Supplemental Proposal:
RESEARCH IN ELEMENTARY PARTICLE PHYSICS

A PROPOSAL TO THE U.S. DEPARTMENT OF ENERGY

THE UNIVERSITY OF TEXAS AT ARLINGTON

Physics Department, 502 Yates Street, Arlington, Texas 76019, USA.

Lead Principal Investigator: Jonathan Asaadi (817) 272 7439 jonathan.asaadi@uta.edu
Co-Principal Investigator: Jaehoon Yu

Administrative Point of Contact: Sarah Panepinto, 817 272 0243, sarah.panepinto@uta.edu

FOA number: **DE-FOA-0001820**

DOE/Office of Science Program Office: **High Energy Physics**
Topic Area: Intensity Frontier

DOE/Office of Science Program Office Technical Contacts:
Intensity Frontier: Glen Crawford, 301-903-9458, glen.crawford@science.doe.gov

DOE Award Number: DE-SC0011686
PAMS Letter of Intent tracking number: LOI-0000014874

Cover Page Supplement

List of Research areas:

- **Intensity Frontier PI's:** Jonathan Asaadi, Jaehoon Yu

Lead PI: Jonathan Asaadi

	Name	**Research Area**	**Year 1 Budget** *11/01/18 - 10/31/19*	**Year 2 Budget** *11/01/19 - 03/31/20*	**Total Budget** w
Lead-PI	Jonathan Asaadi	Intensity Frontier	$41,580	$21,405	$62,985
co-PI	Jaehoon Yu	Intensity Frontier	$41,580	$21,405	$62,985
	Grand Total:		$83,160	$42,810	$125,970

Table 1: Table summarizing budget request for this supplemental proposal ($ in thousands). The request is divided evenly amongst the UTA PI's.

Part I
Research at the Intensity Frontier

The UTA group currently is playing a leadership role across the Fermilab short-baseline (SBN) and long-baseline (LBN) neutrino programs. The UTA group, as of August 2018, consists of two postdocs, four graduate students, and two PI's funded from a mixture of base-grant, start-up funds, and teaching assistantships. This has allowed UTA to play successful roles across many of the liquid argon testbeam and neutrino experiments. Table 2 provides a high-level overview of the people and tasks currently being undertaken.

Summary of PI, Postdoc, and Graduate Personal

Personnel	Associated Task	Years Supported	Source of Support
Postdoc 1 (Animesh Chatterjee)	protoDUNE DP Construction ICARUS Commissioning and Operations DUNE BSM Analysis	2017 - 2020	UTA Base Grant
Postdoc∗ (Andrea Falcone)	ICARUS Installation, Simulation, and Commissioning LArIAT Run Coordinator SBND CRT Construction	2017 - 2019	UTA Start-up funds
Graduate Student 1 * (Zack Williams)	SBND Cold Electronics Testing, protoDUNE Cold Electronics Testing MicroBooNE Operations and Data Analysis	2017 - 2018 2018 - 2020	UTA Start-up funds UTA Base Grant
Graduate Student 2a (Sepideh Shahsavarani)	MiniBooNE Data Analysis protoDUNE DP Construction	2017 - 2018	UTA Base Grant
Graduate Student 2b (Hector Carranza)	protoDUNE DP Commissioning ICARUS Commissioning and Operations protoDUNE/ICARUS Data Analysis	2017 - 2018 2019 - 2020	Teaching Assistantship UTA Base Grant
Prof. Jonathan Asaadi	SBN/DUNE	2017 - 2020	UTA Base Grant
Prof. Jae Yu	DUNE/SBN	2017 - 2020	UTA Base Grant

Table 2: Table summarizing the personnel working on the various projects as described in the original proposal. Note: Personnel marked with "*" denote that their effort is supported for some phase of the project utilizing Asaadi's start-up funds. This is done to maximally leverage the UTA group across both DUNE and the SBN program.

As of September 2018, PI Asaadi's startup has been completely utilized and the funding support for UTA's second postdoc has concluded. In order to continue supporting the institutional responsibilities that UTA has on the ICARUS and SBND experiments, supplemental funding to the base grant is requested to support a postdoc through 2020. The efforts supported by this supplemental proposal will supply critical person-power needed by the ICARUS and SBND experiments as both enter the time critical period of installation, commissioning, and data taking.

Current Scope of Work

Tables 3 summarizes the projects and associated PI's taking a lead role during the current scope of work across the entire intensity frontier effort. In specific, the detector construction and installation roles on ICARUS and SBND are targeted for the requested supplemental proposal. The postdoctoral researcher to be hired will play a critical role on both the ICARUS and SBND experiments. These are roles that have been supported thus far via the startup funding for Andrea Falcone and will continue to be institutional responsibility for UTA over the next years.

