

RF Sources for Project X

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Project X Machine Advisory Committee
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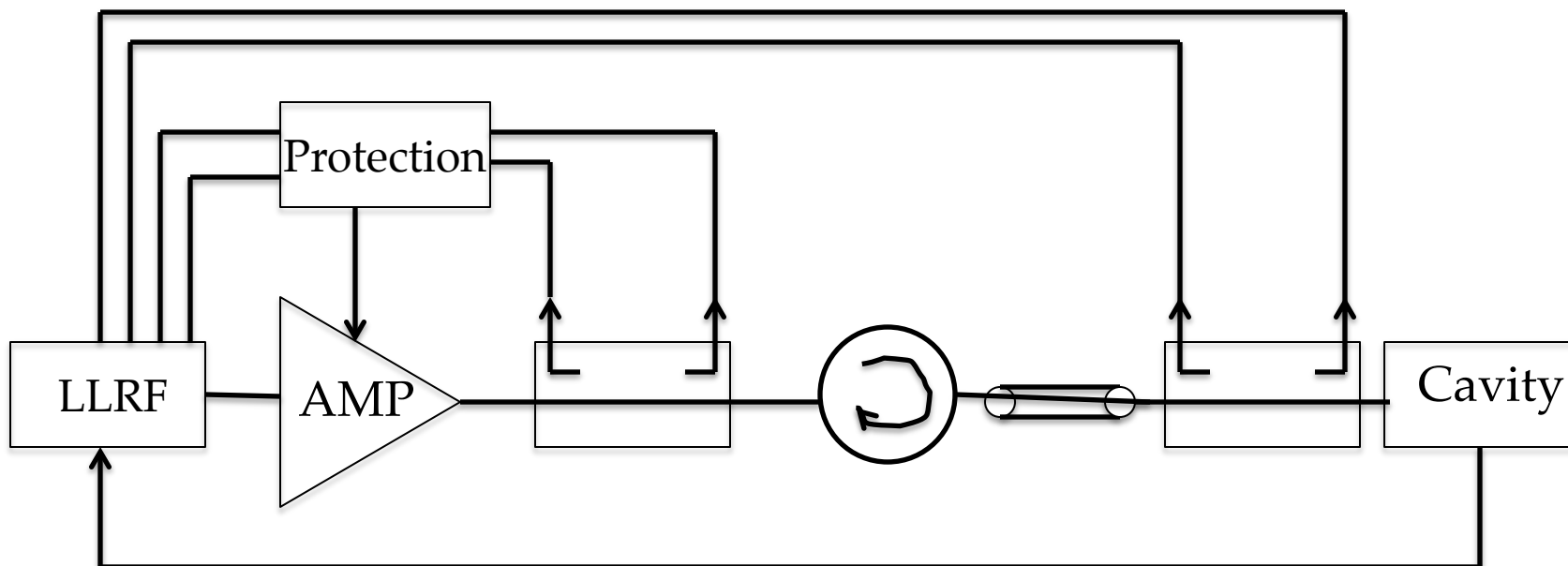


- List of RF systems for Project X
- Basic Block Diagram
- RFQ 162.5 MHz, 2 Bruker 75 kW solid-state
- Coupler test stand 162.5 MHz, 10 kW Thomson solid-state amp
- Coupler test stand 325 MHz, 10 kW Bruker solid-state amp
- 325 MHz RF R&D at BARC, India
- 650 MHz RF R&D at RRCAT, India
- 650 MHz IOT amplifiers
- 1.3 GHz Klystrons
- Separator cavities
- PXIE



