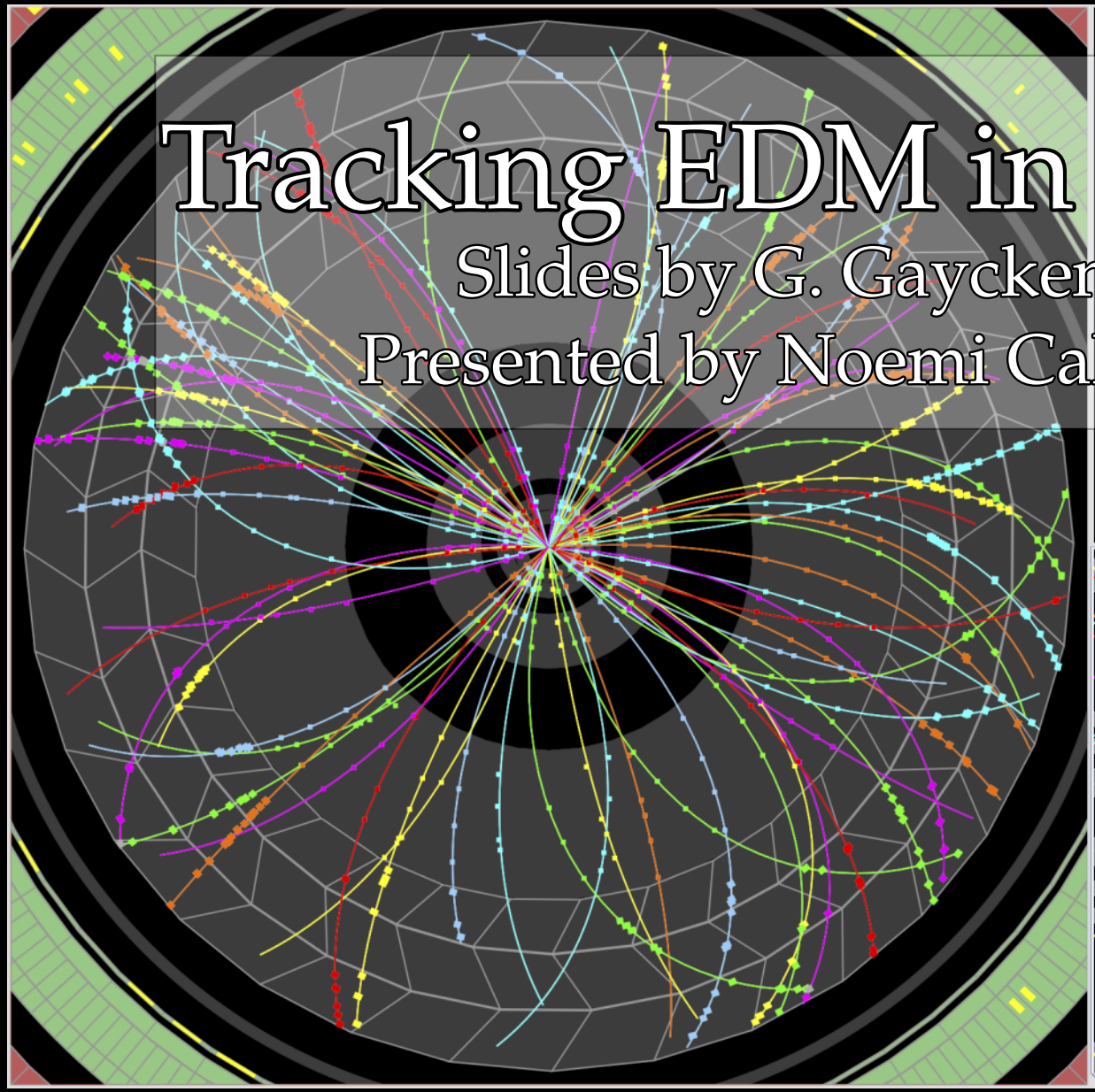
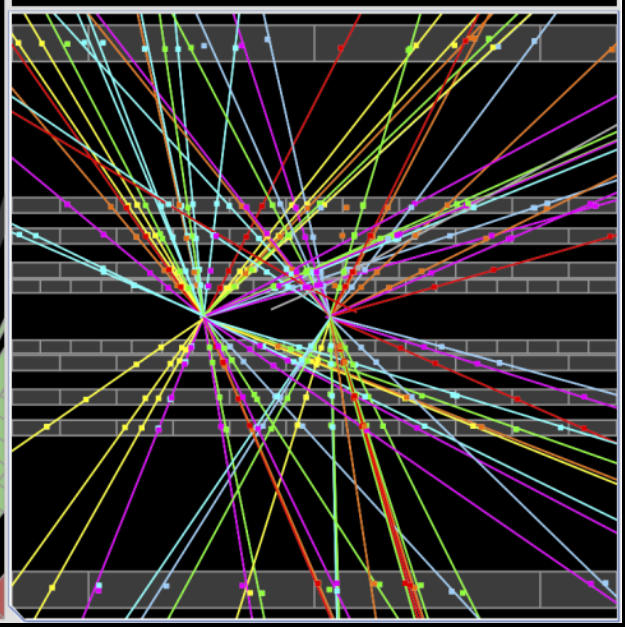
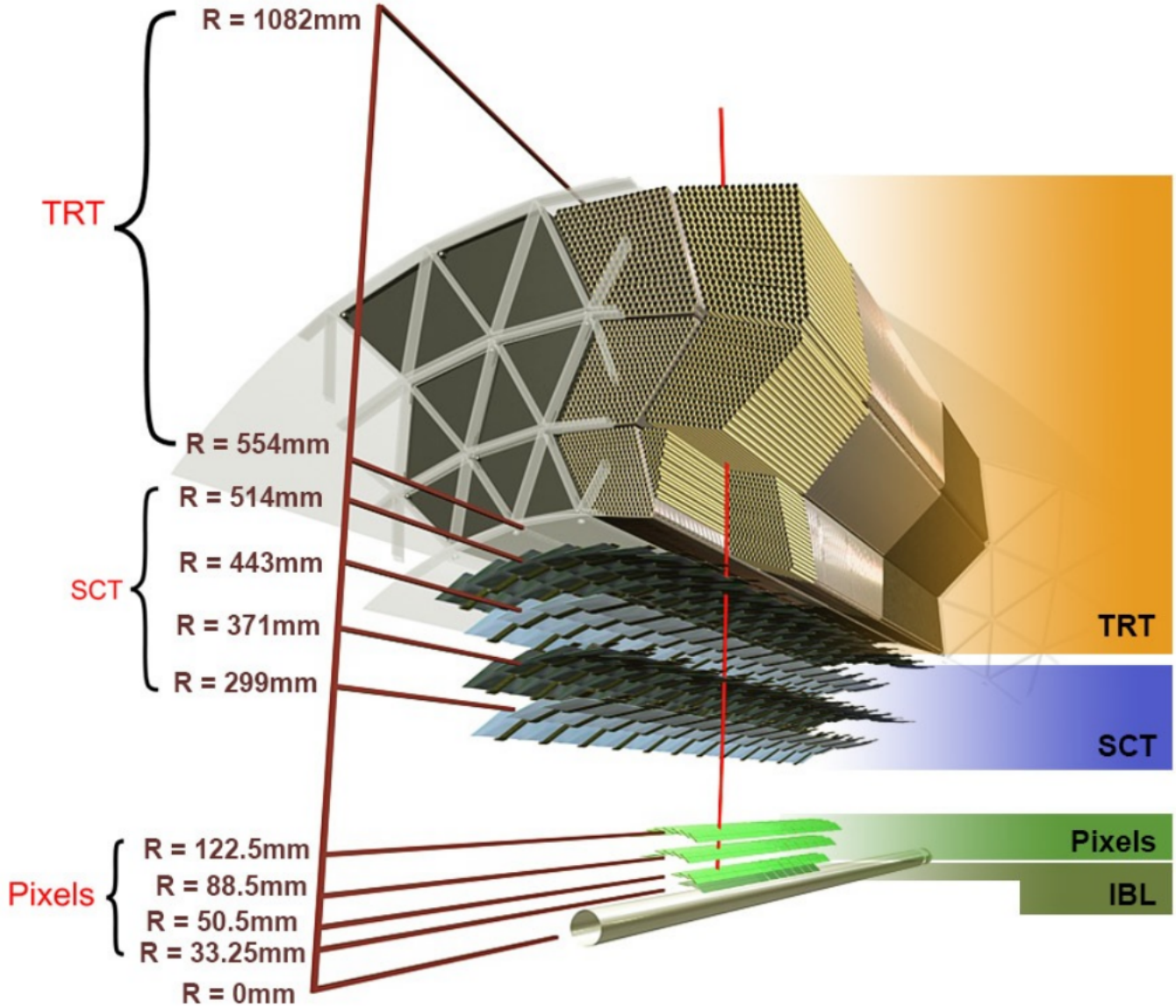
Tracking EDM in ATLAS

