Ring Imaging Cherenkov Counter (RICH)

Program Management Plan

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RICH Project Review
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Introduction

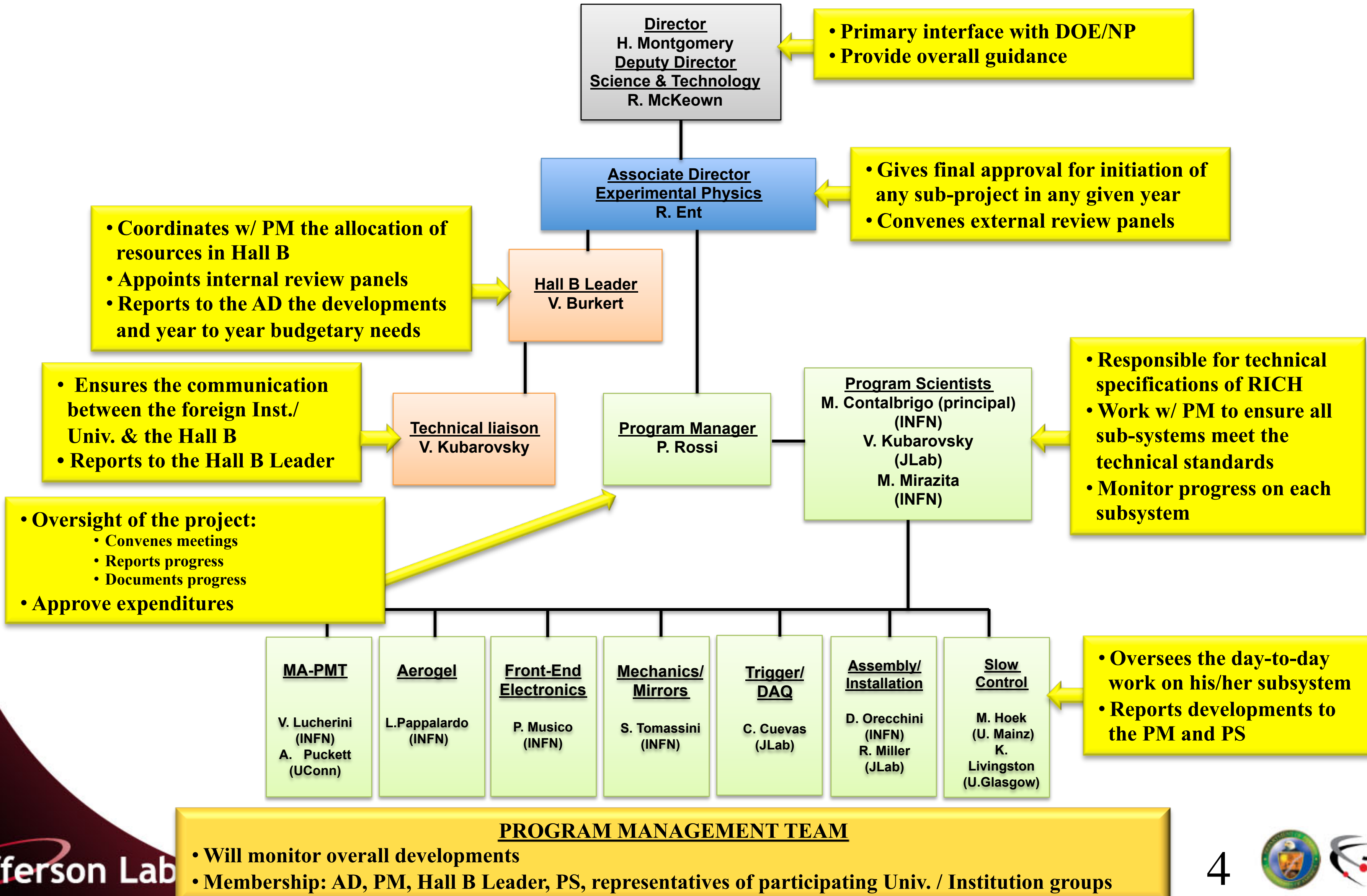
- The RICH Program will be executed as a joint collaboration between:
  - Argonne National Lab (USA)
  - Duquesne University (USA)
  - Kyungpook National University (Republic of Korea)
  - INFN, sezione di Bari (Italy)
  - INFN, sezione di Ferrara (Italy)
  - INFN, sezione di Genova (Italy)
  - INFN, sezione di Roma 1 & ISS (Italy)
  - INFN, Laboratori Nazionali di Frascati(Italy)
  - J. Gutenberg Universitat Mainz (Germany)
  - Thomas Jefferson National Accelerator Facility (USA)
  - Universidad Tecnica Federico Santa Maria (UFSM – Chile)
  - University of Connecticut (USA)
  - University of Glasgow (UK)