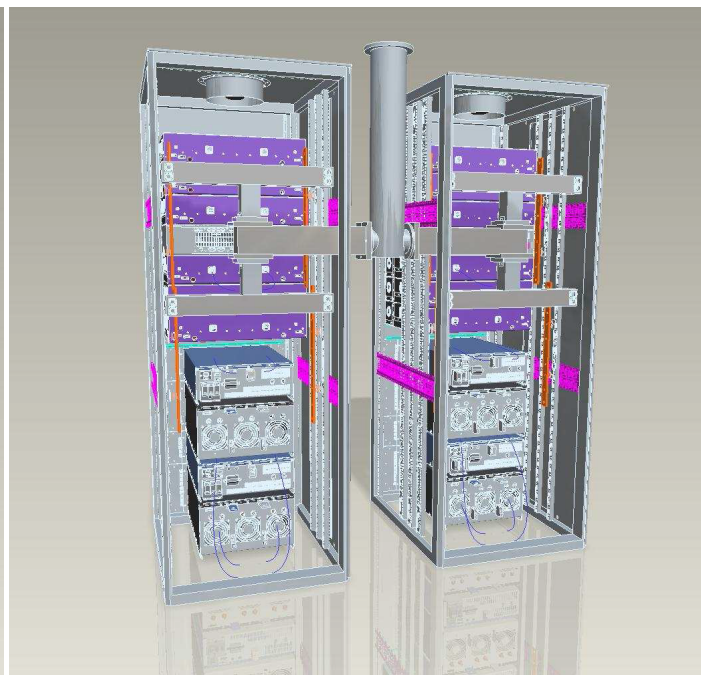
Project X: 2 mA to 1 GeV, 1 mA to 8 GeV

• RFQ:	2	75 kWatt solid-state 162.5 MHz
• Bunchers:	3	4 kWatt solid-state 162.5 MHz
• HWR:	8	4 kWatt solid-state 162.5 MHz
• SSR1:	16	7 kWatt solid-state 325 MHz
• SSR2	35	10 kWatt solid-state 325 MHz
• LB 650	30	60 kWatt IOT 650 MHz
• HB 650	42	60 kWatt IOT 650 MHz
• HB 650	120	30 kWatt IOT 650 MHz
• ILC 1.3	28	500 kWatt Klystron 1.3 GHz
• <u>Separators</u>	2	4-10 kW various frequencies
	286	Total RF systems





Soon to be Sigmaphi



Front view

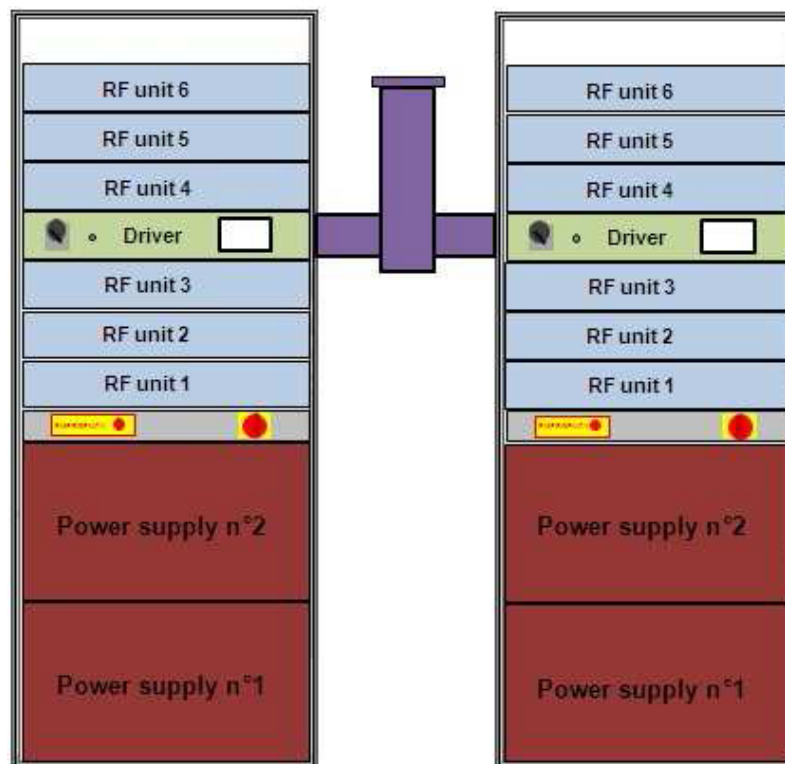
Rear view

Solid-state 75 kW RFQ amplifier



Each RF unit
Delivers approx 7 kW
RF modules and
Power supplies
Are water cooled
For enhanced reliability

