Moderate issues to be fine tunned

- Ready to move to larger scale tests and systems
  - New MC generated for PWG productions:
    - **LF**: **LHC16h7c**_g4_2 (all runs from Pb-Pb, LHC15o)
    - **GA**: **LHC17g5a2** (2012 p-p)
    - G3 sub-cycles have been produced along side with the same software versions (and same OCDB snapshots)

- **DPG**: The upcoming pp reference MC general-purpose production will be done with both G3/G4 – once this done, we'll start using G4 for all productions

MC-to-MC Embedding

- Aimed to have in production for **HI'18**

- Background
  - Large number of productions dealing with injected signal + background events
    - Rough estimation, **~10%** of all MC productions
  - Embedding envisaged long time ago
    - SDigits implementation exactly for this scope
    - Andreas & Federico, 2003 - https://arxiv.org/pdf/physics/0306092.pdf

Embedding Strategies
Roberto, DPG Offline, Mar'17

Local merging (WORKING):

All done in the same job
Generate 1 background event (only simulation)
Generate N signal events
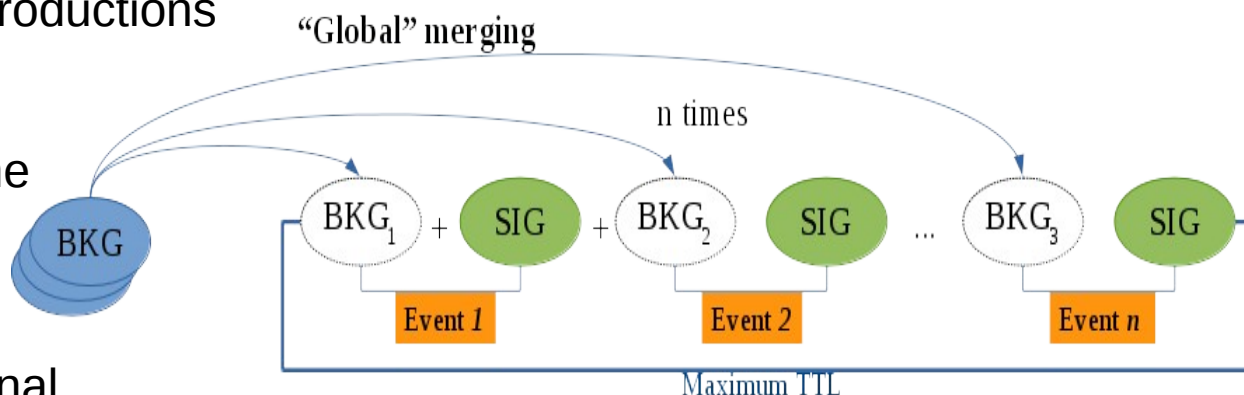and merge to the same background
- 🟢 No need to write SDigits to AliEn (save disk)
- 🟢 No I/O via network
- 🟢 No need to change LPM scheme
- 🟢 Background event is saved, may be used
- 🔴 Reuse factor cannot be too large

Global merging:

Create a pool of background events
SDigits to be reused for several productions
- 🟢 Reuse factor can be large
- 🟢 Can be used by more PWGs
- 🟢 No need to change LPM scheme
- 🔴 Large I/O via network
- 🔴 Complex workflow on LPM
- 🔴 AliRoot/AliPhysics matching
       between background and signal