Slides by G. Gaycken

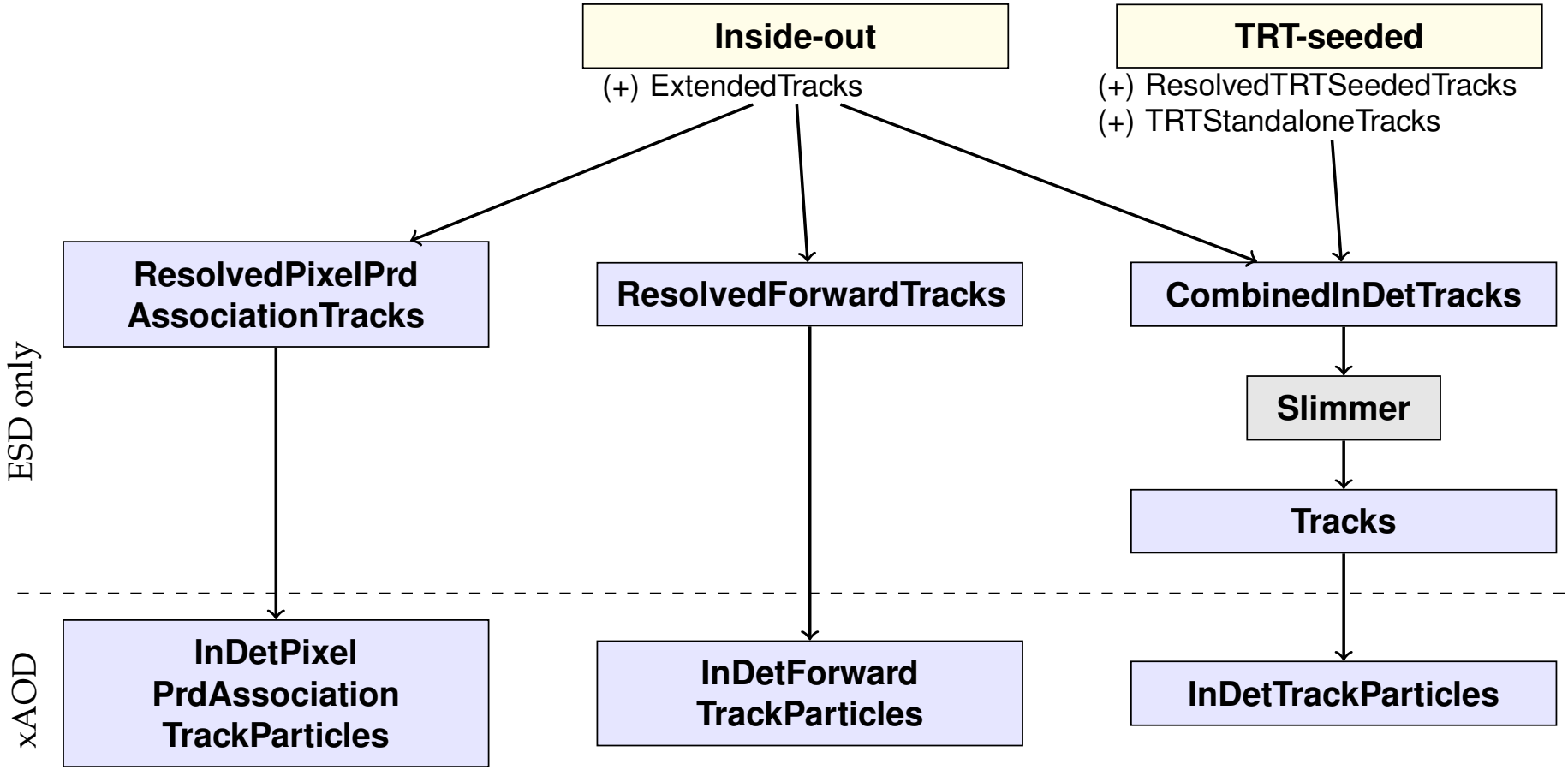
Presented by Noemi Calace






R = 1082mm
TRT
R = 554mm
R = 514mm
R = 443mm
SCT
R = 371mm
R = 299mm
R = 122.5mm
R = 88.5mm
Pixels
R = 50.5mm
R = 33.25mm
R = 0mm
TRT
SCT
Pixels
IBL

Track collections



Inside-out – Si tracks

StoreGate

Pixel,SCT RDO

→ PixelRDORawData (git, lxr)
→ SCT_RDORawData (git, lxr)

Algorithms

Clusterization

→ PixelClusterization (git, lxr)
→ SCT_Clusterization(git, lxr)

Pixel,SCT Cluster

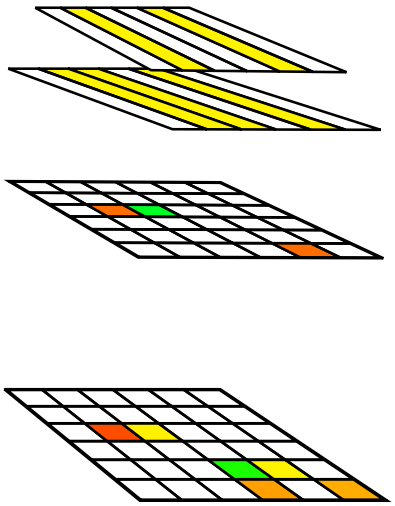
→ PixelCluster (git, lxr)
→ SCT_Cluster (git, lxr)

SpacePoint Formation

→ SiTrackerSpacePointFinder (git, lxr)

SpacePoints

→ SpacePoint (git, lxr)



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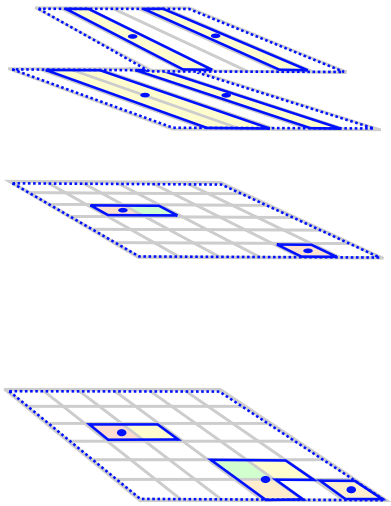
SP Seeded Track Finder

→ SiSPSeededTrackFinder (git, lxr)

(F:git, lxr)



