IoLaser Cost & Schedule

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IoLaser Initial Design Review

Los Alamos NATIONAL LABORATORY EST. 1943

DUNE

IoLaser Schedule for ProtoDUNE-II

S. No.	Activity	Start Date	End Date
ProtoDUNE			
A1	ProtoDUNE-SP-II IoLaser design work (phase 1)	12/1/19	7/30/20
A2	Purchase Class-IV UV laser & laser box optics for ProtoDUNE-SP-II	3/1/20	11/30/20
M1	**Calibration Scope review workshop**	**5/11/20**	**5/31/20**
A3	Io Laser Design work towards ProtoDUNE-SP-II Preliminary Design Review (PDR) (phase 2)	8/1/20	1/30/21
A4	Procure laser system components	8/1/20	4/31/2021
M2	**ProtoDUNE-SP-II IoLaser Initial Design Review**	**9/16/20**	**9/18/20**
S1	**ProtoDUNE-SP-I Disassembly TCO drift volume**	**10/1/20**	**11/30/20**
S2	**Open TCO ProtoDUNE-SP-I**	**11/1/20**	**12/31/20**
A5	Procure custom flanges, electronics board and DAQ components	12/1/20	4/31/2021
A6	Engineering/design work during procurement, fabrication, testing, integration, and installation (phase 3)	1/1/21	12/31/21
S3	**Remove ProtoDUNE-SP-I TPC**	**1/1/21**	**3/31/21**
M3	**ProtoDUNE-SP-II IoLaser Design PDR**	**1/31/21**	**1/31/21**
A7	Fabrication & Assmebly of the laser system	3/1/21	8/30/21
S4	**ProtoDUNE-SP Cryostat accessible**	**4/1/21**	**8/31/21**
A8	Test IoLaser components/system in warm/cold	7/1/21	9/30/21
M4	**Laser Box unit(s) arrive at CERN**	**7/31/21**	**7/31/21**
A9	Assemble & Install laser boxes on Cryostat and test alignment	8/1/21	8/15/21
S5	**Install ProtoDUNE-SP-2 Detector**	**8/1/21**	**12/31/21**
M5	**Laser periscope units arrive at CERN**	**10/30/21**	**10/30/21**
A10	Assemble & Install Laser periscopes into the detector & test alignment	11/1/21	11/20/21
S6	**Close ProtoDUNE-SP cryostat TCO**	**1/1/22**	**1/31/22**
S7	**Fill ProtoDUNE-SP-II Detector**	**2/1/22**	**4/30/22**
A11	Engineering support for IoLaser during commissioning and data taking (phase 4)	1/1/22	6/30/22
A12	Design validation and data analaysis for IoLaser in ProtoDUNE-SP-II	5/1/22	12/1/23

We Are Here

- **12 main activities**
- **5 high-level milestones**

Activities (A#)
Milestones (M#)
PD-SP-II global milestones (S#)

EDMS document with more details

Milestones towards ProtoDUNE-II

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A2	Purchase Class-IV UV laser & laser box optics for ProtoDUNE-SP-II	3/1/20	11/30/20
M1	**Calibration Scope review workshop**	**5/11/20**	**5/31/20**
A3	Io Laser Design work towards ProtoDUNE-SP-II Preliminary Design Review (PDR) (phase 2)	8/1/20	1/30/21
A4	Procure laser system components	8/1/20	4/31/2021
M2	**ProtoDUNE-SP-II IoLaser Initial Design Review**	**9/16/20**	**9/18/20**
S1	**ProtoDUNE-SP-I Disassembly TCO drift volume**	**10/1/20**	**11/30/20**
S2	**Open TCO ProtoDUNE-SP-I**	**11/1/20**	**12/31/20**
A5	Procure custom flanges, electronics board and DAQ components	12/1/20	4/31/2021
A6	Engineering/design work during procurement, fabrication, testing, integration, and installation (phase 3)	1/1/21	12/31/21
S3	**Remove ProtoDUNE-SP-I TPC**	**1/1/21**	**3/31/21**
M3	**ProtoDUNE-SP-II IoLaser Design PDR**	**1/31/21**	**1/31/21**
A7	Fabrication & Assmebly of the laser system	3/1/21	8/30/21
S4	**ProtoDUNE-SP Cryostat accessible**	**4/1/21**	**8/31/21**
A8	Test IoLaser components/system in warm/cold	7/1/21	9/30/21
M4	**Laser Box unit(s) arrive at CERN**	**7/31/21**	**7/31/21**
A9	Assemble & Install laser boxes on Cryostat and test alignment	8/1/21	8/15/21
S5	**Install ProtoDUNE-SP-2 Detector**	**8/1/21**	**12/31/21**
M5	**Laser periscope units arrive at CERN**	**10/30/21**	**10/30/21**
A10	Assemble & Install Laser periscopes into the detector & test alignment	11/1/21	11/20/21
S6	**Close ProtoDUNE-SP cryostat TCO**	**1/1/22**	**1/31/22**
S7	**Fill ProtoDUNE-SP-II Detector**	**2/1/22**	**4/30/22**
A11	Engineering support for IoLaser during commissioning and data taking (phase 4)	1/1/22	6/30/22
A12	Design validation and data analaysis for IoLaser in ProtoDUNE-SP-II	5/1/22	12/1/23

