

# PXIE RFQ Schedule and Budget

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# Topics

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- Scope of work - LBNL and FNAL
- Fabrication Plan
- Schedule
- Budget

# LBNL Project Scope

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- RFQ physics design
- Engineering analysis
- Detailed RFQ structure design
- Fabrication tests
- RFQ module fabrication
- Module performance verification
- RFQ 4-module assembly
- Final tuning and verification



# FNAL Scope

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- Material procurement: test material, RFQ vane Cu, braze clamp and joint plate stainless, tuner Cu
- RFQ couplers and windows - design, fab, procure
- Vacuum hardware procurement - pumps, manifolds
- Support structure - design and fabrication
- Cooling system - chiller procurement
- Instrumentation procurement - temperature sensors, flow meters, pressure gauges, vacuum gauges
- Cooling system manifolds - TBD

# Fabrication Plan

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- A series of fabrication tests are being carried out by LBNL
  - Procedures and drawings by LBNL
  - Materials have been ordered by FNAL
  - LBNL will carry out fabrication tests and document results
  - Vane cutter tests are now under way
  - Numerous equivalent tests are well under way at IMP Lanzhou

# Fabrication Plan (cont'd)

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- Module fabrication will be carried out primarily in the LBNL main shop
  - Fabrication drawing package and related documentation generated by LBNL
  - FNAL will procure most module materials
  - Some specialized work by outside vendors: gun-drilling, brazing, e-beam welding
  - LBNL will oversee all aspects of module fabrication
- LBNL will specify requirements for RFQ subsystems
  - Support structure, cooling system, couplers, etc.
  - FNAL to carry out design/fab/procurement in these areas

# Schedule Comments

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- LBNL began officially working on the RFQ project late in FY10
- Design work has run largely in parallel with the IMP Lanzhou RFQ with the work on the PXIE RFQ trailing by several months
- With both projects soon entering the fabrication phase, LBNL efforts will focus on the PXIE RFQ construction in-house (IMP RFQ fab in China)
- Construction schedule is not driven by limitations in manpower, shop capabilities or budget as much as by the sequential nature of the fabrication process

# Project Schedule

LBL Task Description	Q4 '11	Q1 '12	Q2 '12	Q3 '12	Q4 '12	Q1 '13	Q2 '13	Q3 '13	Q4 '13	Q1 '14	Q2 '14	Q3 '14
Engineering Analysis of RFQ structure	■											
Physics Design of RFQ	■											
Detailed Design of RFQ Structure			■									
Complete Fabrication Tests				■								
Recieve Long Lead Materials					■							
Machining of RFQ Vanes							■					
Final Braze of RFQ Modules									■			
Performance Verification of RFQ Modules										■		
Assembly of RFQ on Support Structure											■	
Final RFQ Tuning and Verification												■

FNAL Task Description	Q4 '11	Q1 '12	Q2 '12	Q3 '12	Q4 '12	Q1 '13	Q2 '13	Q3 '13	Q4 '13	Q1 '14	Q2 '14	Q3 '14
Procurement of Test Materials					■							
Procurement of Module Materials					■							
RF Couplers and Windows					■					■		
Procure Vacuum Hardware										■		
Support Structure Design and Fab							■					
Procure Water Cooling Chillers									■			
Procure Instrumentation									■			





# Budget

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- Total PXIE RFQ project cost (LBNL) is ~\$2.2M, including contingency (26%)
- ED&I plus physicist support is ~37% of total budget
- Funding allocated for FY13 appears to be sufficient to prevent schedule slip
- LBNL costs exclude most material and subsystems
- LBNL support for installation, integration and testing at FNAL not specifically listed in budget estimate

# Budget Breakdown

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## Labor Costs

Physics design, engineering analysis	\$152k
Detailed design	\$358k
Fabrication follow	\$191k
Performance verification	\$96k

## Fabrication/assembly Costs

Fabrication tests	\$122k
Cavity modules	\$813k
Cavity subcomponents	\$255k
Verification hardware	\$179k

# Summary

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- Engineering design and analysis of the RFQ has been completed by LBNL
- The PXIE and IMP RFQ's designs are nearly identical and are being carried largely out in parallel
- A series of fabrication tests are under way
  - Tests at LBNL to be complete by April '13
  - Equivalent tests are far along at IMP Lanzhou
- Final design drawings to be complete by Feb. '13
- Completed RFQ assembly to arrive @ FNAL ~Aug. '14
- Budget/funding profile appears sufficient to complete project

