

A Brief Introduction to ACTS

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Outline

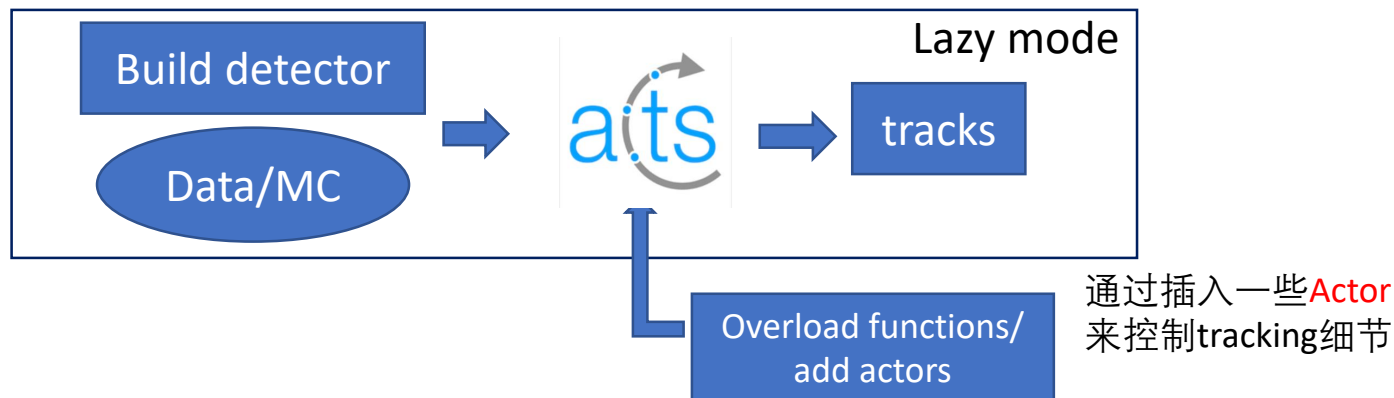
- What is ACTS – a Common tracking software
- What can we benefit
- How/where can we start
- Some intro of models & concept
- Development in ACTS

ACTS – A common tracking software

- 概念来自于ATLAS (Atlas common tracking software)
 - 一方面ATLAS现有代码存在很多问题
 - 重建代码过于庞大
 - Event Data Model极为繁多复杂
 - 重建算法的时间性能差
 - 在统一的EDM和下开发不依赖于探测器几何重建模块
- 开发重建用到的所有模块
 - Geometry, EDM, track finding, fitting, alignment ..
- 不依赖探测器几何与框架
 - 包含构建tracking geometry 的 plugins – 需要TGEO/DD4HEP格式的几何文件
 - 所有核心代码封装封装在acts-core中，每个模块算法独立于外部框架，通过经过boost的unit test测试
 - 有一个简单实现GAUDI的acts-framework，可以实现事例循环、模拟、数字化等基本流程，可以做事例级别的测试

ACTS – A common tracking software

- 灵活



```
PropagatorOptions<ActionList<MaterialInteractor, KalmanActor>> options;
```

- 代码效率要求高
 - C++新特性(如智能指针防止内存泄漏) now c++ 17
 - 模板元编程, 编译期处理
 - 数学计算工具(Eigen..)
- 多线程/支持机器学习
 - ACTS-framework: 提供多事例并行计算
 - Future plan: 事例级别
 - ML support : maybe future plan