Scope and Dependencies

- The RICH project is led by INFN (Italy) and will be executed as a join collaboration with the US, Chile, UK, Germany and Republic of Korea.
- It requires the completion of CLAS12 as part of the JLab 12 GeV upgrade project.
- It relies on contribution of funds from international groups such as INFN/ Italy, Chile, Germany, UK and Republic of Korea.
- It relies on manpower already committed by non-US contributions.
- **The US scope provides manpower to guarantee successful integration in CLAS12 and purchasing and testing of various electronics components, and installation by the Hall B technical crew.**
- **This RICH Program Management Plan describes the management of the US scope of the project.**

Program Organization

- A clear definition of the roles and responsibilities that individuals and their organizations play will be critical to the success of the RICH Program



Project Cost – Estimating Cost Contingency

- For each of the subsystem of the RICH Project a list of expenditures was developed.

- These lists include **cost estimates** based on:
    - catalog prices
    - vendor quotes
    - previous experience
    - technical estimates

- The **cost contingency** for a given RICH subsystem was calculated based on a Risk Factor which is function of:
    - the sophistication of the technology
    - the maturity of the design effort
    - the accuracy of the cost sources
    - the impact of delays in the schedule.

- Risk analysis was performed for each subsystem.

- **The labor** required to build each item was folded in **only for the JLab cost** estimate.

Project Cost – Cost Contingency/Risk Factors

Schedule Risk

- **No schedule risk has been assigned to this project** since a delay in the completion of the RICH will not put the schedule of the CLAS12 completion at risk.

Cost Risk

- If there is a **recent price quote** from a vendor or a **recent catalog price**: **10% contingency** (DAQ electronics, mechanics).
- If there is **not a sufficiently robust production process : additional 15%** (Front-End electronics).
- Special case: **MA-PMTs** for which we have a recent price quote. The assigned **20% contingency** captures a possible procurement of next generation PMT, where the 20% is based on the maximum increase of the quote price as given by the vendor.
- If the items are not **"off-the-shelf" of a single vendor** the contingency is discussed under the technical risk (aerogel, mirrors).
- A 30% contingency has been assigned to the shipment as the estimated cost is based on previous experience and not on a quote.

Technical Risk

Indicates how common the technology is that is required to accomplish the task or fabricate the component.

- If the technology is so common that the element can be bought "off-the-shelf" it has **very low technical risk: no additional contingency assigned.**
- For elements that **extend the current "state-of-the-art"** in the technology: **30% contingency** (aerogel, mirrors).

Design Risk

It is directly related to the maturity of the design effort.

- If the element **design is nearly complete**, quantity counts and parts lists finished: **risk factor of 0** (RICH external frame, electronic panel)
- When **no accurate studies** have been made we assign a **30% contingency** (gas -------system and slow control)

Sub-system	Contingency (%)
MA-PMTs	20
Aerogel	30
DAQ electronics	10
Front-End Electronics	25
Mechanics	10
Mirrors	30
Gas System	30
Slow Control	30
Shipment	30

Project Cost

	Base Cost (K$)	Cont. (%)	Cost Cont. (K$)	TOTAL Cost (K$)	JLab	INFN	CHILE
MA-PMTs	1023,4	20	204,7	1228,1	1228,1		
Aerogel	550,8	30	165,2	716	253	463	
DAQ electronics	243,2	10	24,3	267,5	267,5		
Front End Electronics	180,1	25	45	225,1		225,1	
Mechanics	55,5	10	5,6	61,1	13,75	47,3	
Mirrors	436,5	30	131	567,5		267,5	300
Gas System	20	30	6	26	26		
Slow Control	10	30	3	13	13		
Shipment	20	30	6	26		26	
TOTAL	2539,5		590,8	**3130,3**	**1801,4***	**1028,9****	**300*****

Base Cost + Contingency
1503,7+297,6K$ (~20%)

* The Jlab TOTAL includes procurement&labor

** The INFN TOTAL includes ONLY procurement;
Labor: in average for each fiscal year 10FTE physicists+4.5FTE technicians & engineers.