Activities (A)
Milestones(M)
PD-SP-II global milestones

Scope review workshop

Initial Design review (happening now)

IoLaser 60%design review
Dates to be confirmed

- **3 months nominally assigned for QA/QC tests**

Laser box units arrive at CERN July 2021

- **Labor estimated: 4 people onsite for 3 weeks**

Laser periscope units arrive at CERN Oct. 2020

- **Labor estimated: 5 people onsite for 4 weeks**

- **Labor estimated: 6 people over 1.5 years**

S. No.	Activity	Start Date	End Date	Status
ProtoDUNE				
A1	ProtoDUNE-SP-II IoLaser design work (phase 1)	12/1/19	7/30/20	✓ (design work towards initial design review)
A2	Purchase Class-IV UV laser & laser box optics for ProtoDUNE-SP-II	3/1/20	11/30/20	✓ (Laser procured, started procurement of optics)
M1	**Calibration Scope review workshop**	**5/11/20**	**5/31/20**	✓ (Done!)
A3	Io Laser Design work towards ProtoDUNE-SP-II Preliminary Design Review (PDR) (phase 2)	8/1/20	1/30/21	✓ (Started)
A4	Procure laser system components	8/1/20	4/31/2021	✓ (Started in August; long lead times due to COVID-19)
M2	**ProtoDUNE-SP-II IoLaser Initial Design Review**	**9/16/20**	**9/18/20**	✓ (Happening right now!) **We Are Here**
S1	**ProtoDUNE-SP-I Disassembly TCO drift volume**	**10/1/20**	**11/30/20**	
S2	**Open TCO ProtoDUNE-SP-I**	**11/1/20**	**12/31/20**	
A5	Procure custom flanges, electronics board and DAQ components	12/1/20	4/31/2021	✓ (started at LANL & LIP)
A6	Engineering/design work during procurement, fabrication, testing, integration, and installation (phase 3)	1/1/21	12/31/21	✓ (started at LANL & LIP)
S3	**Remove ProtoDUNE-SP-I TPC**	**1/1/21**	**3/31/21**	
M3	**ProtoDUNE-SP-II IoLaser Design PDR**	**1/31/21**	**1/31/21**	
A7	Fabrication & Assmebly of the laser system	3/1/21	8/30/21	✓ (Fabrication & Assembly plans ongoing)
S4	**ProtoDUNE-SP Cryostat accessible**	**4/1/21**	**8/31/21**	
A8	Test IoLaser components/system in warm/cold	7/1/21	9/30/21	✓ **(Two lab spaces establishing at LANL)** One ready by Sept. 2020 One will be ready by early 2021 (aiming for March 2021)
M4	**Laser Box unit(s) arrive at CERN**	**7/31/21**	**7/31/21**	
A9	Assemble & Install laser boxes on Cryostat and test alignment	8/1/21	8/15/21	
S5	**Install ProtoDUNE-SP-2 Detector**	**8/1/21**	**12/31/21**	
M5	**Laser periscope units arrive at CERN**	**10/30/21**	**10/30/21**	
A10	Assemble & Install Laser periscopes into the detector & test alignment	11/1/21	11/20/21	
S6	**Close ProtoDUNE-SP cryostat TCO**	**1/1/22**	**1/31/22**	
S7	**Fill ProtoDUNE-SP-II Detector**	**2/1/22**	**4/30/22**	
A11	Engineering support for IoLaser during commissioning and data taking (phase 4)	1/1/22	6/30/22	
A12	Design validation and data analaysis for IoLaser in ProtoDUNE-SP-II	5/1/22	12/1/23	

Activities (A)
Milestones(M)
PD-SP-II milestones

Status towards ProtoDUNE-II: Where are We?