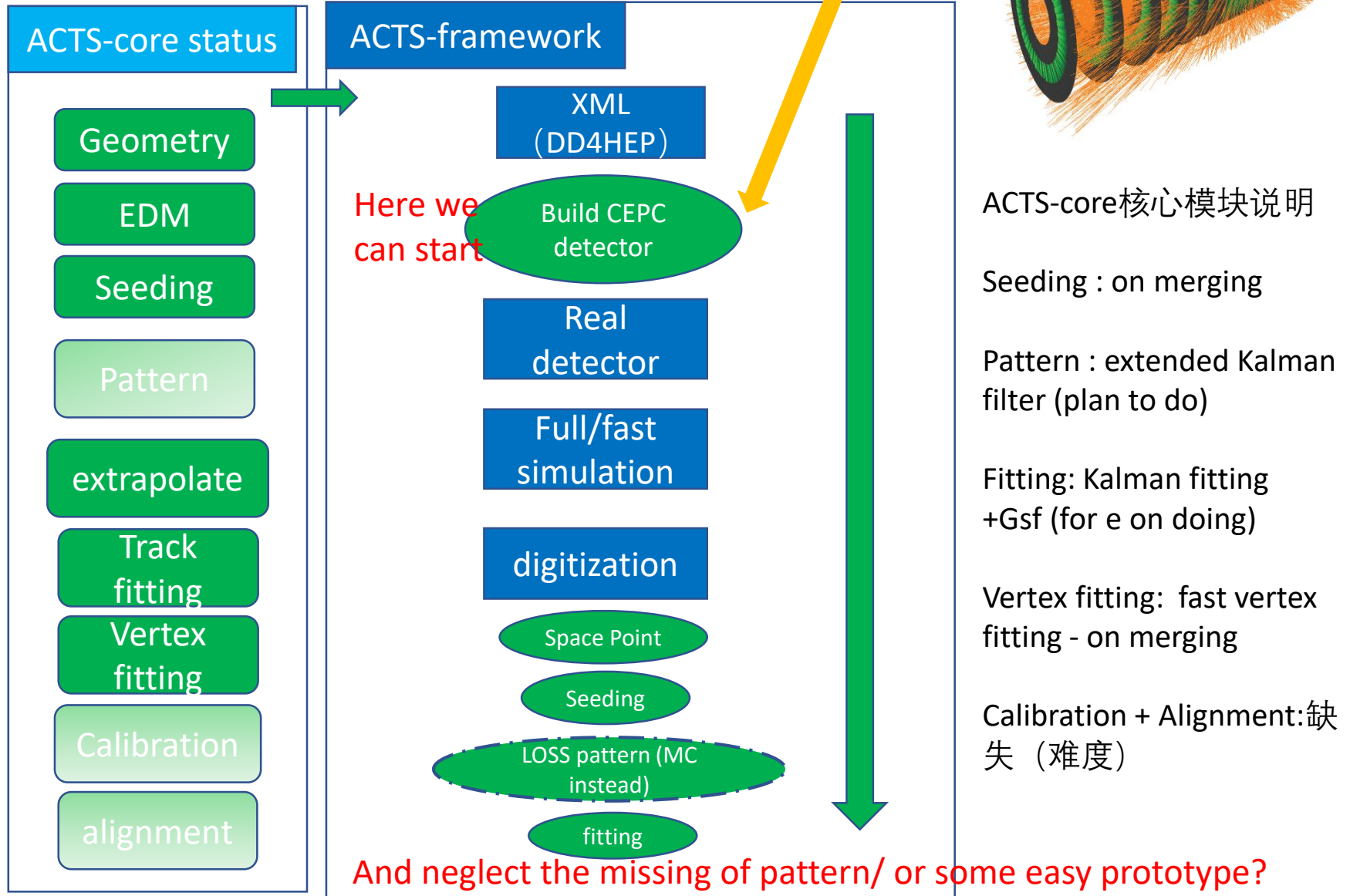
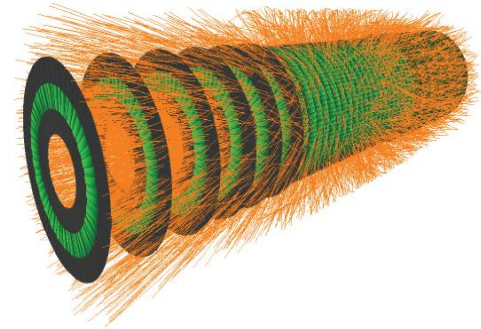
Acts tracking is like a drama, just needed good some actors

What we can benefit

- 整个重建框架独立于探测器几何 — 只需要输入探测器的几何就可以执行完整的重建流程，我们只需要调试或者增加一些特殊的方法，降低开发的成本
- 这种灵活的方式可以方便的提供多个探测器版本的重建进行比较
- 有专门的开发团队进行维护

