

ITK Simulation

Pixel R&D Projects Meeting

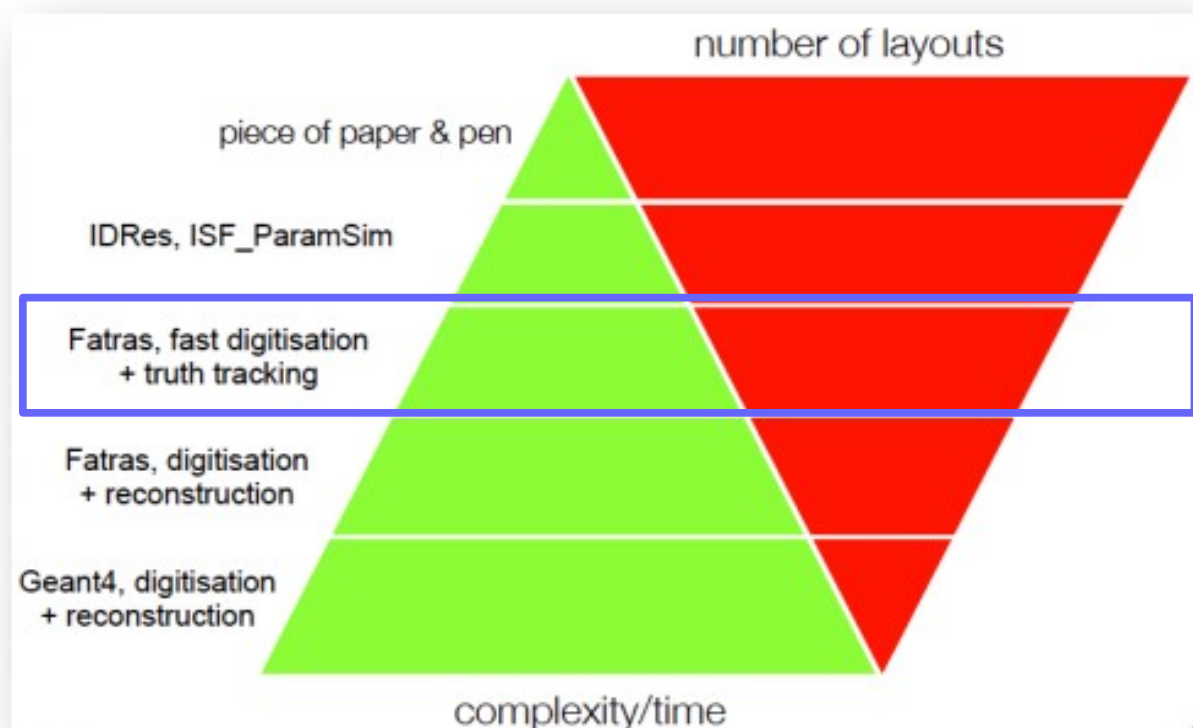
Milano – 08/06/2015

People involved:

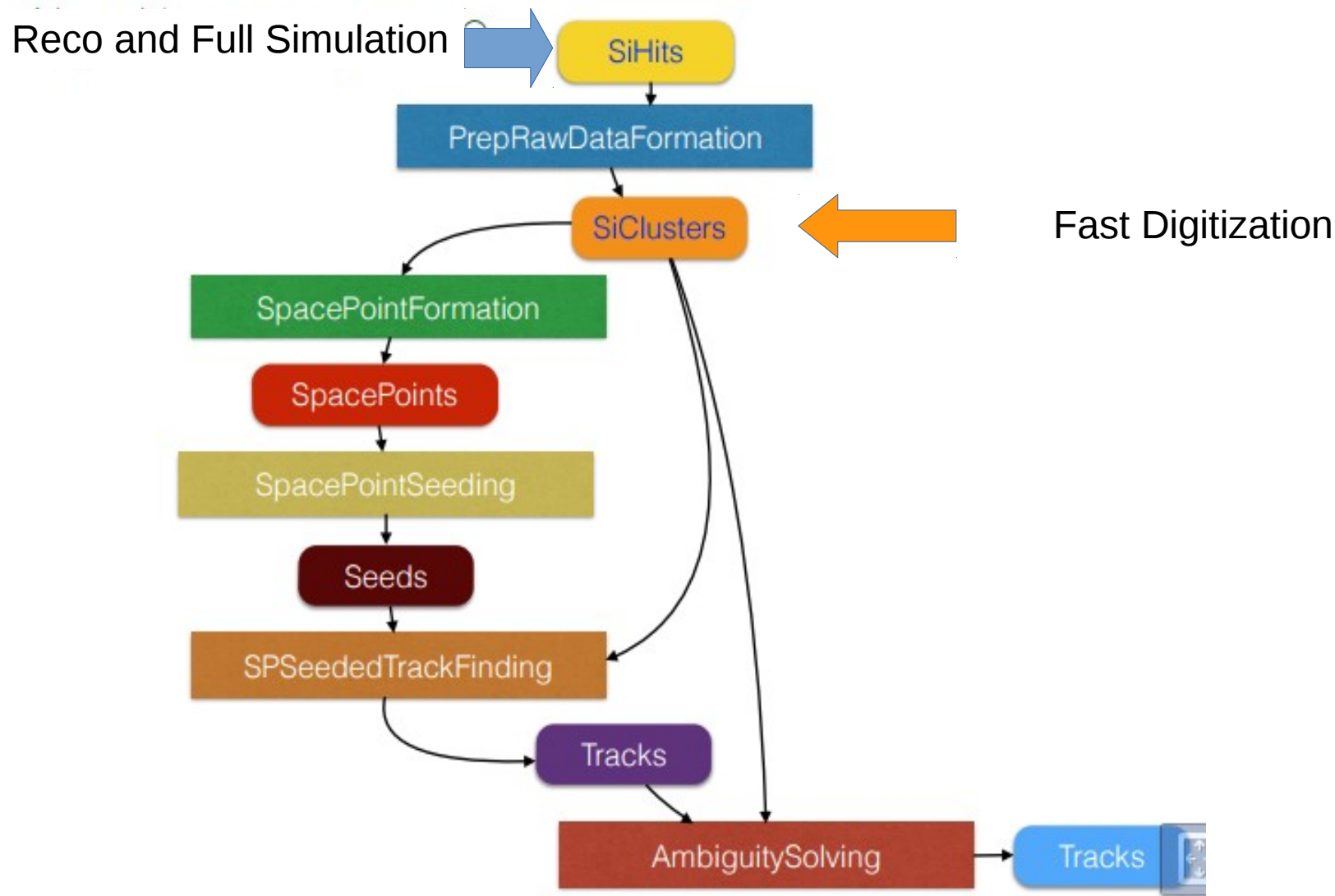
Gabriele Chiodini, Claudia Gemme, Federica Fabbri,
Anna Mastroberardino, Matteo Negrini, Antonio Sidoti,
Max Sioli

Activity

- Starting in Dec 2015 qualification from Federica Fabbri (PhD Bologna student)
 - Work performed under “Itk Simulation” subgroup (Chair: H. Hayward and A. Korn)
 - Already some operative meetings with interested people in Lecce, Cosenza and Genova (e.g. <https://indico.cern.ch/event/387685/>)
- Fast digitization



Detailed Simulation and Reco Sequences



0 From A. Szalburger's presentation :
<https://indico.cern.ch/event/387373/contribution/4/material/slides/0.pdf>

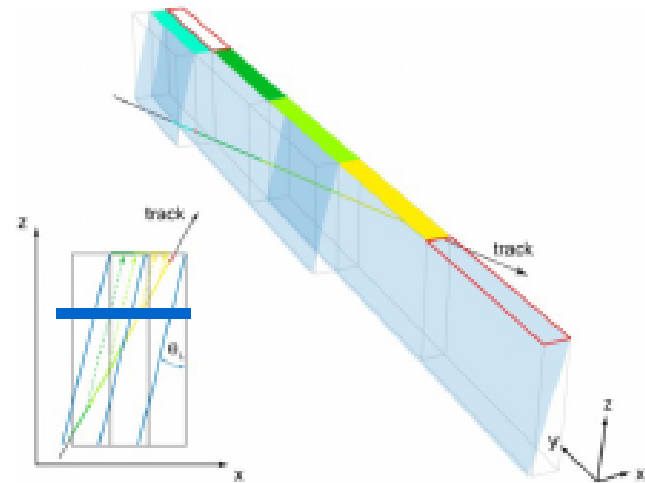
Fast Digitization

Digitization → simulated energy deposits converted into the detector readout format by detailed simulation of the detector response