Can we get there?

- As shown, we made an early start on everything (especially in view of COVID-19). This review will help us further refine our designs and plans. We think we are on track to get there. We are increasing our resources (especially in terms of people power) to ensure this.
- We welcome feedback on this and ways to improve our organization and planned activities.
- We do worry a bit about integration aspects and addressing all of them in-time. More active help on that aspect would be very helpful especially since the challenges are different for ProtoDUNE and DUNE.

Current Personnel & FTE

LANL

- S. Gollapinni (Scientist): 0.65
- M. Fani (Postdoc): 1.0
- J. Boissevain (Mech. Eng.): 0.5
- V. Sandberg (Physicist): 0.4
- E. Renner (Student Eng.): 0.3
- E. Guardincerri (Scientist): 0.13
- Postdoc#2 (TBD): 1.0

LIP (Portugal)

- J. Maneira (Scientist): 0.65
- N. Barros (Scientist): 0.5
- R. Alves (Mech. Eng.): 0.3
- F. Neves (Scientist): 0.15
- V. Solovov (Scientist): 0.2
- F. Barao (Faculty): 0.1 (from 2021)

U. of Hawaii

- J. Maricic (Faculty): 0.4
- R. Dharmapalan (postdoc): 1.0
- A. Dvornikov (grad. Student): 1.0

KSU

- G. Horton-Smith (Faculty): 0.1

FNAL

- S. Chappa (elec. eng.): 0.1
- A. Ghosh (elec. eng.): 0.1

S8	South Dakota logistics warehouse available	4/1/22	4/1/22
A13	IoLaser design work towards DUNE FD PRR	8/1/22	7/31/23
M6	**IoLaser Production readiness review for DUNE FD (IoLaser)**	**4/1/23**	**4/1/23**
A14	Procure UV laser, box, optical bench assembly, associated instruments (9 units)	5/1/23	2/28/24
A15	Procure Periscope structure (Inc. 2 mirrors, optical tubes) (12 units)	5/1/23	2/28/24
A16	Procure flanges (12), 5 electronics board and DAQ communication	5/1/23	2/28/24
A17	Procure rack components (9 units)	5/1/23	2/28/24
A18	Fabrication & Assembly of 12 Laser system(s)	7/1/23	4/31/24
A19	IoLaser system Engineering work during fabrication, testing, integration, and installation	7/1/23	6/31/24
A20	IoLaser system testing in warm/cold at collaborating institutes	1/1/24	6/31/24
S9	Beneficial occupancy of cavern 1 and central utility cavern (CUC)	10/1/22	10/1/22
S10	CUC Counting Room Accessible	4/1/23	4/1/23
M7	**Laser Box units (9) arrive at SURF**	**1/1/24**	**1/1/24**
S11	Top of detector module#1 cryostat accessible	1/1/24	1/1/24
A21	Assembly of 9 Laser box units in the cavern	1/8/24	2/15/24
A22	Installation and alignment of 9 Laser boxes	2/1/24	3/31/24
M8	**Laser periscope units (12) arrive at SURF**	**8/1/24**	**8/1/24**
S12	Start of detector module#1 TPC Installation	8/1/24	8/1/24
A23	Assembly of 12 Laser periscope units in the cavern	9/1/24	1/31/25
A24	Installation of 12 Laser System Periscopes and alignment	2/1/25	3/31/25
S13	End of detector module#1 TPC Installation	5/31/25	5/31/25
S14	Close detector module#1 TCO	7/1/25	7/31/25
S15	Filling of detector module#1	8/1/25	1/31/26
A25	Engineering support for 12 laser systems during commissioning and initial data taking	2/1/26	7/31/26
S16	Top of detector module#2 cryostat accessible	1/1/25	1/1/25
S17	Start of detector module#2 TPC Installation	8/1/25	8/1/25
S18	End of detector module#2 TPC Installation	5/31/26	5/31/26

Production readiness review after ProtoDUNE-II results

IoLaser Schedule for DUNE-FD-I

(not part of the charge)

- Milestones & Activities numbering continues from ProtoDUNE
- Very high-level schedule
- Schedule is built for 9 lasers and 12 periscopes (of course the exact not finalized yet)
- Will be updated in the near future