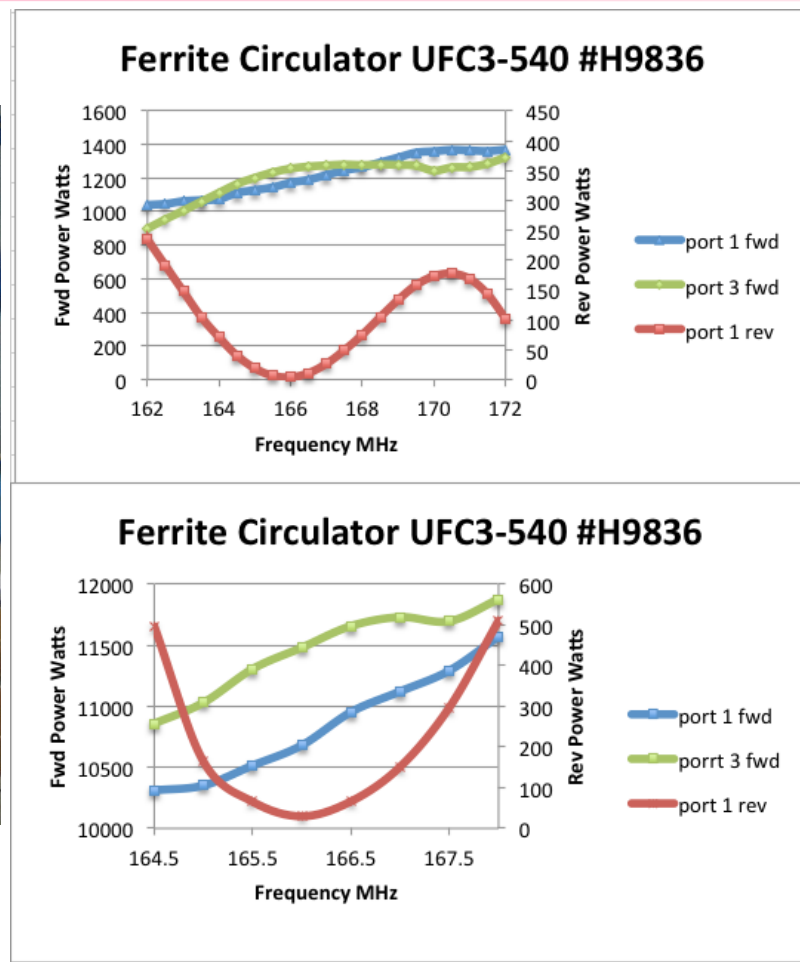
Front view

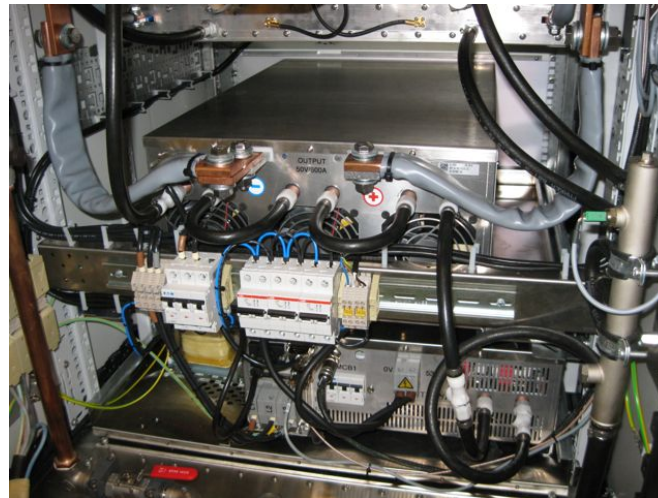




Thomson 10 kW Solid-state amp for testing HWR couplers at Argonne

Preliminary Test of 75 kW 162.5 MHz Circulator





10 kW 325 MHz coupler test stand solid-state amplifier



325 MHz 10 kW Solid-state
amp for coupler test stand @ MDB





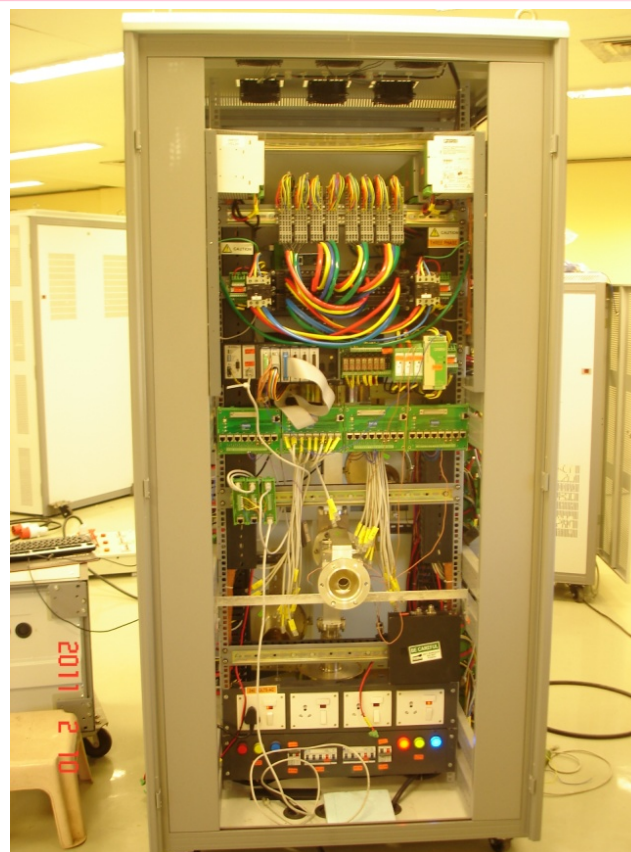
	Combined Output power (W)	Efficiency (DC/RF) %	Gain (dB)	comments
1	3000	69.76	21.5	Short term testing
2	3200	71.27	21.5	Short term testing

Four RF amplifier modules have been tested up to 900 Watt (max). Then, they are operated at 750 W and 800 W, combined to get 3 kW and 3.2 kW respectively.





Front View of 8 kW SSPA



Rear View of 8 kW SSPA









Various Frequency Separator Cavities

$1.5 \times 162.5 \text{ MHz} = 243.75 \text{ MHz}$ for PXIE (2 way split RT)

$(n) \times 81.25 \text{ MHz}$ for 1 GeV (two way split SC)

$(n + 1/4) \times 81.25 \text{ MHz}$ for 3 GeV (three way split SC)

