



NP Accelerator R&D and AI/ML Principal Investigators Exchange Meeting

November 30, 2021

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DOE Office of Nuclear Physics**



Outline:

- This Meeting
- NP Accelerator R&D
- FY 2020 Accelerator R&D FOA and awards
- FY2020 Data, AI and ML Lab call and awards
- FY2021 Data Analytics AI/ML FOA and awards
- Presentation Guidelines



DOE SC code of conduct

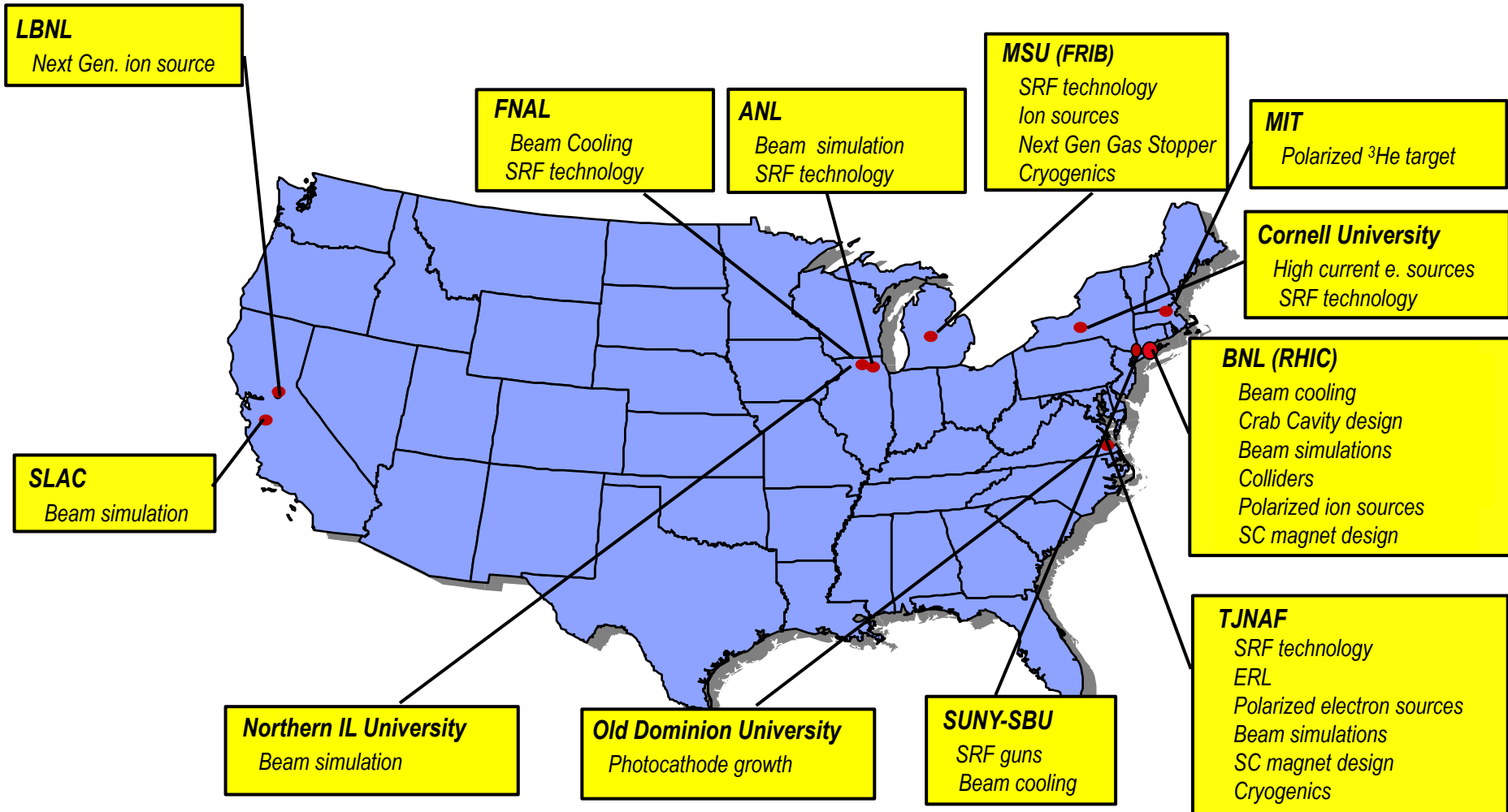
- *The direct link is:*
- <https://science.energy.gov/sc-2/research-and-conduct-policies/diversity-equity-and-inclusion/>
- *“The DOE Office of Science (SC) is fully committed to fostering safe, diverse, equitable, and inclusive work, research, and funding environments that value mutual respect and personal integrity. Effective stewardship and promotion of diverse and inclusive workplaces that value and celebrate a diversity of people, ideas, cultures, and educational backgrounds is foundational to delivering on the SC [mission](#). The scientific community engaged in SC-sponsored activities is expected to be respectful, ethical, and professional.*
- *The DOE SC does not tolerate discrimination or harassment of any kind, including [sexual or non-sexual harassment](#), bullying, intimidation, violence, threats of violence, retaliation, or other disruptive behavior in the federal workplace, including DOE field site offices, or at national laboratories, scientific user facilities, academic institutions, other institutions that we fund, or other locations where activities that we support are carried out...”*



