Implementation of CALO PDs in HerdSoftware

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Add photodiodes in simulation geometry

- Add LPD and SPD in the same way in all calo geometries
- 3 dimensions and distance between photodiodes settable from geometric datacard
- PDs are absorbed inside the crystals by distance pdShift (settable from geometric datacard)

  Uniform placement of PDs in every calo geometry (no need to adjust to different passive material for different geometries)

  No impact on results expected:

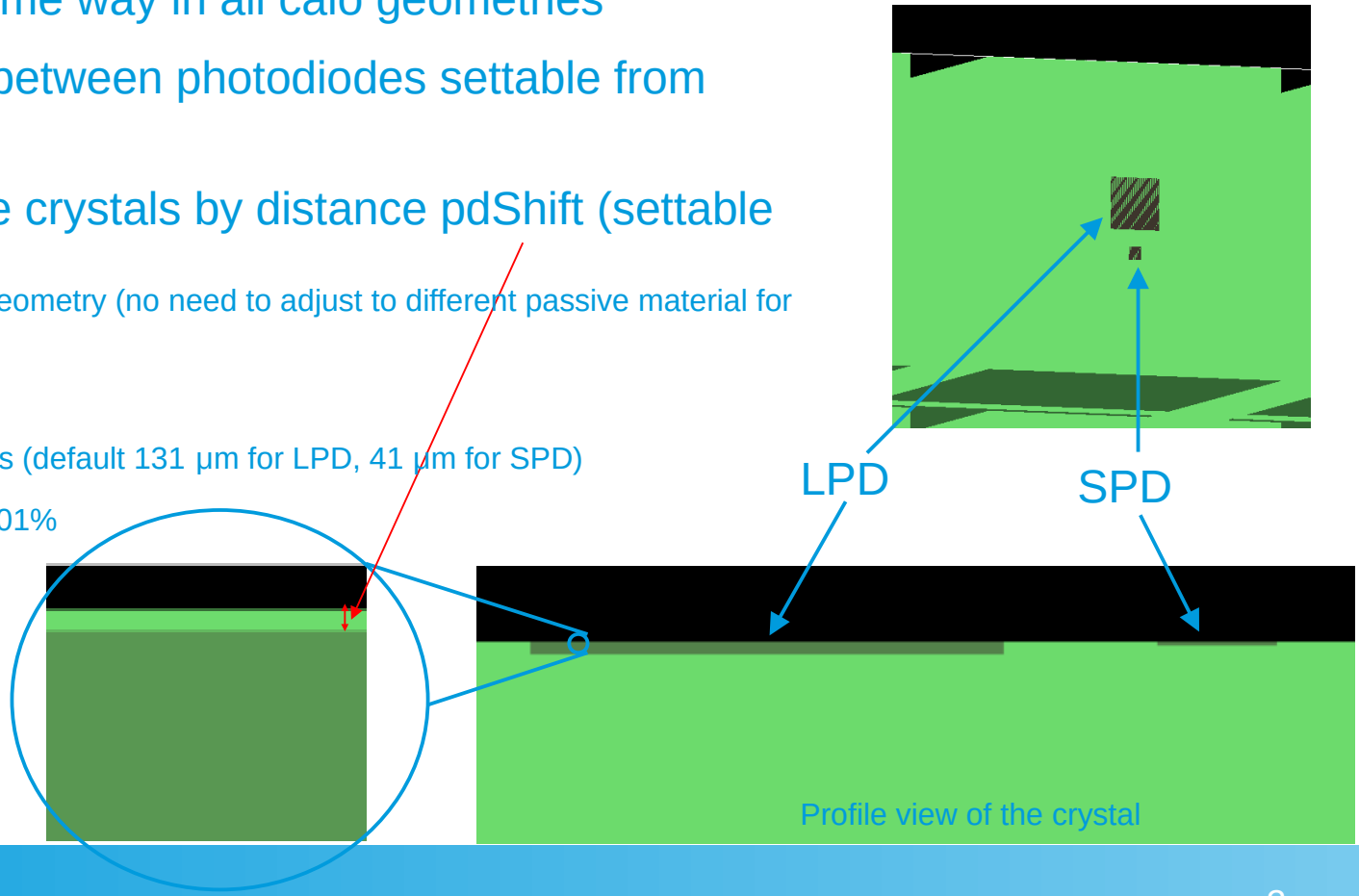
  - PDs shifted by only pdShift+PD thickness (default 131 µm for LPD, 41 µm for SPD)