IF Summary Current Scope of Work

Experiment	Project	Location	Lead PI
DUNE	protoDUNE SP-APA QA/QC and installation	UTA/CERN	Asaadi
	BSM Physics	UTA	Yu
	protoDUNE DP-FC Construction	UTA/CERN	Yu
SBND	Cold Electronics TPC Test-stand	UTA/FNAL	Asaadi
	Detector Construction, Installation, and Commissioning	FNAL	Yu
	Cross-Section Data Analysis	UTA/FNAL	Asaadi
MicroBooNE	TPC Detector Expert	UTA/FNAL	Asaadi
	Detector Operations	UTA/FNAL	Asaadi
	Cross-Section Data Analysis	UTA/FNAL	Asaadi
ICARUS	Detector Installation and Commissioning	FNAL	Asaadi
	NuMI Off-Axis Cross-Sections & Low-mass Dark Matter	UTA/FNAL	Yu
MiniBooNE	Beam Dump Dark Matter Search	UTA/FNAL	Yu

Table 3: Overview of the UTA projects across the Intensity Frontier

Current ICARUS/SBND Accomplishments

The UTA postdoc currently supported via startup funds (Andrea Falcone) and under the mentorship of PI Asaadi and Yu has played a leadership role on the LArIAT and ICARUS experiments as well as providing supporting roles for construction of the Cosmic Ray Tagger (CRT) to be used in SBND.

During Falcone's time at UTA (2015 - 2018) he took part in the upgrade of the ICARUS light detection system at CERN playing a central role in the testing of the PMT's and their installation into the cryostat [2], [3]. UTA has also been involved in the simulation and testing of the readout electronics for the light detection system [4] as well as being one of the main drivers of the simulation of the scintillation light coming from neutrino interactions and PMT response within the full ICARUS Monte Carlo [1]. These accomplishments have positioned the UTA group to continue our role in the commissioning of the ICARUS detector and the expertise to continue to drive the simulation and readout of the ICARUS PMT and trigger system.

UTA has leveraged its leadership on the LArIAT detector to aid in the installation and data taking of the SBND Vertical Slice Test which saw the installation of prototype SBND cold front end motherboards on the LArIAT TPC. PI Asaadi was supported via a Fermilab Neutrino Physics Center Fellowship and worked in tandem with Falcone to recently help complete the first data taking period with the new electronics. Falcone has also spent a portion of his time working on the SBND CRT, making trips to the University of Bern to aid in the construction of the CRT panels. The experience working with the SBND readout electronics and CRT and UTA's considerable background working with the LArIAT experiment has positioned the group well to continue to make substantial contributions to the experiment working on the readout and triggering of the SBND experiment.

The UTA postdocs have had successful and visible leadership roles during their time at UTA and the researcher funded by this supplement will enter a group with a wealth of experience on both the ICARUS and SBND experiment allowing them to take on critical and timely tasks for both experiments.

Proposed Scope of Work

The proposed scope of work to be carried out by the postdoc supported from this supplemental request is one already defined by the original proposal (DE-SC001168) by taking part in the con-

struction, commissioning, and operation of the ICARUS and SBND experiments. The term for this appointment would be between November 2018 and March 2020 with the possibility of extension pending the outcome of UTA's the next competitive review. The postdoc is foreseen to be in residence at Fermilab throughout the duration of the position and thus will be able to give person-power to installation tasks as well as be among readout and simulation experts. The postdoc will have two UTA graduate students at Fermilab during this appointment, providing them both with a team of support and the opportunity to mentor and work with students.

Table 4 provides and overview of the key tasks and timelines that are foreseen for the postdoc supported by this supplemental request. These times are divided along the current SBN schedule with installation and development tasks taking place between November 2018 and May 2019 and operations and deployment foreseen between June 2019 and March 2020. The roles and responsibilities for these tasks are described in greater detail below.

IF Summary of Proposed Work

Experiment	Project	Timeline	Time Commitment (FTE)
ICARUS	TPC/PMT Electronics Installation and Testing	Nov 2018 - May 2019	0.4
SBND	Trigger and Readout Testing and Development	Nov 2018 - May 2019	0.4
ICARUS	Light and Charge Monte Carlo Simulation and Trigger Studies	Nov 2018 - May 2019	0.2
SBND	Trigger and Readout Deployment and Integration	June 2019 - March 2020	0.4
ICARUS	Commissioning and Data Taking Operations	June 2019 - March 2020	0.3
ICARUS & SBND	Integrated Physics Software Trigger Development	June 2019 - March 2020	0.3

Table 4: Overview of the UTA projects across the Intensity Frontier

Role on ICARUS

The UTA group has been playing a key role on the ICARUS experiment, as described above, involved in the light detection system and the simulation efforts. In addition to these roles, PI Asaadi has taken on the role of deputy TPC electronics convener (along side Sandro Centro from Padova, Matt Worcester from Brookhaven, and Mike Mooney from Colorado State University).

The postdoc supported by this supplemental proposal will be leveraging this expertise to contribute to the installation and testing of the PMT and TPC electronics as they arrive at Fermilab and are installed on the cryostat. During these initial months both PI Asaadi and Yu expect to be spending extended periods at Fermilab to aid in the information transfer and to contribute directly to the ongoing installation work.