- Annual direct NP investment in accelerator R&D through the competitive funding opportunity announcement (FOA) and National Laboratory Accelerator R&D for FY2020-21 has been on the order of \$13.5 M per year. There was a Lab only AI/ML funding announcement from BES, HEP, and NP which is part of this Exchange meeting.
- NP is also investing in non-EIC accelerator R&D with focus on key technology areas and in **core competencies** at NP laboratories
- Accelerator science proposals to NP that are under consideration for FY 2022 and beyond FOAs may include specific topics such as:
 - Next generation Ion source, SRF and in *situ* plasma processing for recovering Q_0 and gradient
 - Nb₃-Sn coated SRF cavities with higher performance than Nb based cavities
 - Components of NP related “SC Accelerator Initiatives”



Core Competencies at NP Labs and Universities



FY20: Accelerator R&D FOA (Topic of this Exchange meeting)

FUNDING OPPORTUNITY ANNOUNCEMENT (FOA)

Research and Development for Next Generation Nuclear Physics Accelerator Facilities

Funding Opportunity Number : DE-DE-FOA-0001230

ISSUE DATE: April 1, 2020

Application Due Date: May 1, 2020

- *Accelerator R&D for this announcement was in the following general categories:*
 - *Accelerator R&D that significantly advances the state-of-the art accelerator capabilities of relevance to next generation machines for the study of nuclear physics.*
 - *Accelerator R&D that significantly advances the state-of-the art accelerator capabilities of relevance to improving the performance of existing facilities studying nuclear physics.*
- *In particular, proposals in the following areas were encouraged:*
 - *Transformative accelerator R&D in SRF technology for restoring cryomodule performance at SRF-based accelerator facilities.*
 - *Transformative accelerator R&D in next generation ion and electron sources.*
- *Artificial Intelligence and Machine Learning was not included in this FOA because of a standalone multi-office Laboratory call in this area.*



NP FY2020-21 Awards in Accelerator R&D FOA							
#	Proposal ID	Institution	Proposal Title	PI and Co-PI	FY2020 Funding (k\$)	Total Collab funding Y1 (k\$)	Total 2-year fundin (k\$)
1	254578	TJNAF	Using improved growth techniques such as CBE to grow high polarization strained superlattice GaAs/GaAsP photocathodes, including those with Distributed Bragg Reflector structure	Stutzman, Marcy	126.2	126.2	252.5
2	255054	Cornell	High current sources for spin polarized and unpolarized electron beams	Bazarov, Ivan	184.0	367.9	367.9
3	254811	TJNAF	Photocathodes with 90% polarization and QE greater than 1% for DOE NP	Poelker, Matthew	180.0	230.0	460.0
	254853	BNL		Wang, Erdong	50.0		
4	255032	MSU	Gas Stopper Developments for Improved Purity and Intensity of Low-Energy, Rare Isotope Ion Beams	Ringle, Ryan	178.0	356.0	356.0
5	254,943	ANL	Development of Practical Niobium-Tin Cavities for Ion Linacs	Kelly, Michael	450.5	675.6	1191.3
	254,946	RadiaBeam		Kutsaev, Sergey	80.0		
	349799	FNAL		Posen, Sam	65.2		
6	254442	TJNAF	High Voltage Insulators and Electrodes for 500 kV DC High Voltage Photogun with Inverted Insulator Design	Hernandez-Garcia, Carlos	269.4	269.4	538.9
7	255039	SUNY	Superconducting RF electron gun	Litvinenko, Vladimir	201.3	922.4	1442.1
	254801	FNAL		Yakovlev, Vyacheslav	139.1		
	254816	TJNAF		Poelker, Matthew	200.1		
	254881	BNL		Jing, Yichao	180.6		
8	254406	TJNAF	In Situ Plasma Processing of Superconducting Cavities	Powers, Tom	607.5	701.0	1402.0
	254781	ORNL		Doleans, Marc	93.5		
Total year 1 Awards: \$3.65M						3649	