Fast Digitization →

- ♦ Ignore the simulated energy deposits
- ♦ Pixel charge depends only on geometrical path of tracks in pixel
- ♦ Applied correction due to presence of magnetic field (Lorentz angle correction)

Changes in pixel geometry are applicable during fast digitization without rerun GEANT4 simulation (detector simulation)



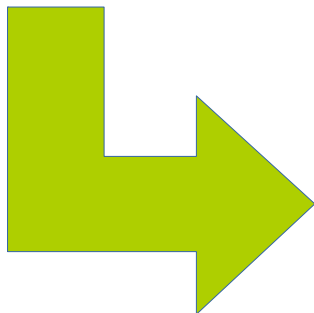
Fast Digitization: goals

What we can do

- Modify sensors (pixel dimensions, R/O granularity, thickness)
- Switch ON/OFF sensors or full layers/disk
- Use Standard pixels/ 3D/HV-CMOS/HV-MPAS

What we CANNOT do:

- Layout studies (LoI, Alpine, SLIM etc..)
- Impact of thickness on track variations (multiple scattering, dE/dx , δ -rays, conversions,...)
- Clustering studies (Fast digitization gives already Siclusters)



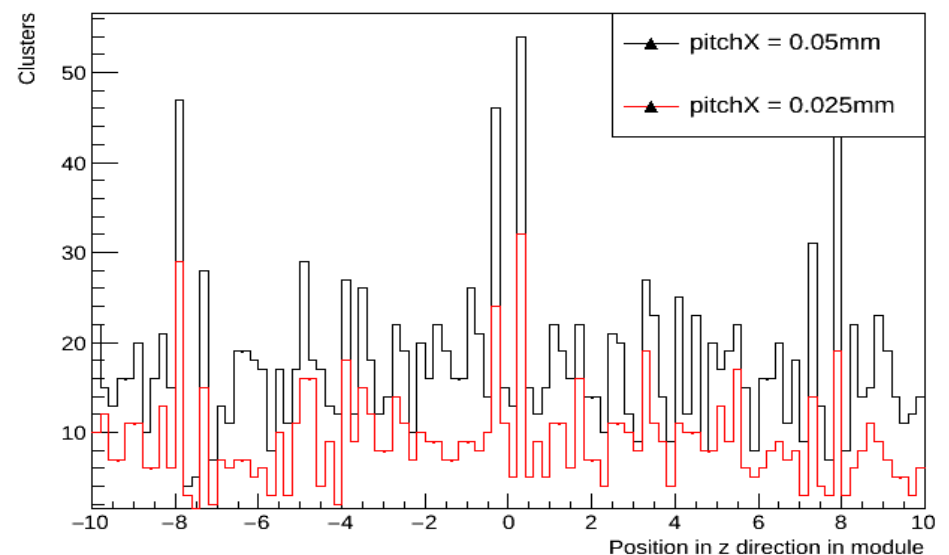
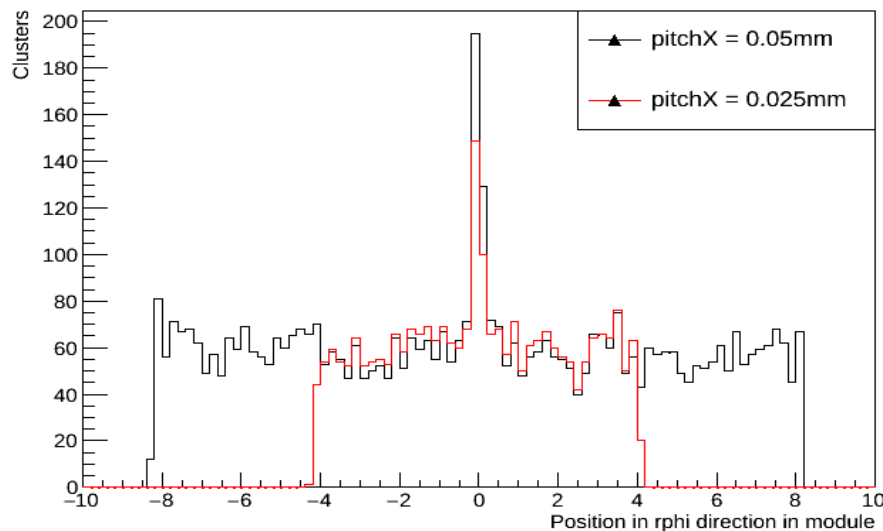
Perform TDAQ. Reco performance and physics studies (tracking, b-tagging etc)

