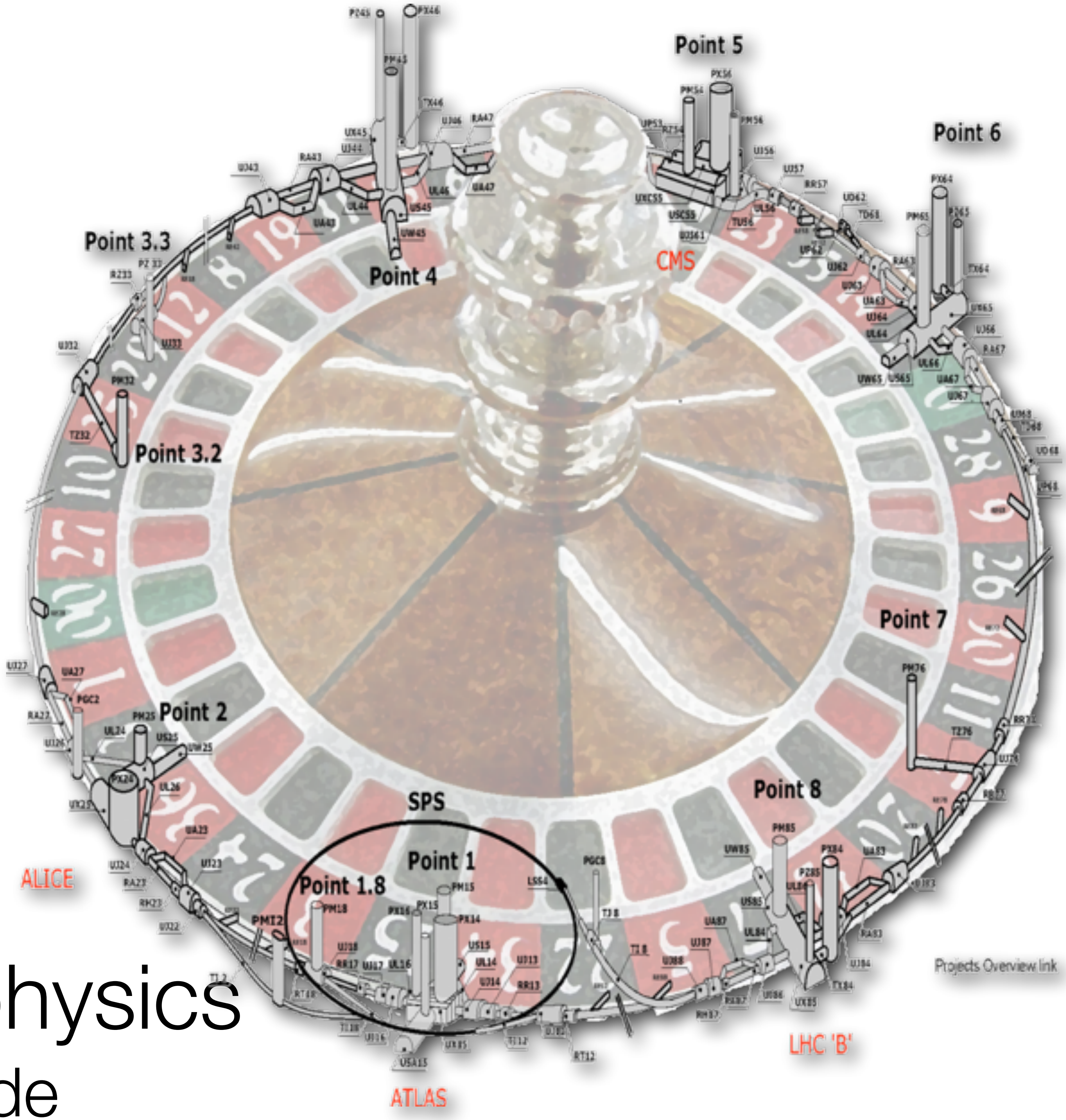


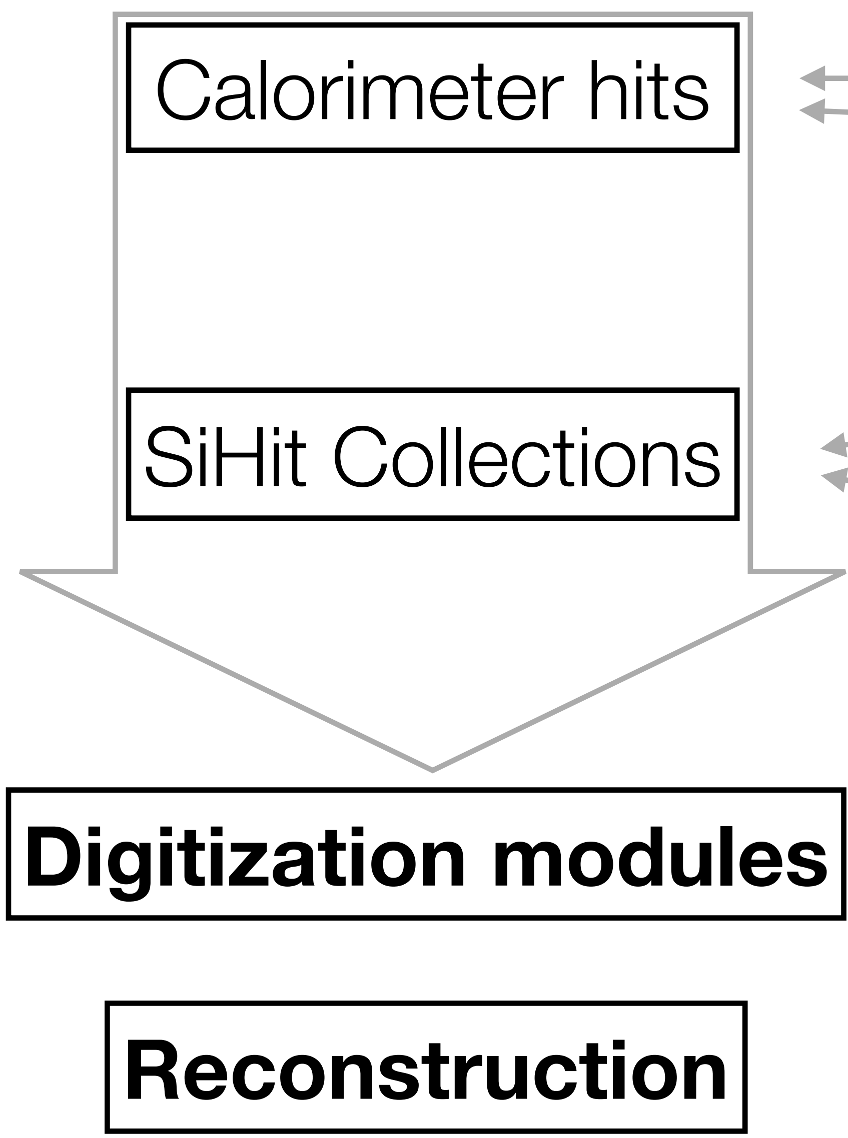
Consequences of fast MC for physics

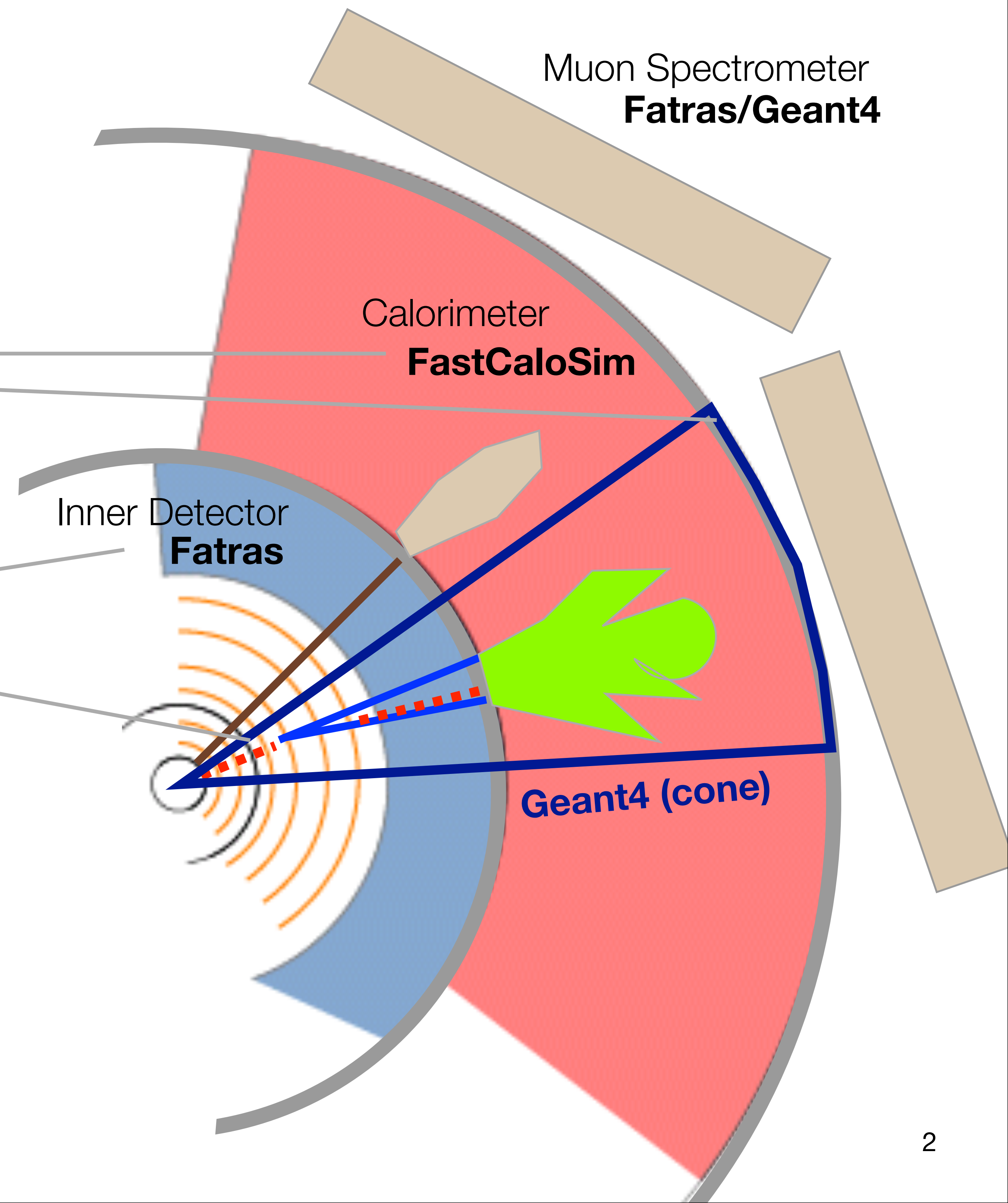
+ a little bit of upgrade

A. Salzburger (CERN)

(0) **ISF** - default output