Subject of this year's PI meeting (no significance to color codes in rows)



SC AI Lab Call Lab-20-2261 (Also, topic of this Exchange meeting)

DEPARTMENT OF ENERGY
OFFICE OF SCIENCE
BASIC ENERGY SCIENCES
HIGH ENERGY PHYSICS
NUCLEAR PHYSICS



**DATA, ARTIFICIAL INTELLIGENCE, AND MACHINE LEARNING
AT DOE SCIENTIFIC USER FACILITIES**

**DOE NATIONAL LABORATORY PROGRAM ANNOUNCEMENT NUMBER:
LAB 20-2261**

ANNOUNCEMENT TYPE: INITIAL

Announcement Issue Date:	March 9, 2020
Submission Deadline for Proposals:	May 1, 2020, at 5 PM Eastern Time



NP Lab AI-ML proposals Lab-20-2261

- *This was a SC Laboratory call from BES, HEP and NP allowing 2 proposals per user facilities.*
- *NP received 3 proposals in accelerators and 2 in experiments and detectors.*

PI Name	SC Lab	Proposal Title	FY 2020 Award (\$)	Total Award (\$)
David Lawrence	TJNAF	A.I. Assisted Experiment Control and Calibration	270,000	810,000
Christopher Tennant	TJNAF	AI for Improved SRF Operation at CEBAF	450,000	1,350,000
Brahim Mustapha	ANL	Use of Artificial Intelligence to Optimize Accelerator Operations and Improve Machine Performance	280,000	840,000

- *Each proposal was mail reviewed by 4 reviewers:*
- *Funding in Year-1 came from accelerator R&D base funds (total of \$1M / year).*
- *These are 3 –year awards, FY21-22 funding are subject to availability of appropriated funds*



DEPARTMENT OF ENERGY
OFFICE OF SCIENCE
NUCLEAR PHYSICS



**DATA ANALYTICS FOR AUTONOMOUS OPTIMIZATION AND
CONTROL OF ACCELERATORS AND DETECTORS**

FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER:
DE-FOA-0002490

ANNOUNCEMENT TYPE: INITIAL
CFDA NUMBER: 81.049

FOA Issue Date:	DATE: March 16, 2021
Submission Deadline for Applications:	DATE: April 30, 2021, 11:59 PM Eastern Time



FY2021 FOA: Data, Artificial Intelligence and Machine Learning

Scope: Focus on research and development in artificial intelligence and machine learning methods (AI/ML) to maximize the production, mining, analysis, and control of data generated at the existing and future scientific user facilities and to optimize their scientific output

- Proposed research should impact a variety of technical challenges in control, modeling, data acquisition and analysis*
- These challenges may require advances in, or applications of state-of-the-art capabilities in, for example, storage systems, I/O, data and metadata management, and advanced computing hardware. Possible collaboration with ASCR to address these challenges.*
- Will contribute to advances in data management, fast extraction of useful information, and efficient use of that information to guide new experiments*

Application requirements:

- Estimated Award Size/Duration:** \$300K to \$1M/year for 2 years
- Eligible Institutions:** universities/colleges, DOE laboratories, other federal agencies
- Review Process:** panel review of full proposals by external peer reviewers. **Completed in August 2021**
- Preproposals or Letters of Intent: Not required**

Total NP Funding: \$ 5.7 M over 2 years

Awards Status: **SC “Public Release” on the awards still pending until university awards are processed by Grants and Contracts. No public announcements should be made by institutions until notified.**



NP AI/ML FY2021 DE-FOA-0002490 Awards (DRAFT)

Proposal ID	Institution	Proposal Title	PI	Total 2-year Award (\$) FY21-22	
261347	MIT	Intelligent experiments through real-time AI: Fast Data Processing and Autonomous Detector Control for sPHENIX and future EIC detectors	Roland, Gunther	500,000	
0000261363	NJIT		Yu, Dantong	250,000	
0000261359	FNAL		Tran, Nhan	250,000	
0000261349	LANL		Lead Institution	Liu, Ming Xiong	500,000
			Total Collaboration	1,500,000	
0000261341	UNC	Deep Learning for Germanium-Based Neutrinoless Double Beta Decay Searches	Gruszko, Julieta	450,000	
261295	LBNL	Machine Learning Optimization Upstream and Downstream of the Accelerator: The Cases of VENUS and GRETA	Crawford, Heather	1,000,000	
0000261348	LLNL	AI-driven detector design for the EIC	Angerami, Aaron	400,000	
0000261358	UC, Riverside		Lead Institution	Arratia, Miguel	280,000
0000261353	LBNL		Nachman, Benjamin	300,000	
			Total Collaboration	980,000	
261346	ANL- ATLAS		Autonomous Optimization of the Secondary Beam Production and Delivery at the ATLAS In-Flight Facility	Hoffman, Calem	750,000
261364	ANL-ATLAS	Modern Data Analytics for the Large Gamma-Ray Spectrometers: GRETINA/GRETA and Gammasphere via Machine Learning and Optimization	Carpenter, Michael	1,000,000	
			Total 2-year awards	5,680,000	



FOA Title	Planned Release date	Eligible Institutions
Accelerator R&D for next generation NP facilities	2022	Universities and SC Labs
AI/ML for NP Accelerators and Detectors	2023	Universities and SC Labs

- **For Accelerator R&D FOA:** *R&D for next generation NP facilities or improving capabilities of current NP Facilities. Specific interests includes but not limited to Next generation ion sources, Polarized electron photocathodes and in situ plasma processing of cryomodules. May also includes components of high priority NP related “SC Accelerator Initiatives”.*
- **For AI/ML FOA:** *NP is interested in supporting technical development at the intersections between real-time ML and the control and optimization of accelerator systems operation and detector design using AI models. This will be a follow on to the Data Analytics FOA, just “renamed”*



Communications between NP and PI for Accelerator R&D work

Two modes of communications between PIs and NP office: Quarterly reports and an annual face to face meeting with all PI in one place.

➤ Quarterly Reports

- PIs are asked to submit quarterly reports to NP in a “Small Project” format. The FY2020 4th quarter request was sent on **October 3rd, 2021**. Quarterly reports are reviewed by the Division (they are not just filed away).

➤ PI Exchange Meeting:

- **Accelerator R&D:** Since 2015, NP conducts annual “PI Exchange” meetings with presentations on current status of work by all Principal Investigators who received awards under previous fiscal year funds.
- **AI/ML:**
 - **This year:** for Data science and AI/ML efforts we are including the three Lab awards.
 - **Next year:** we will have a separate AI/ML exchange meeting that will cover years 2-3 of Lab awards and the 6 new awards for the FY2021 FOA



- Presentations on current status of work by all Principal Investigators (PIs) who received awards
 - under FY20 FOA [DE-FOA-0001230](#) for Accelerator R&D
 - Under FY20 Lab call [Lab-20-2261](#) for Data and AI/ML
- This is not a review, and no review panel is involved. Presentations will be made to NP Office Program Managers and Division Directors, and possibly a few PMs from HEP and BES Program Offices.
- To facilitate exchange of information between PIs and the NP Office and among PIs and institutions on all current NP Accelerator R&D and AI/ML funded efforts.
- A continuation of yearly meetings on NP supported Accelerator R&D for next generation NP facilities.