Current Status

Fast Digitization package implemented:

→ **TODO: no 3D/HV-MAPS/HVCMOS implemented**

Can successfully modify granularity (in GeoPixelSiCrystal.h and PixelModuleDesign.h)



→ **TODO: Modify globally (also for reco) in a “smart” way (i.e. not rewriting whole geometry)**

TODO: Run reconstruction on fast digitization clusters

Conclusions and Plans

- Integrate fast digitization in rel20(and+) ATLAS
upgrade SW framework (from GEN to xAOD)
- Once layout is defined perform detailed performance
studies
- Ambitious program
 - A lot of space to contribute!

BackUp

Details

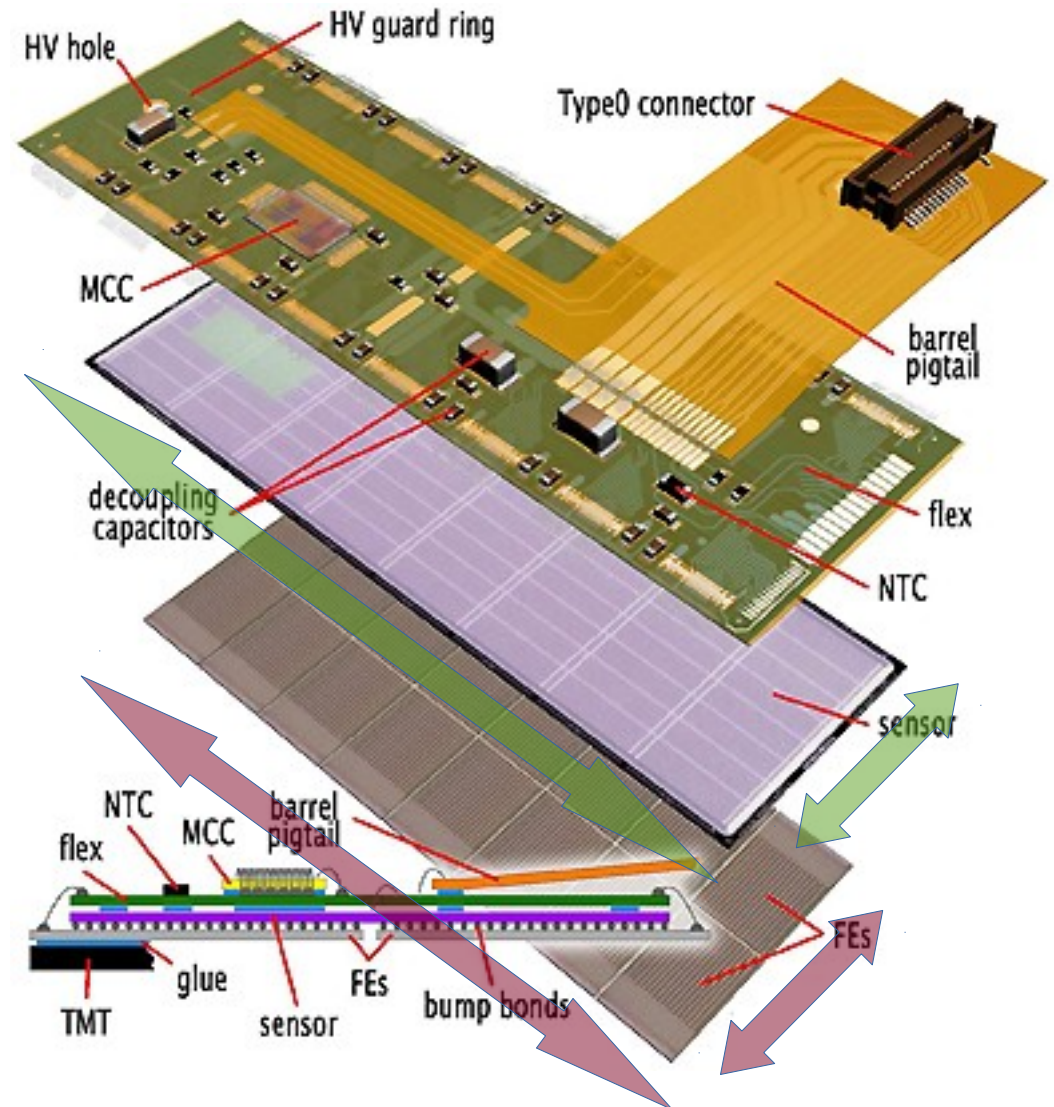
PixelModuleDesign.h

```
/** Constructor with parameters:
    local axis corresponding to eta direction
    local axis corresponding to phi direction
    local axis corresponding to depth direction
    thickness of silicon sensor
    number of circuits in one circuit column
    number of circuits in one circuit row
    number of cell columns per circuit
    number of cell rows per circuit
    number of diode columns connected to one circuit
    number of diode rows connected to one circuit */
```