Activities (A)
Milestones(M)
DUNE FD Milestones (S)

IoLaser Cost: ProtoDUNE-II

Hardware Deliverable	Quantity	Institution	CORE Cost Estimate	Funding Source	Status of funding
ProtoDUNE: UV laser, box, optical bench asembly, associated instruments	2	LANL	110,000	DUNE US project	Approved
ProtoDUNE: Periscope structure (inc. 2 mirrors, optical tubes, linear/rotary seals)	2	LANL	180,000	DUNE US project	Approved
ProtoDUNE: Custom flanges for ports (inc. electrical insulation)	2	LIP	7000	Portugal	Approved
ProtoDUNE: Electronics board for instrumentation control and DAQ communication	2	LIP	10,000	Portugal	Approved
ProtoDUNE: Rack for laser PS, electronics board, control PC, network	2	LANL	50,000	DUNE US project	Approved
ProtoDUNE-SP-2: Cameras in Laser periscope (full system)	2	KSU	10,000	DUNE US project (through LANL)	Approved

Costs include R&D and testing planned

- IoLaser Detailed Budget Sheet (being refined as vendor quotes are received)
  - Roughly $180k per laser system including the laser
- M&S for both top-FC and End-wall designs is covered by DUNE US project except for ~$20k support form LIP
- Funding for test facilities at LANL covered by Gollapinni LANL funds & DOE ECA
- Also, modest support from LIP on Fabrication and testing resources

IoLaser Cost: ProtoDUNE-II

Labor Deliverable	Institution	Funding Source	Status of funding
ProtoDUNE: Person-power for hardware design, production, commissioning: faculty (3 FTE.yr), postdocs (4 FTE.yr), grad student (3 FTE.yr), engineer (2.1 FTE.yr), technician (1 FTE.yr)	LANL	DUNE US Project, DOE ECA, LANL LDRD	Approved
ProtoDUNE: Person-power for hardware design, production, commissioning: faculty (2.5 FTE.yr), engineer (1.0 FTE.yr), technician (0.8 FTE.yr)	LIP	Portugal	Approved
ProtoDUNE-SP-II: Camearas on Laser Periscope: Person-power for hardware design, production, commissioning: faculty (0.2 FTE.yr), grad students (0.3 FTE.yr), engineer (0.05 FTE.yr), technician (0.02 FTE.yr)	KSU	DOE IF Base, DUNE US Project	Approved

- Engineering support (including electrical engineering support) for the laser box and top-FC periscope design covered by DUNE US project
- End-wall engineering support from LIP
- Scientific personnel from US institutes covered by a variety of funds: LANL LDRD, DOE ECA, DOE IF Base
- Also, significant scientific support from LIP for the overall project

LBLS Cost: ProtoDUNE-II

Hardware

Deliverable	Quantity	Institution	CORE Cost	Funding Source	Status of funding
ProtoDUNE: Pads with 10 PIN diodes and cables	2	Hawaii	$2,000.00	DUNE U.S. Project	approved
ProtoDUNE: LBLS Pad DAQ interface	2	Hawaii	$3,000.00	DUNE U.S. Project	approved
ProtoDUNE: Mirror LBLS prototypes	4	LIP	$3,000.00	Portugal	approved

Costs include R&D and testing planned

Labor

Deliverable		Institution		Funding Source	Status of funding
ProtoDUNE : Person-power for mirror pads hardware design, production, commissioning: faculty (1/12 FTE.yr), engineer (1/12 FTE.yr), technician (1/6 FTE.yr)		LIP		Portugal	Approved
ProtoDUNE : Person-power for PIN diode pads hardware design, production, commissioning: faculty (1/3 FTE.yr), postdocs (0.3 FTE.yr), grad students (0.5 FTE.yr), engineer (1/12 FTE.yr), technician (0.3 FTE.yr)		Hawaii, LANL		DOE IF Base, DUNE US Project	Approved

Pretty modest costs

Summary

- Haven't covered DUNE costs (as scope is not final; EDMS document *as an example* gives a projection of cost for one scope scenario)
- LBLS schedule discussed in talks tomorrow. Will largely follow the IoLaser schedule but more closely with the FC installation
- Projected ProtoDUNE-II schedule for IoLaser looks realistic; good progress in design and other activities are on track.
- We thank the US project for their support in developing and prototyping these important calibration systems for DUNE!
- Scientific support from a variety of non-project funds with a significant contribution from LIP

Backup