Features in LArPandoraContent v03_09_00

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Overview

- Two key Pandora-related developments

  - Consolidated reconstruction approach
    - Simplifies and improves the downstream usage Pandora outputs
    - Generic approach: can be used for all LArTPC detectors!

  - Track + shower extraction into separate LArSoft producers
    - Requested to expose non patrec decisions for collaboration
    - Introduces a breaking change

- <u>We request help from the dunetpc & uboonecode coordinators to check our .fcl footprint in their repositories</u>

Consolidated reconstruction

- Pandora can deliver reconstructed particles using two different <u>patrec hypotheses</u>
    1. Optimised for cosmic-rays
    2. Optimised for neutrino interactions

- Which hypothesis should be used a given group of hits?
    - In Pandora, we can try out *both* hypotheses simultaneously
    - Decide which hypothesis to use
    - Produce a **consolidated** output with <u>no double counting</u>

- Using this approach, only a single Pandora instance is needed
    - pandoraCosmic & pandoraNu → pandora
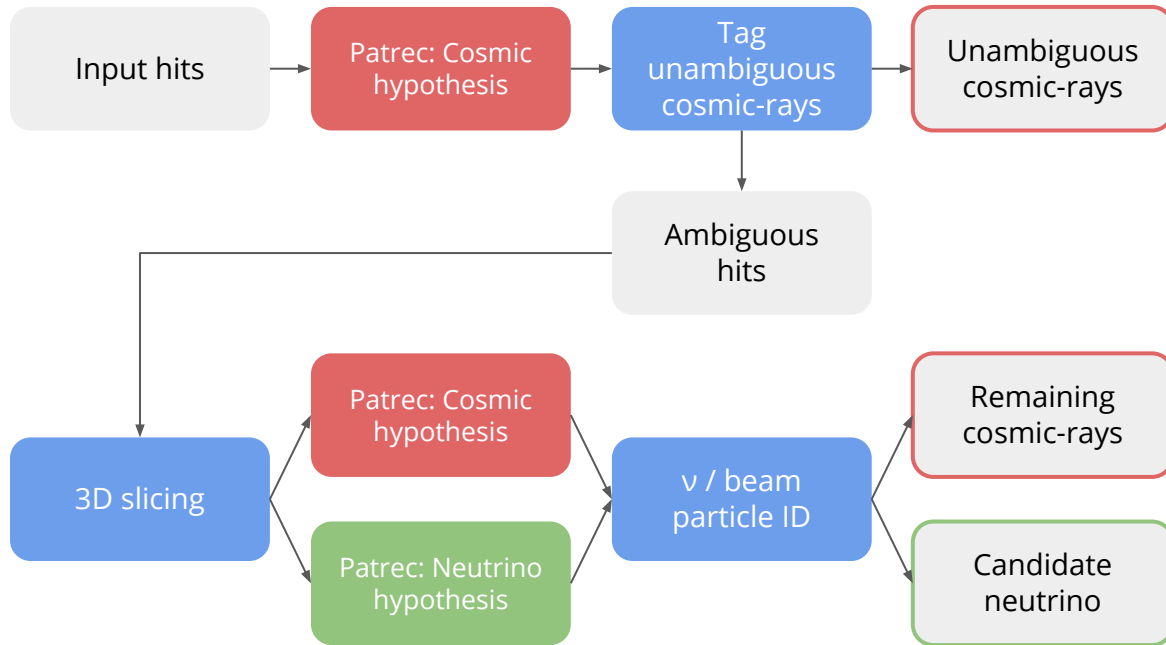   - Users can ask for neutrinos by PFParticle PDG!

This approach is generic, and is used for all detectors!

uboone, SBND, protoDUNE, DUNE FD, ...

Multiple drift volumes ✔
With / without cosmics ✔

Consolidated algorithm flow

- The neutrino / beam particle ID logic is under active development

- Expect updates and improvements in the coming months

Track/shower extraction

The Pandora mandate:

Deliver pattern recognition = hits → clusters → particles → hierarchies

- Tracks & showers are formed *after* the patrec completes
    - They represent high-level properties of the output particles
    - Not within the remit of Pandora (although we can output a tentative estimate in PFParticle)

