RSVP
rare symmetry violating processes

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NSF

The Rare Symmetry Violating Processes Project

Jonathan Kotcher
BNL HEP DOE Review
27-28 April 2005
Brookhaven National Laboratory

Office of Nuclear Physics
Department of Energy

HEP
office of
high energy physics

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Outline

- Overview of experiments, AGS
- Project timelines
- Management, organization
- BNL involvement in RSVP
- Construction project status, cost summary
- Running beams for RSVP: logistics & costs
- Brookhaven commitment, base program support
- Closing remarks

KOPIO Scientific Collaboration

Arizona State University J.R. Comfort, J. Figgins

University of British Columbia, Canada D. Bryman, M. Hasinoff, J. Ives

Brookhaven National Laboratory D. Beavis, I.-H. Chiang, A. Etkin, J.W. Glenn, A. Hanson, D. Jaffe, S. Kettell, D. Lazarus, K. Li, L. Littenberg, G. Redlinger, C. Scarlett, M. Sivertz, R. Strand

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IHEP, Protvino, Russia G. Britvich, V. Burtovoy, S. Chernichenko, L. Landsberg, A. Lednev, V. Obraztsov, R. Rogalev, V. Semenov, M. Shapkin, I. Shein, A. Soldatov, N. Tyurin, V. Vassil'chenko, D. Vavilov, A. Yanovich

INR, Moscow, Russia A. Ivashkin, D. Ishuk, M. Khabibullin, A. Khotjanzev, Y. Kudenko, A. Levchenko, O. Mineev, A. Vasiljev, N. Yeshov

KEK, Japan M. Kobayashi

Kyoto University of Education, Japan R. Takashima

Kyoto University, Japan H. Morii, Y. Nakajima, T. Nomura, N. Sasao, T. Sumida, N. Taniguchi, H. Yokoyama

University of Montreal, Canada J.-P. Martin

University of New Mexico B. Bassalleck, N. Bruner, D.E. Fields, J. Lowe, T.L. Thomas

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TRIUMF, Vancouver, Canada P. Amaudruz, M. Barnes, J. Doornbos, P. Gumplinger, R. Henderson, N. Khan, J. Mildenberger, A. Miller, A. Mitra, T. Numao, R. Poutissou, F. Retiere, A. Sher, G. Wait

Tsinghua University, Beijing, China S. Chen

University of Virginia E. Frlez, D. Pocanic

Virginia Polytechnic Institute and State University M. Blecher, N. Graham, A. Hatzikoutelis

Yale University G. Atoyan, S.K. Dhawan, V. Issakov, A. Poblaguev, M.E. Zeller

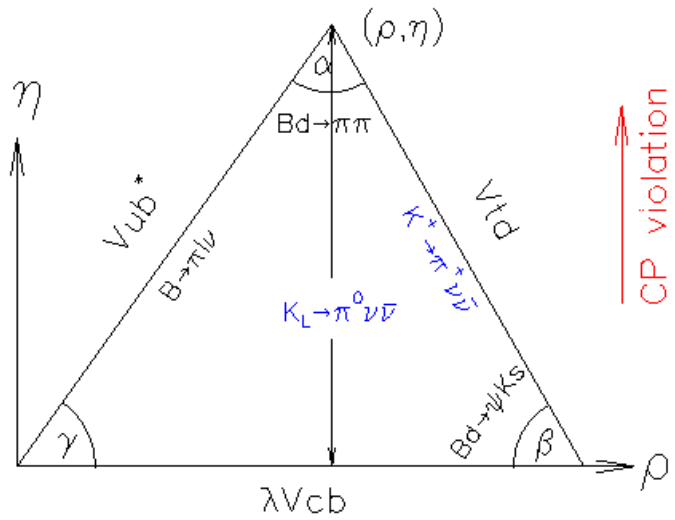
University of Zurich, Switzerland P. Robmann, P. Truol, A. van der Schaaf, S. Scheu