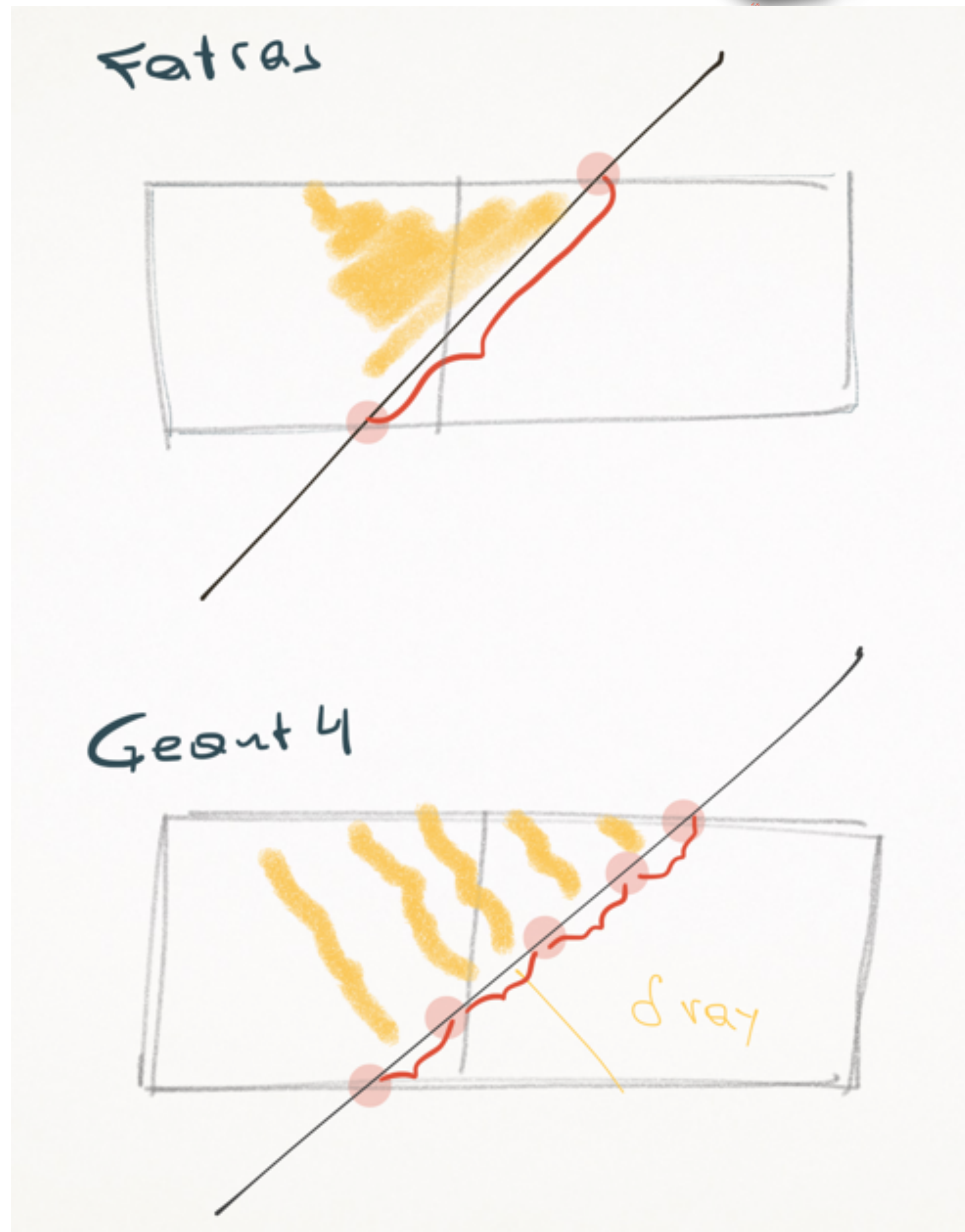
- ISF common output
  - common hit collections used for all simulators
  - common truth writing modules used along the framework





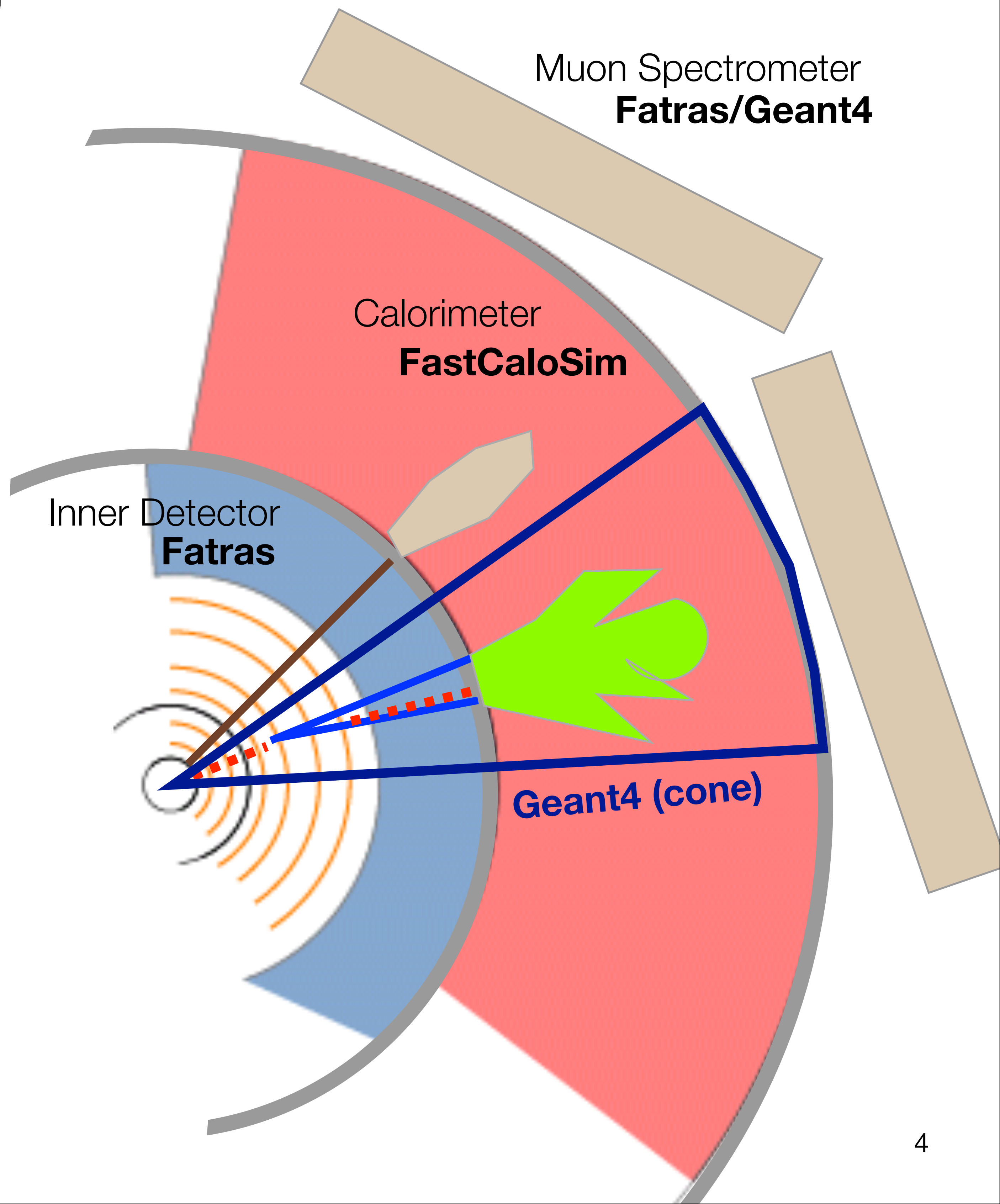
And it's even not only simulation . . .