In addition to this, continued work on the simulation of the PMT and TPC signals within the ICARUS Monte Carlo is expected to continue. This simulation work plays a central role in the interest of developing a software based trigger to help distinguish localized physics signatures from the cosmic ray backgrounds through utilizing the PMT, TPC, and CRT information in an near-line software based trigger. This work is seen an synergistic with the trigger work on SBND and ultimately a unifying piece of the overall SBN physics program.

Role on SBND

The UTA group has been contributing to the testing of various detector components for SBND, as described above, including ASIC chip testing, CRT assembly, and readout electronics testing with the SBND vertical slice test at LArIAT. Most recently UTA has partnered with the University of Pennsylvania group to play a leading role in the testing, development, and implementation of the Photon Trigger Board (PTB) in the SBND readout. This critical role allows UTA to leverage its experience with the various pieces of SBND hardware as well as our experience with the PMT system in ICARUS (which shares the same CAEN digitization boards and similar readout software).

The postdoc supported by this supplemental proposal is foreseen to play a leading role in the testing and implementation of the PTB beginning using the data acquisition test stands currently built at Fermilab. These test stands include the SBND TPC readout electronics, CAEN PMT digitizers (common between ICARUS and SBND), CRT frontend boards, and the Photon Trigger Board. This test stand will allow for the integration and testing of the various triggering schemes foreseen for SBND utilizing the ICARUS/SBND common artDAQ software framework as well as exploration of an integrated software based trigger similar to that being used in ICARUS.

In addition to playing a leadership role on the triggering and readout for the SBND experiment, the postdocs residence at Fermilab will allow them to participate in additional installation tasks as deemed necessary by the collaboration and as their other responsibilities allow.

Conclusion

A supplemental request to support a postdoctoral researcher to work on the SBND and ICARUS experiments from November 2019 through March 2020 will allow the UTA group to continue its leadership role on these experiments. The UTA group has leveraged PI Asaadi's startup funds to successfully execute their current scope of work and contribute the to Fermilab neutrino program.

The person funded by this supplemental proposal will execute critical and well defined tasks on both the ICARUS and SBND experiment during the proposed period of work. In addition to providing needed person-power to the experiments during their installation, commissioning and operation phases, critical roles in the readout, triggering and simulations for the ICARUS and SBND experiments would go understaffed in the absence of this continued effort adversely effecting the experiments.

Appendix 01: Biographical Sketch – Senior Investigators
Jonathan Asaadi

Education and Training

Institution	*Location*	*Major*	*Degree & Year*
Undergraduate Institution	University of Iowa	Physics	B.S. 2004
Graduate Institution	Texas A&M University	Physics	M.S. 2007
Graduate Institution	Texas A&M University	Physics	PhD. 2012

Research and Professional Experience

Assistant Professor	University of Texas Arlington	2015 – Present
Postdoctoral Researcher	Syracuse University	2012 – 2015

Relevant Publications

- **First measurement of the cross section for ν_μ and $\bar{\nu}_\mu$ induced single charged pion production on argon using ArgoNeuT**
  ArgoNeuT Collaboration: R. Acciarri et al
  Phys. Rev. D 98, 052002 (2018) , arXiv: 1804.10294 **(Reviewer and Collaborator)**

- **Tetraphenyl Butadiene Emanation and Bulk Fluorescence from Wavelength Shifting Coatings in Liquid Argon**
  J. Asaadi, B. J. P. Jones, A. Tripathi, I. Parmaksiz, H. Sullivan, Z. G. R. Williams
  Submitted to JINST, arXiv: 1804.00011 **(Primary author and primary analyzer)**

- **First Demonstration of a Pixelated Charge Readout for Single-Phase Liquid Argon Time Projection Chambers**
  J. Asaadi, M. Auger, A. Ereditato, D. Goeldi, R. Haenni, U. Kose, I Kreslo, D. Lorca, M. Luethi, C. Rudolf Von Rohr, J. R. Sinclair, F. Stocker, C. Tognina, M. Weber
  Submitted to JINST, arXiv:1801.08884 **(Contributing author and analyzer)**

- **A New Light Higgs Boson and Short-Baseline Neutrino Anomalies**
  J. Asaadi, E. Church, R. Guenette, B. J. P. Jones, A. M. Szelc
  Phys. Rev. D 97, 075021 (2018), arXiv:1712.08019 **(Contributing author and analyzer)**

- **Design and construction of the MicroBooNE Detector**
  MicroBooNE Collaboration: R. Acciarri, et. al
  JINST 12 P02017 (2017) arXiv:1612.05824 **(Contributing author and analyzer)**

- **First Observation of Low Energy Electron Neutrinos in Liquid Argon TPC Detectors**
  ArgoNeuT Collaboration: R. Acciarri et al
  Phys. Rev. D 95, 072005 (2017), arXiv: 1610.04102 **(Reviewer and collaborator)**

- **Construction and Assembly of the Wire Planes for the MicroBooNE Time Projection Chamber**
  R. Acciarri, C. Adams, J. Asaadi, J. Danaher, B.T. Fleming, R. Gardner, S. Gollapinni, R. Grosso, R. Guenette, B.R. Littlejohn, S. Lockwitz, J.L. Raaf, M. Soderberg, J. St. John, T. Strauss, A.M. Szelc, B. Yu
  JINST 12 T03003 (2017), arXiv:1609.06169 **(Contributing author and analyzer)**