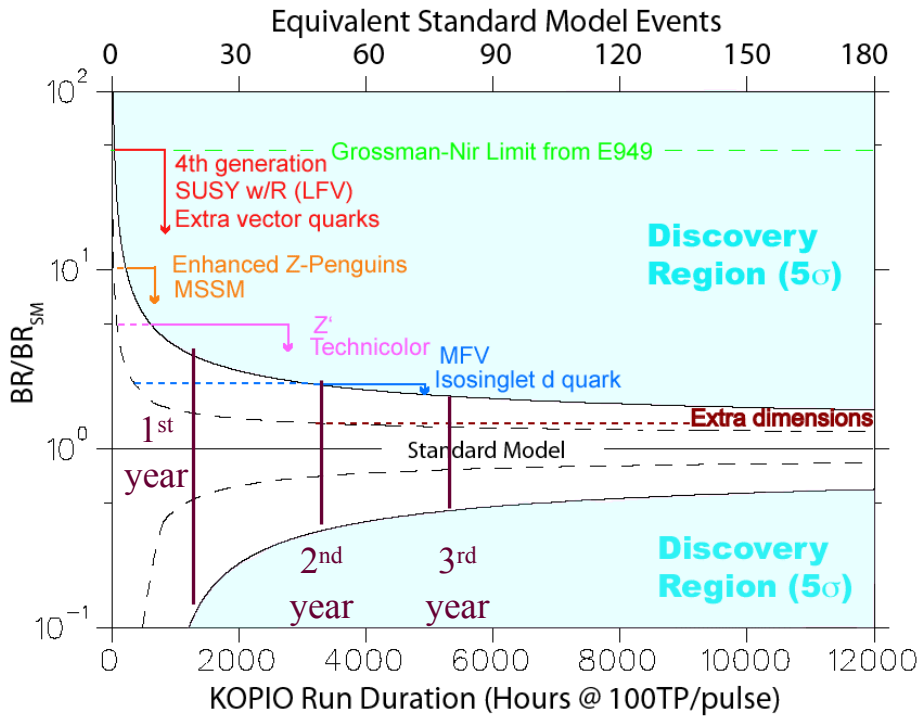
80 scientists, 10 graduate students, 19 institutions, 6 countries

Spokespersons:
D. Bryman (UBC, Canada),
L. Littenberg (BNL),
M. Zeller (Yale)

KOPIO Physics Program

See talk by D. Jaffe





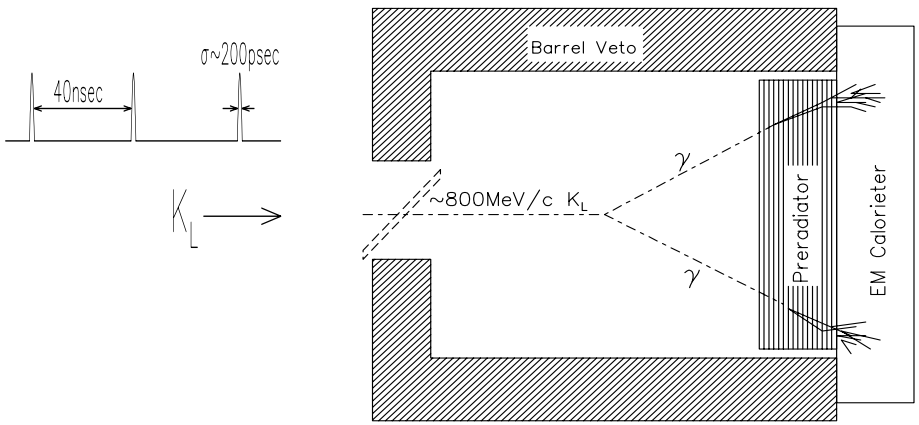
- **Anticipate 10% measurement of $B(K_L \to \pi^0 \nu\nu) \sim 3\times10^{-11}$**
  - **5% measurement of area of unitarity triangle (unique)**
- **Early running provides sensitive probe of non-SM physics**

KOPIO Concept

KOPIO: Measurement of $K_L^0 \rightarrow \pi^0 \nu\bar{\nu}$

CONCEPTS

- Measure as much as possible:
  Energy, position and $ANGLE$ of each photon.
- Work in the C.M. system :
  Use TOF to get the K_L^0 momentum.
- Maximize Photon Veto Efficiency
- Maximize Intensity of Microbunched Beam



AGS Requirements

Proton Beam:

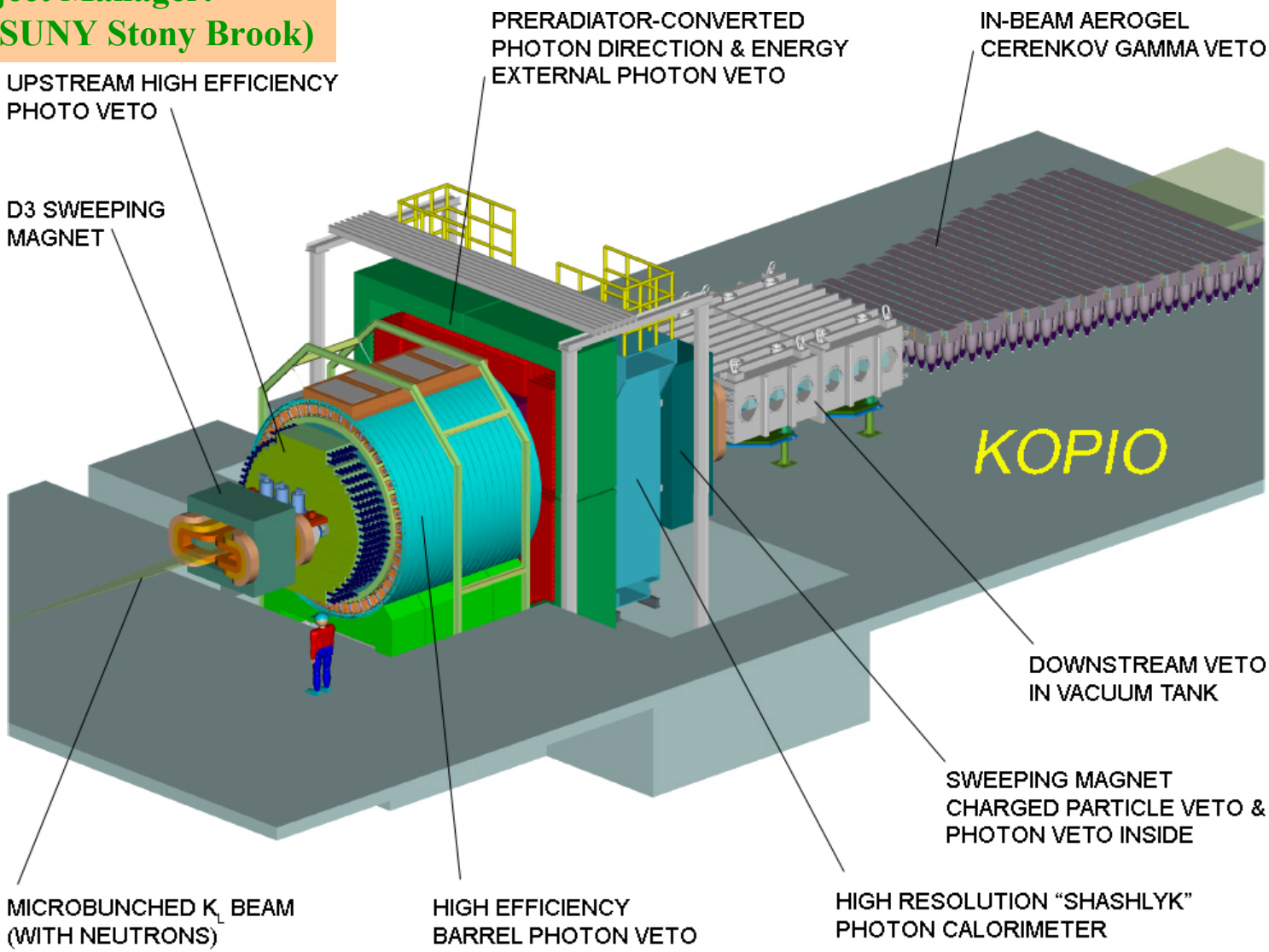
- **100 TP/spill**
- **4.9 sec spill, 2.3 sec interspill period**
- **25 (100) MHz microbunching frequency**
- **200 (260) ps bunch width**
- **Interbunch extinction $1X10^{-3}$**

Kaon Beam:

- **42.5 degree take-off angle**
- **Soft momentum spectrum (0.5, 1.5 GeV)**
- **$3X10^8$ K_L/spill**
- **10 GHz neutrons**

KOPIO Experimental Layout

Project Manager:
M. Marx (SUNY Stony Brook)



MECO Scientific Collaboration

Spokesman: W. Molzon (UCI)

