Strawman Summary

ProtoDUNE topics to be studied

ProtoDUNE detector performance & monitoring		
	reconstruction algorithms performance and energy (and any other) dependencies	
	integrate data from beamline detectors, triggers (beam&cosmic) in the reconstruction: test beam particle hierarchy tuned to include informaton on the beam particle entry point/direction, cosmic mu reconstruction, ...	Wes
	integrate space charge monitoring (lasers or muons) with the reconstruction	M. Mooney, K. McDonald
	develop tools for **APA-to-APA alignment** that can use beam muons, beam halo muons and cosmic muons (in FD we're going to have muons in beam direction from nm and cosmic m as well so tools can be reused)	
	cosmic muons reconstruction, association of EM activity to muons, identification and reconstruction of mu with brems (need to develop tools important for mu background rejection/subtraction in analysis of protoDUNE test beam data; such tools are also needed in nucleon decay searches in FD)	Dorota with Elizabeth
	purity monitoring with muons	J. Hugon

Muon samples to be collected with external muon tagger:

- Direction of events TBD
- Sample size to be TBD

ProtoDUNE topics to be studied

ProtoDUNE physics		
	EM fraction in hadronic shower for shower energy estimation (i.e. separate treatment of EM component and hadron tracks)	
	multiplicity in hadronic interactions, exclusive crossections (inlc. pi0 production models)	
	pi interaction crossections, if statistics is enough one can look for features due to resonances production	Jarek Nowak, S. Bordoni, J. Brown(?)
	hadron shower topology, development of showers: compare with MC models	
	kaons (identification, crosections, ...): very interesting, can be difficult to obtain kaons; please, sign up if you are interested	

Order of magnitude estimate:
~4M beam triggers
(assumes trigger particle selection)

ProtoDUNE topics to be studied

Development of calibration procedures and data-MC studies required for FD physics			
	electron shower: 1) energy resolution (proves instrumental resolution), 2) energy scale	e beam, range of momenta	C.-J. Lin
	muon energy scale	mu beam, range of momenta	
	hadron energy scale at various track system / shower complexity (incl. studies of EM fraction - listed in "physics" goals)	hadron beam, range of momenta	
	missing energy in hadron events (part of energy scale study, important, therefore listed as a separate task), can be considered as a **"physics" goal as well**	hadron beam, 1-5GeV or higher	P. Guzowski
	absolute ADC to energy calibration (cosmic mu, pi0's from beam events), uniformity (e.g. using cosmic muons)	cosmic mu, pi0's, stopping beam particles (protons)	F. Filthaut
	diffusion, E-field response (signal induction), noise effects --> study of deconvolution and image pattern recognition capabilities in real data	1-5GeV/c hadr. beam, cosmic muons (tracks, pi0 vertices)	M. Mooney (& BNL)
	e/gamma separation (1 - use photons from pi0's)	pions, 1-5GeV/c (use pi0 vertices and dE/dx of gamma cascades);	D.Stefan, R.Sulej
	e/gamma separation (2 - use electrons)	starting part of electron cascades	D.Stefan, R.Sulej

Order of magnitude estimate:
pi+ sample beam triggers: 2.0M triggers (no. particle selection)
…

ProtoDUNE-SP UV Laser System

A UV laser system will **not** be included in the protoDUNE-SP design due to lack of resources to implement the system. In addition, including a uv-laser system would increase the complexity of the design and thus increases the overall technical and schedule risk to the project.

→ Do not have detailed studies (earliest possible would be in the fall) to document benefits from a laser calibration system

ProtoDUNE-SP Muon Tagger

The scope of the muon tagging system will be limited to **two 3 x 3 m^2 panels** providing a trigger for through-going low-angle (near horizontal) cosmic-ray muons. A more extensive system will not be considered due to the increased complexity, cost and effort that would be required.

→ Need to revisit requirements for cosmic muon sample
→ placement and size of (additional) muon tagger modules to be studied (time scale is ~ 2-3 months)

ProtoDUNE-SP Minimum Beam Energy

In order to finalize the beam line design, the minimum beam momentum for protoDUNE-SP is assumed to be **1 GeV**. A minimum momentum of 500 MeV would be considered only if a strong physics case is made during the protoDUNE physics workshop at the end of June.

Approach:
Start with sample > 1 GeV

1) Event sample sizes and required triggers for studies with momenta > 1 GeV/c:
   → Need to estimate no. of triggers

2) Studies requiring beam particles with momenta < 1 GeV/c:
   → Need to estimate no. of required triggers

ProtoDUNE-SP DAQ/Computing Assumptions

ProtoDUNE-SP will operate with triggered readout (beam and cosmic-ray). In order to design the system the following parameters will be assumed:

Parameter	Assumption	Maximum
Trigger Rate	25 Hz	50 or 100 Hz
Raw Event Size	230 MBytes	
Lossless compression factor	4	
Beam duty cycle	0.2	
Days of operation in 2018	60	
Storage	1.5 PBytes	2.5 PBytes
Instantaneous Rate	2.3 Gbps	10 Gbps
Local Storage	3 days of data	

The assumed parameters would result in approximately **25 million beam triggers in 60 live-days** of operation, requiring 1.5 PB of storage. Unless there are strong cost arguments, the system will be designed to accommodate the "maximum" scenario. This gives almost a factor two headroom.

ToDo

- Estimate required no. of triggers
  (beam instrumentation requirements)
- Perform study to identify muon sample and tagger system
- Proponents to develop list of milestones and schedule for above tasks
- Translate topics into potential PhD theses and paper topics
- …