ArtG4

Adam Lyon / FNAL SCD

g-2 Simulation Software Workshop October 2012

Remember why

```
// constructionMaterials is essentially a "materials library" class.
// Passing to to construction functions allows access to all materials

  /**** BEGIN CONSTRUCTION PROCESS  ****/

  // Construct the world volume
  labPTR = lab -> ConstructLab();
  // Construct the "holders" of the actual physical objects
#ifdef TESTBEAM
  ArcH.push_back(labPTR);
#else
  ArcH = arc->ConstructArcs(labPTR);
#endif
  // Build the calorimeters
  //  cal -> ConstructCalorimeters(ArcH);
   station->ConstructStations(ArcH);
#ifndef TESTBEAM
  // Build the physical vacuum chambers and the vacuum itself
  VacH = vC -> ConstructVacChamber(ArcH);
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We want a system that makes it easy to avoid...

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This must be preserved

What are the requirements?

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Store geant "products" in the Art event

What did we write?

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Detector construction in code (instead of GDML)

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Conversion of Geant data to Art data

The difficulty

Geant has it's own event loop and data store

Art wants to own the event loop and wants you to use its data store

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Merge these

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Detectors are then producers that pull info out of Geant

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Detectors are then producers that pull info out of Geant

The special Geant producer kicks off the Geant event and the other producers come in afterwards pulling data out of Geant and place into the Art event

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Producer A is not allowed to squirrel away data in a service to be used by Producer B in later processing