Boston University
R. Carey, I. Logashenko, J. Miller, B. L. Roberts

Brookhaven National Laboratory
J. M. Brennan, K. Brown, G. Greene, L. Jia, W. Marciano, W. Morse, P. Pile, Y. Semertzidis, P. Yamin

University of California, Berkeley
Y. Kolomensky

University of California, Irvine
C. Chen, M. Hebert, P. Huwe, W. Molzon, J. Popp, V. Tumakov

University of Houston
Y. Cui, N. Elkhayari, E. V. Hungerford, N. Klantarians, K. A. Lan

University of Massachusetts, Amherst
K. Kumar

Institute for Nuclear Research, Moscow
V. M. Lobashev, V. Matushko

New York University
R. M. Djilkibaev, A. Mincer, P. Nemethy, J. Sculli

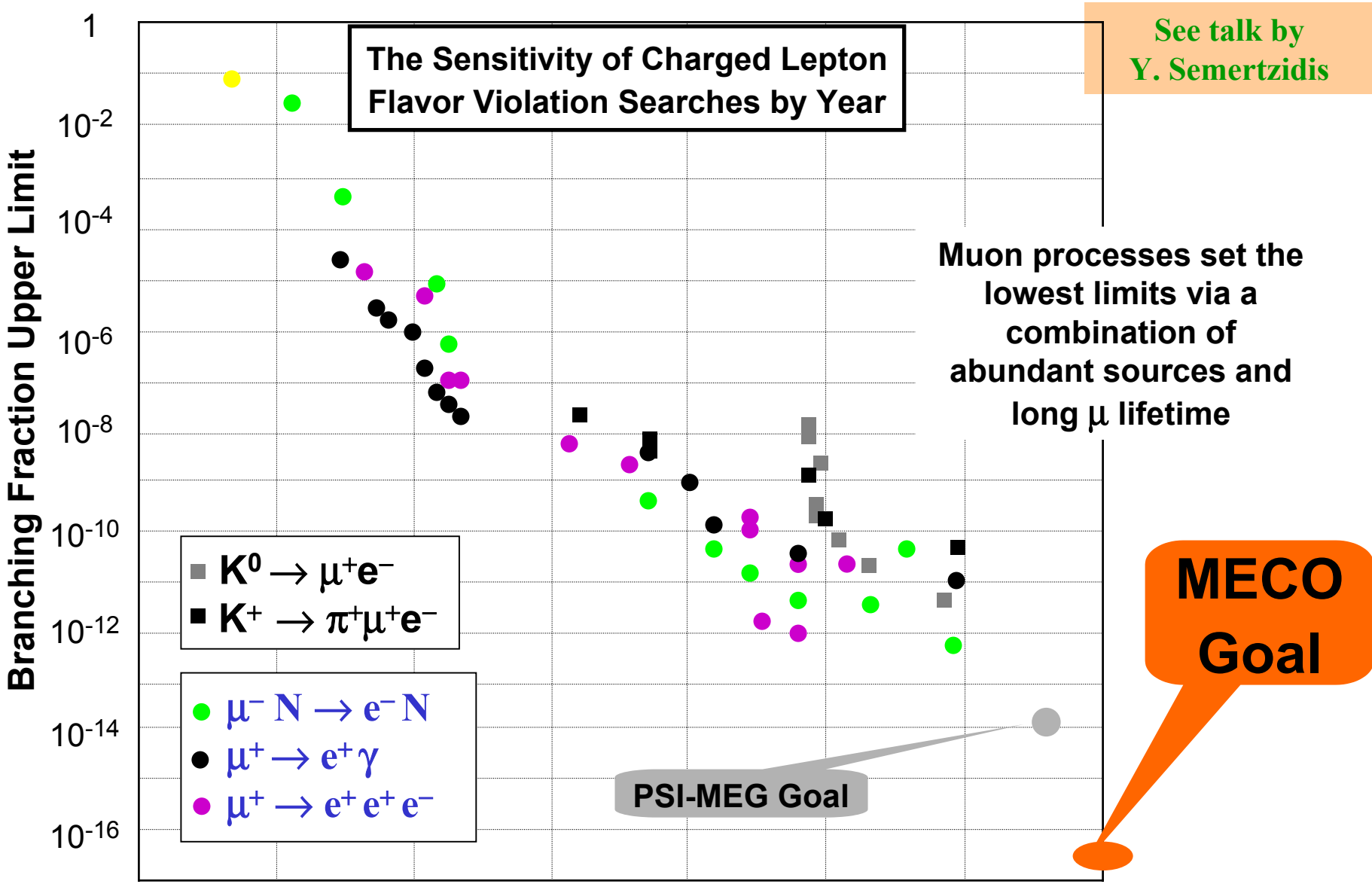
Osaka University
M. Aoki, Y. Kuno, A. Sato

