Reviewer Questions

- 1) Is there a specific Risk Registry for protoDUNE? If so, can you send it to us? If not, can someone gather the risks discussed in the various presentations?

  2) What trigger modes are anticipated for protoDUNE beam and non-beam running? Specifically, will the Photon Detector System provide any triggers to protoDUNE?

  3) A number of test setups (at least 2 at CSU and the duplicate system planned for CERN) use SSPs. Are there more short-term needs for SSPs? All will likely need to run simultaneously. Are the SSPs available, that is, not taken back for retrofit at ANL?

protoDUNE-SP Photon Detector

- **Risks**

Is there a specific Risk Registry for protoDUNE? If so, can you send it to us? If not, can someone gather the risks discussed in the various presentations?

- Risks are tracked in Fermilab risk register:
- https://fermipoint.fnal.gov/collaboration/PM-Tools/Lists/Risk%20Register/Browse%20all%20risks.aspx
- 236 DUNE risks, 4 photon detector, 2 Far detector, 2 protoDUNE, 36 overall protoDUNE risks
- Other risks listed in talks:
  - SiPM/Zutshi – included above, mitigations on next slide
  - Readout/Djurcic - below
    - **Summary of Risks**
    - – S/N is worse than expected; Several possible factors:
    - Longer cable lengths (i.e., SSPs cannot be mounted on top of cryostat)
    - Noise pick-up from other sources
    - Mitigation by prototyping and testing with CERN vertical slice and integration testing at FNAL and BNL test sites

Project Risks

Risk Type	RI-ID	Title	Probability	---	Cost Impact	Schedule Impact	Risk Rank
Threat	RT-131-FD-073	Photon Detector light yield is too low	30 %		2500 k$	3 -- 6 -- 9 months	2 (Medium)
Threat	RT-131-FD-089	Photon detector SiPMs are not qualified for cryogenic use	15 %		1000 k$	2 -- 4 -- 6 months	2 (Medium)
Threat	RT-131-FD-098	ProtoDUNE-SP: Degraded Photon Detectors	5 %		k$	months	0 (Negligible)
Threat	RT-131-FD-117	ProtoDUNE-SP: Photon Detector monitoring software is unavailable for commissioning	15 %		k$	months	0 (Negligible)

Schedule Risk – protoDUNE-SP schedule end date is driven by Long Shutdown at CERN

Mitigation: Advance purchases – light guide bars and acrylic base

Risk FD-073 Photon light yield too low

Far detector Risk, mitigate by showing sufficient light yield in the prototype – protoDUNE-SP, mitigate by enhancement to light collection efficiency, double-ended readout, mirroring bars, increasing light yield, cathode plane radiator, xenon doping, more detectors

Risk FD-089 Photon detector SiPMs are not qualified for cryogenic use

Far detector Risk, mitigate by testing – see talk, mitigate by allowing flexibility of design to swap photon detector, not only one to make 6mm SiPM, mitigate by making a large prototype detector – protoDUNE-SP

Risk FD-098 ProtoDUNE-SP Degraded Photon Detectors

Prototype detector risk, mitigate by handling controls – shielded lighting during construction and installation specified already, protect during shipping and handling

Risk FD-117 ProtoDUNE-SP Photon Detector monitoring software is unavailable for commissioning

Mitigations: applying from lessons-learned from 35T detector, utilize software developed there, much longer assembly period for this prototype detector to enable testing and commissioning.