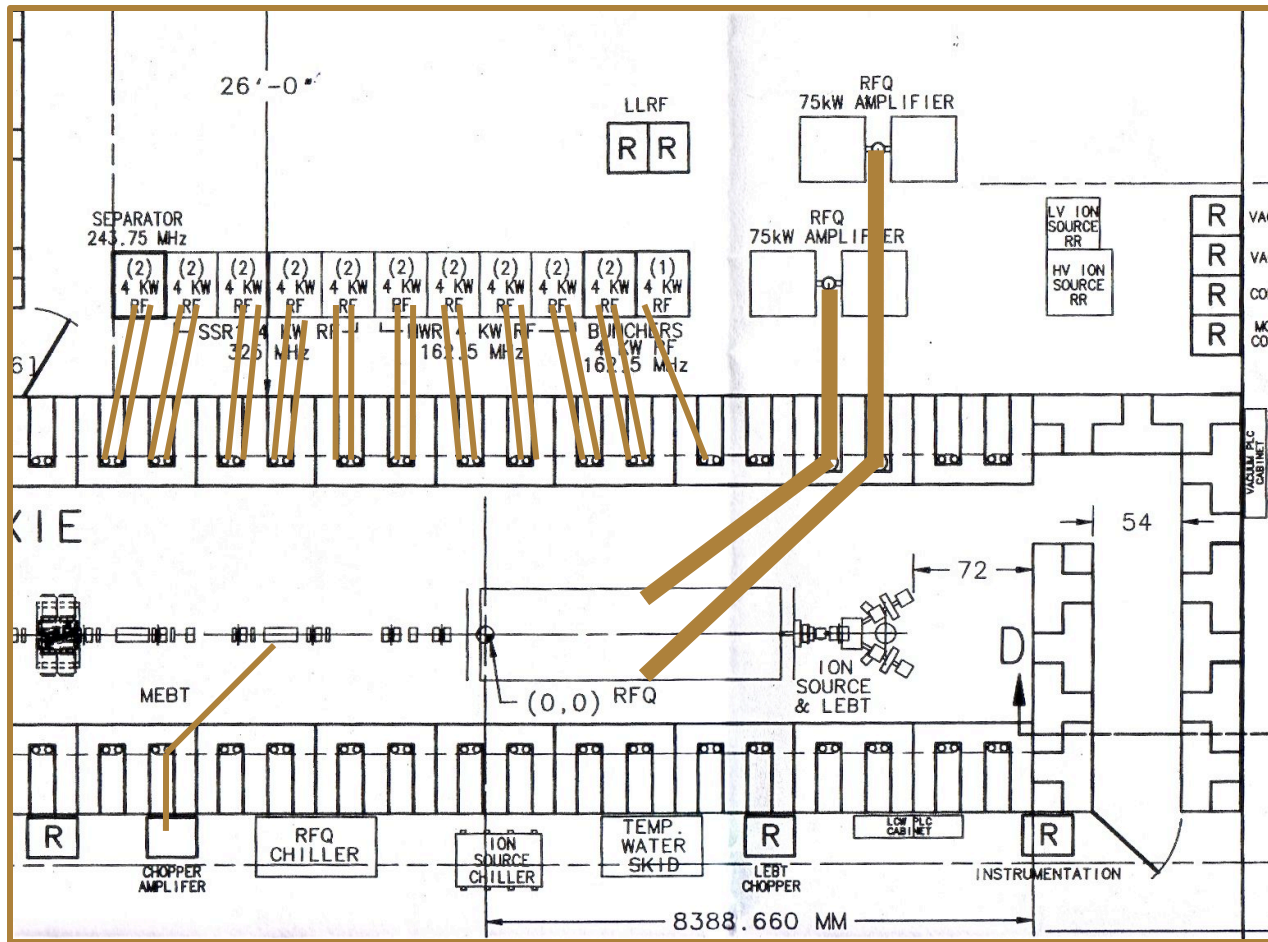
With individual solid-state amplifiers

Power levels varying between 4-10 kW

Driving a transverse deflecting cavity for