- **Measurement of ν_μ and $\bar{\nu}_\mu$ Neutral Current $\pi^0 \rightarrow \gamma\gamma$ Production in the ArgoNeuT Detector**
  ArgoNeuT Collaboration: R. Acciarri et al
  Phys. Rev. D 96, 012006 (2017), arXiv:1511.00941 **(Primary author and primary analyzer)**

- **Testing of High Voltage Surge Protection Devices for Use in Liquid Argon TPC Detectors**
  J. Asaadi, J.M. Conrad, S. Gollapinni, B.J.P. Jones, H. Jostlein, J.M. St. John, T. Strauss, S. Wolbers, J. Zennamo
  JINST 9 P09002 (2014), arXiv:1406.5216 **(Primary author and primary analyzer)**

- **The detection of back-to-back proton pairs in Charged-Current neutrino interactions with the ArgoNeuT detector in the NuMI low energy beam**
  ArgoNeuT Collaboration: R. Acciarri et al
  Phys. Rev. D 90, 012008 (2014), arXiv:1405.4261 **(Reviewer and collaborator)**

Synergistic Activities

- **Deputy co-convener of ICARUS TPC Electronics**
- **CENF-ND Experimental Cross-Section Working Group Convener**
  (in collaboration with Dr. Sara Bolognesi, 2018 - Present)
- **Co-Spokesperson for the LArIAT Experiment**
  (in collaboration with Dr. Jen Raaf, 2016-Present)
- **Fermilab Detector R&D Advisory Board Member** (November 2016 – Present)
- **MicroBooNE TPC Subsystem Lead** (October 2015 – Present)

Collaborators and Co-Editors:

Adam Aurisano	University of Cincinnati	Collaborator
Bruce Baller	Fermilab	Collaborator
Tim Bolton	Kansas State University	Collaborator
Carl Bromberg	Michigan State University	Collaborator
Flavio Cavanna	Fermilab	Collaborator
Eric Church	Pacific Northwest National Laboratory	Collaborator
Janet Conrad	Massachusetts Institute of Technology	Collaborator
Bhaskar Dutta	Texas A&M	Graduate Advisor
Antonio Ereditato	Bern University	Collaborator
Bonnie Fleming	Yale University	Collaborator
Teruki Kamon	Texas A&M University	Graduate Advisor
Igro Kreslo	Bern University	Collaborator
Ornella Palamara	Fermilab	Collaborator
Jennifer Raaf	Fermilab	Collaborator
Brian Rebel	Fermilab	Collaborator
Mitch Soderberg	Syracuse University	Post-doctoral Advisor
Josh Spitz	University of Michigan	Collaborator
Andrzej Szlec	Manchester University	Collaborator
David Toback	Texas A&M University	Graduate Advisor (Chair)
Michele Weber	Bern University	Collaborator
Tingjun Yang	Fermilab	Collaborator
Geralyn Zeller	Fermilab	Collaborator

Graduate Advisors and Postdoctoral Sponsors
Prof. David Toback (Texas A&M)
Prof. Mitch Soderberg (Syracuse University)

Graduate Students and Postdoctoral Associates

Andrea Falcone	University of Texas Arlington	Post-doctoral Researcher
Zach Williams	University of Texas Arlington	Graduate Student
Hunter Sullivan	University of Texas Arlington	Graduate Student

Appendix 02: Current and Pending Support

Jonathan Asaadi
University of Texas Arlington

Sponsor: DOE Comparative Review Funding (Intensity Frontier Research - Current)
Award Number: DE-SC001168
Proposal Title: RESEARCH IN ELEMENTARY PARTICLE PHYSICS
Awarded Amount: $310,000 /year
Total Award Period Covered: 04/01/2017 – 03/31/2020
Person Months per Year from PI: 2 months
Comments: This award supports work on the Fermilab short basline (SBND, MicroBooNE, ICARUS, and LArIAT) experiments and long baseline neutrino experiments (DUNE) for PI Asaadi and Yu.

Sponsor: DOE Comparative Review Funding (Detector R&D - Current)
Award Number: DE-SC001168
Proposal Title: RESEARCH IN ELEMENTARY PARTICLE PHYSICS
Awarded Amount: $90k (2017-2018), $80k (2018-2019), $80k (2019-2020)
Total Award Period Covered: 04/01/2017 – 03/31/2020
Person Months per Year from PI: 0 months
Comments: This award supports work on new light detection device (SiPM Wheel) with PI's Nygren and Jones. This research will continue during the awarded period for this proposal with increasing support from Jones and Nygren.

Appendix 03: Bibliography and References Cited

References

[1] A. Falcone and I. Collaboration, "Performance study of the new light collection system for the icarus t600 detector," *Journal of Physics: Conference Series*, vol. 888, no. 1, p. 012093, 2017.

[2] M. Babicz *et al.*, "Test and characterization of 400 Hamamatsu R5912-MOD photomultiplier tubes for the ICARUS T600 detector," *Submitted to JINST arXiv 1807.08577.*, 2018.