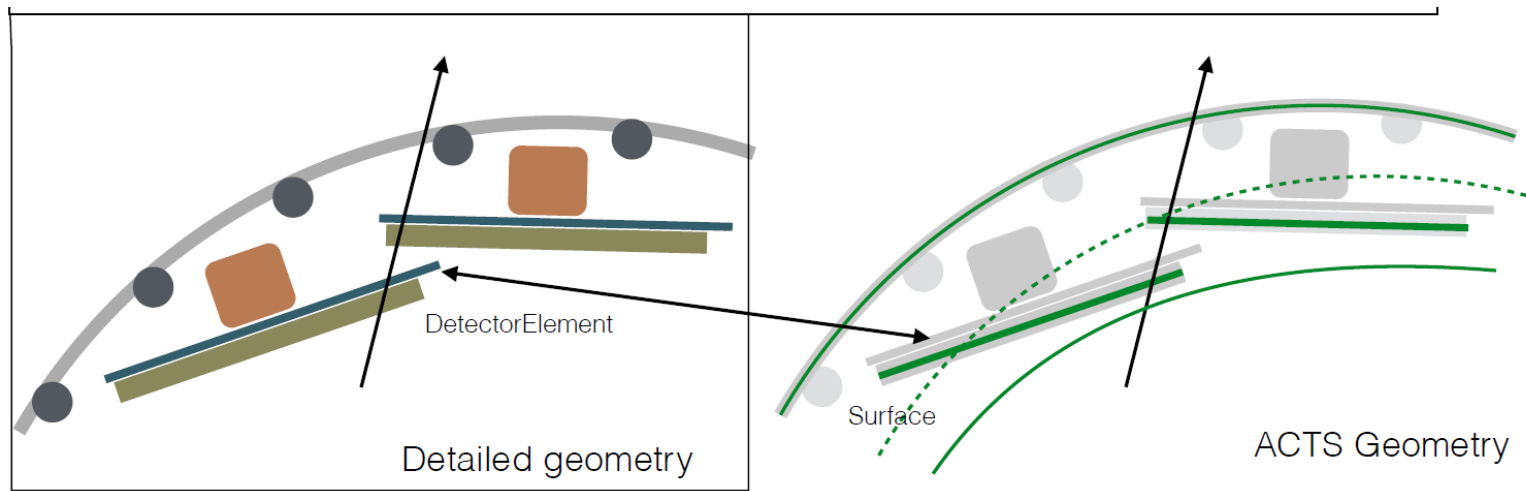
How we can start

可供参考的探测器TrackML



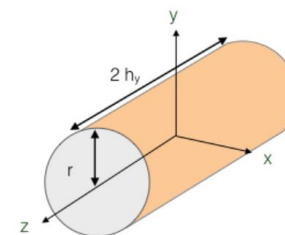
Geometry Concept

- 在ACTS中，所有的几何结构都由Surface构建
- 重建用到的几何(Tracking geometry) 只由基本的surface和物质材料构建
 - Surface->Layer->Volume->glue to tracking Volume
 - Material mapping: on surface or volume



Geometry-Surface

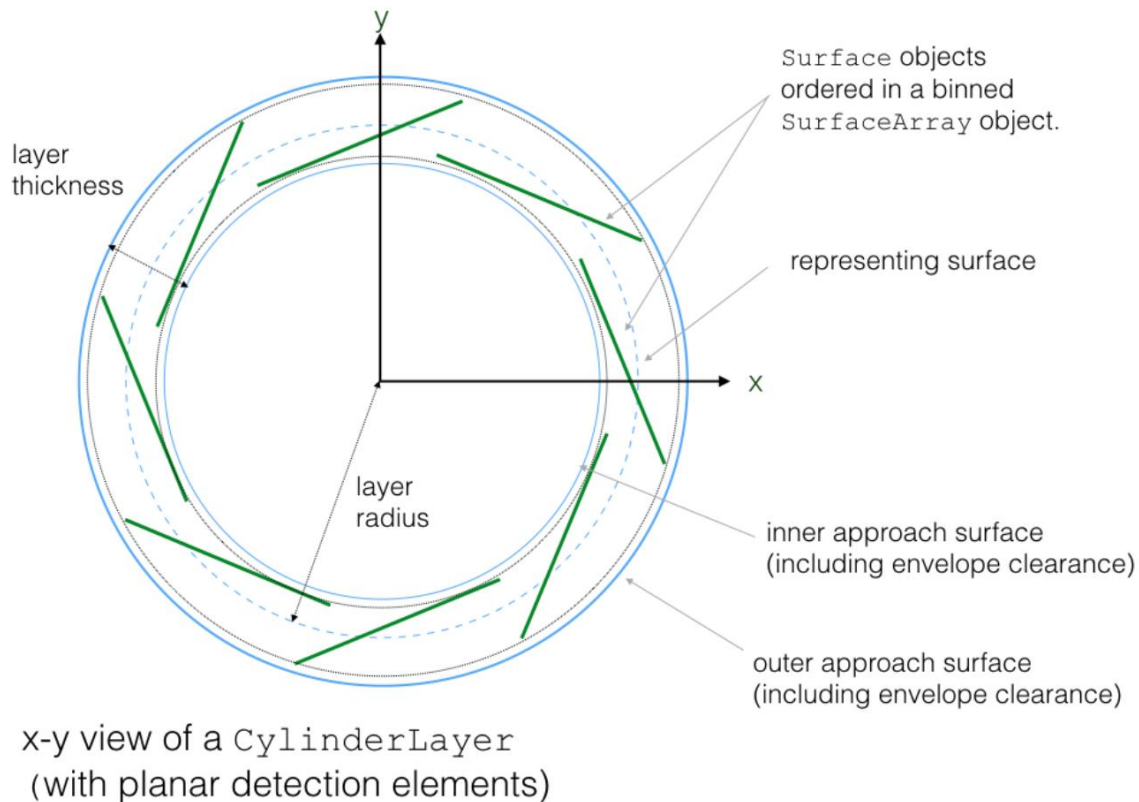
- 描述几何结构的基本单元
 - 位置信息：平移矩阵+旋转矩阵
 - 不同的surface上的测量量的表述不同(径迹传播和Kalman修正时用局部坐标)
 - Binning on surface