Standard way

BKG_1 SIG + BKG_2 SIG ... BKG_3 SIG

Event 1   Event 2   Event n

Maximum TTL

"Local" merging

n times

BKG SIG + BKG SIG ... BKG SIG

Event 1   Event 2   Event n

Maximum TTL

"Global" merging

n times

BKG

BKG_1 + SIG + BKG_2 SIG ... BKG_3 SIG

Event 1   Event 2   Event n

Maximum TTL

Production Validation

- Software preparation (Ruben)
  - Many fixes have been done, AliRoot/AliPhysics ready while ago and all included in AliDPG
- GRID preparation (Miguel, Predrag)
  - Developing and deploying the AliEn new functionality to store background event sub-folder
  - Initial tests on several CERN sites, including Miguel's laptop :)
- Test events for physics validation produced
  - **LHC17c1b**
    - Factor **4** reduction in running time
    - Factor **2.5** reduction in disk space
    - **~3** GB RSS**, ~8%** job loss
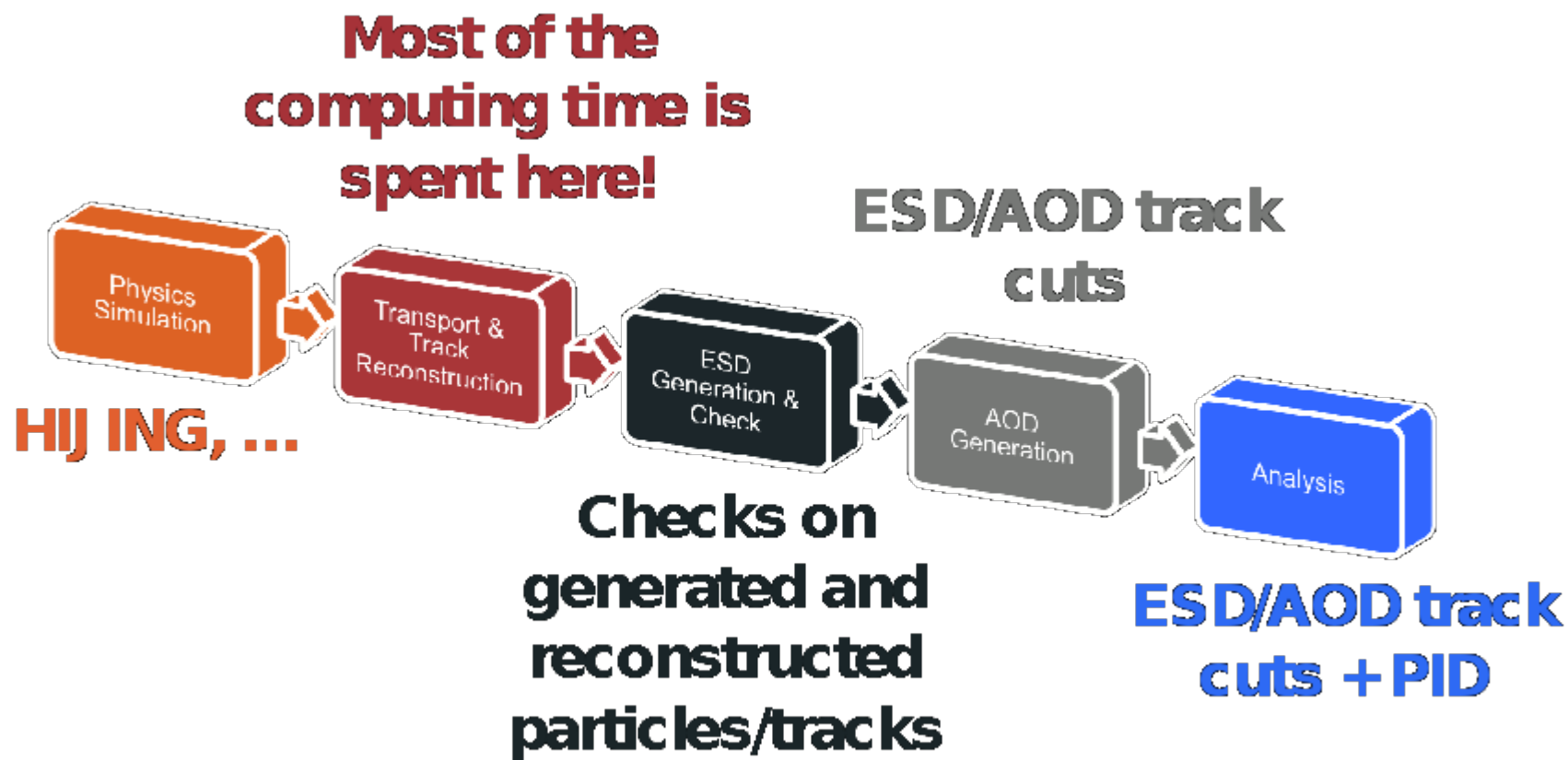 - **To run analysis QA train**