Previously
One LArSoft producer made all Pandora collections

Now
LArPandora delivers only the patrec
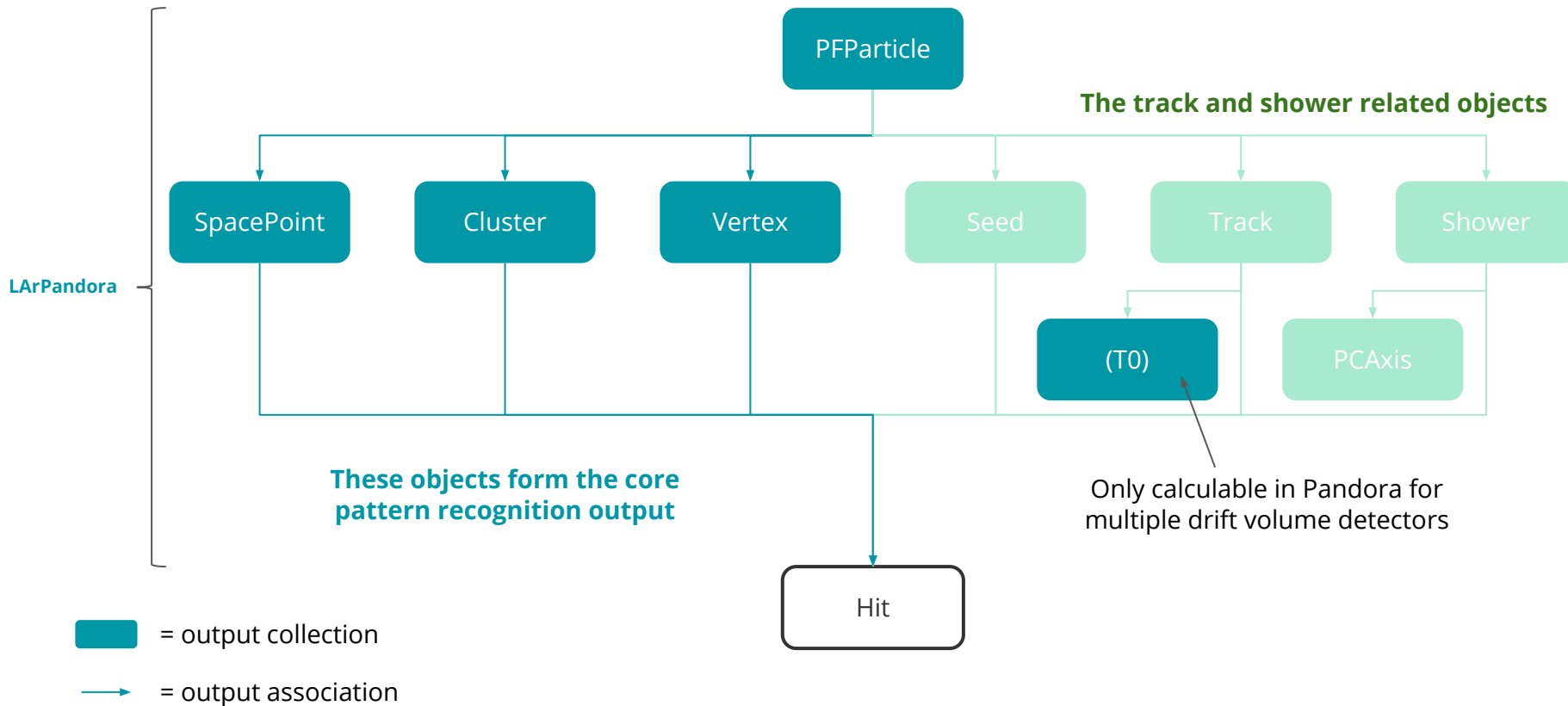Additional LArSoft producers for track and shower creation

```
LArPandora
    ⇩
LArPandora (patrec only)
LArPandoraTrackCreation
LArPandoraShowerCreation
```
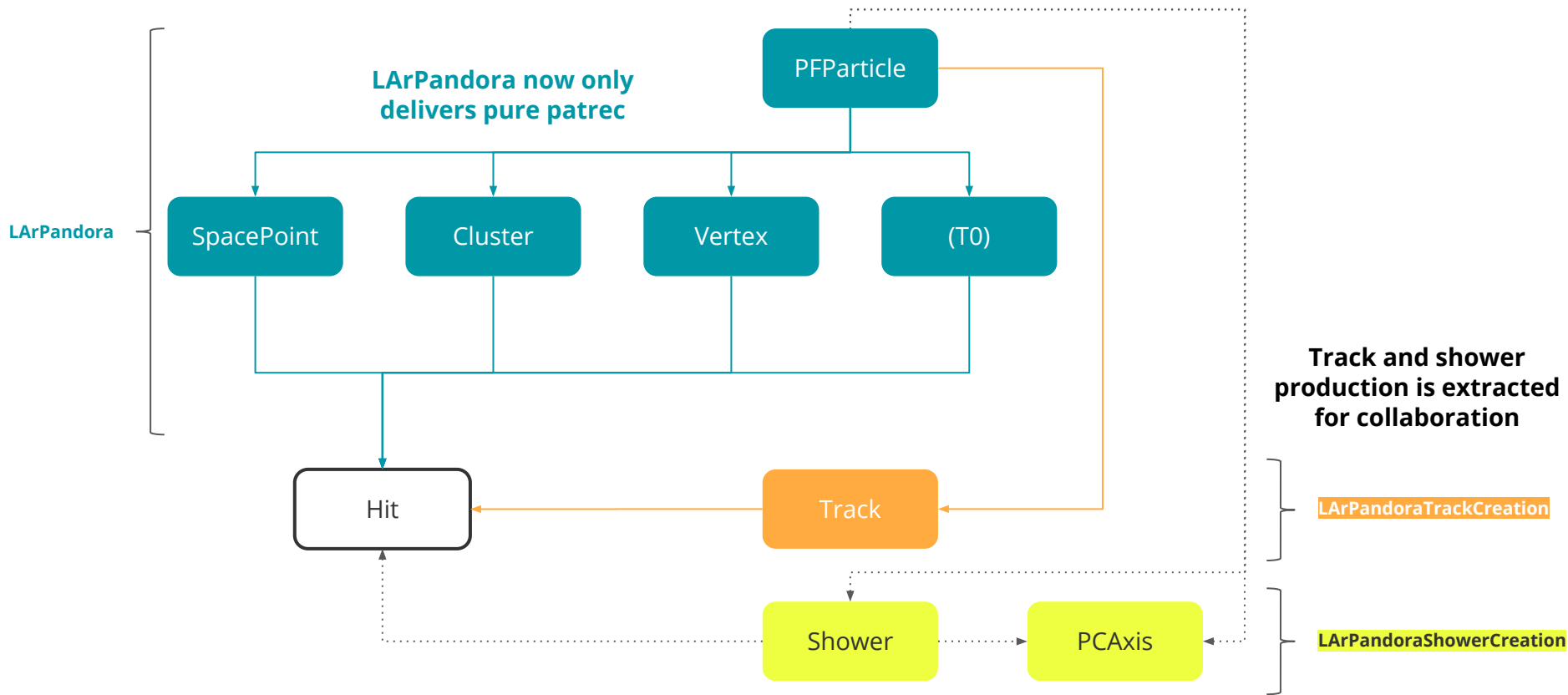
Existing output structure