*** The CHILE TOTAL includes ONLY procurement.

Project Base Cost

Flow of the expenditure through FY13-FY14-FY15-FY16 for the **base cost** of the project

	FY13 IV (K$)	FY14 I (K$)	FY14 II (K$)	FY14 III (K$)	FY14 IV (K$)	FY15 I (K$)	FY15 II (K$)	FY15 III (K$)	FY15 IV (K$)	FY16 I (K$)	FY16 II (K$)
MA-PMTs	200	411,7				411,7					
Aerogel		103,1		167,2		50	85,9			144,6	
DAQ electronics		38				93				112,2	
Front End Electronics		16			67,2	83,7					13,2
Mechanics					27,3			15,7		12,5	
Mirrors		15,4		61,5	115,4		128,8	115,4			
Gas System										20	
Slow Control										10	
Shipment											20

Does not include contingency

	FY13	FY14	FY15	FY16
TOTAL JLAB	200	449,7	554,7	299,3
TOTAL INFN		457,7	314,1	33,2
TOTAL CHILE		115,4	115,4	

Component of each sub-system

MA-PMTs	• 430 MA-PMTs
Aerogel	• Manufacturing engineering • 5.3 m^2 of aerogel produced by Budker INP (Russia)
DAQ Electronics	• FPGA Readout Board (integrated circuits, connectors, passives) Fiber Optics cables (MTP to MTP/LC, Fiber Patch panels) • Low Voltage (Power supply, Fuse Panel, Cables) • High Voltage (Main Frame, HV cards, HV distribution, Multiconductor HV cables) • 1 JLab FTE Manpower (FPGA firmware development, verification and simulation + cable fabrication, testing • and installation + final installation)
F-E Electronics	• Manufacturing engineering • Integrated Circuits (MAROC, NINO, Ext ADC, delay line, voltage • regulator, DAC) • Passives (resistors, capacitors, inductors, multilayer PCB, misc. hardware) • Connectors (SAMTEC TMM, SAMTEC, LV power)
Mechanics	• RICH external frame (aluminum alloy) • Electronic panel (durostone plus aluminum alloy) • Installation tools • 0.14 JLab FTE Manpower for installation in CLAS12
Mirrors	• Spherical Mirrors: • Carbon Fiber Reinforced Polymer (CFRP) Substrate, Mold, CFRP support • and positioning Frame, Coating • Flat Mirrors: • CFRP support Frame, Glass
Gas System	• - Filters, lines, flux and pressure regulators, Nitrogen gas, chiller
Slow Control	• Gas Sensors, lines

Level 1	Schedule	Level 2	Schedule
Start of US scope of RICH Project	30 September 2013		
Start Aerogel procurement	31 December 2013		
Start PMT production	1 February 2014		
		Front-End Electronics: design and control Firmware	31 March 2014
		First PMT delivery	30 April 2014
		External Frame: design completed	30 June 2014
		DAQ: design of the FPGA Board and Firmware development	30 September 2014
Start Mirror procurement	31 October 2014		
		Aerogel: 2 m^2 delivered	31 December 2014
		External Frame : construction completed	31 December 2014
		Front-End and DAQ FPGA boards: production completed	28 March 2015
		Gas System: design completed	30 March 2015

Level 1	Schedule	Level 2	Schedule
		Start mirror characterization	30 June 2015
		Front-End Electronics characterization	30 September 2015
PMT production completed	30 April 2015		
		PMT characterization completed	30 June 2015
Mirror construction completed	30 September 2015		
		Electronics Panel: construction completed	30 September 2015
		Slow Control: procurement completed	31 December 2015
		Gas System: procurement completed	31 December 2015
		Front-End Electronics/Mirrors/External Frame/Electronics Panel delivery to JLab	31 March 2016
Start assembly RICH	1 April 2016		
Aerogel production completed	30 June 2016		
		Completion Assembly RICH	30 July 2016
		Start installation RICH	3 September 2016
RICH project completed	15 September 2016		