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So, to comply, we need ONE producer that produces

Why the golden rule?

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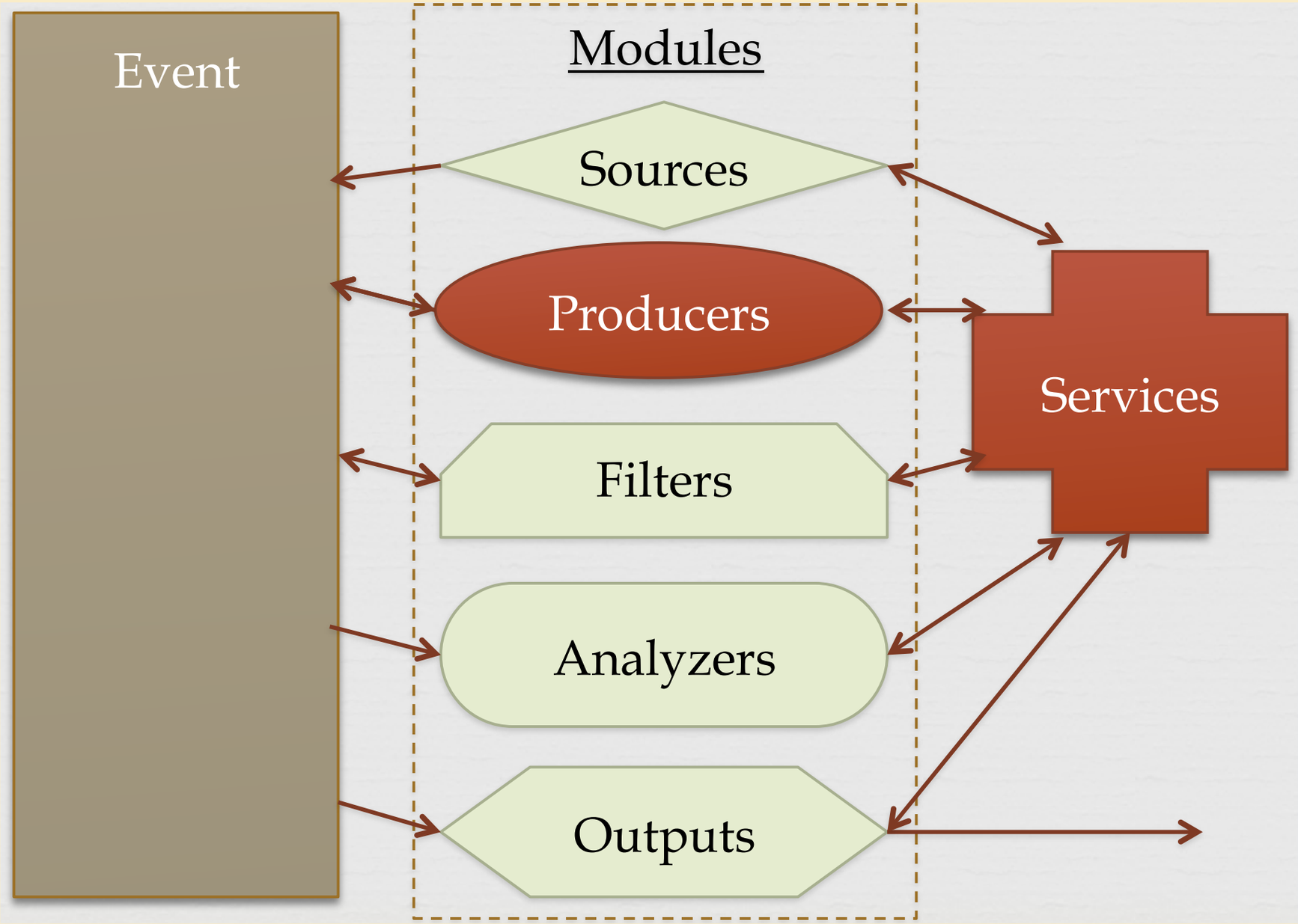
Compatibility with multiprocessor running:
- **Paths may be run on different processors**
- **Producers may be run on different processors**

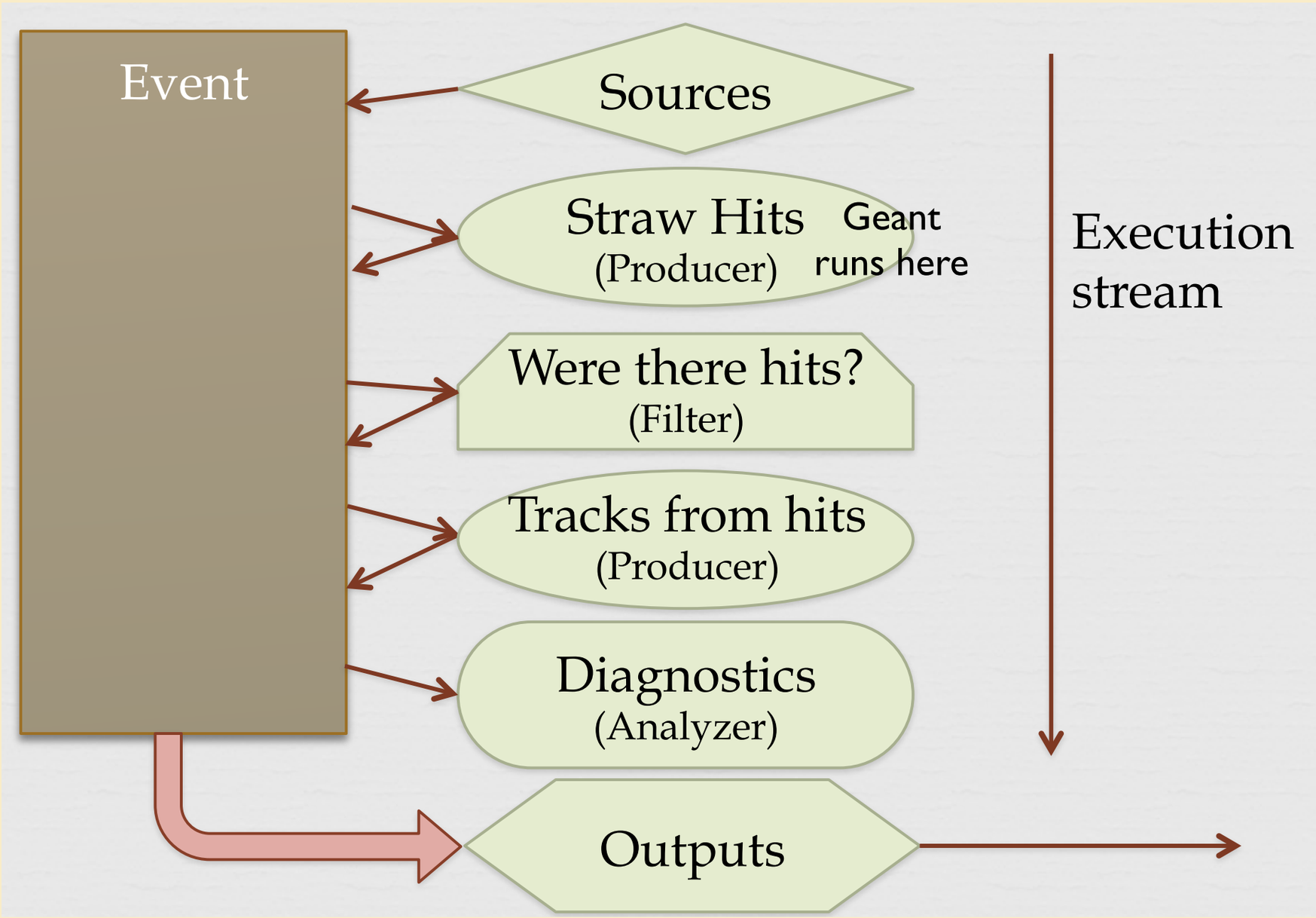
Also makes production on demand much cleaner

So, to comply, we need ONE producer that produces ALL of the data from the Geant event

There can be only one (for GEANT)



Example processing



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#include "GeometryService/inc/Mu2eEnvelope.hh"
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This is part of Mu2e's geometry service header

They #include every detector that you could possibly use

But we don't want "uber" modules

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#include "GeometryService/inc/GeometryService.hh"
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#include "GeometryService/src/DetectorSystemMaker.hh"
#include "GeometryService/inc/WorldG4.hh"
#include "GeometryService/inc/WorldG4Maker.hh"
#include "Mu2eBuildingGeom/inc/BuildingBasics.hh"
#include "Mu2eBuildingGeom/inc/BuildingBasicsMaker.hh"
#include "Mu2eBuildingGeom/inc/Mu2eBuilding.hh"
#include "Mu2eBuildingGeom/inc/Mu2eBuildingMaker.hh"
#include "ProductionTargetGeom/inc/ProductionTarget.hh"
#include "ProductionTargetGeom/inc/ProductionTargetMaker.hh"
#include "ProductionSolenoidGeom/inc/ProductionSolenoid.hh"
#include "ProductionSolenoidGeom/inc/ProductionSolenoidMaker.hh"
#include "ProductionSolenoidGeom/inc/PSEnclosure.hh"
#include "ProductionSolenoidGeom/inc/PSEnclosureMaker.hh"
#include "ProductionSolenoidGeom/inc/PSVacuum.hh"
#include "ProductionSolenoidGeom/inc/PSVacuumMaker.hh"