Surface Type	Local Coordinates	Bound Types available
ConeSurface	[rphi, z]	ConeBounds
CylinderSurface	[r, phi]	CylinderBounds
DiscSurface	[r, phi]	RadialBounds, DiscTrapezoidalBounds
PlaneSurface	[x, y]	RectangleBounds, TrapezoidalBounds, TriangleBounds, InfiniteBounds, EllipseBounds
PerigeeSurface, StrawSurface	[d, z]	CylinderBounds

Geometry-Layer

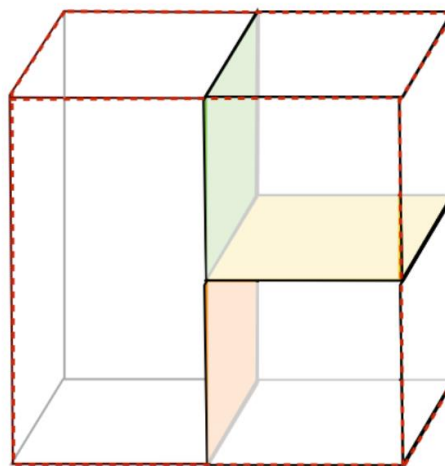
- Surface的拓展，可以包括多个Surface和material



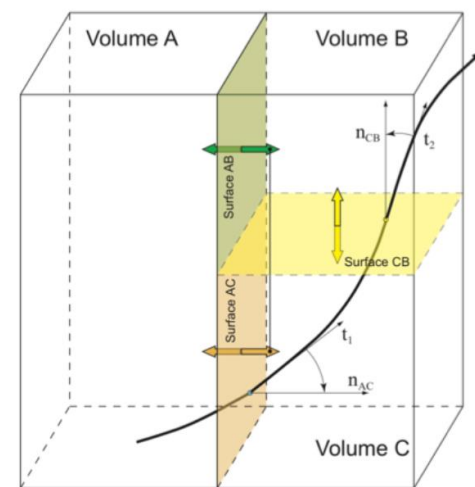
Geometry-Volume

- Volume 是一系列Boundary限定起来的
- TrackingVolume
 - 一系列layer
 - 一系列子volume
 - Material描述
 - 通过Boundary Surface 粘合

glue volume A to container BC:
new container volume ABC



attached boundary
surfaces A_{right} to B_{left} and C_{left}



resulting navigation
through the boundary portals

在径迹推导的时候可以通过边界向量知道导向下一个Volume

CEPC Geometry

- 构建几何需要DD4HEP/TGEO的XML文件
- ACTS有Plugin可以通过将XML文件转化为Tracking Geometry, 可能需要添加一些
- 当前有的几何
 - FCC – 由DD4HEP构建
 - TrackML - c++构建
 - 将会有有一个DD4HEP构建的TrackML, 包括如何构建该几何的说明, 我们可以借鉴模仿

