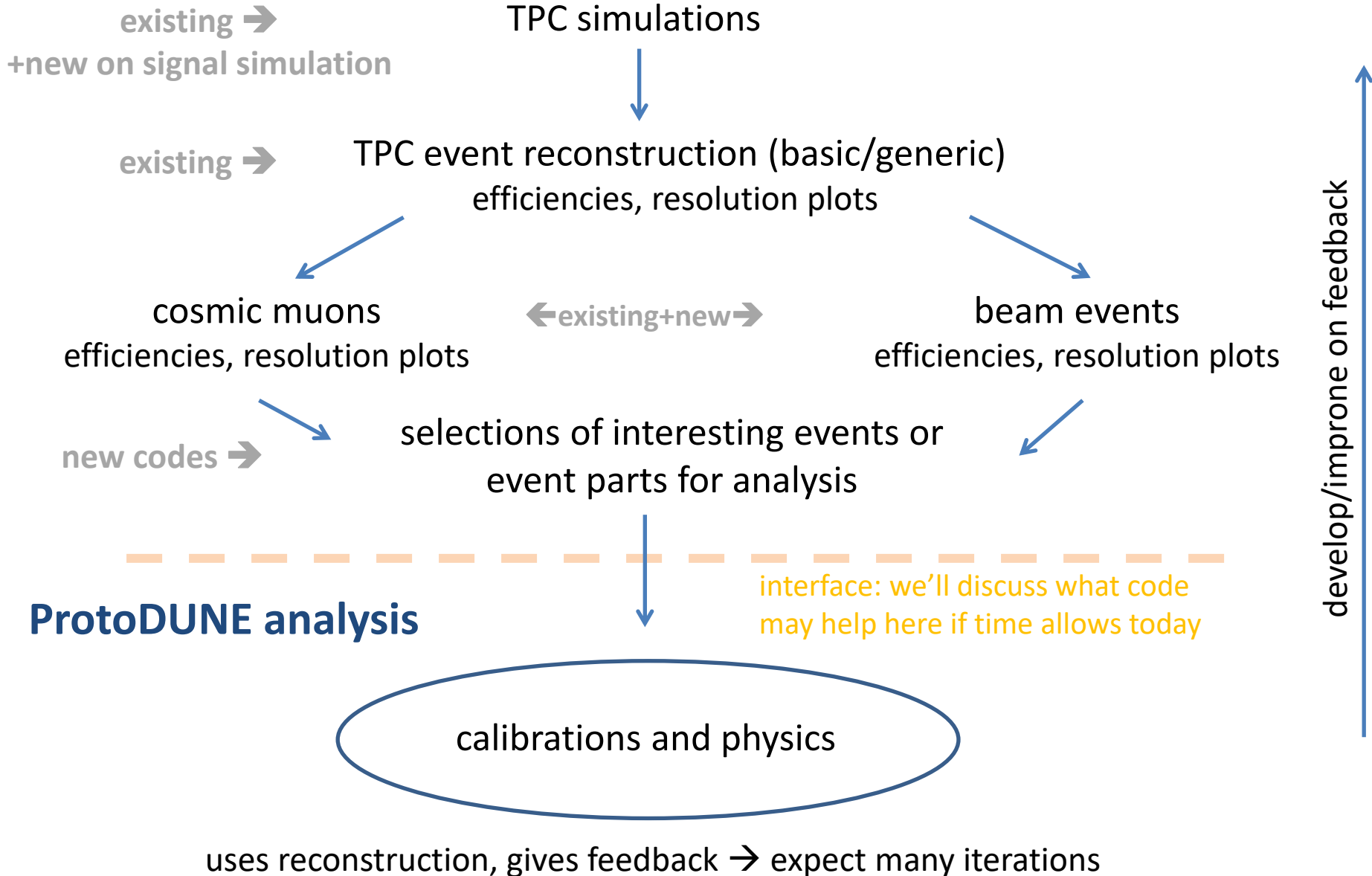


Introduction

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ProtoDUNE reconstruction: what we should do



ProtoDUNE reconstruction: coordinate with *Measurements*

Option 1:

- pick up an analysis topic
- learn what is available, what would be needed to develop
- some tasks just need feedback for implementation in generic tools: work with developers (topics are big, >1 person needed)
- some tasks need original ideas: work on this

Option 2:

- pick up task which covers applications to many analyses, eg. cosmic muons reconstruction, very broad and ambitious if you look into all aspects (so also here >>1 person will be needed surely!)