#include "ProductionSolenoidGeom/inc/PSShield.hh"
#include "ProductionSolenoidGeom/inc/PSShieldMaker.hh"
#include "ProtonBeamDumpGeom/inc/ProtonBeamDump.hh"
#include "ProtonBeamDumpGeom/inc/ProtonBeamDumpMaker.hh"
#include "TargetGeom/inc/Target.hh"
#include "TargetGeom/inc/TargetMaker.hh"
#include "LTrackerGeom/inc/LTracker.hh"
#include "LTrackerGeom/inc/LTrackerMaker.hh"
#include "TTrackerGeom/inc/TTracker.hh"
#include "TTrackerGeom/inc/TTrackerMaker.hh"
#include "ITrackerGeom/inc/ITracker.hh"
#include "ITrackerGeom/inc/ITrackerMaker.hh"
#include "CalorimeterGeom/inc/Calorimeter.hh"
#include "CalorimeterGeom/inc/DiskCalorimeterMaker.hh"
#include "CalorimeterGeom/inc/DiskCalorimeter.hh"
#include "CalorimeterGeom/inc/VaneCalorimeterMaker.hh"
#include "CalorimeterGeom/inc/VaneCalorimeter.hh"
#include "BFieldGeom/inc/BFieldConfig.hh"
#include "BFieldGeom/inc/BFieldConfigMaker.hh"
#include "BFieldGeom/inc/BFieldManager.hh"
#include "BFieldGeom/inc/BFieldManagerMaker.hh"
#include "BeamlineGeom/inc/Beamline.hh"
#include "BeamlineGeom/inc/BeamlineMaker.hh"
#include "GeometryService/inc/VirtualDetector.hh"
#include "GeometryService/inc/VirtualDetectorMaker.hh"
#include "CosmicRayShieldGeom/inc/CosmicRayShield.hh"
#include "CosmicRayShieldGeom/inc/CosmicRayShieldMaker.hh"
#include "ExtinctionMonitorFNAL/Geometry/inc/ExtMonFNALBuilding.hh"
#include "ExtinctionMonitorFNAL/Geometry/inc/ExtMonFNALBuildingMaker.hh"
#include "ExtinctionMonitorFNAL/Geometry/inc/ExtMonFNAL.hh"
#include "ExtinctionMonitorFNAL/Geometry/inc/ExtMonFNAL_Maker.hh"
#include "ExtinctionMonitorUCIGeom/inc/ExtMonUCI.hh"
#include "ExtinctionMonitorUCIGeom/inc/ExtMonUCIMaker.hh"
#include "MECOStyleProtonAbsorberGeom/inc/MECOStyleProtonAbsorber.hh"
#include "MECOStyleProtonAbsorberGeom/inc/MECOStyleProtonAbsorberMaker.hh"
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If you add a new detector, you must remember to change this code too!