- A non-trivial problem is how upstream algorithms react when suddenly the input from simulation is different ?
  - example: SiHit
- With the development of fast digitisation & by-passing reconstruction
  - this problem became a global problem
- Finally, how should the user react in the analysis ?



(1) **ISF** - flavour mixing

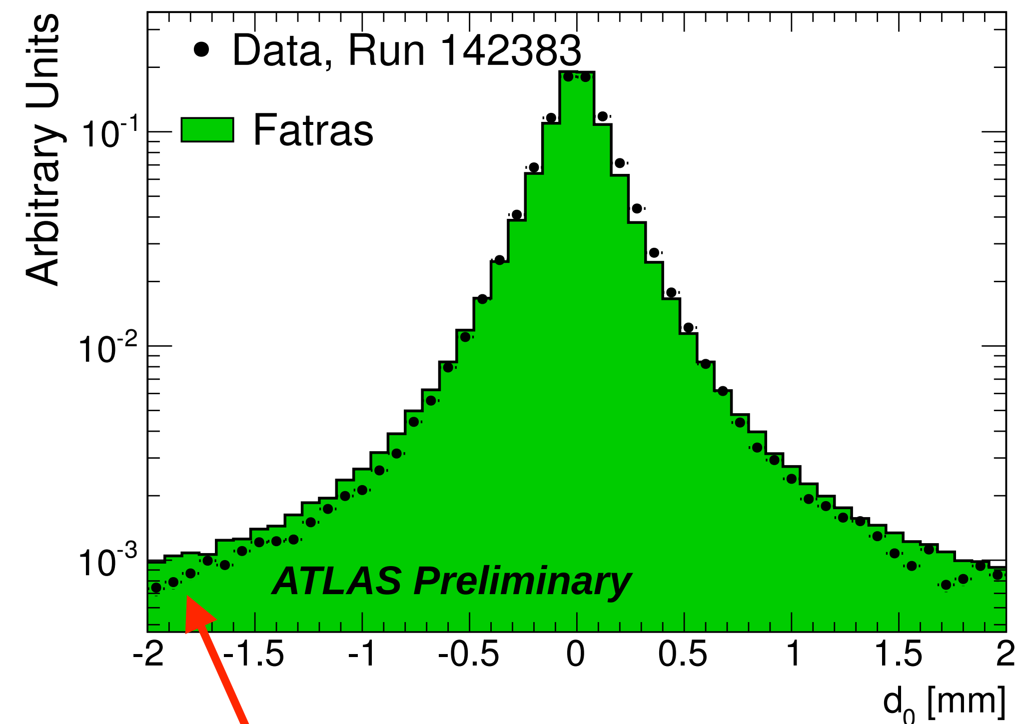
- ISF gives possibility of flavour mixing
  - Elmar discussed that to some detail
  - only robust simulator mixing tried so far:
    the setup must be kept under control
- Different simulators describe data differently well
  - none of the simulators is perfect (also Geant4 is not perfect)
  - imperfections/discrepancies are usually dealt with **data/MC** scale factors

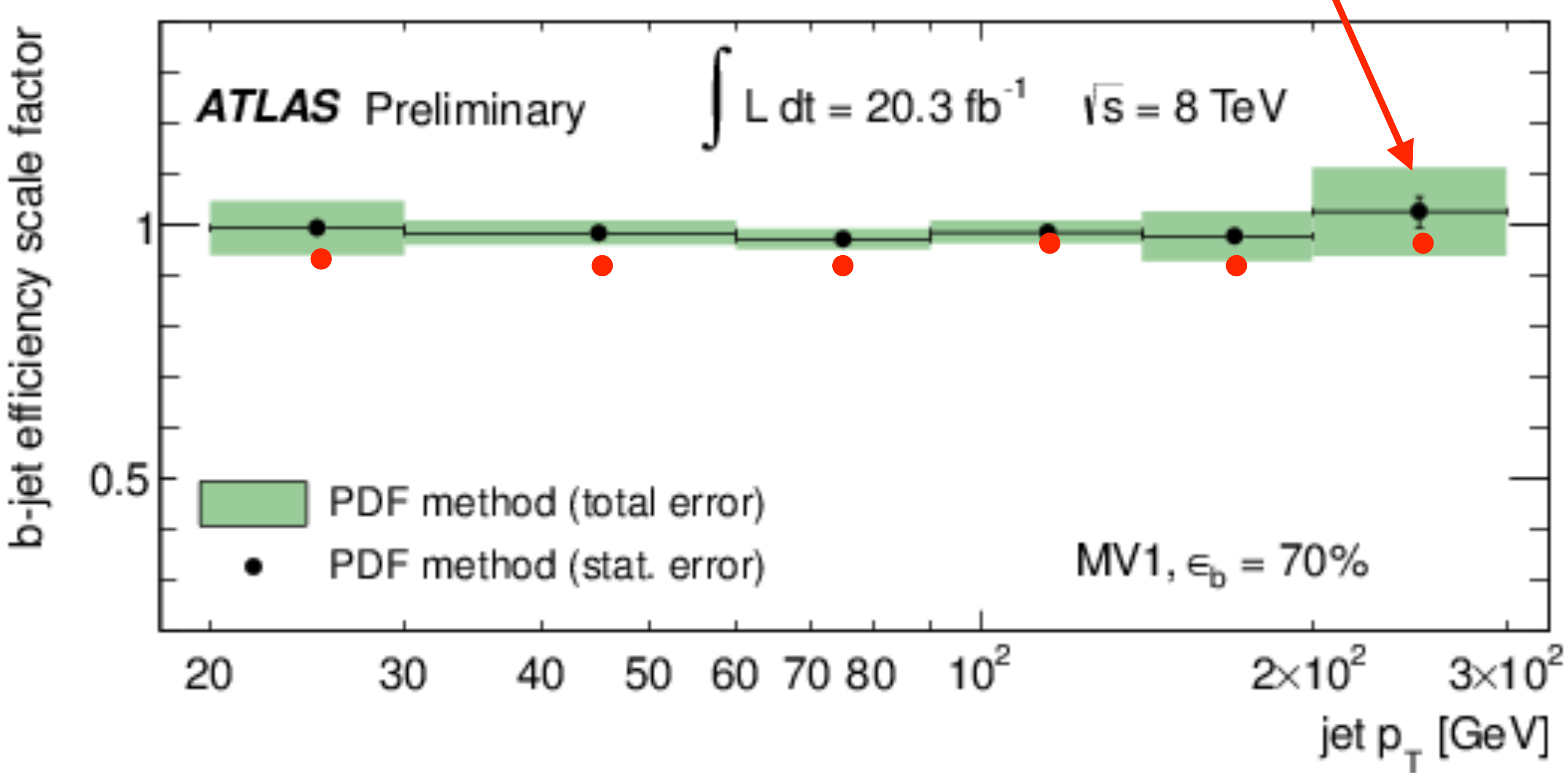


Scale factors

- Data/MC scale factors are determined (mainly) for full simulation

- E.g. b-tagging scale factors
  - those are determined also by residual differences (e.g. tail differences)





what to do if totally different scale factors apply ?