PFParticle

The track and shower related objects

LArPandora

SpacePoint | Cluster | Vertex | Seed | Track | Shower

(T0) | PCAxis

These objects form the core pattern recognition output

Only calculable in Pandora for multiple drift volume detectors

Hit

■ = output collection

→ = output association

The new output structure

Release plan

Module	Changes	Plan
pandora	Some modest new functionality added used by updated LArPandoraContent	Request LArSoft build pandora "external" v03_07_00 Make available, but don't use in any "develop" branches
larpandoracontent	Breaking track + shower extraction changes & consolidated reconstruction	Feature branches available on Redmine: feature/larpandoracontent_v03_09_00
larpandora		
uboonecode	Updates to FHiCL files are required to accommodate breaking changes	Feature branches on Redmine with canonical FHiCL changes in the most important files feature/larpandoracontent_v03_09_00
dunetpc	There are many non-Pandora owned files which need to be audited (some obsolete?)	**Request help from uboonecode & dunetpc to check FHiCL files following track/shower extraction**

Once the required audit is completed and signed off, idea is that
feature branches can be merged into next available LArSoft release!

Summary of test branches

Module	Version	Notes
PandoraSDK	V03-02-00	Request is made available as "pandora" external UPS product v03-07-00
PandoraMonitoring	v03-04-00	(on GitHub, ready to build)
larpandoracontent	feature/larpandoracontent_v03_09_00 (request then tag as v03_09_00)	
larpandora	feature/larpandoracontent_v03_09_00	Request merge once checked over by dunetpc and uboonecode
uboonecode	feature/larpandoracontent_v03_09_00	

Pandora Team

Pandora is an open project and new contributors would be extremely welcome.
We'd love to hear from you and we will always try to answer your questions!

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