Measuring extinction ratio of adjacent buckets in PXIE

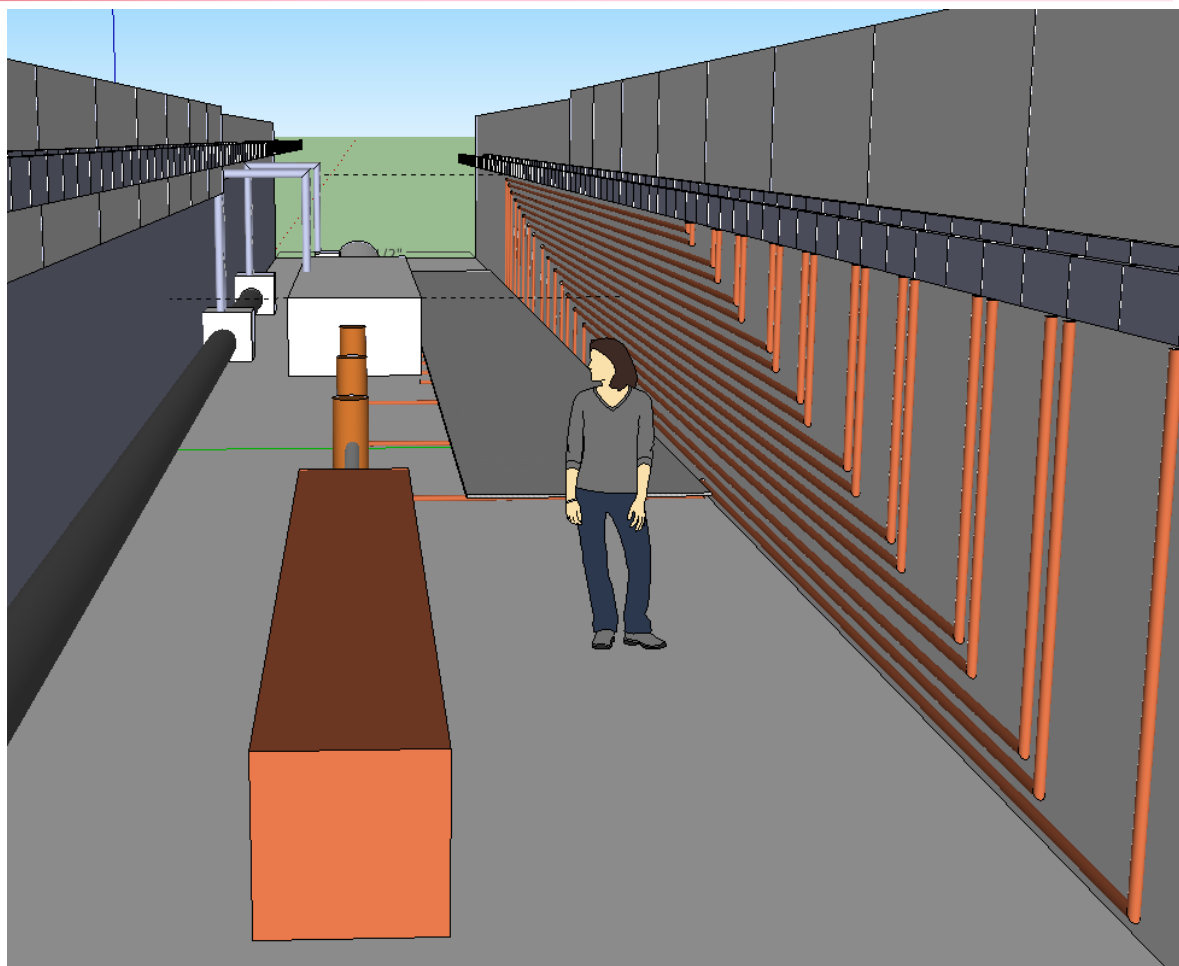
Kicking beam between experiments @ 1 GeV and 3 GeV





