IIFC R&D Deliverables to Fermilab by 2018

Shekhar Mishra

DAE-DOE Discovery Science Collaboration

Deputy Project Manager

PIP-II, Fermilab

U.S. DEPARTMENT OF ENERGY

Fermilab

FY15 IIFC: R&D Focus PIP-II

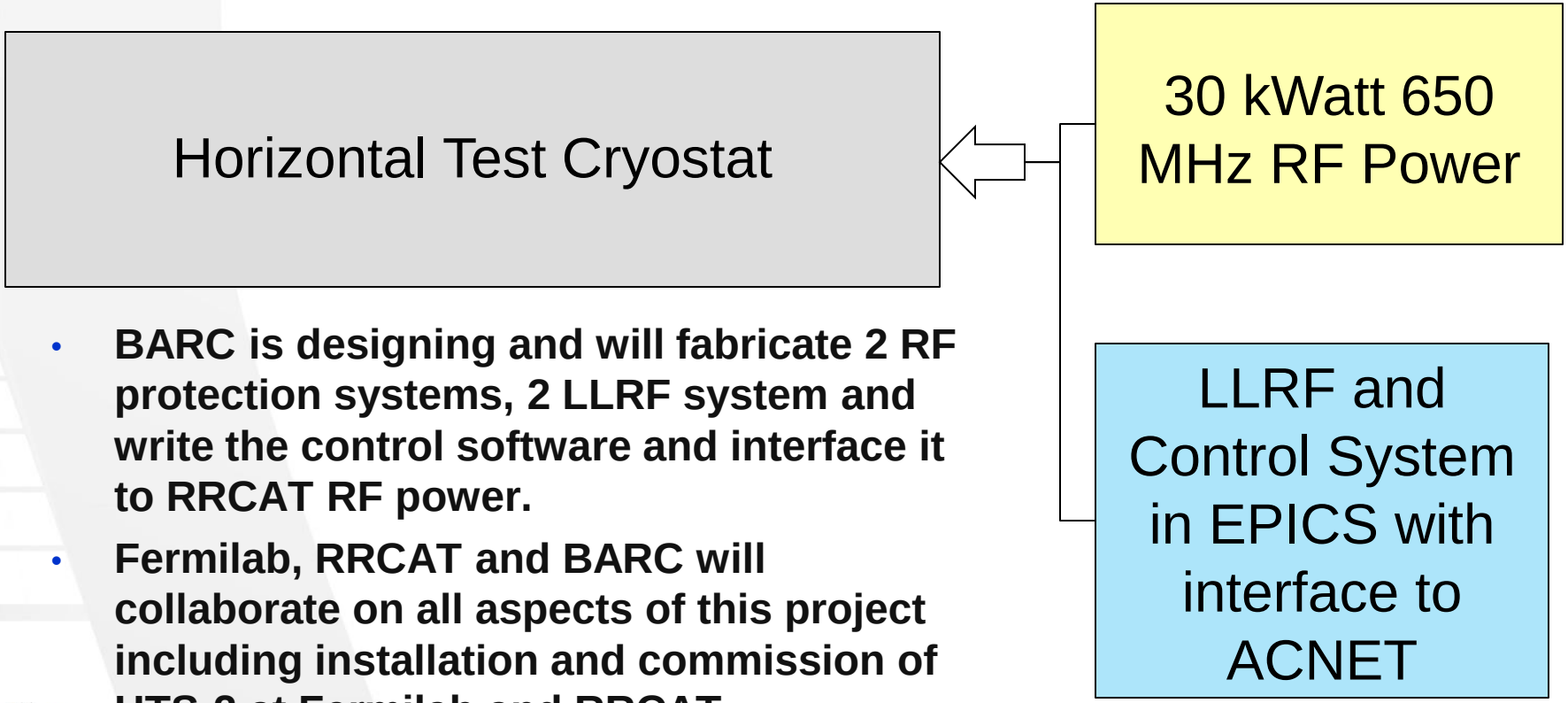
- We are focusing on one areas in SRF
  - HB650 Dressed Cavity and CM design
- We are focusing on two areas in SRF Infrastructure
  - HTS2
  - CMTS-I (May 2015)
- Solid State RF Power with control
  - 325 MHz
  - 650 MHz
- Warm Magnets for PXIE (MEBT)

FY15-17: 650 MHz, β = 0.92 Dressed Cavity

- **Elements of Dressed Cavity**
  - Bare Cavity with End groups and stiffening rings
  - End group interface to Helium Vessel
  - Helium Vessel with magnetic shield
  - Slow mechanical tuner (End)
  - Fast Pizo tuner (End with slow tuner)
  - 60 kWatt RF Coupler
- **Current Status**
  - Bare cavity design has been finalized
    - Mechanical design calculation of the stiffening ring has not been done
    - There are three possible option of the end group design, final selection is needed based on mechanical stability and fabrication
  - Based on the selected End group design its interface to He vessel needs to be designed
  - Design need to be finalized
    - Helium Vessel with magnetic shield
    - Slow mechanical tuner (End)
    - Fast Pizo tuner (End with slow tuner)
    - 60 kWatt RF Coupler

FY15-17: Integrated Horizontal Test Stand

- **RRCAT is designing and will fabricate 2 Horizontal Test Stand for the high power test of the 650 MHz dressed cavity. One will be installed at Fermilab and one at RRCAT.**
- **RRCAT will fabricate two 30 kW, 650 MHz Solid State RF Power for the two HTS.**



