



Changes in LArPandoraContent_v03_12_00

Steven Green on behalf of the Pandora Team

8th May 2018

Three changes in larpandoracontent v03_12_00:

1) Addition of an **Interface to Adaptive Boost Decision Trees (BDT)**:

- Allows Pandora to apply the results of a trained BDT in the reconstruction.
- Machine learning models will be trained using the scikit-learn python package and only applied in Pandora.
- Only used for ProtoDUNE-SP.

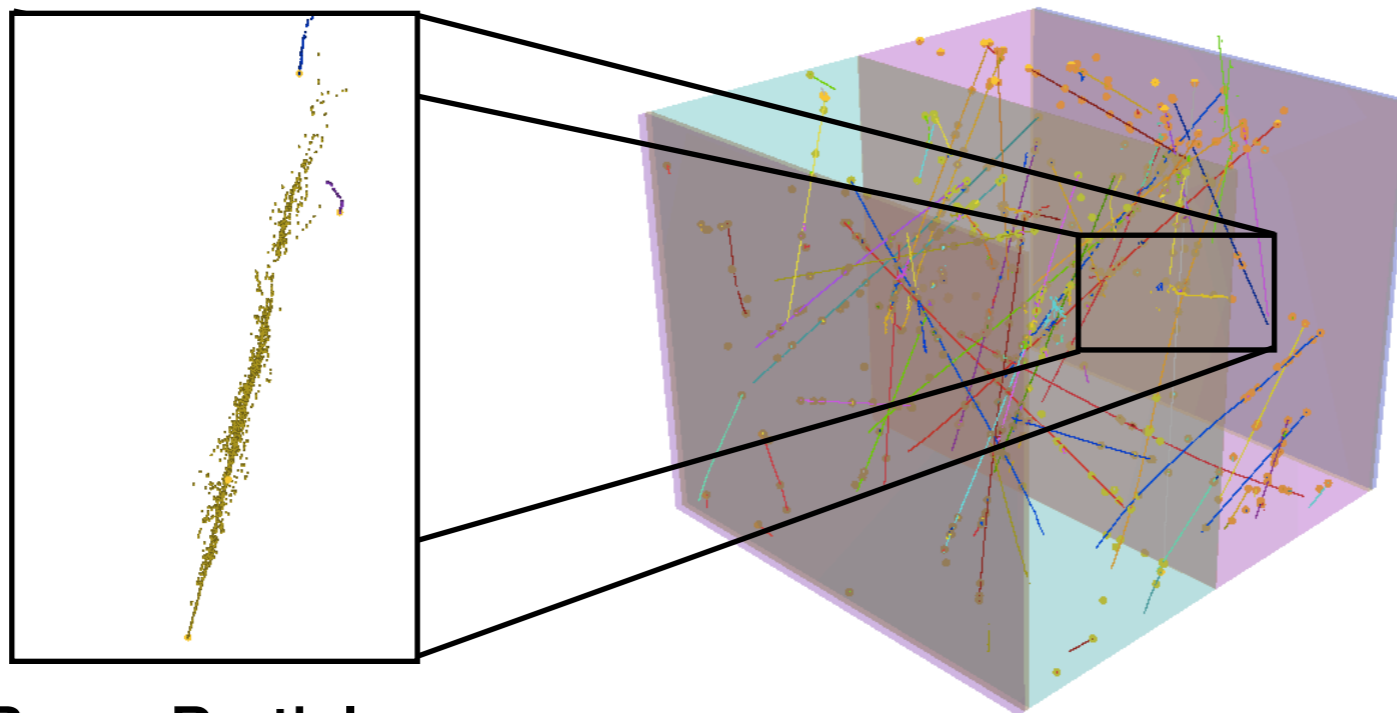
2) Addition of **Test Beam Particle Creation Algorithm**:

- Relabelling of Pandora outputs for test beam use case.
- Only used for ProtoDUNE-SP.

3) Minor change to **Slicing Configuration**:

- Unify the PFParticle track/shower characterisation approach between slicing and neutrino reconstruction.
- Minor change to reconstruction of cosmic-rays.
- Used for ProtoDUNE-SP and MicroBooNE.

- Aim: Extend the use of **Multivariate techniques inside Pandora.**
- New changes unify the application of BDTs and Support Vector Machines (SVMs) in the reconstruction.
- Use of Machine Learning tools inside Pandora is more generic.
- Machine learning models will be trained using the **scikit-learn python** package and only applied in Pandora.
- Pandora now uses a **BDT approach for the Beam Particle ID in ProtoDUNE.**