			276		
		VOBox			
Service	Address	AliEn version	Timestamp	CVMFS version
1. Altaria	188.184.2.32,2001:1458:201:22:0:0:100:1a	v2-19.276	07.11.2017 21:14	2.3.2
2. CERN-AURORA	188.184.2.45,2001:1458:201:22:0:0:100:27	v2-19.276	07.11.2017 21:03	2.4.2
3. CERN-CORONA	137.138.47.232,2001:1458:201:b50e:0:0:100:3c	v2-19.276	07.11.2017 21:13	2.4.2
4. CERN-MIRAGE	137.138.47.244,2001:1458:201:b50e:0:0:100:3d	v2-19.276	07.11.2017 21:07	2.4.2
5. CERN-SIRIUS	172.17.0.2,2001:1458:201:b50e:0:0:100:3e	v2-19.276	07.11.2017 21:07	2.1.20
6. CERN-TRITON	137.138.47.207,2001:1458:201:b50e:0:0:100:39	v2-19.276	07.11.2017 21:07	2.4.2
7. CERN-ZENITH	188.184.2.30,2001:1458:201:22:0:0:100:18	v2-19.276	07.11.2017 21:11	2.4.2
8. Grenoble	lpsc-vobox.in2p3.fr	v2-19.276	07.11.2017 21:11	2.1.19
9. Nemesis	172.17.0.3,2001:1458:201:b50e:0:0:100:c	v2-19.276	07.11.2017 21:13	
10. NIPNE	vobox.nipne.ro	v2-19.276	07.11.2017 21:14	2.1.20
11. Phoenix	188.184.2.37,2001:1458:201:22:0:0:100:1f	v2-19.276	07.11.2017 21:07	2.4.1
12. Pikachu	188.184.2.36,2001:1458:201:22:0:0:100:1e	v2-19.276	07.11.2017 21:09	2.2.3
13. Subatech	nanlcg03.in2p3.fr	v2-19.276	07.11.2017 21:11	2.1.20
14. Trieste	alibox.ts.infn.it	v2-19.276	07.11.2017 21:05	2.3.2

If everything is fine, to start thinking about "Global" merging for background events

FAST SIMULATIONS

- New interest in fast simulations due to the need of large data sets with specific signals, but including the full ALICE detector response:
    - QA tools
    - HF flavor analysis
    - … (add your favorite topic here)

- Fast simulation tool (FT2) available for Upgrade studies:
    - https://alice.its.cern.ch/jira/browse/AOC-3
    - Developed/parametrized by Ruben and Johannes Stiller
    - Used for B meson analysis performance
    - Low mass dielectrons (Upgrade vs. Super-upgrade)

- For Run2 application major changes are needed:
    - Adopt current reconstruction
    - Parametrization of current perfromance
    - Manpower? Weight gain and cost…

Most of the computing time is spent here!

ESD/AOD track cuts

Physics Simulation

Transport & Track Reconstruction

ESD Generation & Check

AOD Generation

Analysis

HIJING, …

Checks on generated and reconstructed particles/tracks

ESD/AOD track cuts + PID

Michael Weber (SMI)