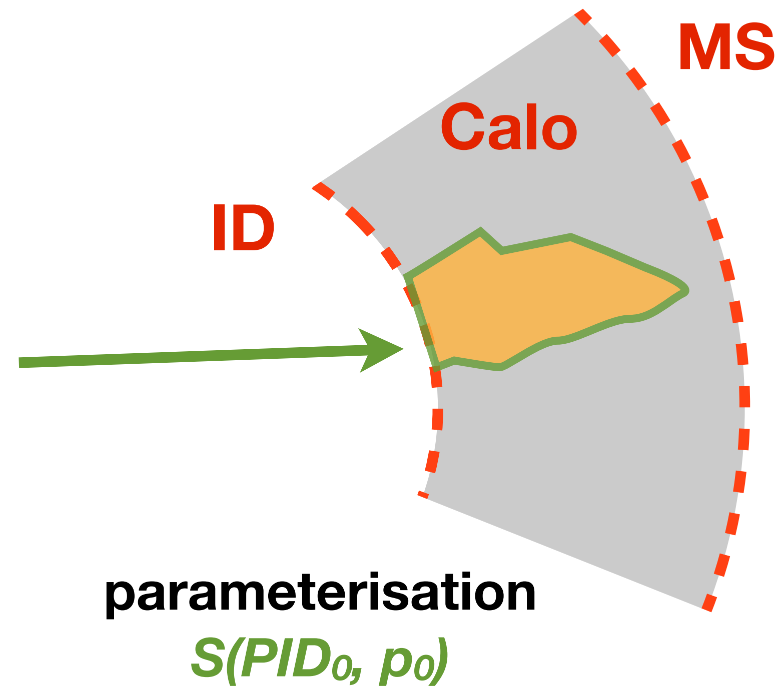
and different system. uncertainties ?

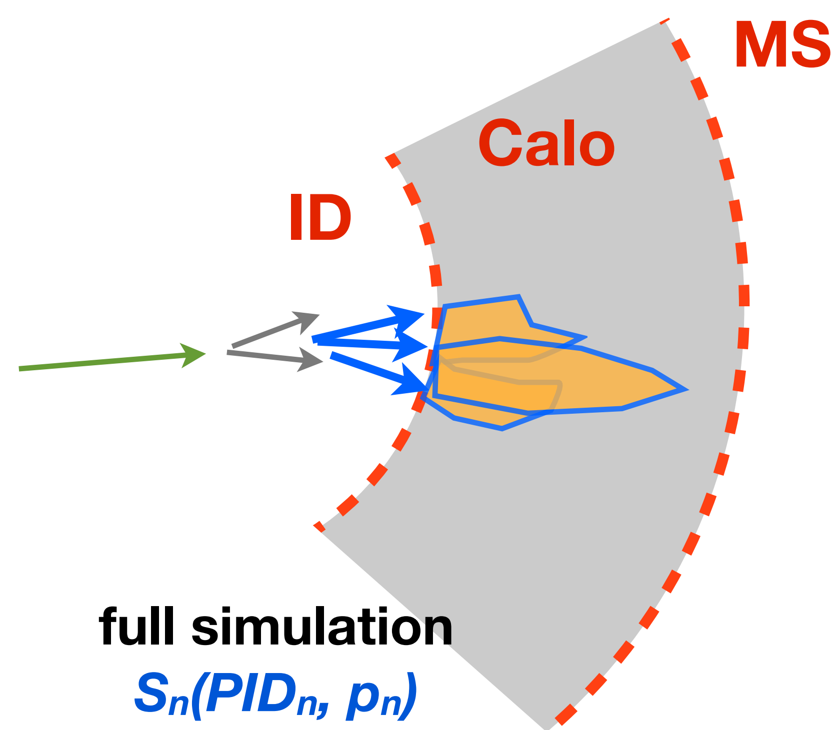
Similar for fast calorimeter simulation

- Parametric simulation is based on some cut-off
  - low energy particles are generally ignored and effects are cumulatively handled

- Full simulation tries to track every particle down to certain energy threshold
  - fill describe fluctuations better by definition
  - Russian Roulette method (see talk from Vladimir), is actually playing with balance

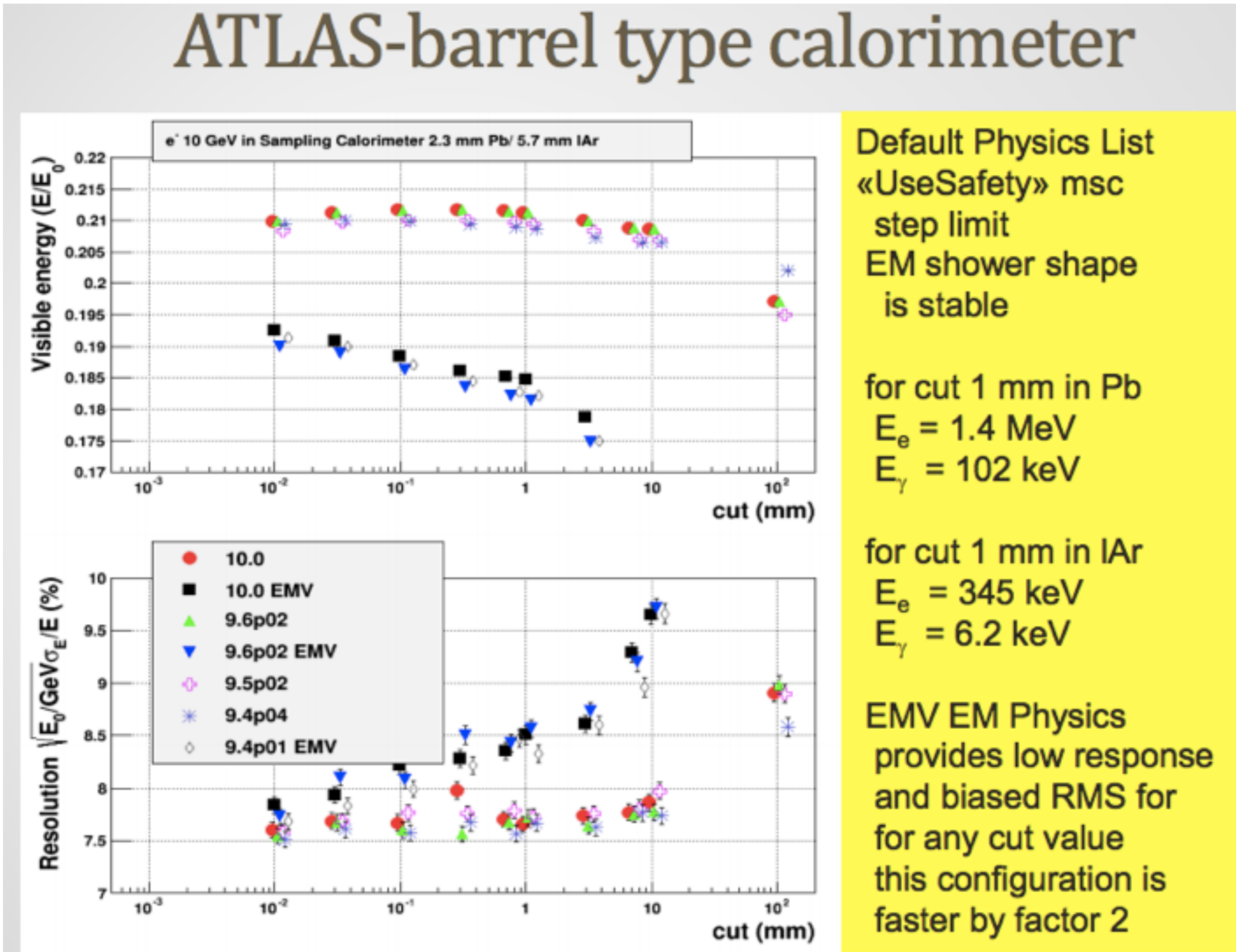
- **What is good/granular enough ?**
  - answer can only be given by looking at the reconstruction & analysis objects