All Remaining Particles
Reconstructed and
Tagged as Cosmic Rays

Beam Particle
Reconstructed and Tagged

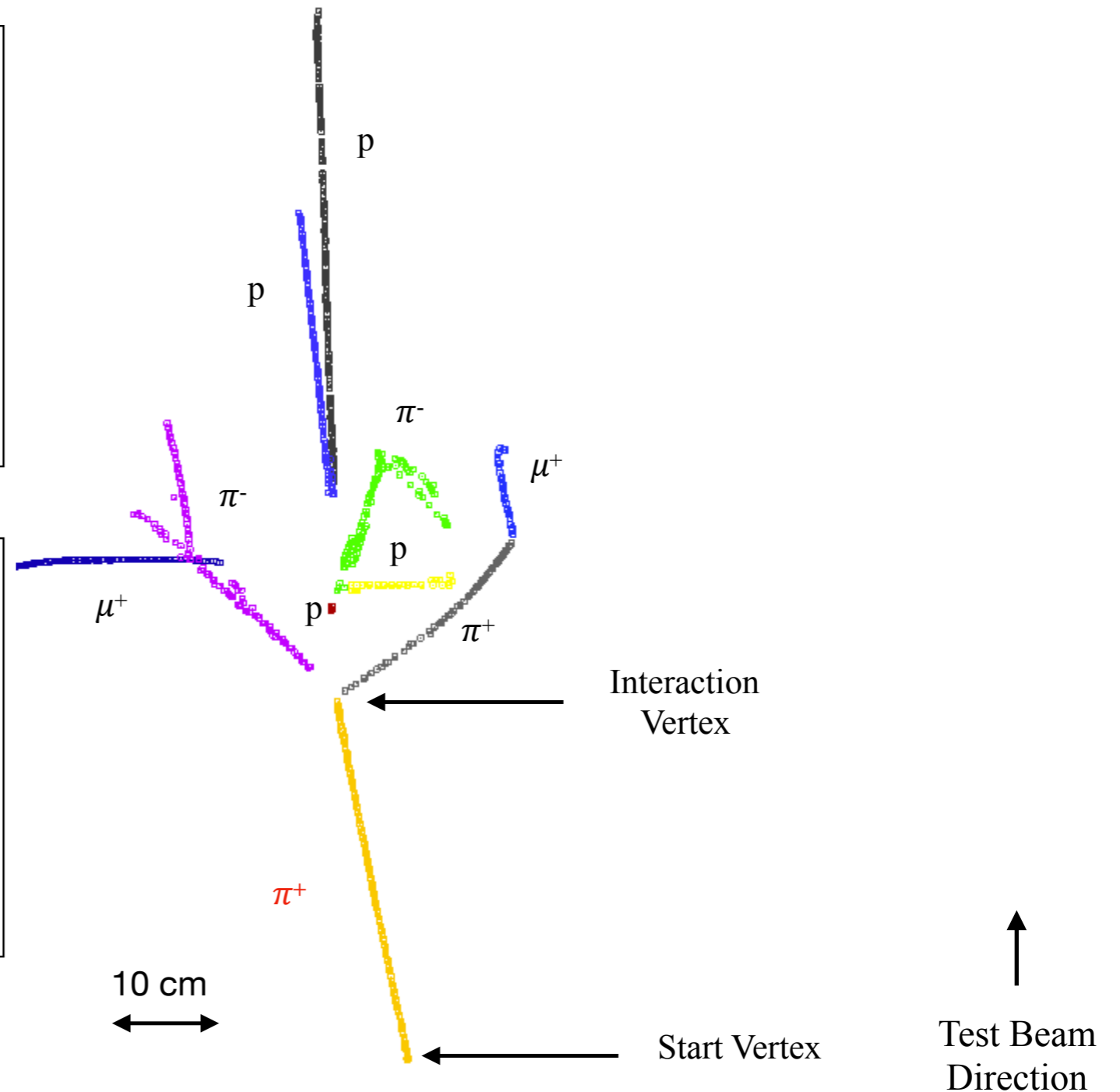
- Aim: Repackage the Pandora output to be **more intuitive for the test beam use case**.
- Neutrino PFParticles now relabelled as test beam particles, either e^- or π^+ depending on whether incoming particle is track or shower like.

Default Reconstruction
 Reconstructed Parent Particle: **Neutrino**
 Vertex: **Interaction Vertex**
 Hits: **No Visible Hits**

Daughter Particles:
 4 x p,
 2 x μ^+
 2 x π^-
 1 x π^+

Test Beam Particle Creation:
 Reconstructed Parent Particle: π^+
 Vertex: **Start Vertex**
 Hits: π^+

Daughter Particles:
 4 x p,
 2 x μ^+
 2 x π^-



For each of these repositories please see:
[feature/larpandoracontent_v03_12_00](#)

●larpandoracontent

- Contains the new c++ described on the previous slides.
- Alongside the new BDT beam particle id, the previous cut based approach is retained.

●larpandora

- XML-only change.
- Minor update to the slicing configuration.

●dunetpc

- XML-only change.
- Pandora reconstruction for ProtoDUNE now uses the test beam particle creation algorithm.

- dune_pardata

- Thanks to A.Himmel and D.Adams, the trained MVA data for the beam particle ID is inside dune_pardata/PandoraMVAData.
- This exists in version v01_29_00 of dune_pardata, which is in dunetpc version v06_75_02 onwards.

- All feature branches have been pushed to Redmine and tested in LArSoft.

Thank you for your attention. Questions?

**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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Please visit <https://github.com/PandoraPFA>

Consolidated Reconstruction: Overview

Thanks to J.Marshall