PI Meeting Presentation Guidelines:

Each presentation should include the following information:

- Description of the project and the current status;
- The main goal of the project for which you received the **FY 2020- 21 Accelerator R&D, and Lab Data AI/ML call awards.**
- A table showing annual budget and the total received to date (see below);
- A table showing major deliverables and schedule; and
- There will be no written report or follow up actions required for this meeting.
- Summary of expenditures by fiscal year (FY):
- All talks will be posted on PI Exchange meeting page on NP website.
- **35 min talks should allow 7 min for Q/A and 30 min talks 5 min for Q/A**

	FY20	FY21	Totals
a) Funds allocated			
b) Actual costs to date			

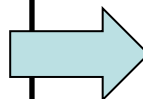


FY2021 PI Meeting Agenda for Awards in FY 20-21

AGENDA : 2021 NP Accelerator R&D and AI-ML PI Exchange Meeting, Tuesday November 30, Via Zoom								
#	Time (E.S.T)	Dur. (min)	Principal Investigator	Institution	R&D Area	Presentation Title	Speaker(s)	
	9:30	5	-	DOE NP	-	Introductory Remarks	Mantica	
	9:35 AM	35	-	DOE NP	-	NP supported Accelerator R&D and AI/ML	Farkhondeh	
1	10:10 AM	30	Stutzman, Marcy	TJNAF	Polarized Sources	Using improved growth techniques such as CBE to grow high polarization strained superlattice GaAs/GaAsP photocathodes, including those with Distributed Bragg Reflector structure	Stutzman	
2	10:40 AM	30	Bazarov, Ivan	Cornell	Electron Sources	High current sources for spin polarized and un-polarized electron beams	Andorf/ Bazarov	
	11:10 AM	15	Break					
3	11:25 AM	35	Poelker, Matthew Wang, Erdong	TJNAF BNL	Polarized Sources	Photocathodes with 90% polarization and QE greater than 1% for DOE NP	Poelker	
4	12:00 PM	30	Ringle, Ryan	MSU	Gas Stoppers	Gas Stopper Developments for Improved Purity and Intensity of Low-Energy, Rare Isotope Ion Beams	Ringle	
5	12:30 PM	35	Kelly, Michael Kutsaev, Sergey Posen, Sam	ANL RadiaBeam FNAL	SRF	Development of Practical Niobium-Tin Cavities for Ion Linacs	Kelly	
	1:05 PM	45	Lunch					
6	1:50 PM	30	Hernandez-Garcia, Carlos	TJNAF	Electron Source	High Voltage Insulators and Electrodes for 500 kV DC High Voltage Photogun with Inverted Insulator Design	Hernandez-Garcia	
7	2:20 PM	35	Litvinenko, Vladimir Yakovlev, Vyacheslav Poelker, Matthew Jing, Yichao	SUNY FNAL TJNAF BNL	SRF Electron Sources	Superconducting RF electron gun	Litvinenko	
8	2:55 PM	30	Powers, Tom Doleans, Marc	TJNAF ORNL	SRF	In Situ Plasma Processing of Superconducting Cavities	Powers	
	3:25 PM	10	Break					
			FY2020 Laboratory Awards in Data and AI/ML					
1	3:35 PM	35	Lawrence, David	TJNAF	AI/ML Detectors	A.I. Assisted Experiment Control and Calibration	Lawrence	
2	4:10 PM	35	Tennant, Christopher	TJNAF	AI/ML Accelerator	AI for Improved SRF Operation at CEBAF	Tennant	
3	4:45 PM	35	Mustapha, Brahim	ANL	AI/ML Accelerator	Use of Artificial Intelligence to Optimize Accelerator Operation	Mustapha	
	5:20 PM	5	Closing Remarks					
	5:25 PM		Adjourn					

NP Matrix for Quarterly Report Review and Assessment.