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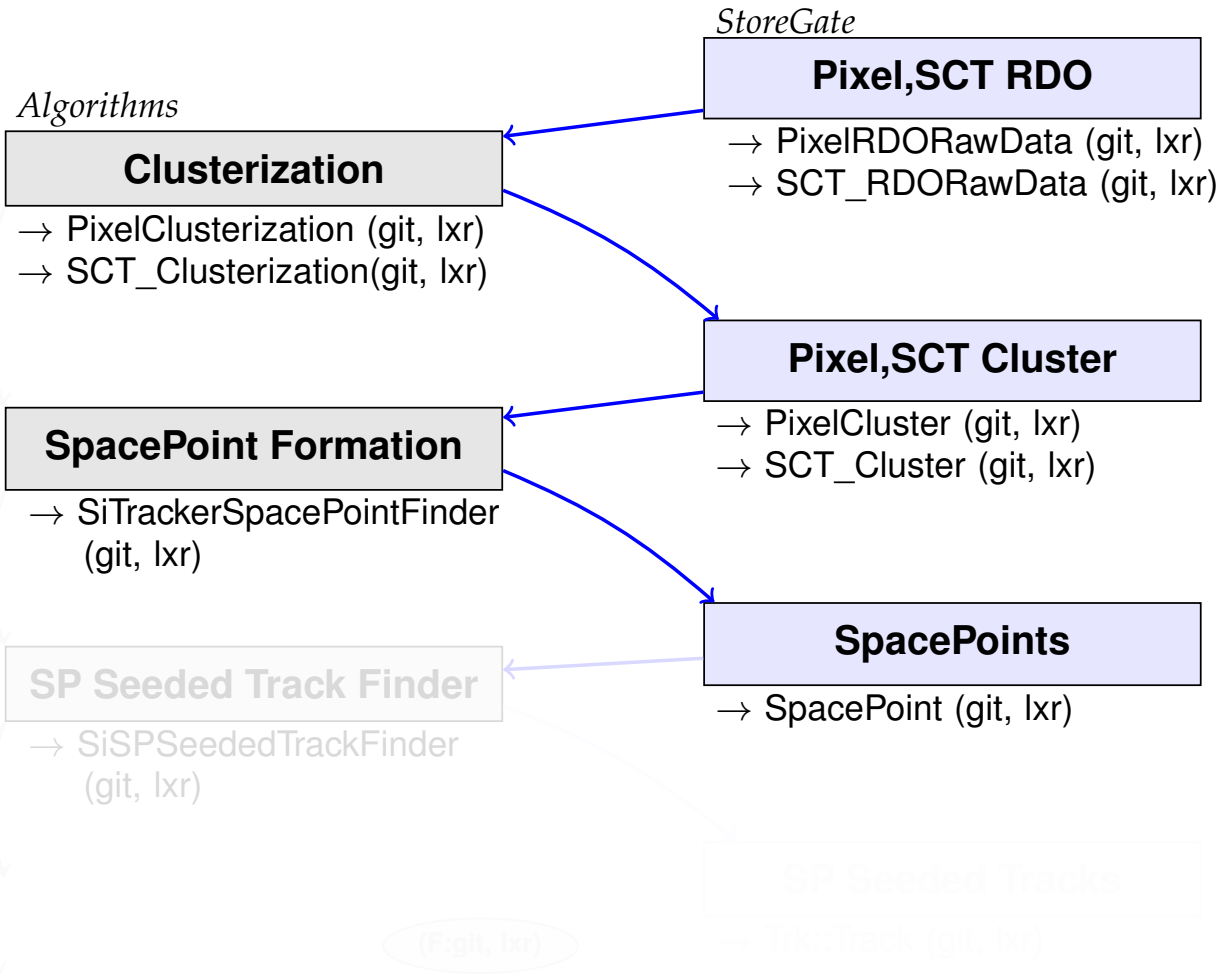

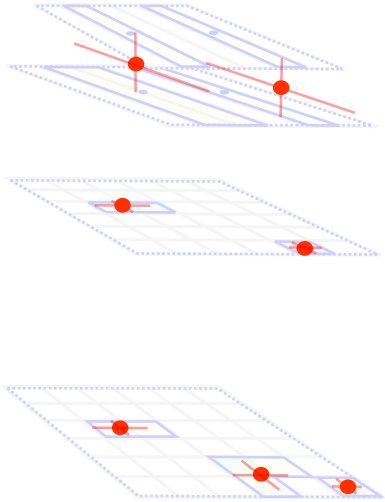

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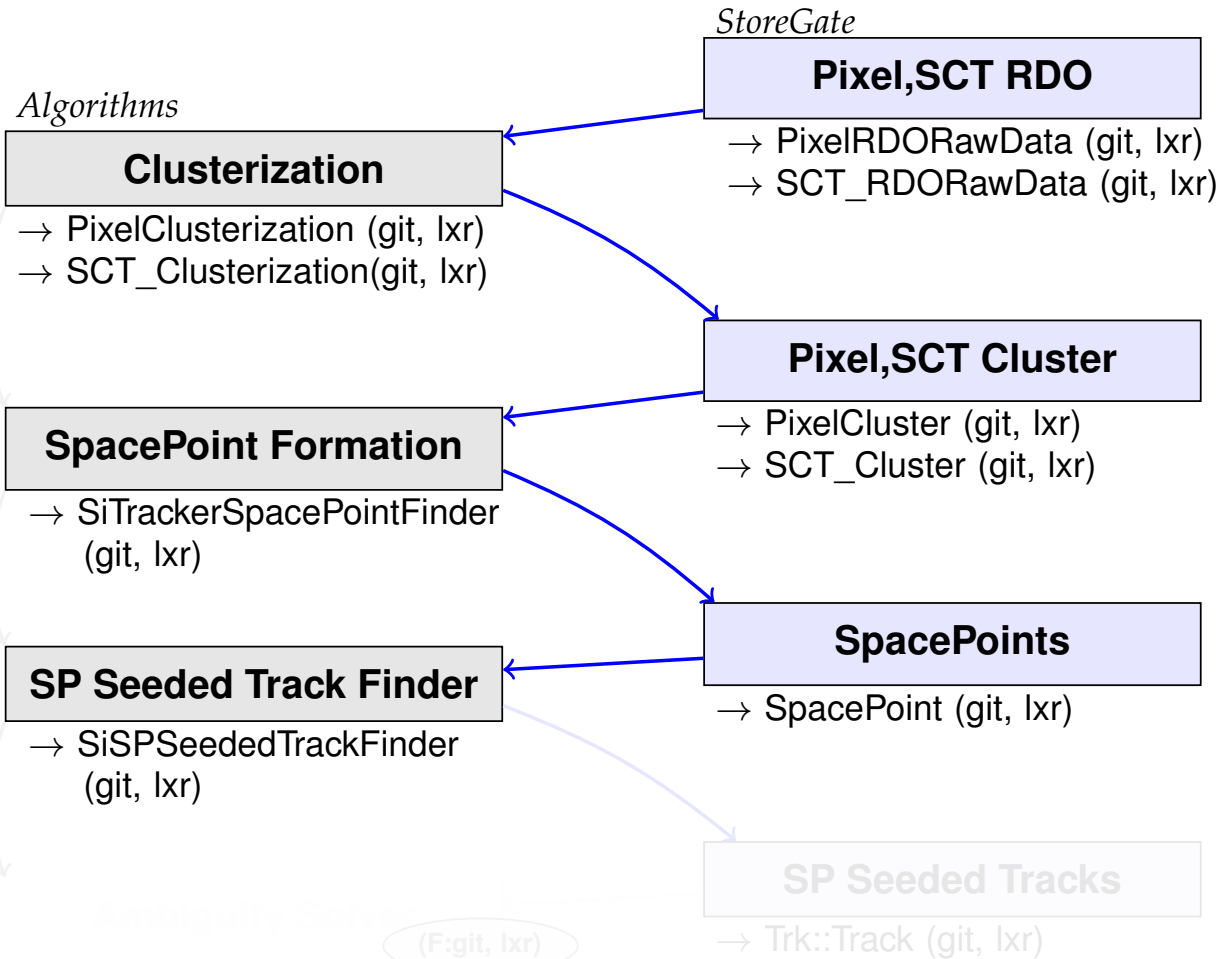