  - Crystal volume reduced by less than 0.001%

- Setup sensitive detectors in physics datacard:

  /GGS/scoring/addGGSIntHitSD lpd

  /GGS/scoring/addGGSIntHitSD spd



Implement reader class for LPD and SPD

- Introduction in dataobjects of: CaloLpdHits.h , CaloSpdHits.h
- Introduction in dataproviders of: GGSCaloLpdHitsreader , GGSCaloSpdHitsreader

Hits produced by GGSDataProvider for the calorimeter:

Object name	Category	Class	Alias	Producer
caloHitsGGS	EVENT	CaloHits	caloHitsMC caloHitsGeV	GGSDataProvider
caloLpdHitsGGS	EVENT	CaloLpdHits	caloLpdHitsMC caloLpdHitsGeV	GGSDataProvider
caloSpdHitsGGS	EVENT	CaloSpdHits	caloSpdHitsMC caloSpdHitsGeV	GGSDataProvider

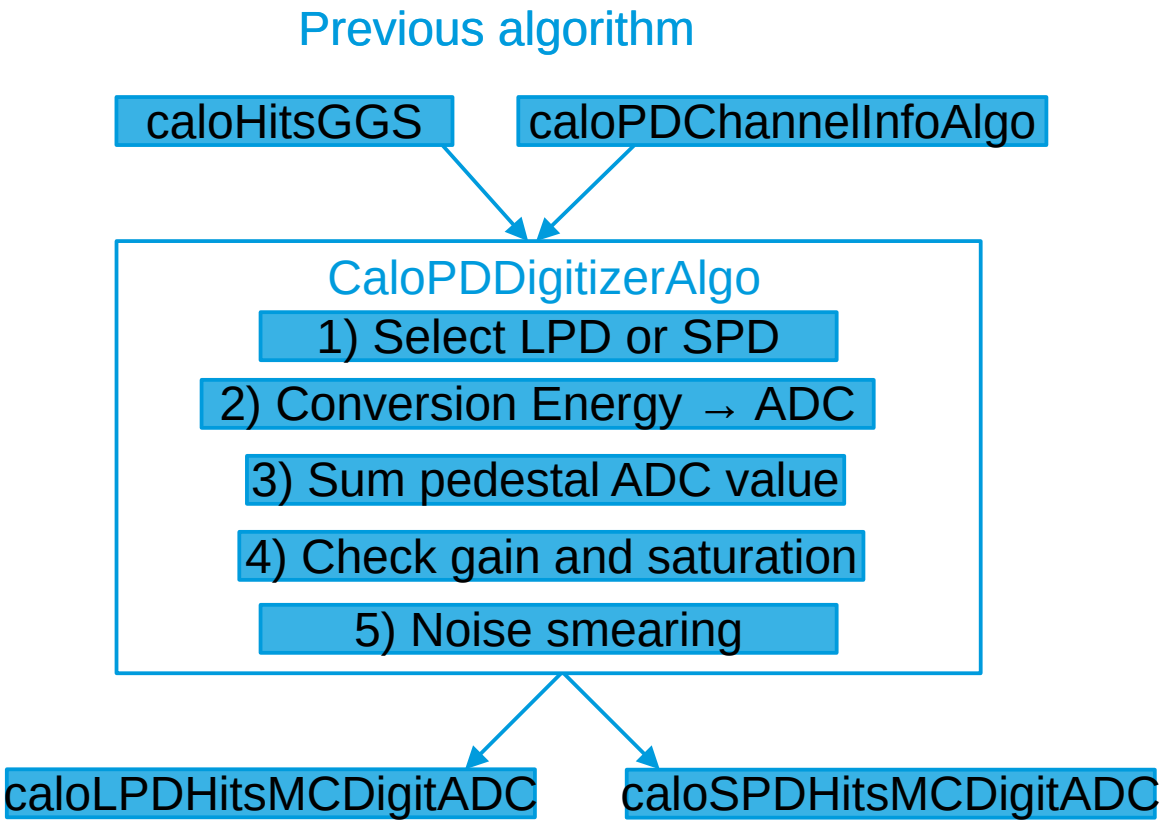
Implement direct ionization in digitization - 1

- Add direct ionization in PDs in digitization of calorimeter hits
- Implement changes in the previous algorithms (developed by Lorenzo Pacini)