Program Change Control

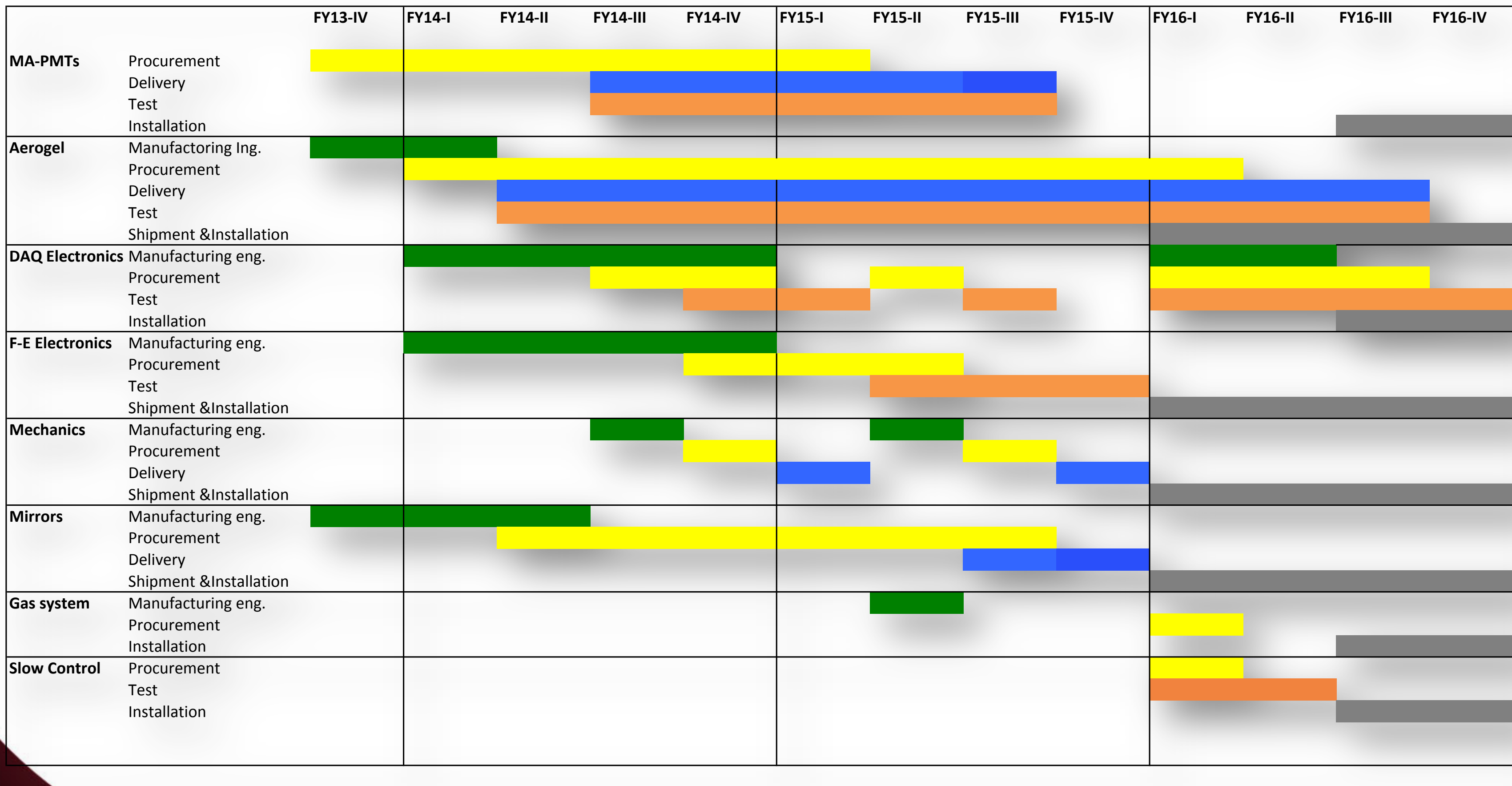
- The RICH Program Management Team will act as Change Control Board (CCB) to evaluate proposed changes to the project baseline.
- Membership of the CCB will consist of the Program Manager, the Hall Leader, the Program Scientists, and the Associate Director when needed.
- Change Control approval levels will be handled in accordance with the table below:

	Level 0 **Associate Director Experimental Physics**	**Level 1** **Program Manager** **Hall B Leader**	**Level 2** **Program Scientists**
Scope / Technical	Any change in scope and/or performance that affects the science	Any change that affects the Deliverables or Key Performance Parameters	NA
Schedule	Any cumulative change at WBS Level 1 that delays completion by > 6 months	Any change to a Level 1 Milestone, or any change to a Level 2 Milestone > 3 months	Any change to a Level 2 Milestone ≤ 3 months
Cost	Any cumulative change at WBS Level 1 that increases the TPC to > 100K$	Any cumulative change at WBS Level 1 < 100K$	NA

This structure has been chosen to guarantee that the project will stay below 2M$

Time Schedule

- The RICH Project schedule covers approximately 3 years.
- The installation of the RICH detector is foreseen at the end of FY16 that is one year before the first experiment might be scheduled where the RICH would be needed.



RICH Project & Reviews

- Progress on each component will be monitored by the Program Scientists and report to the Program Manager.
- The JLab RICH management team will provide a monthly status update to the AD of Experimental Physics via a short written report and a monthly meeting.
- JLab will convene external review panels to evaluate progress on a as needed basis. In the event of any serious problems in the interim, e.g., a detector performance issue, additional appropriate reviews would be convened by JLab.
- RICH Program Team meetings will be held regularly to keep collaborators informed of progress and problems.

Institutions Contributions

INSTITUTIONS	CONTRIBUTIONS
Argonne National Lab, USA	• Feasibility studies • Simulations • Pattern Recognition and Event Reconstruction
University of Connecticut, USA	• PMTs test characterization
Duquesne University, Pittsburgh, USA	• Simulation software maintenance
University of Glasgow, Glasgow, UK	• PMTs detailed characterization • Cosmic test of a small RICH prototype • Slow control development and maintenance
Kyungpook National University, Republic of Korea	• PMT test characterization
INFN Sezione di Bari, Bari, Italy	• Gas system construction
INFN Sezione di Ferrara, Ferrara, Italy	• Design and construction of the large scale RICH prototype • Acceptance tests and characterization of the aerogel • Simulations • Pattern Recognition and event reconstruction • Design, prototyping, construction of the Front End Electronics

INSTITUTIONS	CONTRIBUTIONS
INFN Sezione di Genova, Genova, Italy	• Design, prototyping, construction and test of the Front End Electronics
INFN Laboratori Nazionali di Frascati, Frascati, Italy	• Design and construction of the large scale RICH prototype • PMTs detailed characterization • Mirrors design and quality acceptance tests • Mechanical design
INFN Sezione di Roma1 & ISS, Roma, Italy	• Design, prototyping, construction and test of the Front End Electronics
Institut fur Kernphysik, Mainz, Germany	• Slow control development and maintenance
JLab	• Design, prototyping , construction and test of the DAQ • Acceptance test and characterization of the MA-PMTs • Installation of the RICH detector in CLAS12
Universidad Tecnica Federico Santa Marıa, Valparaiso, Chile	• Development of the Front End electronics for the RICH large scale prototype • Mirrors design and quality acceptance tests

Conclusions_1

- The Italian INFN groups of Bari, Genova, Ferrara, Laboratori Nazionali di Frascati, Roma I/ISS are proposing the construction of a RICH detector to replace **1 sector** of the LTCC in CLAS12.

- The project will be executed as a join collaboration with the US (JLab, Argonne Nat. Lab., Connecticut U., Duquesne U.) Chile, UK, Germany and Republic of Korea.

- This RICH Program Management Plan, here presented, describes the management of the **US scope of the project**.

- The US scope of the project includes:
    - Purchasing the MA-PMTs, the DAQ electronics components, ~1/3 of the aerogel
    - Providing the manpower to develop and test the DAQ electronics and to guarantee a successful integration in CLAS12

Conclusions_2

- The evaluated total cost of the RICH detector (base cost + contingency) includes:
  - manpower + procurement for Jlab
  - only procurement for INFN and Chile

- **The manpower** already committed by **non-US contributions** can be estimated at the order of

  12 FTE/year for physicists
  6 FTE/year for technicians & engineers

- The installation of the RICH detector is foreseen at the end of FY16 that is one year before the first experiment might be scheduled where the RICH would be needed.