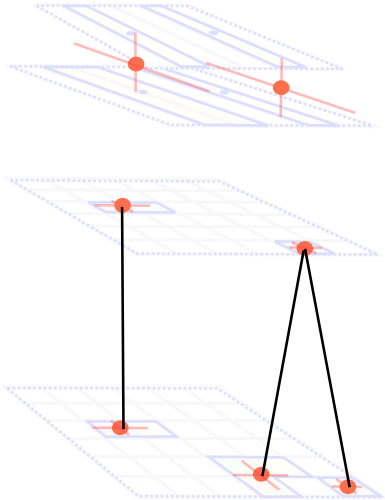

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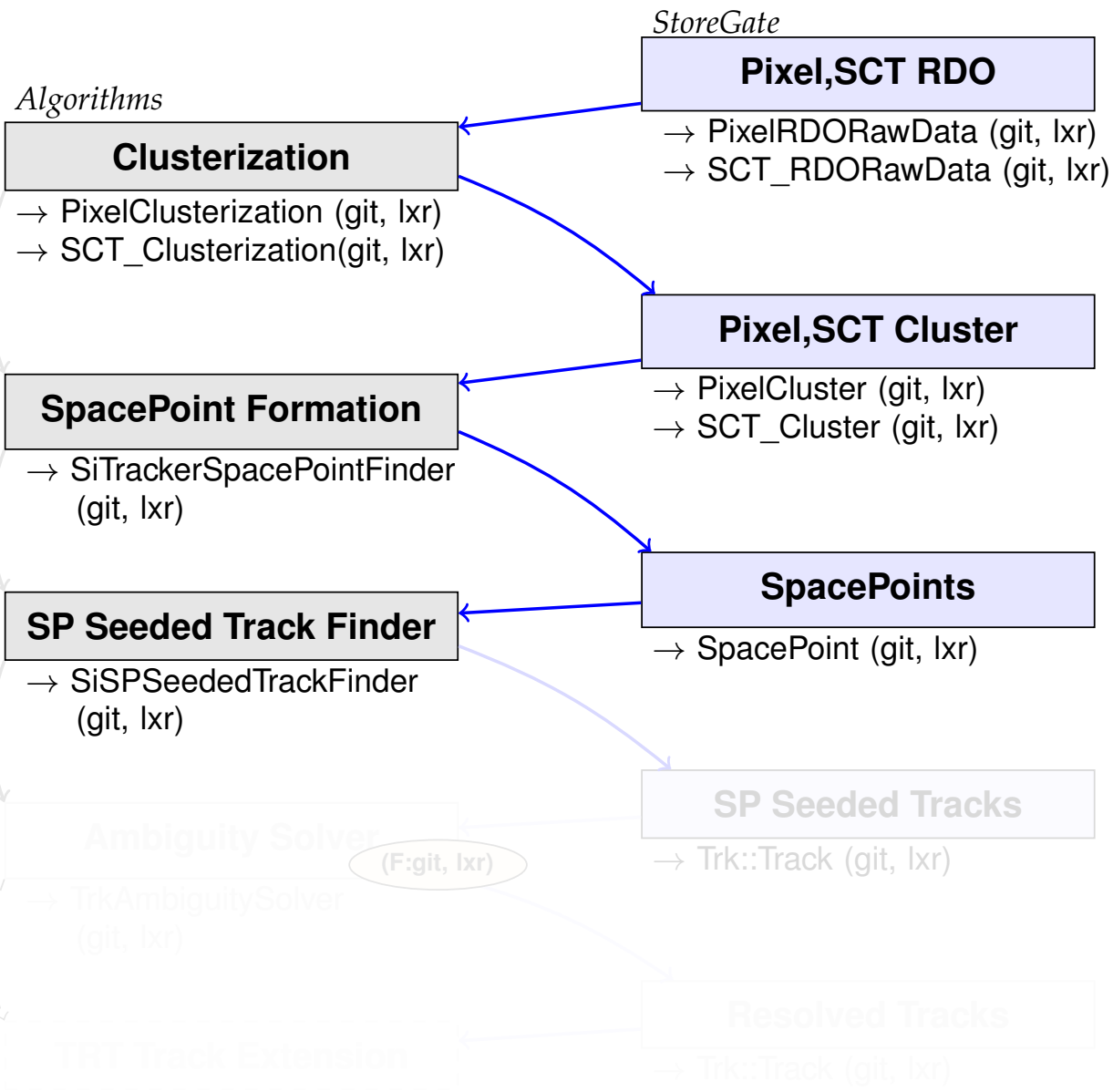

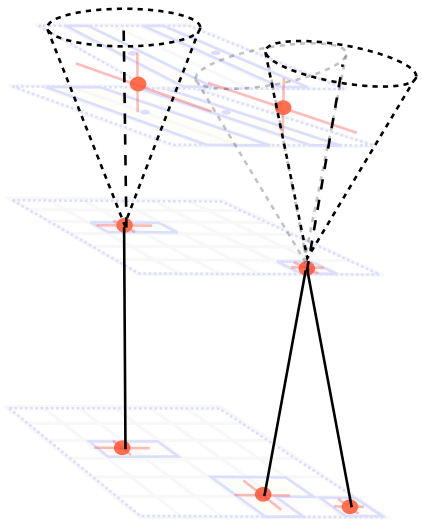

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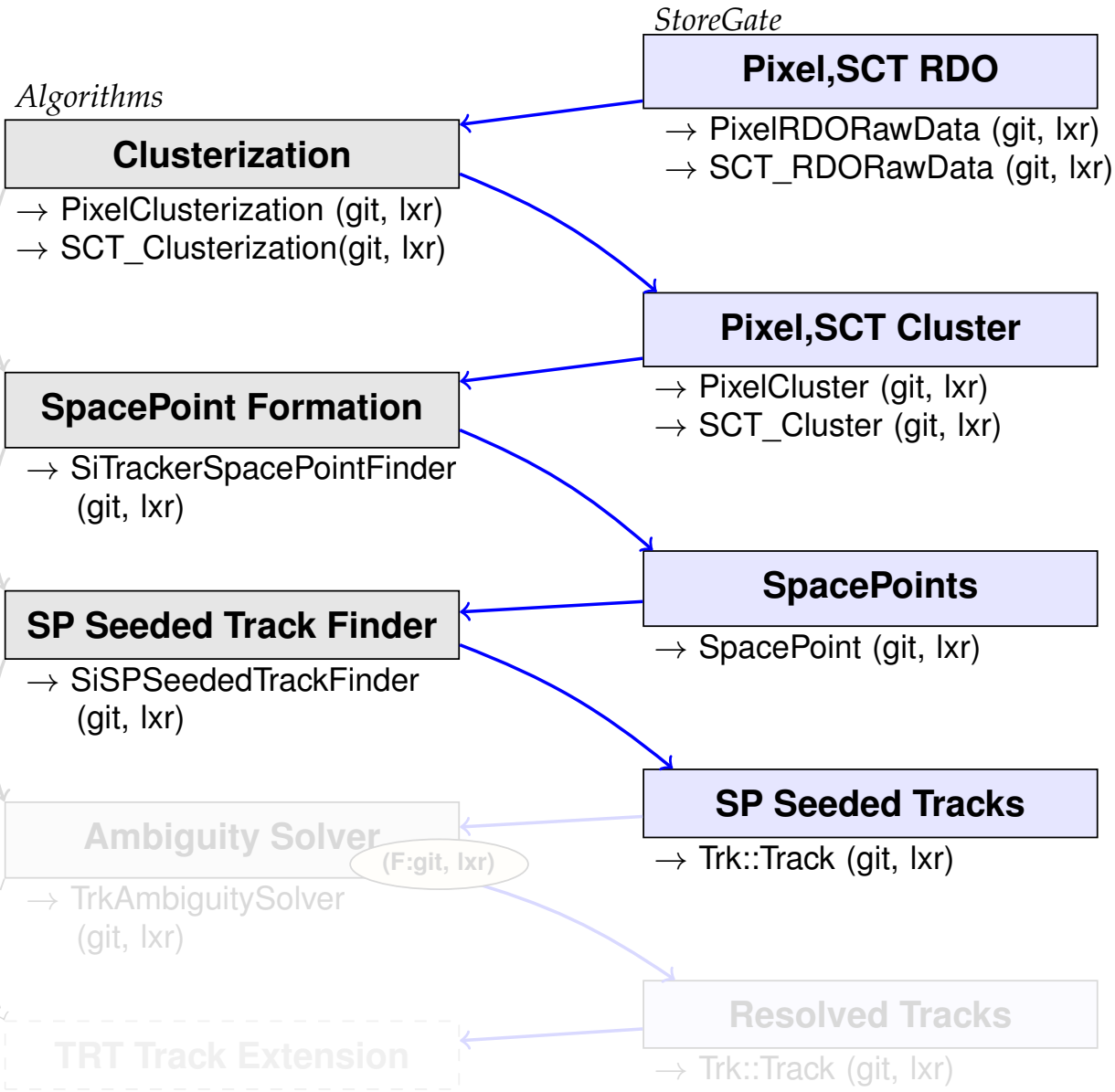