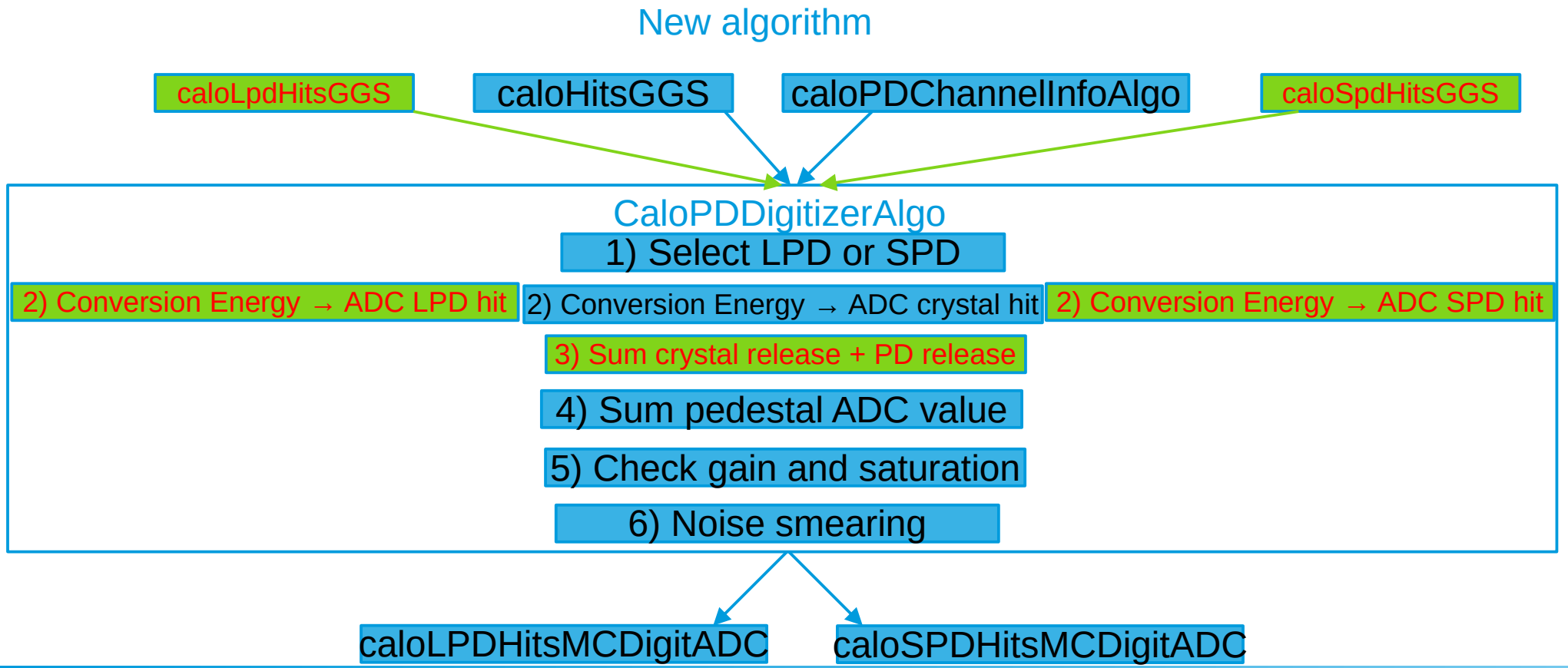
Preliminary work:

- CaloPDChannelInfoAlgo:
  - Add parameters for LPD and SPD: MIP values (theoretical values)
  - Update old parameters for LYSO crystals (MIP value, noise, ratio LPD/SPD, ….)

Implement direct ionization in digitization - 3



Implement direct ionization in digitization - 3



Implement direct ionization in digitization - 4

2) Conversion Energy → ADC

Crystals: calibrated with real data MIP

LPD, SPD: calibrated with theoretical calculation of MIP energy loss in Silicon (we acquired MIP at BTF test beam last June and we will use these info in future)

6) Noise smearing

Performed as last step of digitization

We consider only electronics noise (noise about 20 ADC for a channel)

We are neglecting Poisson's fluctuations in p.e. production and detection (fluctuations < 0.5 ADC/MIP) and in e-h couples production in direct ionization (fluctuations < 0.3 ADC/MIP and < 0.2 ADC/MIP for LPD and SPD respectively)

Software availability

- Available on HerdSoftware master
- Will be included in future release 0.4.0