- It seems we can very well join efforts of Dual Phase & Single Phase teams for test beam data analyses and detector calibrations.
- Tools may be specific for ProtoDUNEs but targetting many FD applications: meetings and effort coordinated with FD reconstruction.
- Develop tools easy to share and start with – we're going to have many new contributors!

ProtoDUNE reconstruction: current activities

*presenters today

- **MCC's: TPC sim/reco productions** (so far cosmics muons, particle gun): ***Elizabeth Worcester** + students, fellows, Tingjun Yang, Karl Warburton.
- **TPC detector simulation**: SP: Martin Tzanov, Elizabeth Worcester, person from in2p3 for DP sig.sim (and lots of efforts for signal simulation and processing in FD group)
- **Beam events reconstruction**:
 - Particle identification: Warwick: Nick Grant, Martin Haigh et al. (also look at Pandora reco chain in collaboration with Cambridge).
 - Hadronic shower reconstruction: ***Jiyeon Han**, ***Andrea Scarpelli**, Stefania Bordoni.
 - Containment/missing energy reconstruction: Pawel Guzowski.
→ Needed input what particles, energy range would be necessary to make studies (MCC7 has one energy bin for each particle, but adding samples on request is simple, DP now using FD geometry → 6x6x6 geom needed).
- **Cosmic muon reconstruction**:
 - Reconstruction efficiency: Kevin Wood (currently very busy but will come back in ~2 months).
 - Stopping muons: Dorota&Robert, Aaron Higuera.
- **Beam events with cosmic muon reconstruction**:
→ The last talk will show needed direction of reconstruction.

Organizational issues

- We send to mailing list: *dune-reco* at fnal.gov, maybe list at cern.ch is needed.
- Better timing may be needed: collisions with other meetings.
- Preparing mini-workshop for LArSoft newbies, at CERN (so European day time). Date to be defined, so far preference for the last days in October:
<http://doodle.com/poll/q82m5kyd6b6nkumr>

ProtoDUNE: calibrations and data-MC for FD physics

- electron showers

- muon energy scale

- hadron energy scale

- missing energy in hadron events

- ADC to energy, uniformity

- calibrations/monitoring with μ

- NDK studies (except K from beam..)

- diffusion, E-field response

- e/gamma separation (π^0 rejection)

- recombination ang. dependency

- PID (stopping/low energy)

ProtoDUNE physics opportunities

- EM fraction in hadronic shower

- π crosssections

- hadron showers topology

- kaons (if available, not likely...)

- exclusive crosssections, hadronic interactions multiplicity, π^0 prod. models

→ not everything will be possible with the beam time/momenta constraints
(as of today, expect most data in 1-few GeV range hadron beam, electron beam)

→ may have no people to cover all tasks

→ follow **Measurement group** meetings for priorities & coordination

ProtoDUNE reconstruction tasks

→ mainly ProtoDUNE measurements

→ with large FD overlap

- **signal processing**

- 1D/2D noise reduction
- 1D/2D deconvolution

→ e / γ (π^0 rejection)

→ **all other reco...**

- **cosmic muon tracks reconstruction**

- selection of topologies: wire-plane-crossing, stopping, ...
- subtraction of charge overlayed with beam event
- association of surrounding EM activity
- integration with muon tagger data

→ μ -based calibrations
...and all ProtoDUNE
measurements

- **CNN-based pattern recognition**

- selection of EM component
- decay / interaction vertex location
- identification / location of „clean” event (stopping cosmic mu, maybe similar idea for beam)

→ μ -based calibrations
 π^0 -based calibrations
e / γ (π^0 rejection)
NDK (decays, vertex)
MC models

- **particle hierarchy reconstruction**

- integration with beamline particle reco
- particle interaction channels classification
- shower categorization for energy reco method

→ crosssections
energy scales
MC models
missing energy

See posted [PhD project](#) on machine learning for LArTPC at CERN!

(6-36 months at CERN, while affiliated with home institute/univ. which eventually gives the degree)

Let's start and discuss more after slides