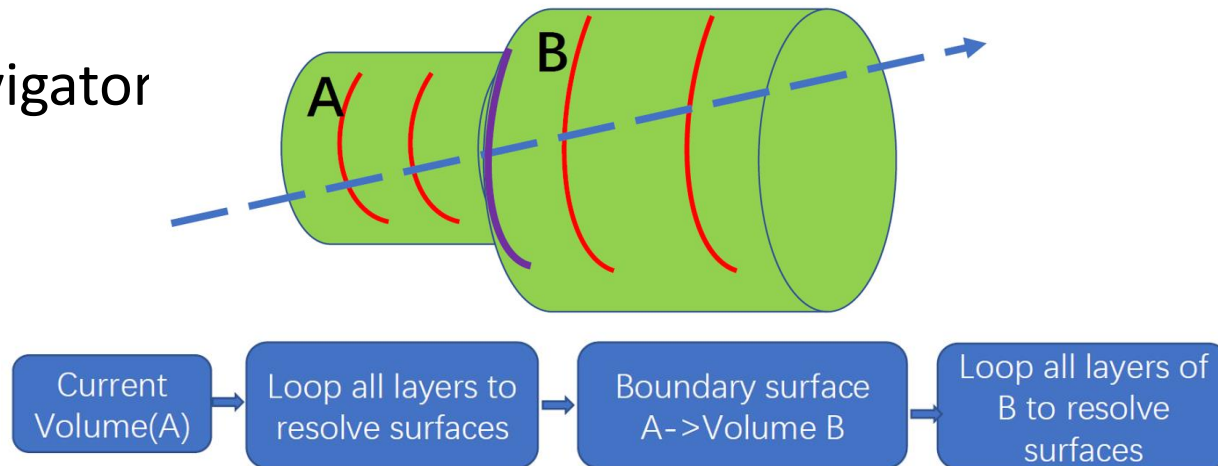
Extrapolate: Stepper & Navigator

- Stepper

- 决定径迹每一步怎么走，走多远
- 决定在Vacuum中走还是在Dense(Calo)环境下走（有能量损失） - 或者是用户添加的其他实现

```
template <typename... extensions>  
struct StepperExtensionList : private detail::Extendable<extensions...>  
{
```