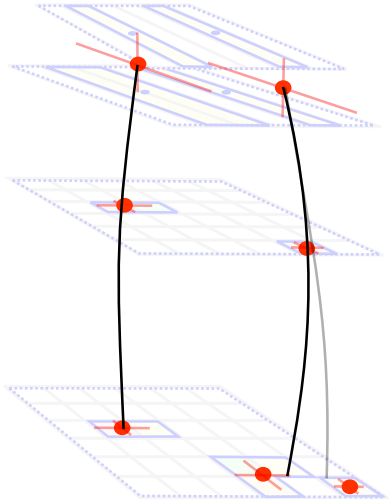

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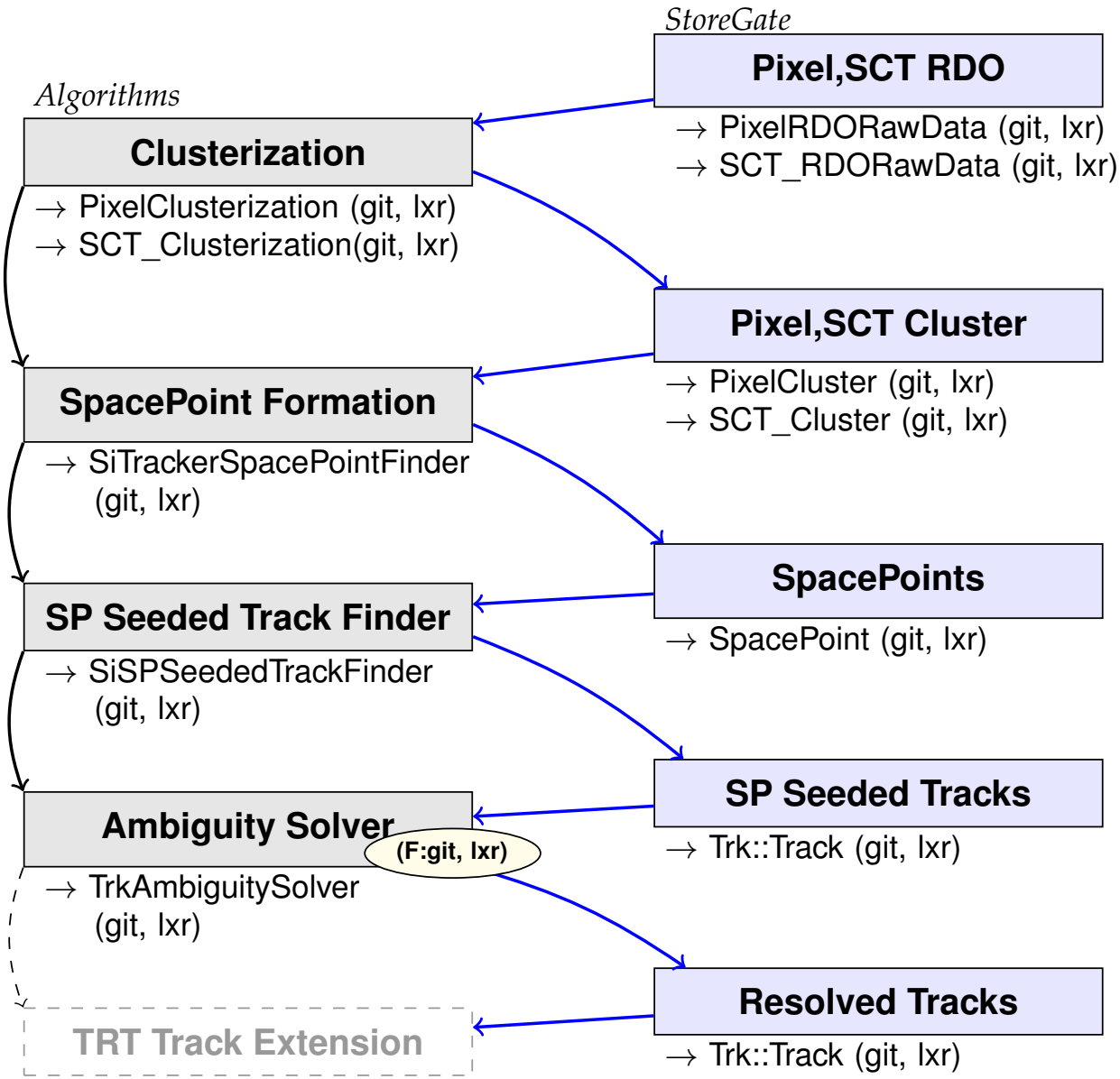
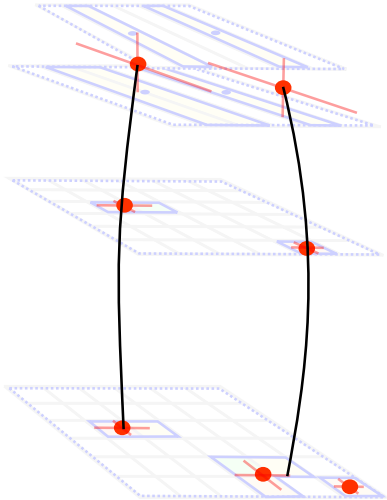
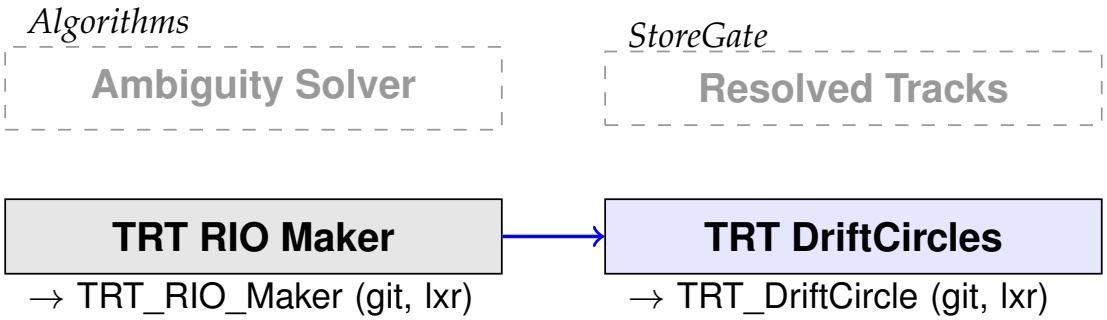
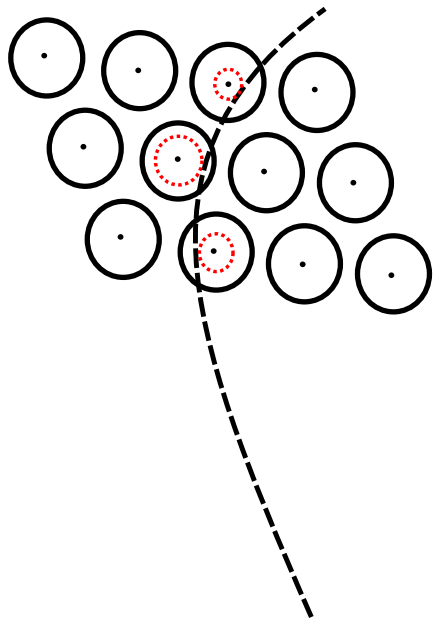




Inside-out – TRT Extension





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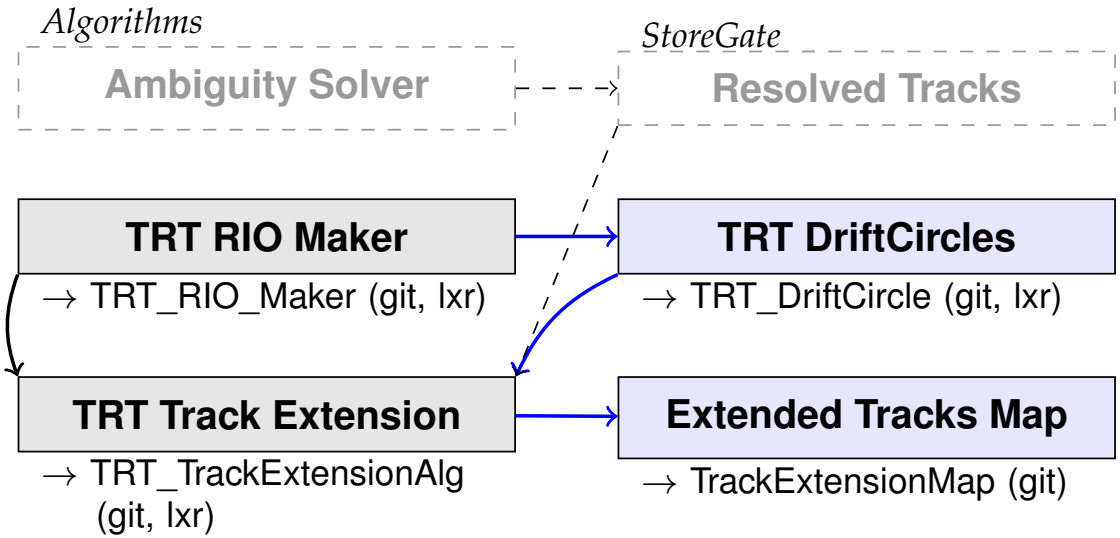