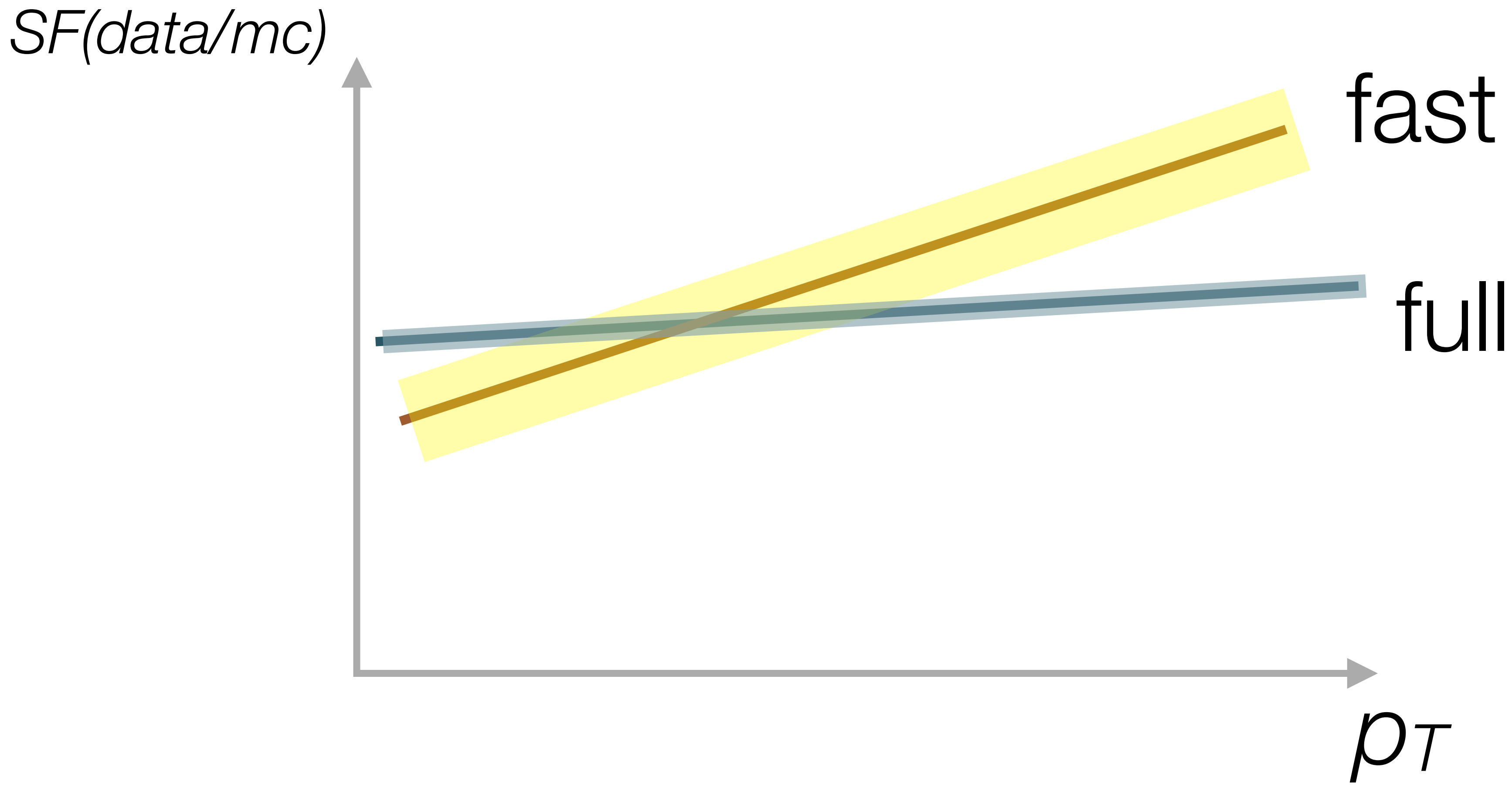
It's not only a fast simulation question

- From Vladimir's talk yesterday
  - different physics lists in Geant4 also will cause differences



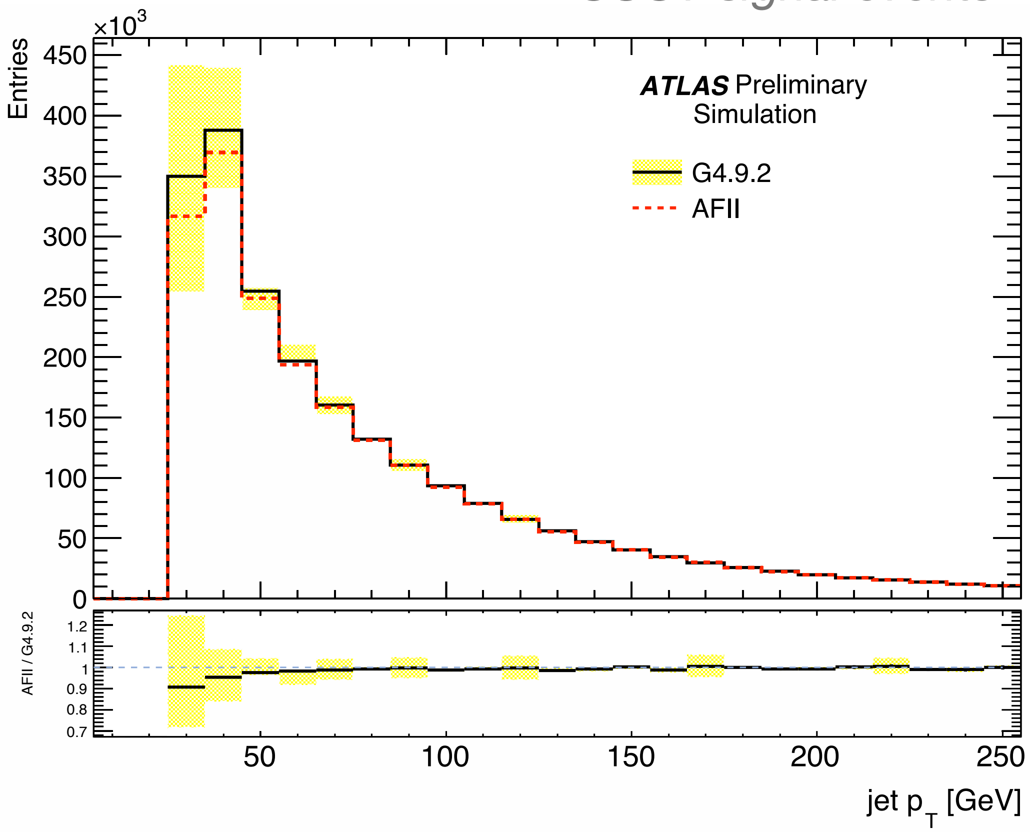
A rule for sanity

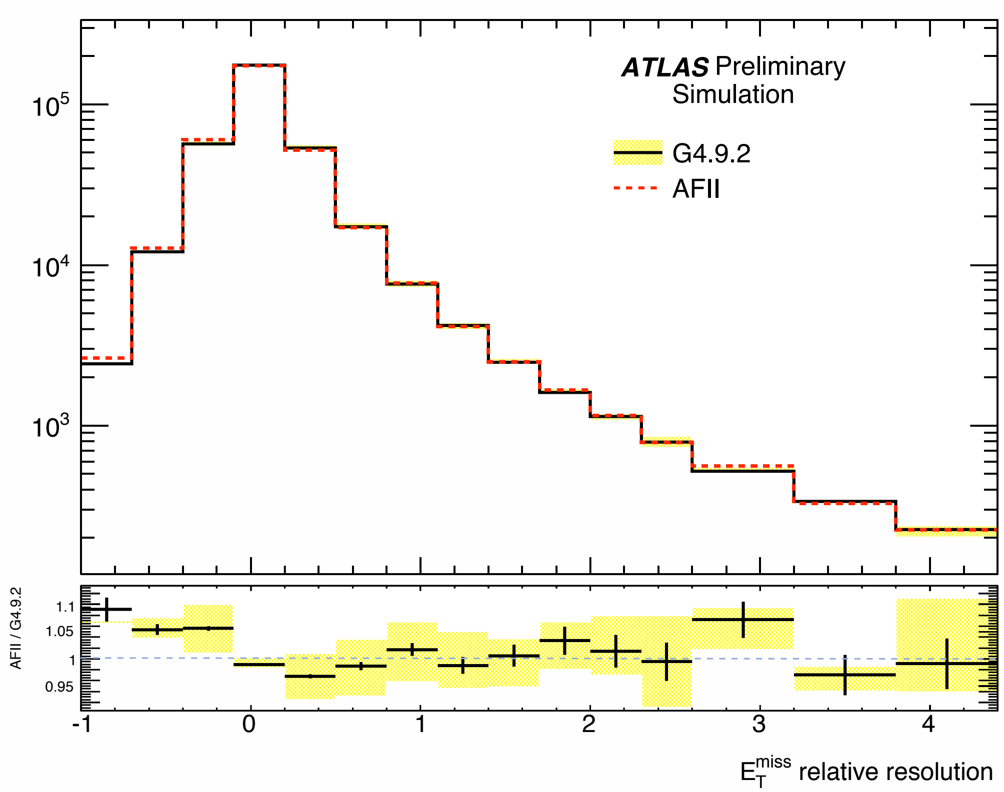
- **Different scale factors are not the end of the world**
  - it's a correction after all and it does not really matter too much, if
  - there isn't a completely different behaviour of scale factors in the phase space of question
  - the systematic uncertainties are rather similar ot (best) identical