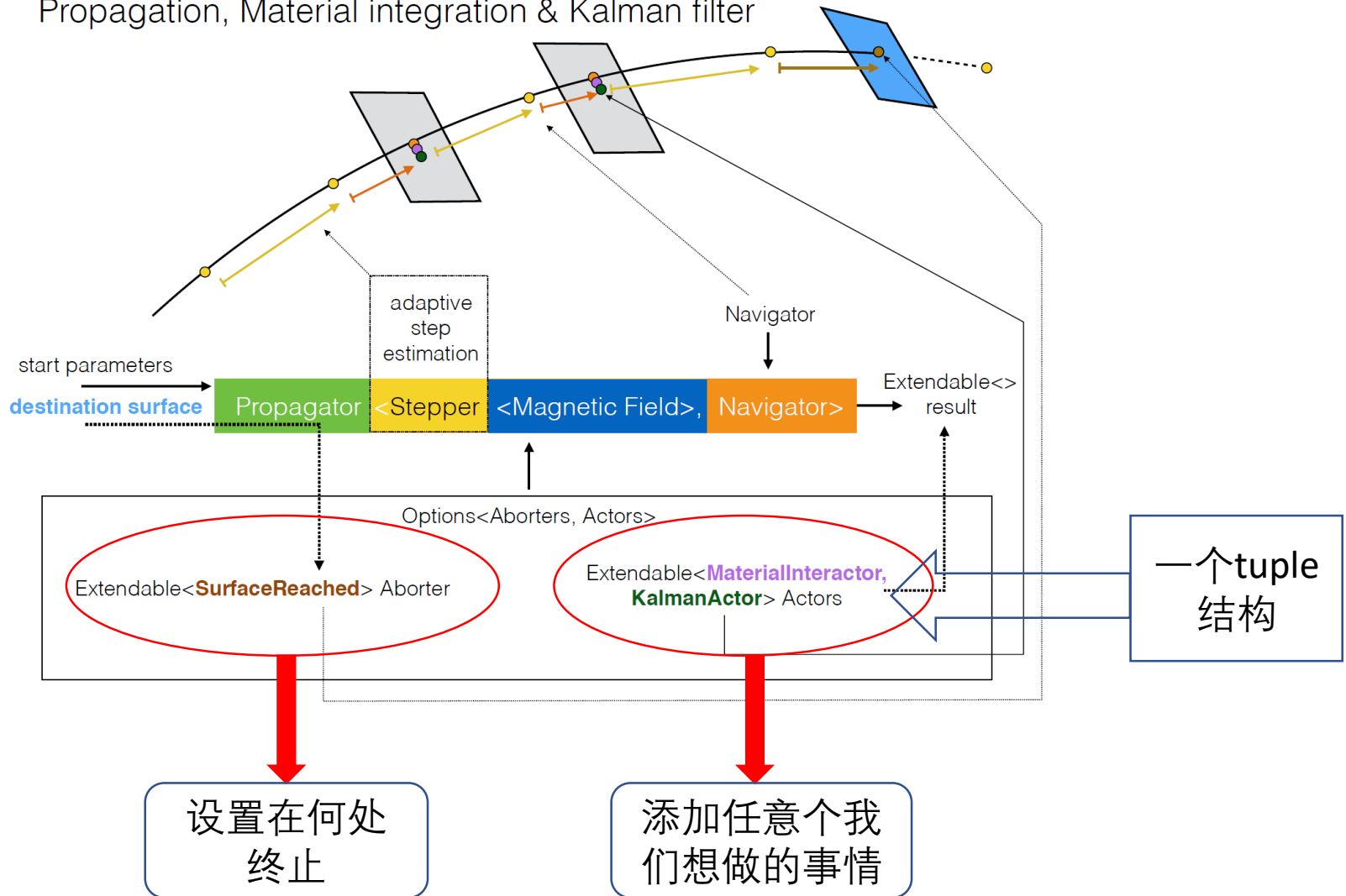
- Navigator



Extrapolate 确定不同平面上的径迹参数（与Surface相关），计算误差矩阵的传播

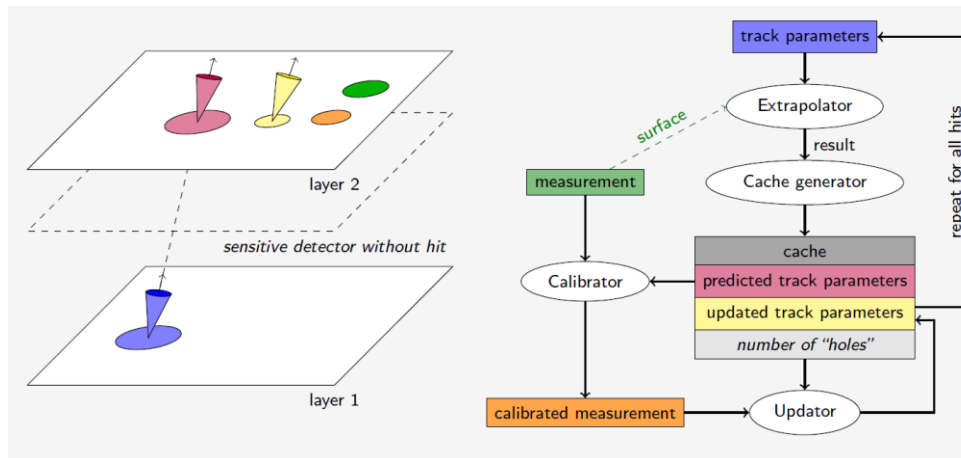
Extrapolate sketch

Propagation, Material integration & Kalman filter



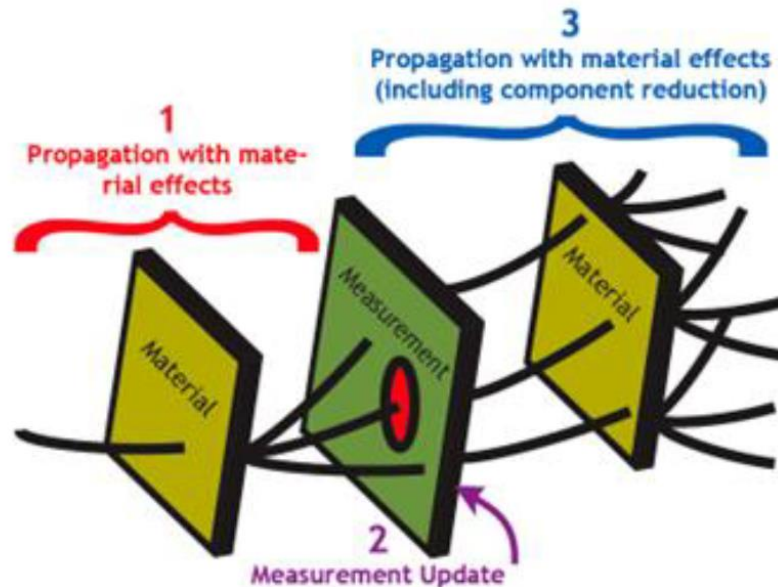
Track finding & Fitter

- Track finding
 - Space Point
 - Seeding
 - Pattern (missing) , a basic global Chi2 fit should be implemented - - no current prototype in ATLAS(only one with Multiscattering and sophisticated)
- Kalman fitter
 - 有完整的Kalman拟合程序
 - Calibration model is missing (empty calibrator in Kalman code)