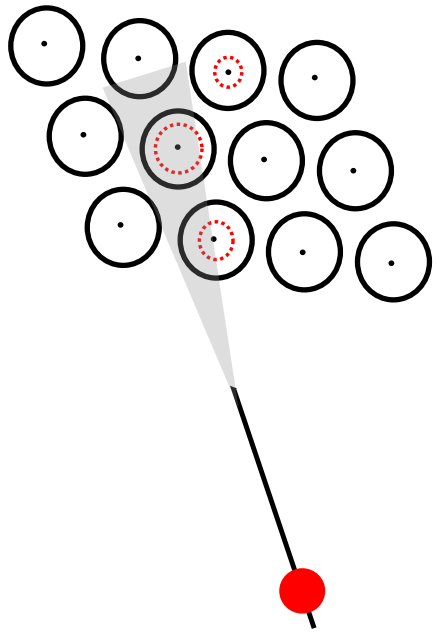

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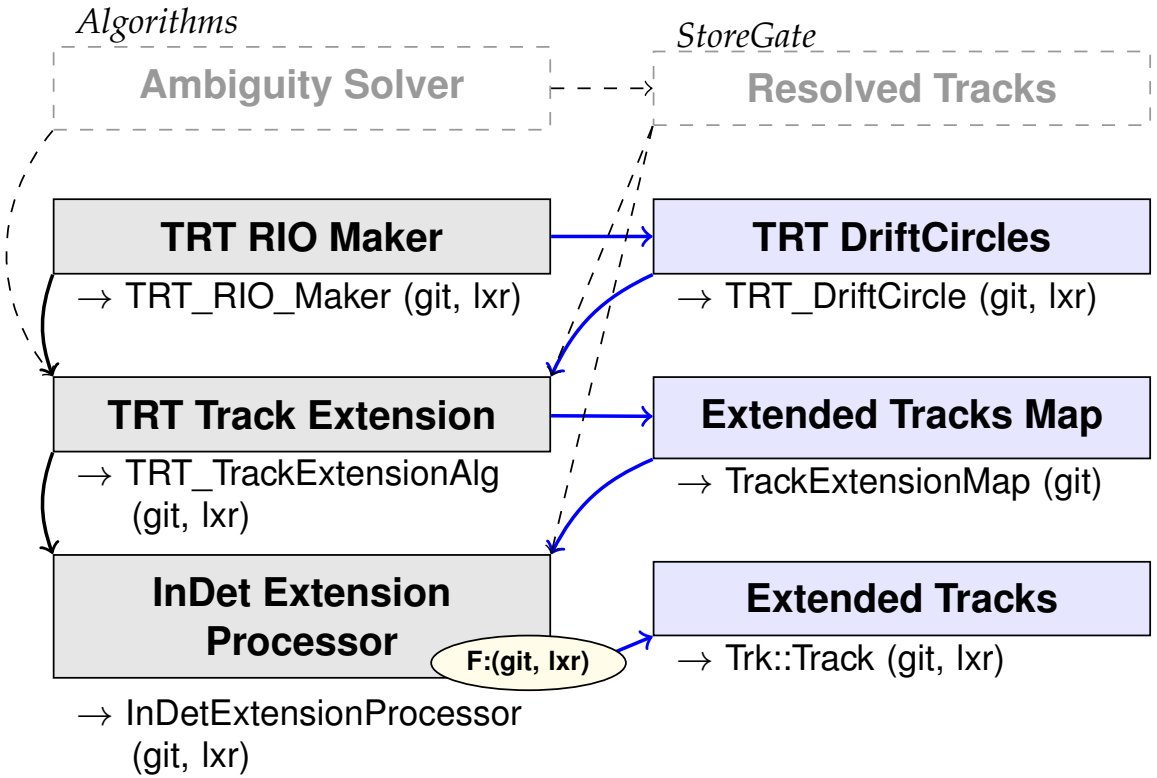

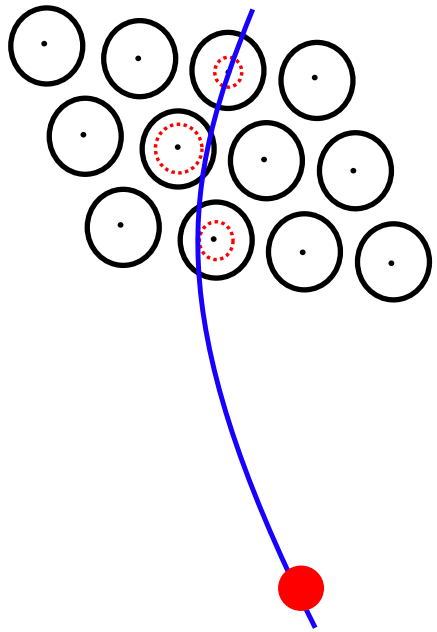

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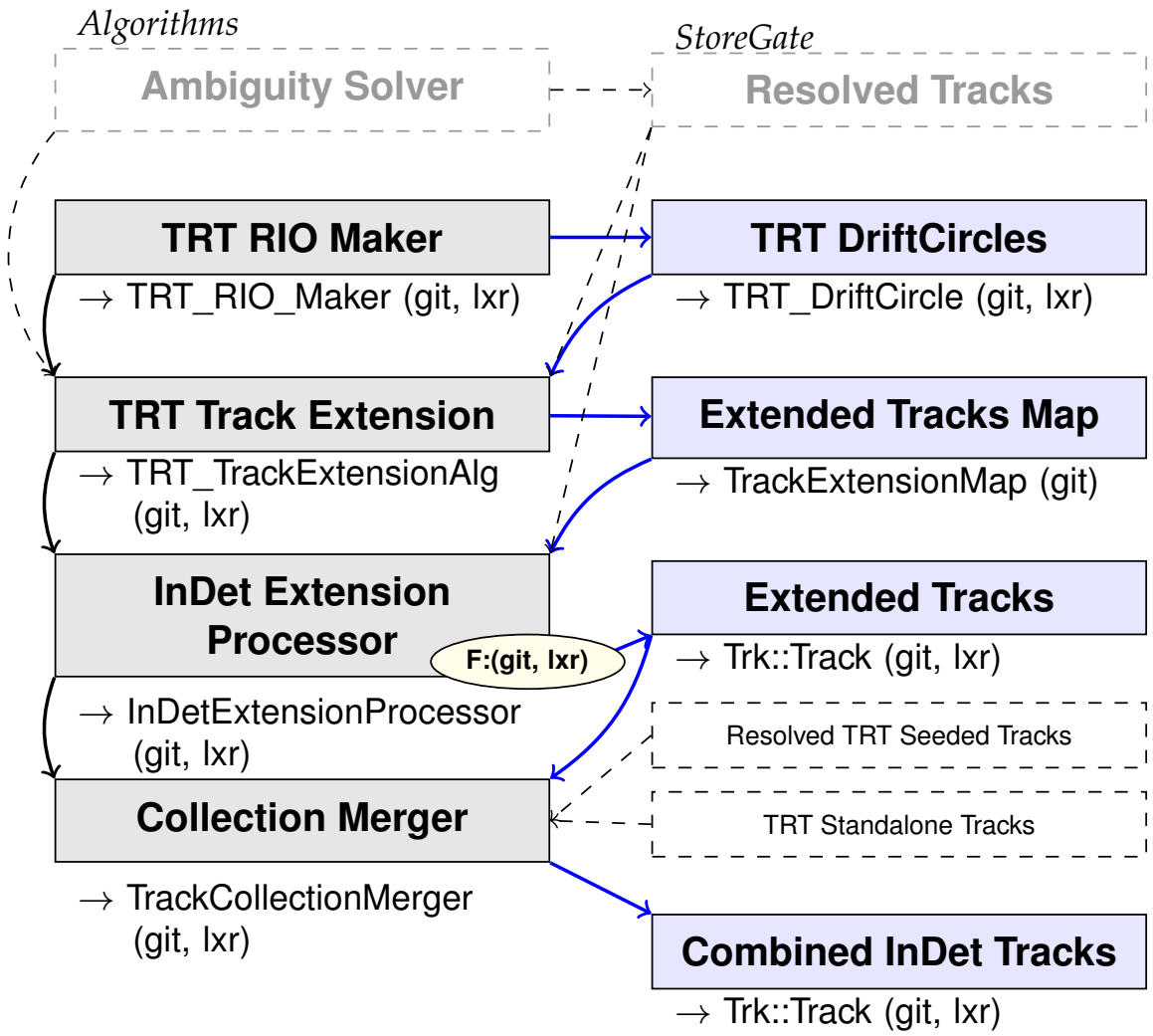
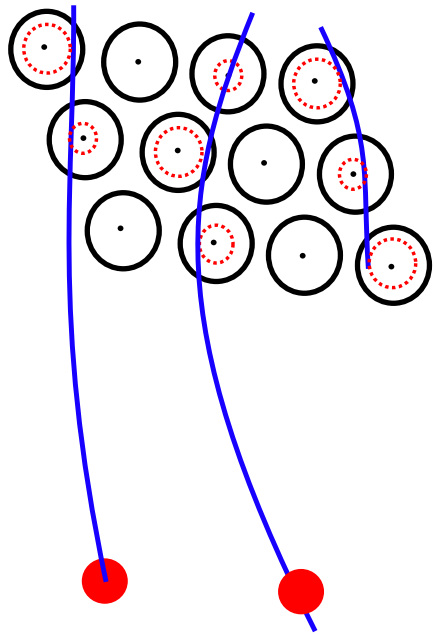
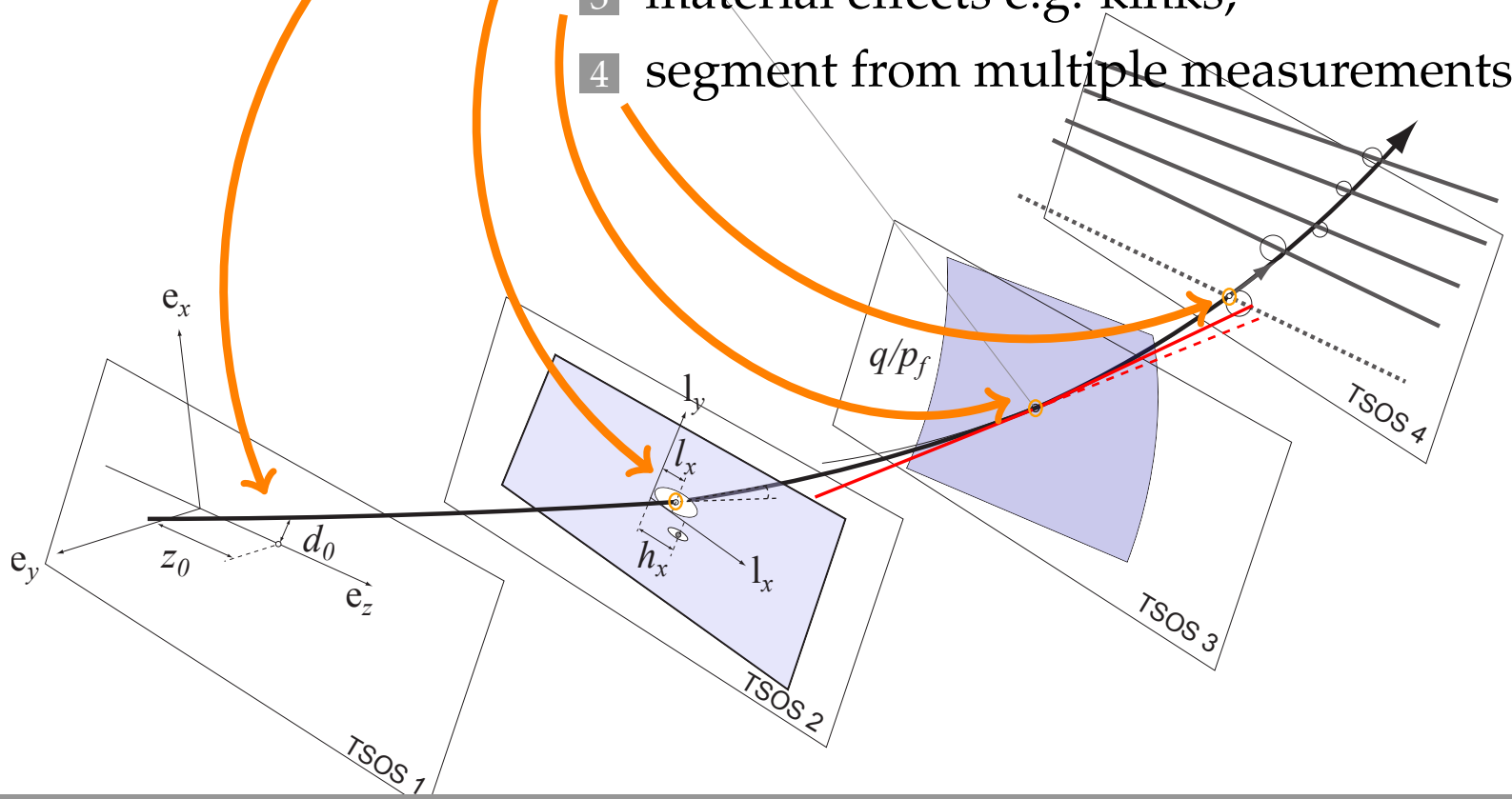