Example in ATLAS: AF2 - in SUSY

SUSY signal events



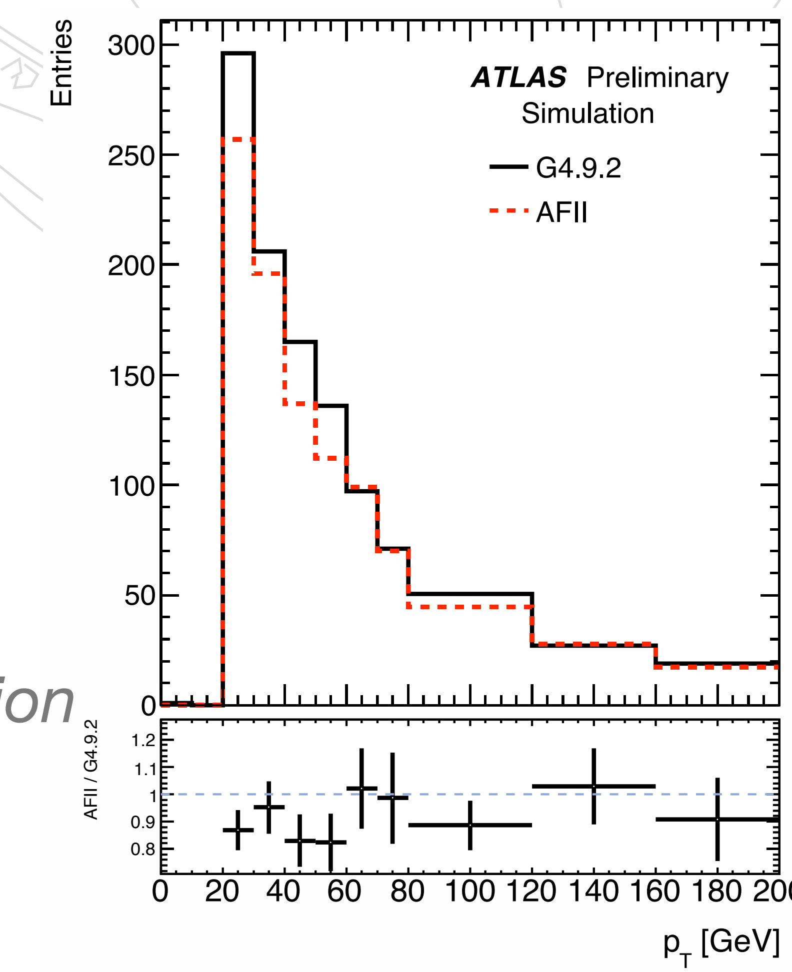


extensive validation in the context of SUSY analyses for summer 2011

AFII was found to be accurate enough within ***systematic of jet energy scale (5%)***

part of the SUSY signal grid simulation of ~ 60 mio events done with AFII

p_T distribution of electron fakes



Bookkeeping & Barcode service

- If simulators or digitisation or reconstruction or even only data/MC calibrations or scale factors are different
  - a bookkeeping method is needed to allow for different behaviour

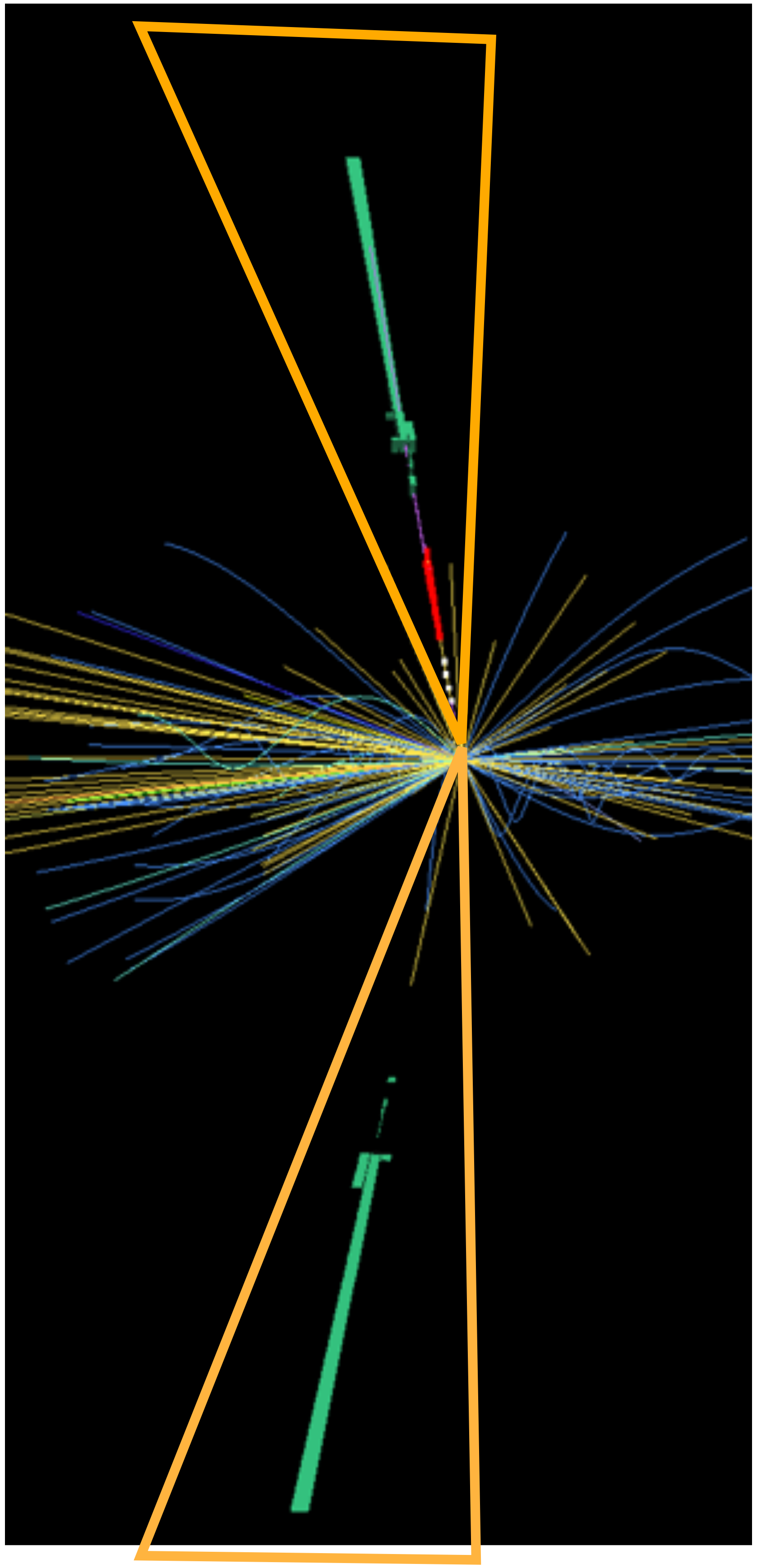
- We decided to put that into the Particle / Hit barcode and make a smart barcode service to decode and encode