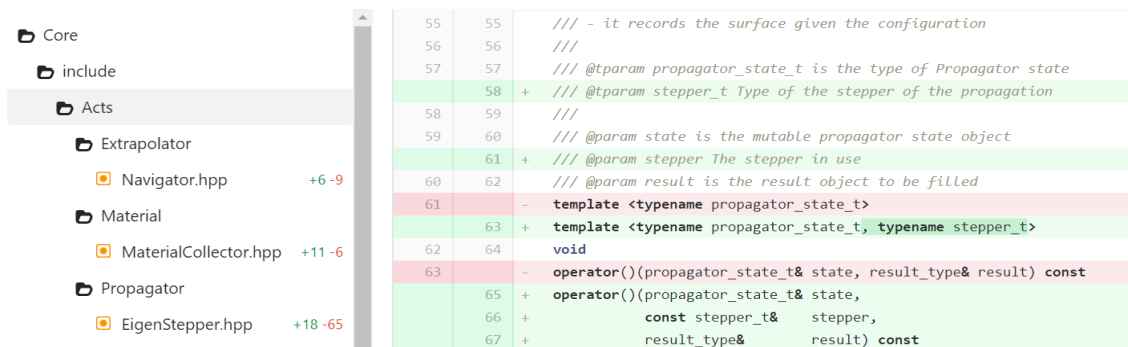
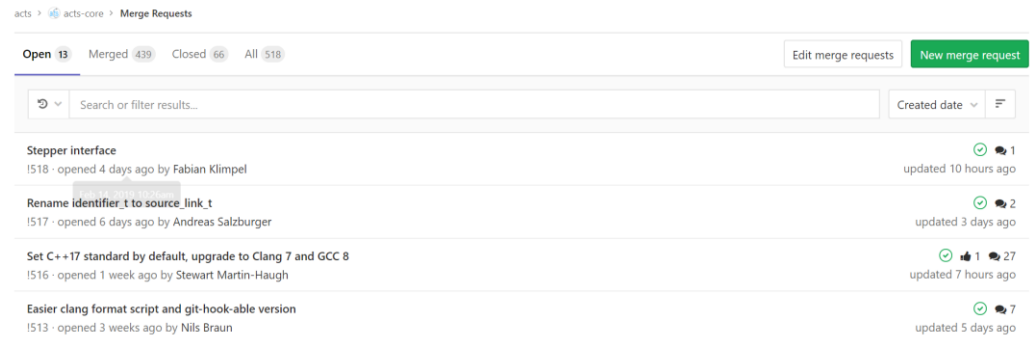
Gaussian sum filter

- Kalman filter : noise/measurement is gaussian
- Electron-bremsstrahlung: none gaussian noise
- GSF is a parallel Kalman to construct the specific energy loss



Development in ACTS

- Gitlab: the code repository: <https://gitlab.cern.ch/acts>
- Local branch -> merge request -> merge to master
 - Others will go through the code and comment
 - At least 2 approved



JIRA: assignment of issues

The screenshot displays the JIRA web interface for the 'acts-core' project. The left sidebar contains navigation links: ACTS, Backlog, Kanban board, Releases, Reports, Issues (selected), Components, and Add-ons. The main content area is titled 'Open issues' with a 'Switch filter' dropdown. A list of issues is shown, ordered by priority, with 'ACTS-565: Move issues to Gitlab' selected. The right panel shows the details for this issue, including its type (Improvement), status (OPEN), priority (Needs Decision), and description. The description asks if there is a reason for keeping issues in a separate Jira tracker and suggests moving them to Gitlab. The 'Attachments' section is empty, and the 'Activity' section shows no comments. The 'People' section lists the assignee as 'Unassigned' and the reporter as 'Moritz Kiehn'. The 'Dates' section shows the issue was created and updated on 15/Jan/19 at 1:46 AM.

Open issues [Switch filter](#) [View all issues and filters](#)

Order by Priority

- ACTS-565: Move issues to Gitlab
- ACTS-433: Review & update step estimation
- ACTS-519: Create StrawSurface constructor fro...
- ACTS-462: Synchronise AtlasStepper / EigenSte...
- ACTS-541: Implement MulitComponentStepper
- ACTS-547: Investigate - change Surface::transfr...
- ACTS-569: Allow possibility to link to a detector...
- ACTS-546: Fitter & Calibrator
- ACTS-568: Introduce payload object for MT calls
- ACTS-495: Extrapolator/Propagator development

+ Create issue

Details

Type: Improvement
Status: OPEN (View Workflow)
Priority: Needs Decision
Resolution: Unresolved
Affects Version/s: None
Fix Version/s: 0.09.00
Component/s: None
Labels: None

Description

Is there a reason why we are keeping the issues in a separate Jira tracker? Should we consider moving the issues over to Gitlab so we have everything in one place? The gitlab interface has quite improved in the past and I would prefer to not to have switch sites.

Attachments

Drop files to attach, or browse.

Activity

All **Comments** Work Log History Activity Subversion

There are no comments yet on this issue.

People

Assignee: Unassigned
[Assign to me](#)
Reporter: Moritz Kiehn
Component Watchers:
Votes: 0 [Vote for this issue](#)
Watchers: 1 [Start watching this issue](#)