Johannes Stiller
Ruben Shahoyan
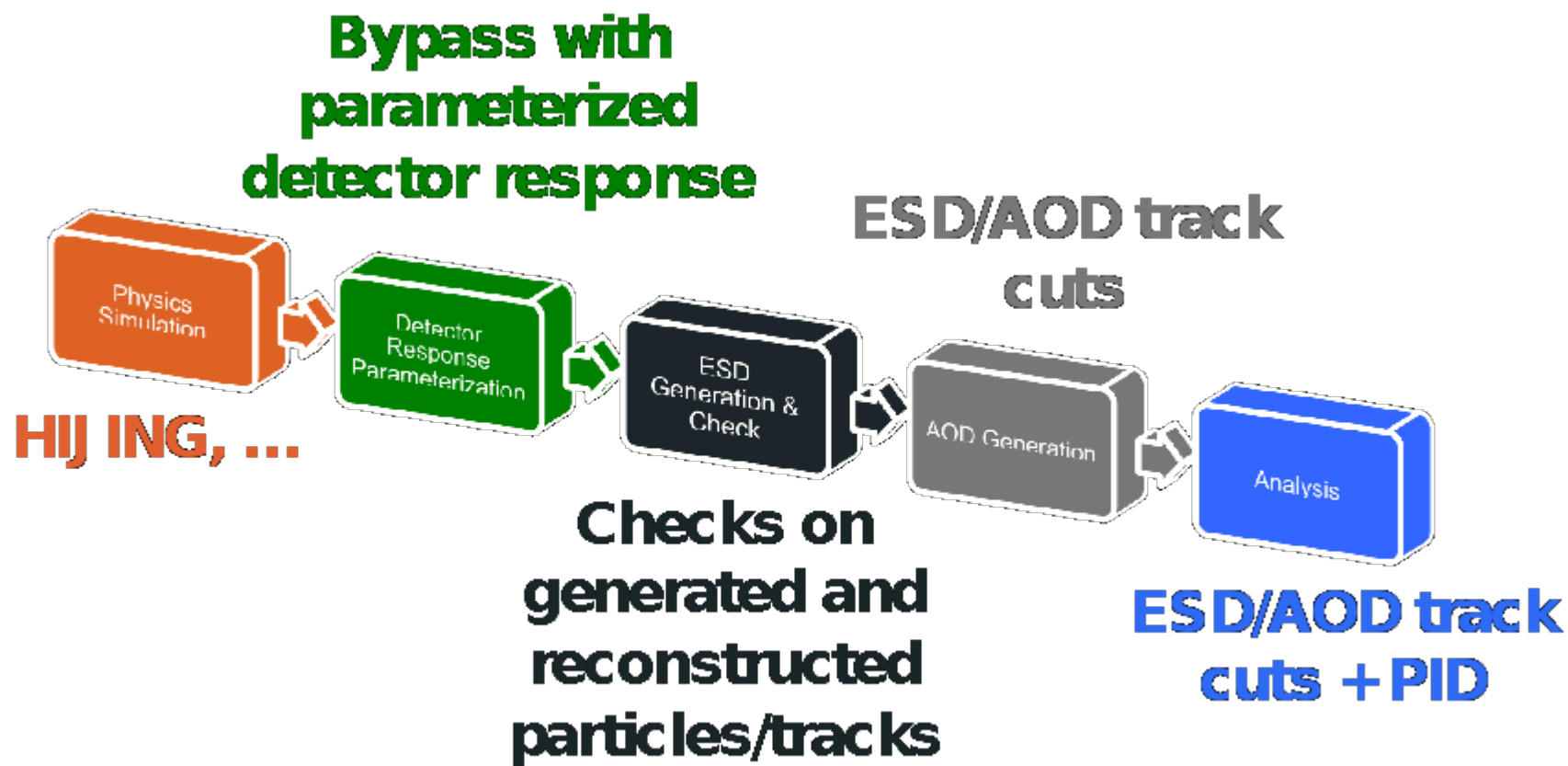
Johannes Stiller
Ruben Shahoyan

Michael Weber (SMI)

FAST SIMULATION TOOL (FT2)

- Probe is propagated outward from vertex to maximum R distance with given step size and random clusters are generated

- Geant-like calculation (multiple scattering, energy loss) taking into account correct geometry **(material budget)**

- Probe reconstruction going inward using Kalman, track related to vertex

- Other features:
  - ExB distortions
  - Cluster pickup probability
  - TPC Cluster Error Parameterization
  - Conversion electrons
  - …