I	I	0	0	I	I	0	I	0	I	I	I	I	0	I	0	I	0	I	I	I	I	0	I	I	0	I	I	0	I	I	I

interaction bits Simulator generation bits barcode core bits

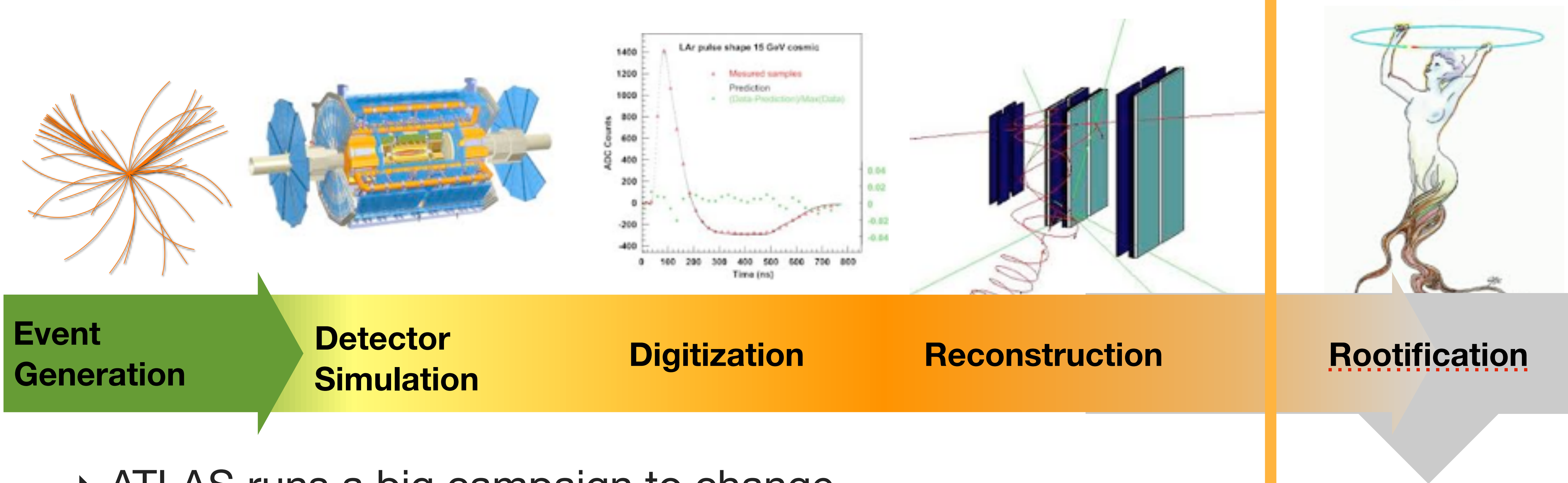
  - we quickly hijacked the Barcode with other information as well, e.g. BCID, primary, secondary information, production process
  - needed to expand the barcode from a 32bit to 64bit

(2) **ISF** - partial event simulation



- ISF allows to do partial event simulation
  - Elmar discussed that to some detail
  - this gives a very large speed-up
- Different reconstruction algorithms, corrections, calibration rely on full event
  - partial event simulation will result in different vertex reconstruction, different calorimeter activity, different missing ET, etc.
- How can the reconstruction & analysis react to this ?

(X) The ATLAS **xAOD** project



- ATLAS runs a big campaign to change the persistent analysis format
  - new xAOD format will be readable in both the ATLAS framework (Gaudi-Athena) and directly through ROOT
- Evident that the simulation has to eventually feed into this object
  - trivial if running through the standard reconstruction chain

xAOD

(X) xAOD & slimming

- New ATLAS xAOD comes with a **thinning/slimming** framework

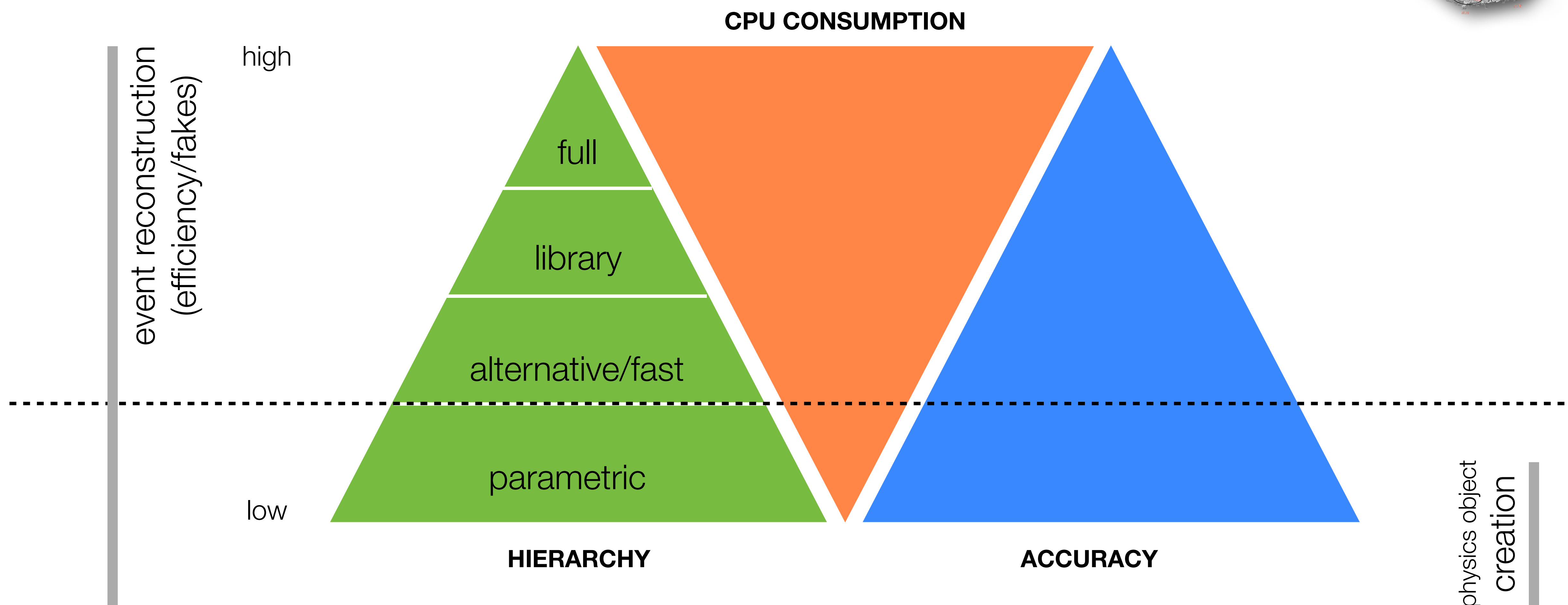
xAOD Object
- *parameter X*
- *parameter Y*
- *parameter Z*
- *parameter A*
- *parameter B*

→

xAOD Object*
- *parameter X*
- *parameter Y*
- *parameter Z*

- Main purpose is to optimise the disk usage for physics analysis groups

(X) **xAOD** & parameteric simulation



xAOD Object

- *parameter X*
- *parameter Y*
- *parameter Z*
- *parameter A*
- *parameter B*

xAOD Object*

- *parameter X*
- *parameter Y*
- *parameter Z*

IdRes

- A few more infos for IdRes, since we talked about it earlier this week
  - IdRes is a little program developed for detector design
  - It needs a simplified detector geometry, material & intrinsic resolutions as an input