[3] M. Bonesini *et al.*, "An innovative technique for TPB deposition on convex window photomultiplier tubes," *Submitted to EPJ Techniques and Instrumentation arXiv 1807.07123.*, 2018.

[4] L. Bagby *et al.*, "New read-out electronics for ICARUS-T600 liquid Argon TPC. Description, simulation and tests of the new front-end and ADC system," *Submitted to JINST arXiv 1805.03931.*, 2018.

Appendix 04: Facilities and Other Resources

The University of Texas (UTA) is the second largest university in the UT system with around 35,000 students. It is a comprehensive doctoral university located in the Dallas-Ft. Worth metroplex. HEP was selected as one of the first "Organized Research Center of Excellence" at UTA in 2011. PI De is the Director of the ORCE:HEP Center, which also includes faculty from commology, astrophysics, space sciences, and computtational sciences. The combined synergy of these activities, along with substantial commitment of university resources, provides strong support to the core DoE HEP mission at UTA. Overall, the university has invested over two million dollars to support HEP research activities.

A prime example of UTA's investment in science was the provision of the 120,000 sq.ft. Physics and Chemistry Research Building in 2006. This building houses a high bay area for HEP, our ATLAS Tier 2 center, three detector development laboratories, an HEP conference room, faculty offices, and postdoc and graduate student offices. The building houses an excellent Physics mechanical workshop with the capabilities to manage large scale detector construction..

One finished lab space at UT Arlington's Physics and Chemistry Research Builiding is a 700 sq. feet lab space with the necessary ventilation for cryogenic experiments to take place. This lab space has recently been completed with a purification and pressure based gas recirculation system for liquid argon detector R&D. This finished lab space also houses desk space, computers, soldering stations, and work space for the undergraduate detector sensor lab as well as a intensity frontier remote operations station. This remote operation station has already been used to take shifts on the LArIAT experiment and is being expanded for remote shift taking on MicroBooNE, SBND, and ICARUS.

A 700 sq foot unfinished lab space adjacent to the purified liquid argon lab and located off the high-bay area has a 3 ton crane for detector construction and assembly. This lab space is located directly adjacent to the UTA physics department machine shop which can be used during detector testing and construction.

In addition to this lab space, the UTA HEP group have retained our previous office suite in Science Hall, and this area has been rennovated as the ATLAS Tier 2 operations and visitors area. The lab space in the basement of Science Hall now houses the purified gaseous xenon system as well as a laboratory space for testing Single Molecule Fluorescence Imaging.

UTA also hosts the SouthWest Tier 2 center (SWT2) for ATLAS, which is one of the largest computing centers for ATLAS, providing over 3000 cores and 3 petabytes of storage. The UTA HEP Tier 3 center is co-located with the Tier 2, providing easy access to ATLAS data.

Appendix 05: Equipment

At UTA we have five separate labs (electronics, optics, etc.) with several high speed oscilloscopes including one with 6 GHz bandwidth, power supplies, logic modules, and electronic racks. In addition we host the ATLAS tier-2 computing center with large amount of computing resources.

A small High Performance cluster dedicated to GPU computing, primarily for Deep Learning studies, which are used by over two dozen HEP collaborators over six experiments. The cluster provides 54 processing cores (108 job slots due to hyper-threading) over 4 systems, with more than 4 GB of RAM per core, 2 GB/s SSD caches in front of 50 TB of storage, 10 Gb interconnectivity, 4 NVidia (3 Kepler, 1 Maxwell) GPUs, 3 AMD GPUs, and an Intel Phi (Knights Corner)

Appendix 7

Additional Budget Requirements

OMB Number: 4040-0001
Expiration Date: 06/30/2011

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 1

* ORGANIZATIONAL DUNS: 064234610

* Budget Type: ■ Project ☐ Subaward/Consortium

Enter name of Organization: University of Texas at Arlington

* Start Date: 11/1/2018 * End Date: 10/31/2019 Budget Period: IF Supplement 1

A. Senior/Key Person

	Prefix	* First Name	Middle Name	* Last Name	Suffix	Project Role	Base Salary ($)	Cal. Months	Acad. Months	Sum. Months	* Requested Salary ($)	* Fringe Benefits ($)	* Funds Requested ($)
1.													0
2.													0
3.													0
4.													0
5.													0
6.													0
7.													0
8.													0

9. Total Funds requested for all Senior Key Persons in the attached file

Total Senior/Key Person 0

B. Other Personnel

* Number of Personnel	* Project Role	Cal. Months	Acad. Months	Sum. Months	* Requested Salary ($)	* Fringe Benefits ($)	* Funds Requested ($)
1	Post Doctoral Associates				50,000	15,000	65,000
0	Graduate Students						0
0	Undergraduate Students						0
	Secretarial/Clerical						0
							0
							0
							0
							0
							0
							0
1	Total Number Other Personnel				Total Other Personnel		65,000