protoDUNE Risks

Threat	RT-131-FD-097	ProtoDUNE-SP: Broken wires on APA	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-098	ProtoDUNE-SP: Degraded Photon Detectors	5 %	k$	months	0 (Negligible)
Threat	RT-131-FD-099	ProtoDUNE-SP: Installation complications (equipment / tooling)	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-100	ProtoDUNE-SP: Components arrive late to CERN, with implications for cold testing	50 %	k$	months	0 (Negligible)
Threat	RT-131-FD-101	ProtoDUNE-SP: Detector components not tested prior to installation	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-102	ProtoDUNE-SP: Cable lengths complicate installation / operation	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-103	ProtoDUNE-SP: Unknown conditions in cryostat during operations	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-104	ProtoDUNE-SP: Loss of key staff prior to project completion	50 %	k$	months	0 (Negligible)
Threat	RT-131-FD-105	ProtoDUNE-SP: Grounding issues at EHN-1	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-106	ProtoDUNE-SP: Kapton tape dissolves in LAr	5 %	k$	months	0 (Negligible)
Threat	RT-131-FD-107	ProtoDUNE-SP: Detector damage caused by loose hardware	5 %	k$	months	0 (Negligible)
Threat	RT-131-FD-108	ProtoDUNE-SP: Confusion due to inconsistent numbering schemes of components	5 %	k$	months	0 (Negligible)
Threat	RT-131-FD-109	ProtoDUNE-SP: Commissioning delayed due to failed equipment	5 %	k$	months	0 (Negligible)
Threat	RT-131-FD-110	ProtoDUNE-SP: Inadequate operational control due to poor cyrogenic control interface	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-111	ProtoDUNE-SP: Components fail integration testing	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-112	ProtoDUNE-SP: Components fail cold testing	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-113	ProtoDUNE-SP: Checkout procedures for components are unavailable	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-114	ProtoDUNE-SP: Hardware requirements not communicated to subsystem; 35t problem perpetuate	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-115	ProtoDUNE-SP: Electronics noise levels impair run results	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-116	ProtoDUNE-SP: Scientific resources unavailable for testing, commissioning, diagnostics	50 %	k$	months	0 (Negligible)
Threat	RT-131-FD-117	ProtoDUNE-SP: Photon Detector monitoring software is unavailable for commissioning	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-118	ProtoDUNE-SP: Delay in testing, installation, commission, due to component failure	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-119	ProtoDUNE-SP: Equipment failure due to failed ventilation / cooling	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-120	ProtoDUNE-SP: Resource competition with other experiments (e.g., SBN)	50 %	k$	months	0 (Negligible)
Threat	RT-131-FD-121	ProtoDUNE-SP: Resource competition with CD2 effort	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-122	ProtoDUNE-SP: Computing support from FNAL/CERN is inadequate	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-123	ProtoDUNE-SP: Inefficiences due to lack of clarity regarding lines of responsibility	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-124	ProtoDUNE-SP: Inefficiency due to lack of clarity regarding incremental goals & milestones	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-125	ProtoDUNE-SP: Communication problems due to geographic dispersal	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-126	ProtoDUNE-SP: Grounding plan is not implemented correctly	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-127	ProtoDUNE-SP: Catastrophic contamination of LAr in the cryostat	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-128	ProtoDUNE-SP: Fall 2016 FNAL HV integration test fails	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-129	ProtoDUNE-SP: Insufficient project management resources	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-130	ProtoDUNE-SP: APA wiring more complex than anticipated	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-131	ProtoDUNE-SP: Unable to maintain HV at 180kV	15 %	k$	months	0 (Negligible)
Threat	RT-131-FD-132	ProtoDUNE-SP: Engineering staff resources insufficient	15 %	k$	months	0 (Negligible)

protoDUNE-SP Photon Detector

- **Trigger**

What trigger modes are anticipated for protoDUNE beam and non-beam running? Specifically, will the Photon Detector System provide any triggers to protoDUNE?

- Beamline will trigger readout for protoDUNE beam events independent of photon system.
  - Spills are ~25Hz for 4.25s. We could read out a waveform for these
  - Could dial back to header only or additional sparsification if rate needs to be limited
- There will also be an external cosmic trigger
- The SSP is capable of generating a trigger to the DAQ for TPC readout for non-beam operation
- Cosmic rate (~1GeV/cosmic == 100% efficient) of 3-4kHz with TPC drift time of >2ms means triggering on cosmic would be 100% on for TPC
  - (Maybe use as a veto)
- Triggering from PDS doesn't seem likely, but it is still an option

protoDUNE-SP Photon Detector

- **Parts availability**

A number of test setups (at least 2 at CSU and the duplicate system planned for CERN) use SSPs. Are there more short-term needs for SSPs? All will likely need to run simultaneously. Are the SSPs available, that is, not taken back for retrofit at ANL?

- The plan would be to retrofit unused modules first, and swap them for ones that are in use so no one loses capabilities