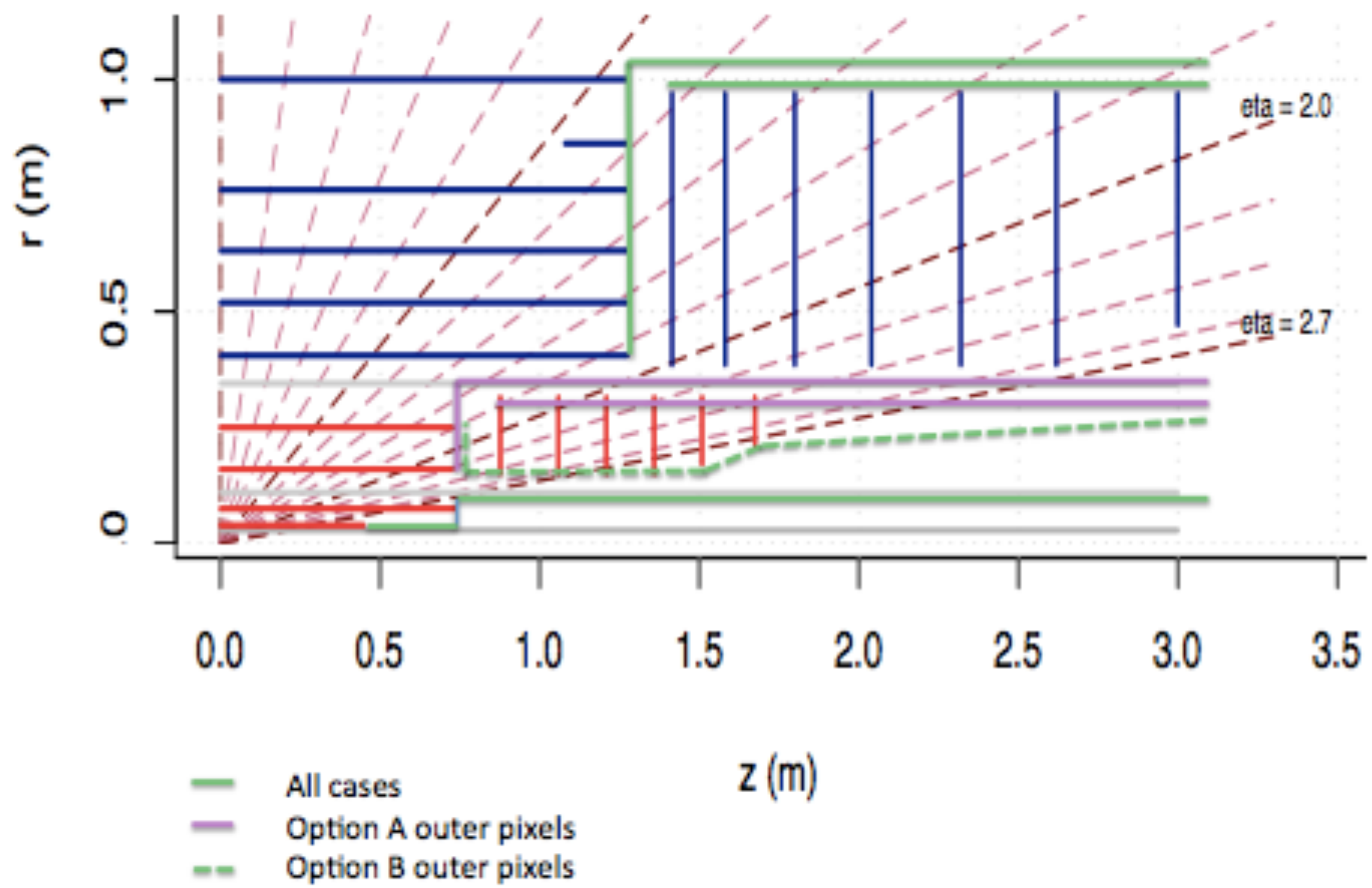
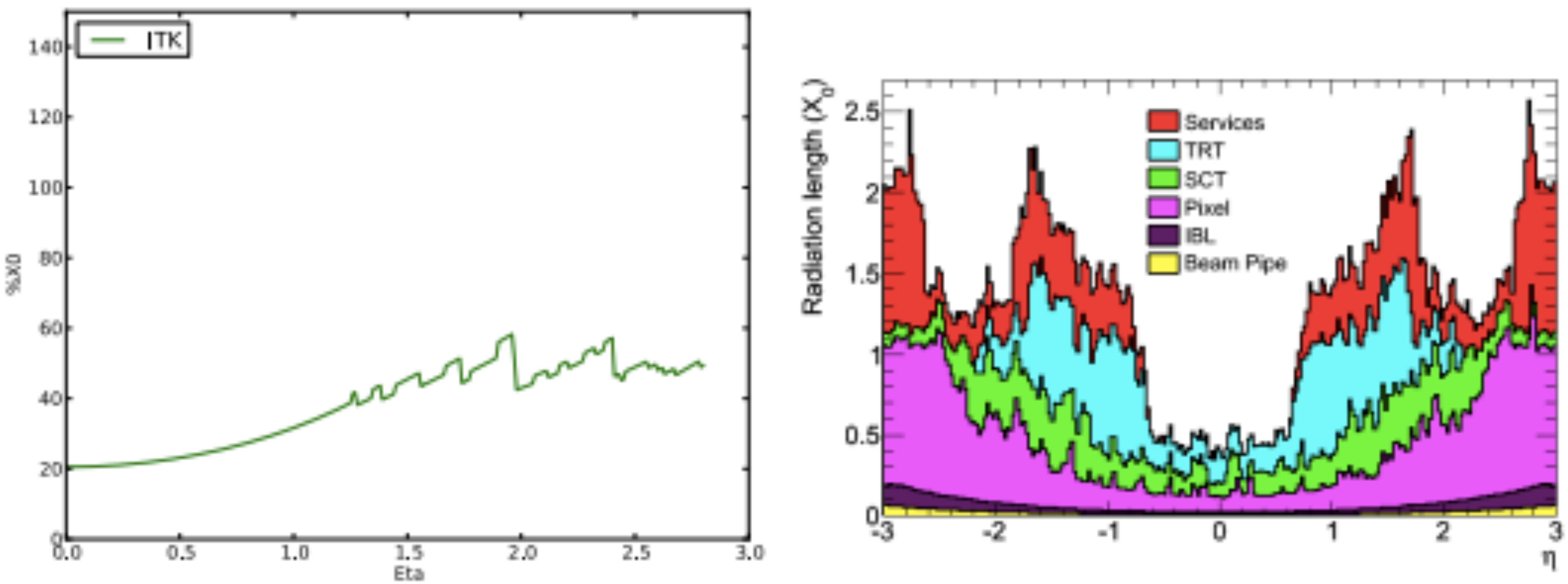


Figure 2. Possible service layouts for the outer pixel layers.

from ATLAS ITK LoI

IdRes

- Based on the detector input, hit coverage and material is estimated



(a) (b)

Figure 3. a) The estimated material budget, expressed as a % X_0, as a function of $|\eta|$. b) The as-built material budget, expressed in units of X_0, for the existing ATLAS ID. The absolute scale of the figures should not be directly compared since the passive material implementation of (b) is more complete, in particular at the barrel end-cap transition. However, a striking comparison is the larger barrel $|\eta|$ range in (a).

IdRes

- This allows to give a good analytical estimate of IP & momentum resolution

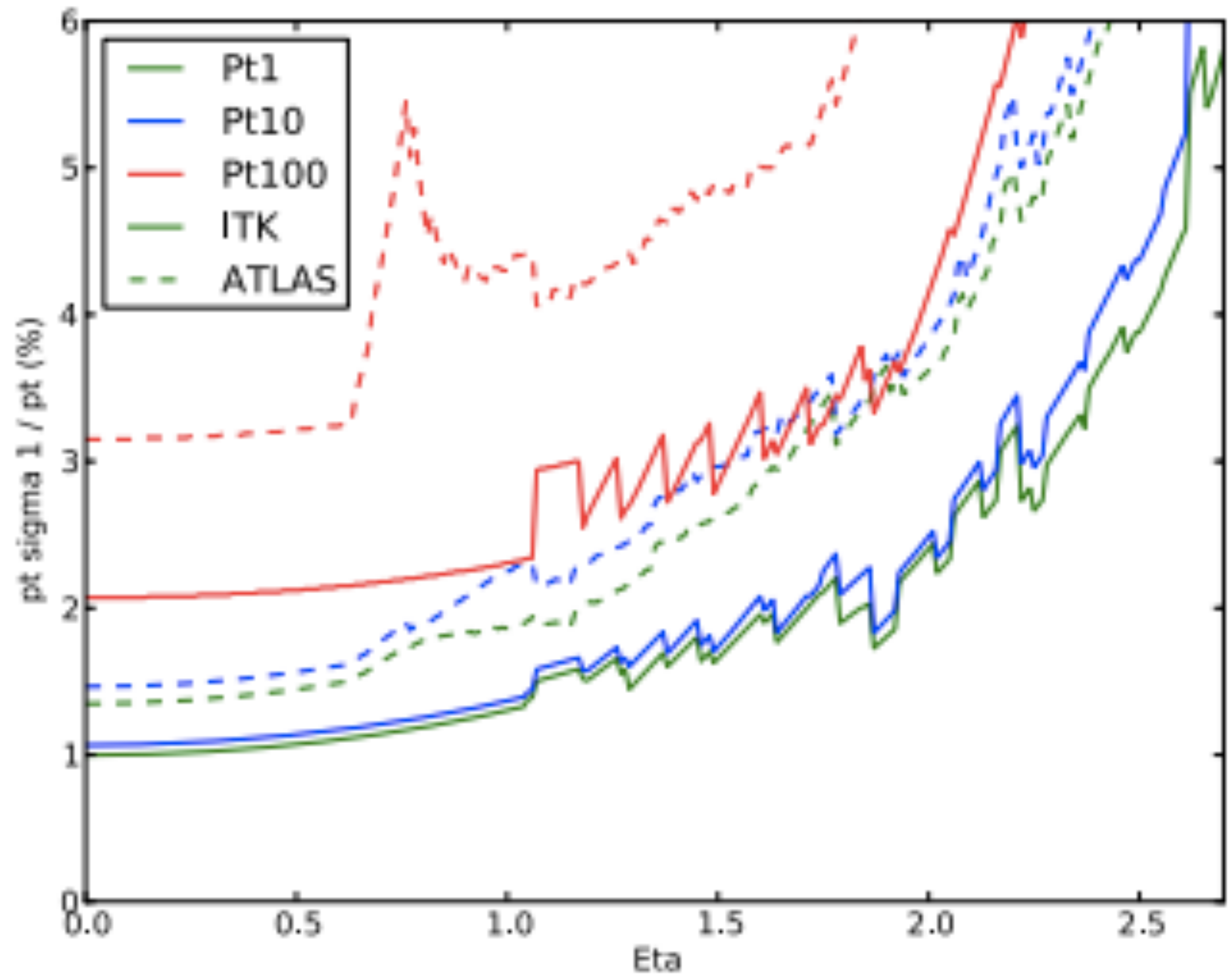


Figure 6. Inverse p_T-resolution using [8], measured as a function of $|\eta|$ for the LoI layout, and comparison with the inverse p_T resolution of the existing ATLAS experiment including the IBL.