Total Salary, Wages and Fringe Benefits (A+B) 65,000

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 1

* ORGANIZATIONAL DUNS: 064234610

* Budget Type: ■ Project ☐ Subaward/Consortium

Enter name of Organization: University of Texas at Arlington

* Start Date: 11/1/2018 * End Date: 10/31/2019 Budget Period: IF Supplement 1

C. Equipment Description

List items and dollar amount for each item exceeding $5,000

	Equipment item	* Funds Requested ($)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.	Total funds requested for all equipment listed in the attached file	
	Total Equipment	0

D. Travel	Funds Requested ($)
1. Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	1,000
2. Foreign Travel Costs	0
Total Travel Cost	1,000

E. Participant/Trainee Support Costs	Funds Requested ($)
1. Tuition/Fees/Health Insurance	
2. Stipends	
3. Travel	
4. Subsistence	
5. Other	
Number of Participants/Trainees — Total Participant/Trainee Support Costs	0

RESEARCH & RELATED BUDGET - SECTION F-K, BUDGET PERIOD ☐

* ORGANIZATIONAL DUNS: 064234610

* Budget Type: ■ Project ☐ Subaward/Consortium

Enter name of Organization: University of Texas at Arlington

* Start Date: 11/1/2018 * End Date: 10/31/2019 Budget Period: F Supplement 1

F. Other Direct Costs — Funds Requested ($)

1.	Materials and Supplies	
2.	Publication Costs	
3.	Consultant Services	
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	STEM Tuition	
9.		
10.		
	Total Other Direct Costs	0

G. Direct Costs — Funds Requested ($)

Total Direct Costs (A thru F)	66,000

H. Indirect Costs

	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	* Funds Requested ($)
1.	Off Campus IDC	26	66,000	17,160
2.				
3.				
4.				
	Total Indirect Costs			17,160

Cognizant Federal Agency

(Agency Name, POC Name, and POC Phone Number)

I. Total Direct and Indirect Costs — Funds Requested ($)

Total Direct and Indirect Institutional Costs (G + H)	83,160

J. Fee — Funds Requested ($)

83,160

OMB Number: 4040-0001
Expiration Date: 06/30/2011

RESEARCH & RELATED BUDGET - SECTION A & B, BUDGET PERIOD 1

* ORGANIZATIONAL DUNS: 064234610

* Budget Type: ■ Project ☐ Subaward/Consortium

Enter name of Organization: University of Texas at Arlington

* Start Date: 11/1/2019 * End Date: 03/31/2019 Budget Period: IF Supplement 2

A. Senior/Key Person

	Prefix	* First Name	Middle Name	* Last Name	Suffix	Project Role	Base Salary ($)	Cal. Months	Acad. Months	Sum. Months	* Requested Salary ($)	* Fringe Benefits ($)	* Funds Requested ($)
1.													0
2.													0
3.													0
4.													0
5.													0
6.													0
7.													0
8.													0

9. Total Funds requested for all Senior Key Persons in the attached file

Total Senior/Key Person 0

B. Other Personnel

* Number of Personnel	* Project Role	Cal. Months	Acad. Months	Sum. Months	* Requested Salary ($)	* Fringe Benefits ($)	* Funds Requested ($)
1	Post Doctoral Associates				25,750	7,725	33,475
0	Graduate Students						0
0	Undergraduate Students						0
	Secretarial/Clerical						0
							0
							0
							0
							0
							0
							0
1	Total Number Other Personnel				Total Other Personnel		33,475

Total Salary, Wages and Fringe Benefits (A+B) 33,475

RESEARCH & RELATED BUDGET - SECTION C, D, & E, BUDGET PERIOD 1

* ORGANIZATIONAL DUNS: 064234610

* Budget Type: ■ Project ☐ Subaward/Consortium

Enter name of Organization: University of Texas at Arlington

* Start Date: 11/1/2018 * End Date: 10/31/2019 Budget Period: IF Supplement 1

C. Equipment Description

List items and dollar amount for each item exceeding $5,000

	Equipment item	* Funds Requested ($)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.	Total funds requested for all equipment listed in the attached file	
	Total Equipment	0

D. Travel	Funds Requested ($)
1. Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	500
2. Foreign Travel Costs	0
Total Travel Cost	500

E. Participant/Trainee Support Costs	Funds Requested ($)
1. Tuition/Fees/Health Insurance	
2. Stipends	
3. Travel	
4. Subsistence	
5. Other	
Number of Participants/Trainees — Total Participant/Trainee Support Costs	0

RESEARCH & RELATED BUDGET - SECTION F-K, BUDGET PERIOD ☐

* ORGANIZATIONAL DUNS: 064234610

* Budget Type: ■ Project ☐ Subaward/Consortium

Enter name of Organization: University of Texas at Arlington

* Start Date: 11/1/2018 * End Date: 10/31/2019 Budget Period: F Supplement 1

F. Other Direct Costs

		Funds Requested ($)
1.	Materials and Supplies	
2.	Publication Costs	
3.	Consultant Services	
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	STEM Tuition	
9.		
10.		
	Total Other Direct Costs	0

G. Direct Costs

	Funds Requested ($)
Total Direct Costs (A thru F)	33,975

H. Indirect Costs

	Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	* Funds Requested ($)
1.	Off Campus IDC	26	33,975	8,834
2.				
3.				
4.				
	Total Indirect Costs			8,834

Cognizant Federal Agency

(Agency Name, POC Name, and POC Phone Number)

I. Total Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Institutional Costs (G + H)	42,809

J. Fee

Funds Requested ($)
83,160

0.1 Intensity Frontier Program Budget Justification

Preamble: This section provides the budget justifications for the intensity frontier supplemental proposal. Detailed description for each of the items is given in year one. A canonical cost of living adjustment rate of 3% is applied to all salaries in the subsequent years. Year two contains fewer details as in year one, but instead reflect the base rate and where noted any significant changes in effort.