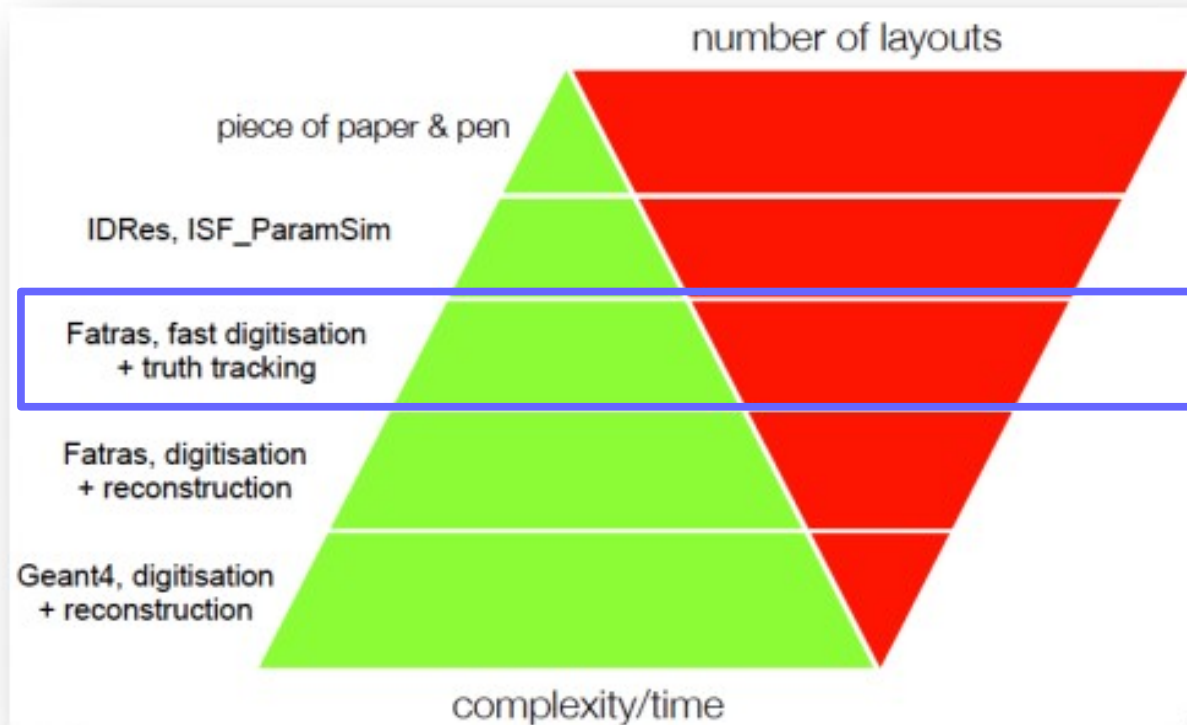
```
PixelModuleDesign(const double thickness,
    const int circuitsPerColumn,
    const int circuitsPerRow,
    const int cellColumnsPerCircuit,
    const int cellRowsPerCircuit,
    const int diodeColumnsPerCircuit,
    const int diodeRowsPerCircuit,
    const PixelDiodeMatrix * matrix,
    InDetDD::CarrierType carrierType,
    int readoutSide = -1,
    bool is3D=false);
```