- **BARC is designing and will fabricate 2 RF protection systems, 2 LLRF system and write the control software and interface it to RRCAT RF power.**
- **Fermilab, RRCAT and BARC will collaborate on all aspects of this project including installation and commission of HTS-2 at Fermilab and RRCAT.**

IIFC R&D: PIP-II Cavity, CM and Infrastructure

- SSR1 (PIP-II, Fermilab/DAE)
  - 2 Bare cavities (Q1FY15)
  - 4 Dressed cavities (Q4FY17) ← Open to discussion
- SSR2 (PIP-II, DAE/Fermilab)
  - 4 Dressed cavity (Q2FY17)
  - 2 Horizontal Tested (Q4FY17)
- LB650 (PIP-II, CERN/DAE/Fermilab)
  - 2 Cavity VTS (Q2FY17)
  - 2 Dressed Cavity Horizontal Tested (Q2FY18)
- HB650 (PIP-II, DAE/Fermilab)
  - 4 Dressed Cavity HTS (Q4FY17)
  - CM Design finished (Q4FY16)
- HB650 CM (PIP-II, Fermilab/DAE)
  - 1 CM (Q1FY17)
- HTS-2 (Q1FY17) (DAE/Fermilab)
- 650 MHz CMTF (Q3FY18) (DAE/Fermilab)

FY17-18 IIFC Annex I : PIP II RF Power

- 325 MHz RF Power for PXIE (Q2FY17)
  - 10, 10 KW RF Power system
  - LLRF System
  - RF Protection System
  - Interface to Accelerator
- 650 MHz RF Power (2) HTS-2 and (6) CMTF (Q1FY17, Q2FY18)
  - 8, 30 kW Solid State RF System
  - LLRF System
  - RF Protection System
  - Interface to Accelerator

IIFC Annex I: PIP II

- MEBT
  - 51 Magnets (Q1 FY16)
- SRF Linac Magnet (Initiate work on Annex I)
  - Superconducting Solenoid
    - SSR1 and SSR2
  - Warm Magnet
    - 650 MHz CM
- 12th plan Annex I work to be initiated by DAE/Fermilab
  - Cryogenic Plant design and order
  - Nb order for PIP-II Cavities

Overall R&D Schedule

Pre CD-3 Phase R&D with IIFC																						Goals	DAE Funding
	Q1FY15	Q2FY15	Q3FY15	Q4FY15	Q1FY16	Q2FY16	Q3FY16	Q4FY16	Q1FY17	Q2FY17	Q3FY17	Q4FY17	Q1FY18	Q2FY18	Q3FY18	Q4FY18	Q1FY19	Q2FY19	Q3FY19	Q4FY19			
Warm Linac																							
Source																							
LEBT																							
RFQ																							
MEBT Magnets					51																	BARC to fabricate 51 magnets with power supply	Annex I
MEBT Commissioned																						MEBT tested at Fermilab with beam	
HWR																							
Cavity																							
Dressed Cavity																							
Cryomodule at PXIE																						HWR CM tested at Fermilab with beam	
SSR1																							
Cavity	2																					IUAC fabricated 2 bare cavity,	R&D
Dressed Cavity												4										DAE to fabricated 4 Dressed Cavity	R&D
Cavity String																							
8 10 KWatt, 325 MHz RF										8												8 RF, 10 KWatt Power Commissioned	Annex I
Cryomodule at PXIE																						SSR1 CM tested at Fermilab with beam (50 MeV)	
SSR2																							
Cavity																						SSR2 Design Finished	R&D
Dressed Cavity										4												BARC to produce 4 Dressed Cavity	R&D
Dressed Cavity Horizontal Test												2										2 SSR2 Dressed Cavity Fabricated and Horizontal tested	R&D
LB650																							
Cavity VTS							2															2, Cavity VTS tested RRCAT/VECC	R&D
Dressed Cavity										2												2 Cavity Dressed	R&D
Dressed Cavity Horizontal Test														2								2, LB650 Dressed Cavity Tested at Fermilab/RRCAT	R&D
HB650																							
8 Cavity VTS																						8 Cavity VTS	
Dressed Cavity Design Finished																						Dressed Cavity Design Finished	
Dressed Cavity Horizontal Test												4										8 Cavity Horizontal Tested, Four from RRCAT	R&D
Cryomodule Design																						Cryomodule Design Finished	R&D
Cryomodule Fabrication															1							Cryomodule Fabricated	
10 30 KWatt 650 MHz RF														10								8 RF Powered comissioned at Fermilab	Annex I
Cryomodule Test at 650 CMTF																						HB650 MHz Cryomodule Tested at Fermilab	
Infrastruture																							
650 MHz HTS Desgin Finished																						HTS Desgin Finshed	R&D
650 MHz Horizontal Test Stand									1													HTS Commissioned at Fermilab	R&D
650 MHz Cryomodule Test Stand															1							650 MHz CMTF Commissioned with Cryogenic	R&D
			DAE Deliverables								Fermilab Milestone							Many Sub Project Manager				

Summary

- **We are working on several R&D topics under IIFC. These R&D should conclude by the end of FY18.**
- **We propose to initiate work on a few projects for the Phase I of Annex I consistent with our R&D and PIP-II/HISPA plans as outlined in the DAE DPR.**
- **At the conclusion of these R&D in FY18, Fermilab, DOE and DAE will decided on the final deliverable table from DAE → DOE for PIP-II by 2023.**
- **Remaining deliverable will be for PIP-III after 2023.**