The tasks carried out off-campus incur substantially different indirect rates (51.5% on-campus versus 26% off-campus), therefore this request which is entirely off-campus incurs a significantly reduced indirect rate.

1. **Cumulative - 17 Month**
    - **Senior Personnel**: No senior personnel support is requested.
    - **Postdoctoral Researcher**: A request for one postdoctoral fellow is made using the base salary of $50,000 per annum for the first year and a canonical 3% cost of living adjustment is applied in subsequent year. The total requested amount for this item is $125,969. The fringe benefit rate is 30% of the request. Since it is anticipated to have the postdoctoral fellow 100% off campus and located full time at Fermilab, the indirect rate for this is 26% of the cost. This researcher will be contributing to the SBND and ICARUS experiments at Fermilab during their time with UTA.
    - **Graduate Students**: No support for graduate students is requests
    - **Undergraduate Students**: No support for undergraduate students is requested
    - **Travel and Cost of Living Adjustment**: A request for $1,500 total for travel is requested. This portion of the supplemental is meant to be used for COLA support for postdoctoral fellow. The amount is requested to be placed in our groups LSA at Fermilab to minimize the indirect cost at UTA.
    - **STEM Tuition**: No STEM tuition support is requested
    - **M&S**:No M&S is requested
    - **Total Fringe Benefit**: The total cost for the fringe benefit for 17 month period is $22,725.
    - **Total Indirect**: The total indirect cost computed using the off-campus (26%) rate is $25,994.
    - **Grand Total for the entire proposal**: The total request for the seventeen month period is $125,969.
2. Year 1: 11/01/18 - 10/31/19
    - **Senior Personnel**: No senior personnel support is requested.
    - **Postdoctoral Researcher**: A request for one postdoctoral fellow is made using the base salary of $50,000 per annum. The fringe benefit rate is 30% of the request. Since it is anticipated to have the postdoctoral fellow 100% off campus and located full time at Fermilab, the indirect rate for this is 26% of the cost.
    - **Graduate Students**: No support for graduate students is requests
    - **Undergraduate Students**: No support for undergraduate students is requested
    - **Travel and Cost of Living Adjustment**: A request for $1,000 total for travel is requested during the first year. This portion of the supplemental is meant to be used for COLA support for postdoctoral fellow. The amount is requested to be placed in our groups LSA at Fermilab to minimize the indirect cost at UTA.
    - **STEM Tuition**: No STEM tuition support is requested

- **M&S**:No M&S is requested
- **Total Fringe Benefit**: The total cost for the fringe benefit is $15,000.
- **Total Indirect**: The total indirect cost computed using the off-campus rate (26%) described above is $17,160.
- **Grand Total for Year 1**: The grand total request for year one is $83,160.

3. Year 2: 11/01/19 - 03/31/19

    - **Senior Personnel**: No senior personnel support is requested.
    - **Postdoctoral Researcher**: A request for one postdoctoral fellow is made using the base salary of $51,500 per annum, requested for the 6 month period. totalling $25,750 The fringe benefit rate is 30% of the request. Since it is anticipated to have the postdoctoral fellow 100% off campus and located full time at Fermilab, the indirect rate for this is 26% of the cost.
    - **Graduate Students**: No support for graduate students is requests
    - **Undergraduate Students**: No support for undergraduate students is requested
    - **Travel and Cost of Living Adjustment**: A request for $500 total for travel is requested during the second year. This portion of the supplemental is meant to be used for COLA support for postdoctoral fellow. The amount is requested to be placed in our groups LSA at Fermilab to minimize the indirect cost at UTA.
    - **STEM Tuition**: No STEM tuition support is requested
    - **M&S**:No M&S is requested
    - **Total Fringe Benefit**: The total cost for the fringe benefit is $7,725.
    - **Total Indirect**: The total indirect cost computed using the off-campus rate (26%) described above is $8,834.
    - **Grand Total for Year 1**: The grand total request for year two is $42,809.

Appendix 8: Intensity Frontier Data Management Plan

The scope of work described in this supplemental proposal does not expand beyond that which is originally described in funded project. The data management plan included here is a restatement of that original data management plan.

The projects described in this supplement proposal for the intensity frontier do not produce any data on their own; they merely make use of data generated by the activities related to the, SBND, and ICARUS experiments. These experiments have a data management policy consistent with the Department of Energy's data management plan (found here http://science.energy.gov/funding-opportunities/digital-data-management/). This policy conforms with that of the Data Preservation in High Energy Physics (DPHEP) study group, which has described a hierarchy for the types of data that particle-physics experiments produce, and given recommendations for how such data should be preserved for future use.