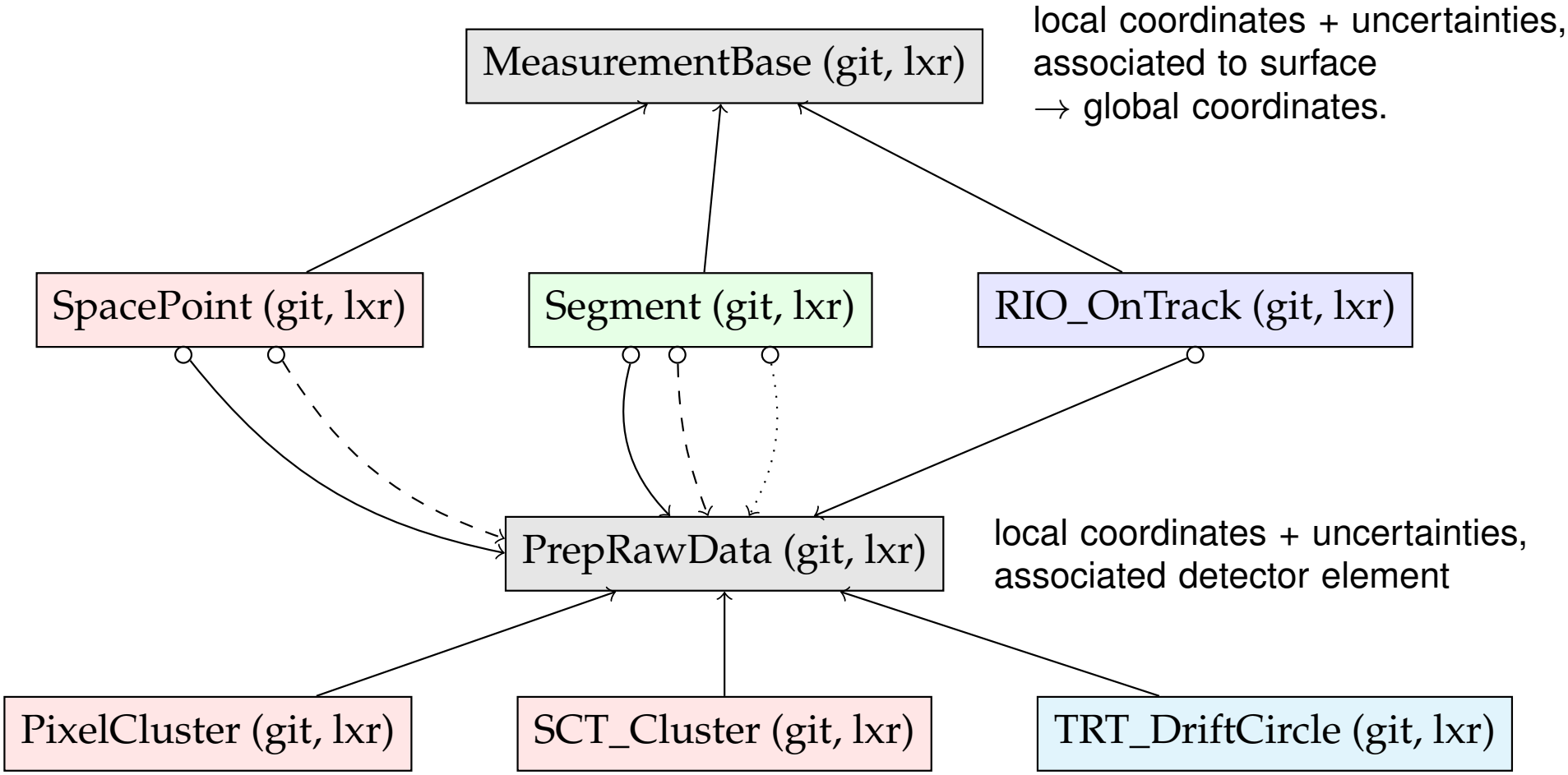
Trk::Track (ESD)

contains inputs for fitting and fit results, mostly contained in list of TrackStatesOnSurfaces(→git, lxr) e.g.