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To be fair: the Mu2e configuration file predates Art

Our alternative

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One producer to rule Geant (entirely): artg4_module.cc

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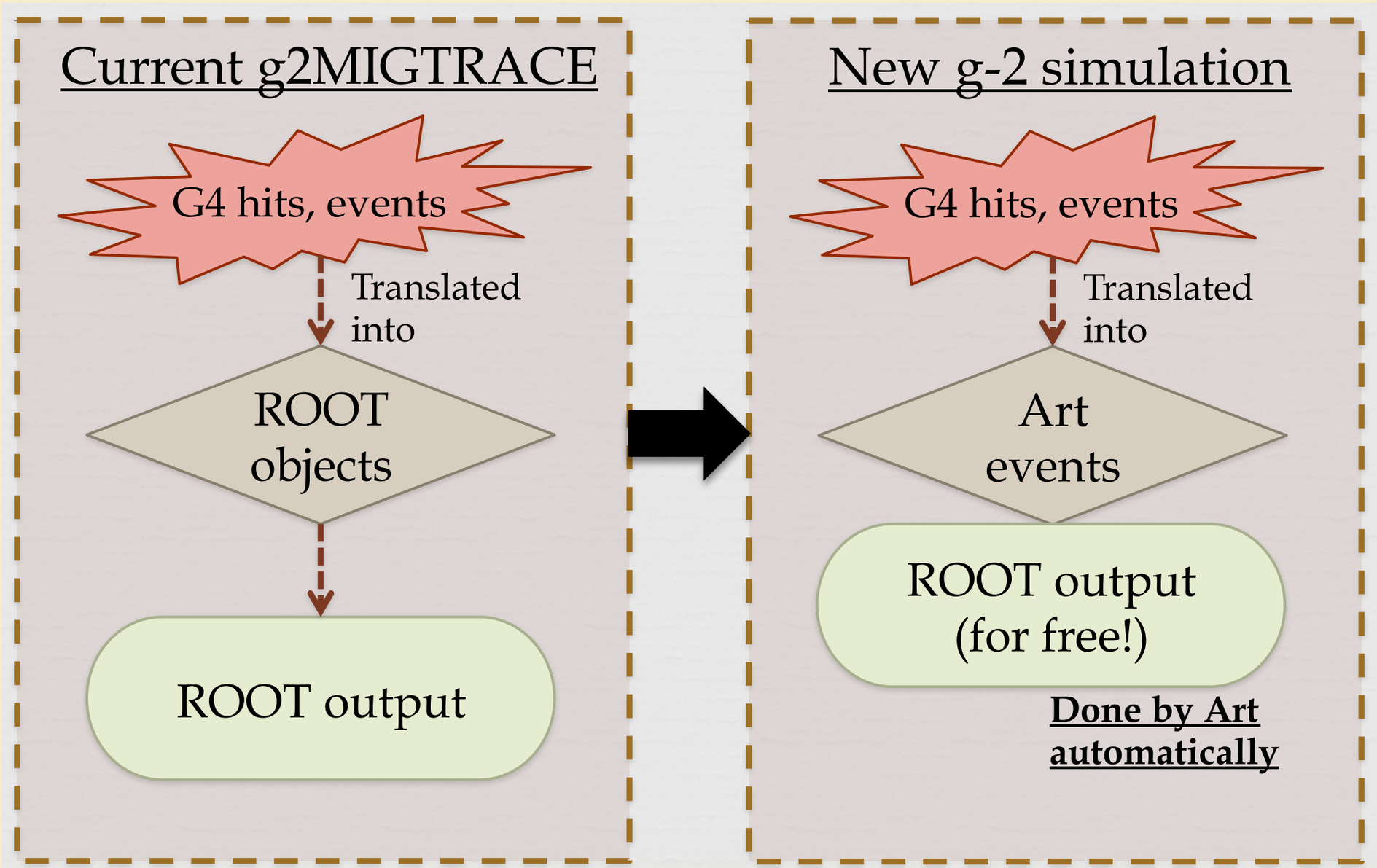
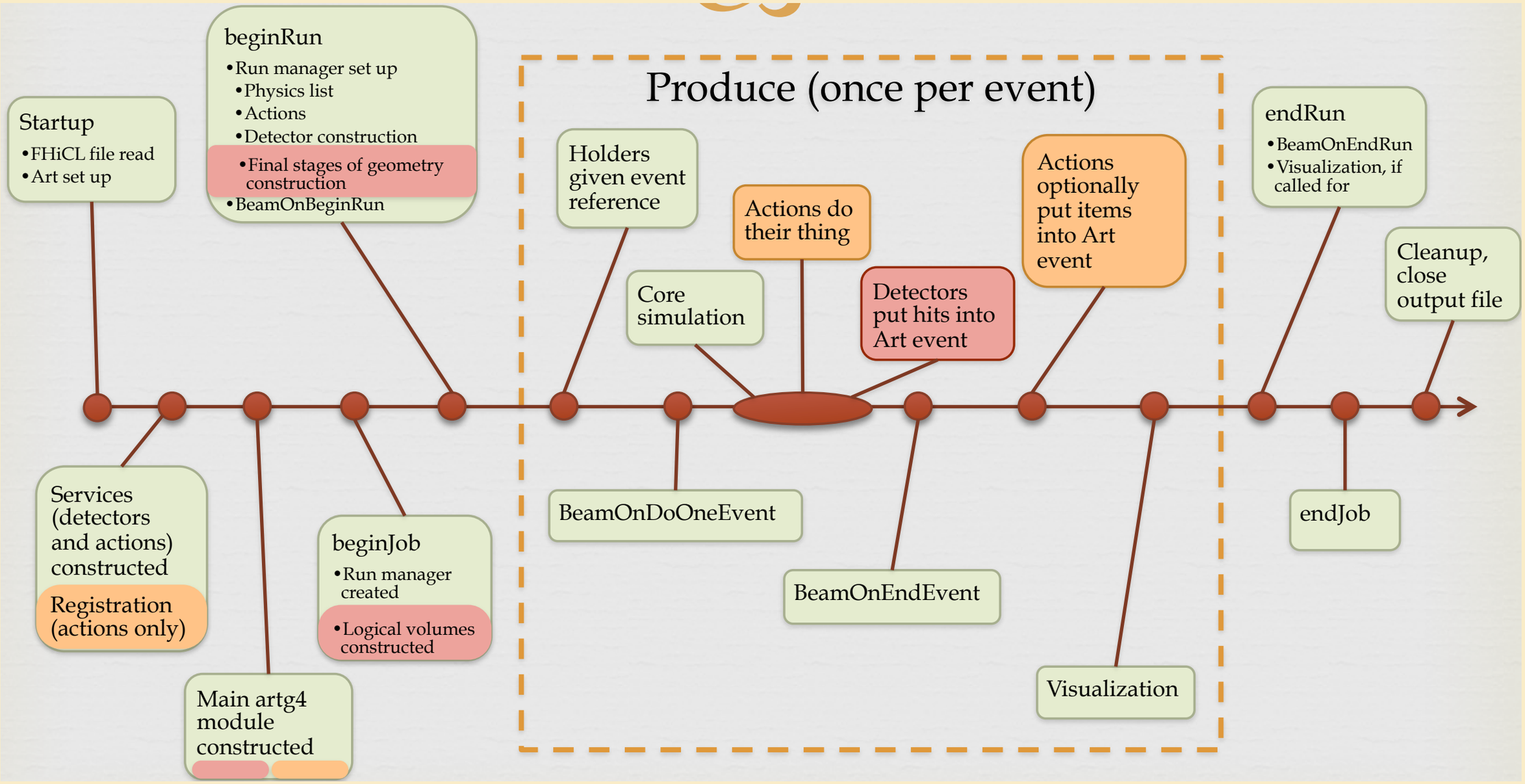
Getting data into Art



Timeline


Startup
•FHiCL file read
•Art set up
beginRun
•Run manager set up
•Physics list
•Actions
•Detector construction
•Final stages of geometry construction
•BeamOnBeginRun
Produce (once per event)
Holders given event reference
Actions do their thing
Actions optionally put items into Art event
Core simulation
Detectors put hits into Art event
endRun
•BeamOnEndRun
•Visualization, if called for
Cleanup, close output file
Services (detectors and actions) constructed
Registration (actions only)
Main artg4 module constructed
beginJob
•Run manager created
•Logical volumes constructed
BeamOnDoOneEvent
BeamOnEndEvent
Visualization
endJob

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Nearly all of the heavy-Geant physics & construction code can remain as is (Whew!)

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No - wait - first look at

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https://cdcvs.fnal.gov/redmine/projects/artg4/wiki/Wiki