Dates

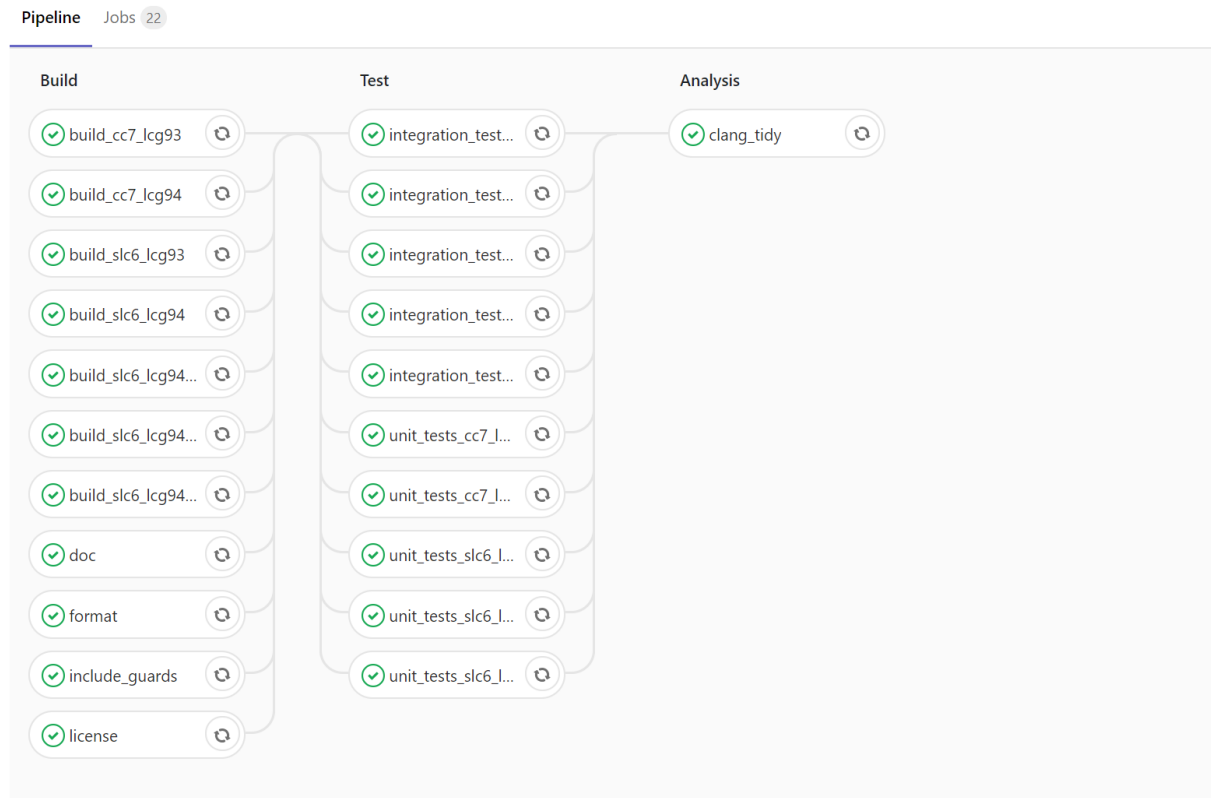
Created: 15/Jan/19 1:46 AM
Updated: 15/Jan/19 1:46 AM

Agile

[View on Board](#)

CI – continues integration

- Push 的代码会经过编译/执行/格式/代码重复/内存等检查，所有通过后才能merge到master



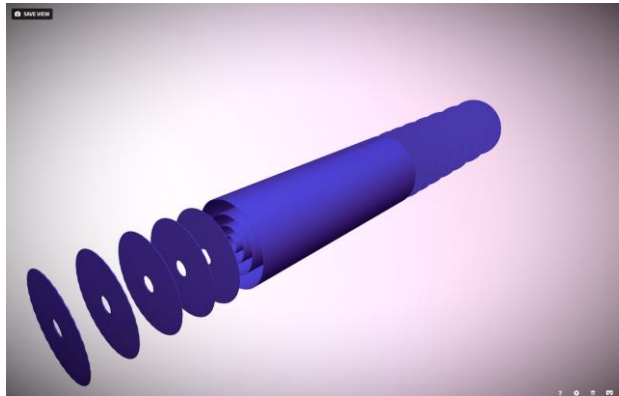
Something else

- All information can get from <https://gitlab.cern.ch/acts> – most parts are public,

try to build a acts-core & acts-framework and execute

`./ACTFWGenericGeometryExample` to get a TrackML Geometry

And `./PropagationExample` to do propagate in detector



- 一些有用的manual: <https://gitlab.cern.ch/acts/acts-documentation/tree/master/docs>
- 关于ATLAS/ACTS资料上传到了CERN BOX: jin zhang,最近我会上传到IHEP BOX

总结

- ACTS现有重建的多数模块，部分模块仍在开发中
- 大部分模块可以在ACTS框架(acts-framework)下用
- 由于目前确实pattern模块，如果在假设所有track找到的情况下做完整的重建
- CEPC的几何构建需要构造DD4HEP的XML文件，下一步看起来有比较明确的参照来构建CEPC的几何