The types of data these experiments produce include the raw data produced by the detectors, the reconstructed version of the raw data, and simulated events. SBND and ICARUS have their own mechanisms for archiving data, including producing both digital and tape storage of raw data, and any data that resides at our institution will merely be a copy of data that is stored permanently by the experiment. Thus, there is no need for this project to separately manage or archive any experimental data. No personally identifiable information is expected to be generated during the execution of the project, and thus no explicit plans to protect confidentiality or personal privacy are used.

The analysis of the experimental data is described in published, peer-reviewed journal articles; summaries of data analyses that are released to the public (often as contributions to conferences); and notes that are circulated internally within SBND and ICARUS as well as public technical notes made available using Fermilab's Technical Publication. The journal articles are archived by the journals themselves, and are also typically available through the arxiv.org e-print archive. The public analysis summaries and internal notes are archived by the SBND and ICARUS experiments and are available through Web interfaces. All collaborations encourage frequent and timely publication of results related to the research described in this proposal and thus data generated by the activities described here are expected to have near annual publication releases (through peer reviewed papers and contribution to conferences).

SNBD and ICARUS data management will be defined in accordance with an agreement between the Fermilab Scientific Computing Division and the SBND and ICARUS collaborations, as will be detailed in a Technical Scope of Work (TSW) document to be drafted and agreed upon before the start of data taking. Fermilab resources will provide a means to store, manage, access, and share the raw data and reconstruction data, as well as all of the research dependent analysis and calibration data.
Precise details of SBND and ICARUS data formats are still to be determined, but the data may be conceptually categorized into different “Tiers” based on the volume, their source, the required processing and selection criteria, and the expertise required to consume or reproduce the data. Substantial quantities of simulated data will also be generated as an important ingredient in the analysis of real data collected by the detectors. The policies outlined here apply to both real and simulated forms of data. Each Tier is described in the subsections below. Tiers are listed in order of derivation: Raw Data, Reconstruction Data, Analysis Data, Published Data. The nominal policy on sharing and preservation of data in each Tier and how these data can be validated are given. Data sharing is considered to either be among members of the collaboration or between the collaboration and non-members. Preservation only considers copies of data shared within the collaboration. Requests for any

expansion beyond the nominal policies described may be considered by the collaboration at any time on a case-by-case basis.

The Raw Data Tier includes all files produced directly from experiment devices (e.g., detector DAQ, environment monitors, beam monitors) and files holding the information used to configure these devices. The bulk of this Tier's data will come from the SBND and ICARUS detectors and consist of digitized signals from TPC wires, optical detectors, and muon detectors in custom packed binary formats that require special software to be read. Also included in the Raw Data Tier is information about the beam and environment held in relational databases. Raw Data is only shared among collaborators. The volume, infrastructure, and expertise required to produce and consume this data makes sharing outside the collaboration impractical. In principle, all collaborators have access to this data but in practice only a few are expected to access a small portion of it. The primary consumer of this data is the official collaboration production processing. All data in this Tier is archived to tape storage at Fermilab for the lifetime of the experiment and at least 5 years after data taking ceases as per the official Fermilab Data Management Plan. Additionally, the ICARUS raw data will be replicated to tape storage at CERN. Plans for permanent preservation will be made at the time when data taking ceases in order to utilize appropriate technological choices. Validation of the Raw Data Tier is largely done by validating the proper operation of the devices that acquired it. This is done through detector commissioning and special-purpose studies as well as continual monitoring of the data acquisition by human shift operators.

The Reconstruction Data Tier consists of files derived from Raw Data. It consists of intermediate results from processes such as noise reduction, signal extraction, imaging, pattern recognition, vertex and particle identification, as well as derived calibrations. The volume of data in this Tier is at least as large as Raw Data. Data in this Tier is shared following the same policies as the Raw Data Tier. Data in the Reconstruction Data Tier is preserved to disk and tape at least until it is superseded by newer processing and is no longer actively utilized for measurements. Typically, long term preservation is not cost effective as Reconstruction Data can be reproduced by rerunning the software. Validation of this data is performed by comparisons between its similar derivations from Raw Data.

An Analysis Data Tier consists of a down-sampling of the Reconstruction Data. Selection criteria are applied that reduce which quantities and triggers are kept. Expertise not generally available to the general public is needed to interpret the data in this tier. Data in this Tier is shared following the same policy as the Raw Data Tier. Processes producing this data are relatively simple and validation is done by collaborators to assure the selection criteria perform as expected.

Published Data consists of files directly used to produce the tables and figures used in published documents. The volume of data is relatively small, typically in formats that are readable with common tools (including ROOT), and hold quantities which may be properly interpreted by an individual with general understanding of the field. Files of Published Data can be made available at the time of publication along with the digital document, either through references given in the document or by request to the collaboration. Published Data files will be preserved by the collaboration for the lifetime of the collaboration. Preservation policy of files shared through an external service will be determined by that service. Validation of these files will be done through the publication policy and procedures of the collaboration.

Appendix 9

Other Attachments