GeoPixelSiCrystal.h

```
private:
    InDetDD::PixelDiodeMatrix * makeMatrix(double phiPitch, double etaPitch, double etaPitchLong, double etaPitchLongEnd,
        int circuitsPhi, int circuitsEta, int diodeRowPerCirc, int diodeColPerCirc);
```



Fast Digitization



A.Salzburger
<https://indico.cern.ch/event/355826/>

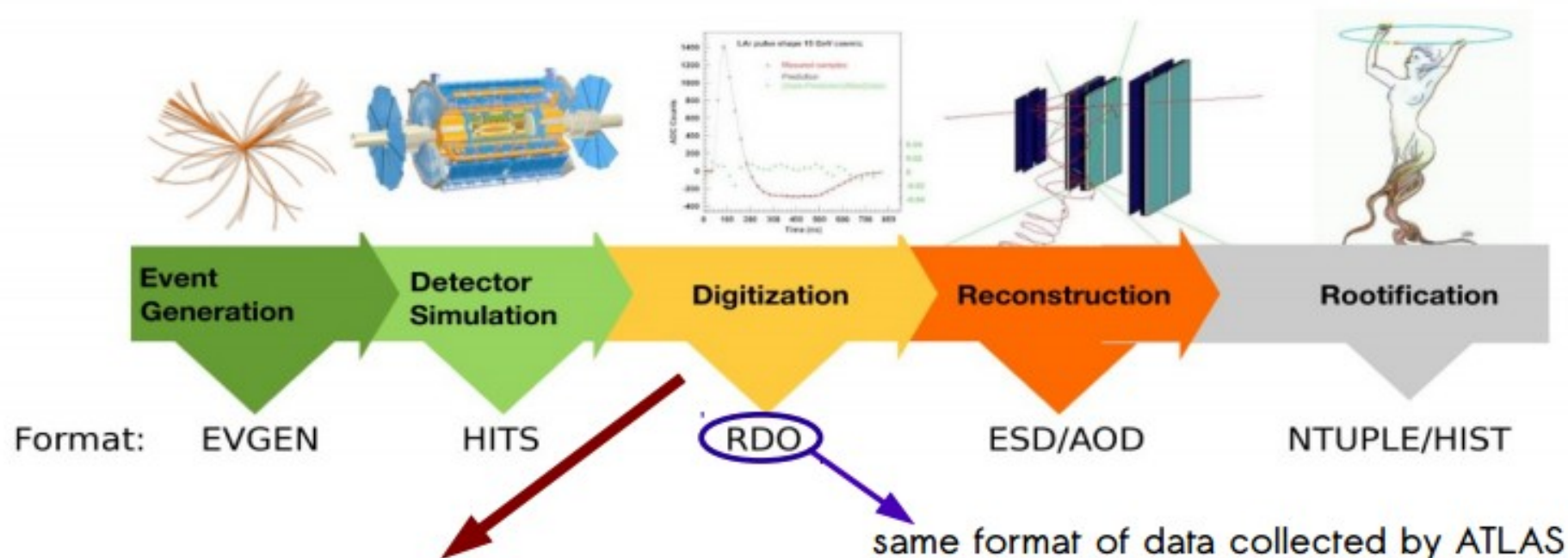
Decisione su:

- Layout
- Granularita` dei sensori

Per i diversi layout cf Feb. ITK Week:
<https://indico.cern.ch/event/361445/>

→ Goal della Itk Layout Task Force (C. Gemme and A. Salzburger)

Simulation Chain



Work on this step for pixel detector

- ▣ Fast & Standard Digitization
- ▣ Qualification Task
- ▣ How to install and run
- ▣ Main Program
- ▣ Output and reconstruction

14/04/15

Attività di simulazione ITK