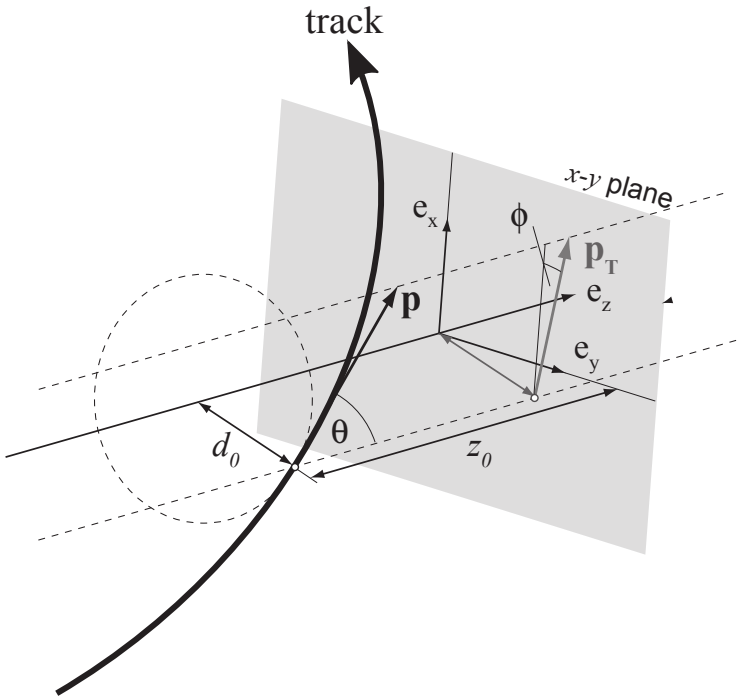
1. Track defining parameters
2. measurement and track parameters at surface of measurement
3. material effects e.g. kinks,
4. segment from multiple measurements.



Class hierarchy – measurements

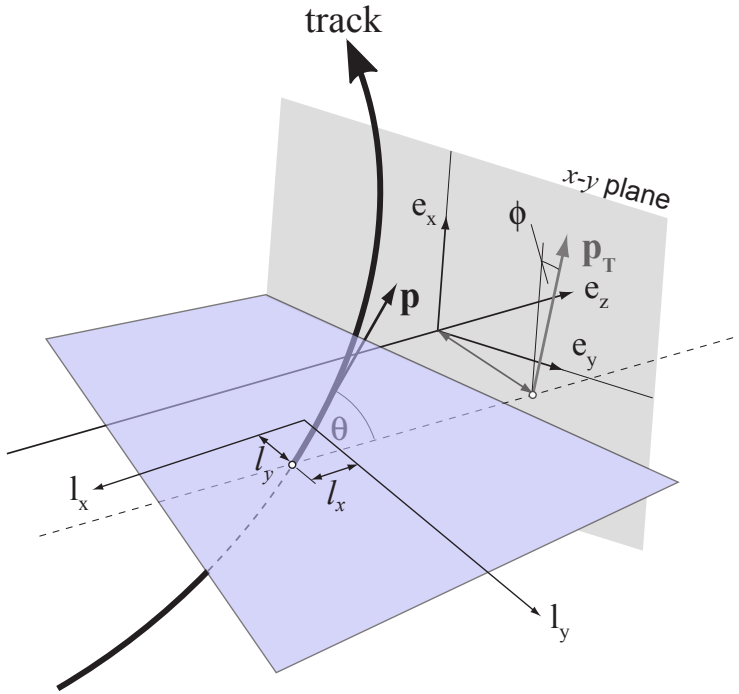


Track Parameters



Global track parameters e.g. wrt. perigee

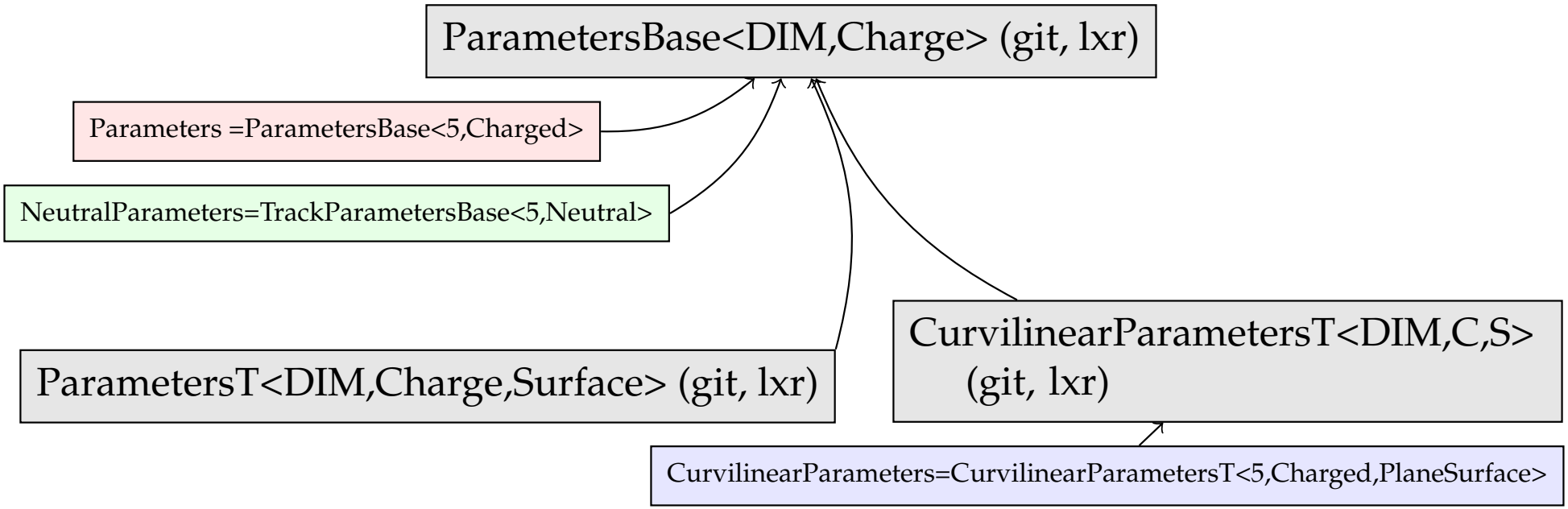
$$\left(d_0, z_0, \phi, \theta, \frac{q}{p}\right)$$



Track parameters in **local** coordinates e.g. detector module

$$\left(l_x, l_y, \phi, \theta, \frac{q}{p}\right)$$

Class hierarchy – parameters



Instances TrackParameters (git, lxr), NeutralParameters (git, lxr):

Surface Charge=Charged(Neutral)	type
PerigeeSurface	(Neutral)Perigee
PlaneSurface	(Neutral)AtaPlane
StraightLineSurface	(Neutral)AtaStraightLine
ConeSurface	(Neutral)AtaCone
CylinderSurface	(Neutral)AtaCylinder
DiscSurface	(Neutral)AtaDisc

xAOD::TrackParticle (AOD)

For analysis →xAOD::TrackParticle (git)

- created from Trk::Track
- can hold track parameters at multiple positions, but usually only defining parameters (d_0, z_0, ϕ, θ, q/p) and parameters at first measurement are kept
- contains lower triangular covariance matrix of track parameters
- track summary (number of hits, holes, pixel dE/dx etc.)
- There are some helper methods for derived quantities (p_T uncertainty, d_0 significance including beam spot uncertainty)(→TrackParticlexAODHelpers; git), and tools for track particle selection (twiki) and systematics (twiki)

Vertex Finding

- There are many vertex fitter available in ATLAS: TrkVKalVrtFitter (git, lxr), InDetV0FinderTool (git, lxr), InDetAdaptiveMultiPriVxFinderTool (git, lxr)
- many accept as input xAOD::TrackParticle and xAOD::NeutralParticle (git)
- output is xAOD::Vertex (git), which
- provides 3D coordinate and covariance, links to charged and neutral particles, n.d.o.f and χ^2

Further Information

- Inner Tracking Combined Performance Group (twiki) e.g.
  - Guidelines for physics analyses (InDetTrackingPerformanceGuidelines)
- Inner Detector Software Documentation (twiki) e.g.
  - ATLAS Tracking algorithms ATL-SOFT-PUB-2007-007
  - ATLAS Tracking EDM ATL-SOFT-PUB-2007-003
- Code documentation :
  - doxygen
  - the xAOD Tracking base classes (xAODTracking)
  - helper functions for xAOD TrackParticles (TrackParticlexAODHelpers)

Future developments – Run3

- Migration to multithreaded reconstruction for Run3
- Links from track particles to primary vertices will be deprecated!
- (Iterative) migration to ACTS, A (modern) common (ATLAS,FCC, ?) Tracking Software
- Severe lack of experts in InnerDetector tracks reconstruction(similar for all domains)

→ if You are interested You are very welcome!