- Parametrized to LHC13d19 (full upgrade simulation)

Johannes Stiller
Ruben Shahoyan

Michael Weber (SMI)

Production anchor pass name

		Production tag and anchoring						Request tracking
		Files				- Any - ▾		
Tag	**Jira tickets**	**Git** **AliEn**	**Anchor prod.**	**Pass**	**Collision**	**Energy (GeV)**	**Run list**	**Comment**
LHC17j4d_fast	7487	📁 📁	LHC16q	pass1	p-Pb	5,020	4	Lambdac -> pK0s anchored LHC16qt, Hijing, FAST only
LHC17j4d_cent_wSDD	7487	📁 📁	LHC16q	pass1	p-Pb	5,020	4	Lambdac -> pK0s anchored LHC16qt, Hijing, CENT
LHC17j4c_fast	7487	📁 📁	LHC16q	pass1	p-Pb	5,020	4	Lambdac -> pKpi anchored LHC16qt, Hijing, FAST
LHC17j4c_cent_wSDD	7487	📁 📁	LHC16q	pass1	p-Pb	5,020	4	Lambdac -> pKpi anchored LHC16qt, Hijing, CENT
LHC17j8c	7529	📁 📁	LHC15o	pass1	Pb-Pb	5,020	10	HIJING cent 50-90 % + injected phi and K* anchored to Pb-Pb, (2015) …
LHC17j8b	7529	📁 📁	LHC15o	pass1	Pb-Pb	5,020	10	HIJING cent 10-50 % + injected phi and K* anchored to Pb-Pb, (2015) …
LHC17j8a	7529	📁 📁	LHC15o	pass1	Pb-Pb	5,020	10	HIJING cent 0-10 % + injected phi and K* anchored to Pb-Pb, (2015) data
LHC17j6b	7542	📁 📁	LHC17n	pass1	Xe-Xe	5,440	2	Xe-Xe, anchored to LHC17n with ITSrecopoints included, EPOS-LHC
LHC17j4b2	7487	📁 📁	LHC16d, LHC16e, LHC16g LHC16h, LHC16j, LHC16k LHC16l, LHC16o, LHC16p	pass1	p-p	13,000	37	Lambdac -> pK0s, anchored to pp @, ported, LHC16d, e, g, h, j, k, l,…
LHC17j4a2	7487	📁 📁	LHC16d, LHC16e, LHC16g LHC16h, LHC16j, LHC16k LHC16l, LHC16o, LHC16p	pass1	p-p	13,000	37	Lambdac -> pKpi, anchored to pp @, ported, LHC16d, e, g, h, j, k, l,…
LHC17j7	7531	📁 📁	LHC17n	pass1	Xe-Xe	5,440	2	Xe-Xe, General-purpose Monte Carlo Xe-Xe (LHC17n), HIJING
LHC17j6	7542	📁 📁	LHC17n	pass1	Xe-Xe	5,440	1	Xe-Xe, anchored to LHC17n with ITSrecopoints included
LHC17j4b	7487	📁 📁	LHC16d, LHC16e, LHC16g LHC16h, LHC16j, LHC16k	pass1	p-p	13,000	2	Lambdac -> pK0s, anchored to pp @, LHC16d, e, g, h, j, k, l, o, p

- Original request (Jens, Pietro) to include the anchored RAW pass name for MC productions
- Easier to handle in the future with the OCDB timestamp functionality (see Francesco's talk)
- A bit of ambiguity due to variations like pass1/pass1_pidfix – under discussion
- Link to page http://alimonitor.cern.ch/MC
- **Written into ESDs and available at analysis level (PIDresponse → OADB, TPC splines)**

Conclusions

- Geant4 validation continues, to be extended to other system(s) and energies

- MC-to-MC embedding ongoing development, in testing phase

- New tools being investigated (FT2)

DPG is grateful to get the support from all experts

Thank you!