*Accelerator on Left
due to radiation shielding
and dump requirements
in a tight space*

*Raised floor
Over coax feeds*





Layout: PXIE RF Power Milestones		Filter All: Milestone, PXIE RF Power Milestones, PXIE Schedule																											
Activity Name	Finish	FY2013				FY2014				FY2015				FY2016				FY2017				FY2018				FY2019			
		FQ1	FQ2	FQ3	FQ4	FQ1	FQ2	FQ3	FQ4	FQ1	FQ2	FQ3	FQ4	FQ1	FQ2	FQ3	FQ4	FQ1	FQ2	FQ3	FQ4	FQ1	FQ2	FQ3	FQ4	FQ1	FQ2	FQ3	FQ4
RFQ RF Design and Distribution Layout Co...	03-Apr-13	◆ RFQ RF Design and Distribution Layout Complete																											
RFQ RF Equipment Delivered	02-Aug-13	◆ RFQ RF Equipment Delivered																											
RFQ RF Distribution Functional	31-Oct-13	◆ RFQ RF Distribution Functional																											
RFQ Delivery to FNAL*	22-Sep-14	◆ RFQ Delivery to FNAL*																											
MEBT RF Equipment PO Released	01-Oct-14	◆ MEBT RF Equipment PO Released																											
RFQ Ready for Installation	21-Oct-14	◆ RFQ Ready for Installation																											
Approval to Run RF Power to RFQ	27-Jan-15	◆ Approval to Run RF Power to RFQ																											
RFQ RF Distribution and Interlocks Tested	16-Feb-15	◆ RFQ RF Distribution and Interlocks Tested																											
MEBT RF Equipment Delivered	03-Aug-15	◆ MEBT RF Equipment Delivered																											
SSR1 RF Equipment PO Released	01-Oct-15	◆ SSR1 RF Equipment PO Released																											
HWR RF Equipment PO Released	01-Oct-15	◆ HWR RF Equipment PO Released																											
Beam through the MEBT*	18-May-16*	◆ Beam through the MEBT*																											
SSR1 RF Equipment Delivered	01-Aug-16	◆ SSR1 RF Equipment Delivered																											
HWR RF Equipment Delivered	01-Aug-16	◆ HWR RF Equipment Delivered																											
SSR1 Installation Complete	29-Sep-16	◆ SSR1 Installation Complete																											
SSR1 RF Power Ready	28-Oct-16	◆ SSR1 RF Power Ready																											
PXIE Stage 1 Complete*	30-Nov-16	◆ PXIE Stage 1 Complete*																											
HWR Cryomodule Delivery To FNAL*	31-Mar-17*	◆ HWR Cryomodule Delivery To FNAL*																											
HWR Installation Complete	30-Jun-17	◆ HWR Installation Complete																											
PXIE Stage 2 Complete*	30-Aug-17*	◆ PXIE Stage 2 Complete*																											
PXIE Stage 3 Complete*	17-Aug-18	◆ PXIE Stage 3 Complete*																											