Syracuse University
R. Holmes, P. Souder

University of Virginia
C. Dukes, K. Nelson, A. Norman

College of William and Mary
M. Eckhause, J. Kane, R. Welsh

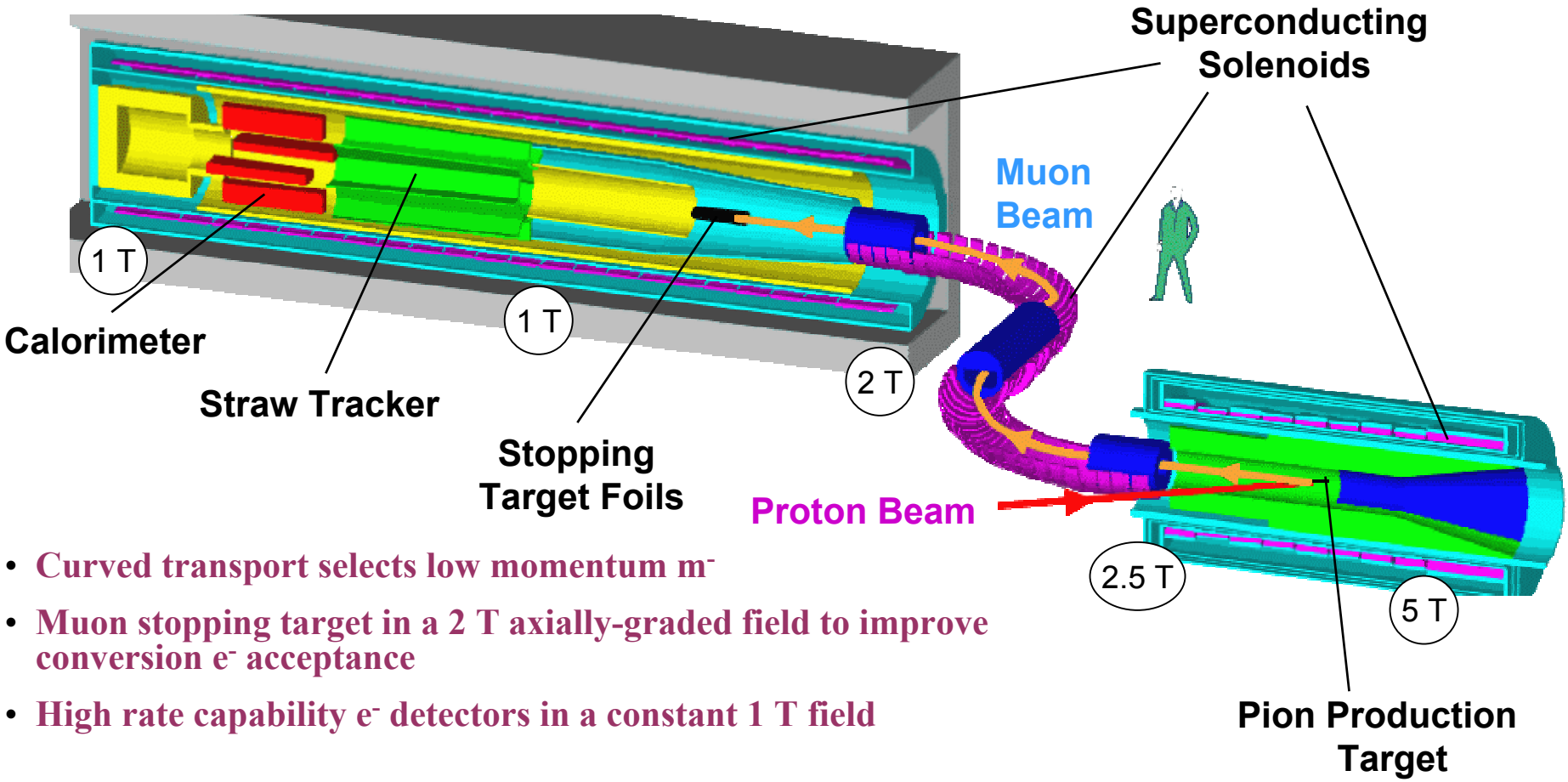
MECO Scientific Goals



MECO Experimental Layout

- 1000–fold increase in m beam intensity over existing facilities
  - High Z target for improved pion production
  - Axially-graded 5 T solenoidal field to maximize pion capture