- *NP matrix for Quarterly Report and progress assessment.*
- *Make sure your quarterly reports addresses elements of this matrix for our evaluation*
- *Continue to use the NP “small Project” template Ms. Saryna Camron sends you.*



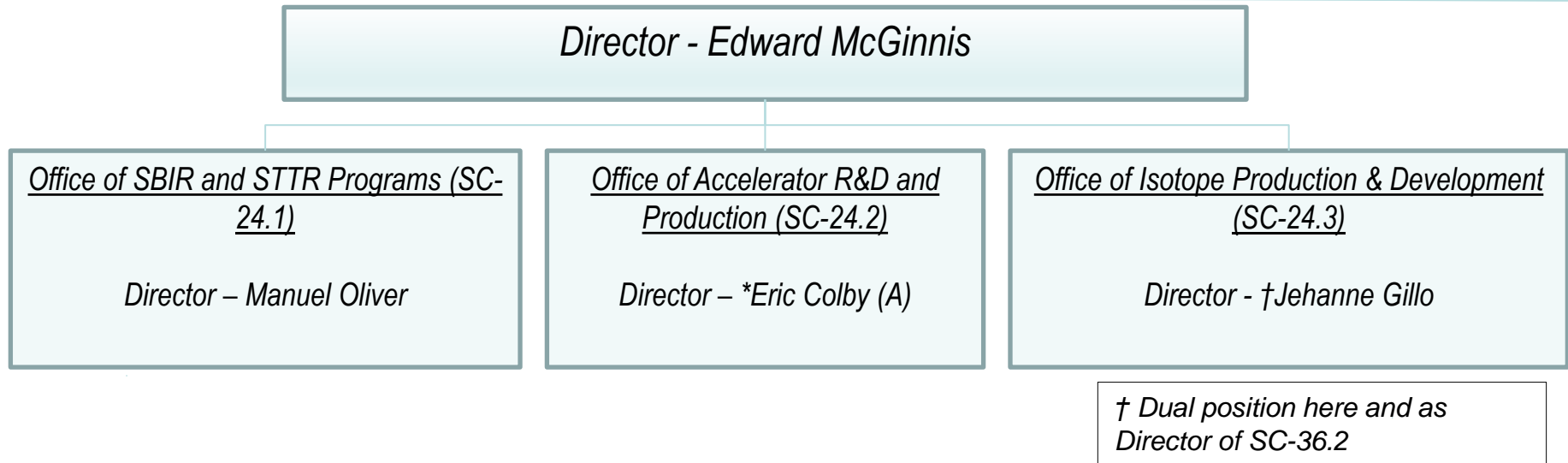
1-	PI’s performance during the quarter
a	Progress made
b	Milestones met
c	Any breakthrough
2-	Assessment of risk mitigation
a	Issue communicated?
b	appropriate mitigation strategies
3-	Likelihood of achieving project goals
a	Will they meet cost and schedule
b	Will they deliver the promised scope
4-	Recommendation on need for action
a	Are there any actions you need to take in response to points above



Thank You



Office of Engineering & Technology (SC-24)



- **ARDAP (SC-24.2) will**

- Develop and maintain a long-term accelerator science & technology (AS&T) strategy
- Help to coordinate and maximize the synergy of the individual SC Programs' AS&T investments.
- Invest in R&D and public-private partnerships to help rebuild the U.S. supply chain
- Invest in use-inspired basic R&D to transition technology into broader applications in medicine, security, and industry.



ARDAP Mission

...is to coordinate and make accelerator R&D and production investments that are aimed at addressing Accelerator Science & technology (AS&T) gaps to help ensure that future U.S. accelerator-based physical science R&D priorities will be met.

▪ **ARDAP will fulfill its mission by:**

- Maintaining a strategic picture of AS&T needs and worldwide competition;
- Facilitating coordination of Programmatic AS&T R&D investments across SC;
- Investing in selected cross-cutting AS&T areas;
- Providing a system engineering perspective for SC facility projects;
- Supporting workforce development, when needed;
- Maturing key AS&T technologies and developing capable U.S. vendors;
- Transitioning accelerator technology to broader uses.

Objective: Ensure a robust pipeline of next-generation AS&T to support physical sciences research while providing technology advances and industrial strength that position the U.S. to lead the world for decades to come.