  - To eliminate prompt backgrounds, $< 10^{-9}$ extinction required

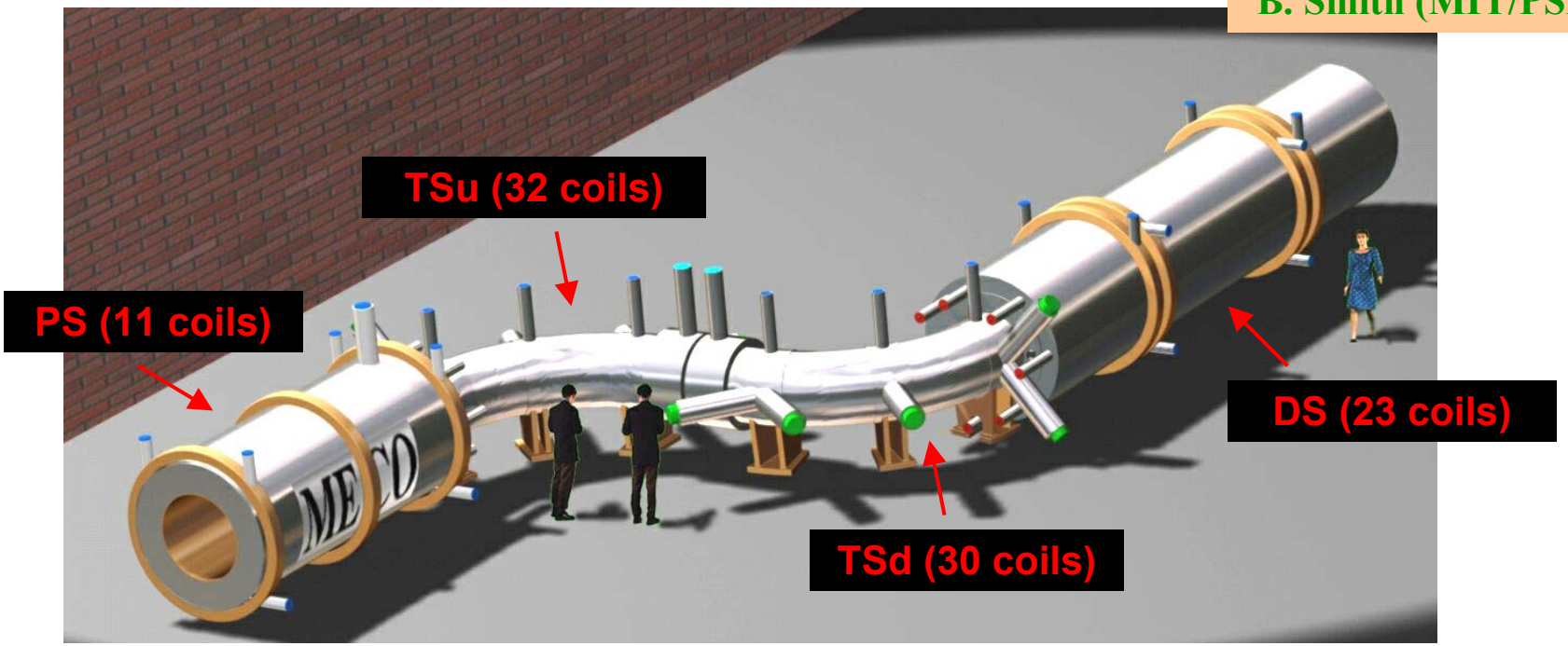
Project Manager:
M. Hebert (UCI)



- Curved transport selects low momentum m^-
- Muon stopping target in a 2 T axially-graded field to improve conversion e^- acceptance
- High rate capability e^- detectors in a constant 1 T field

MECO Superconducting Solenoids

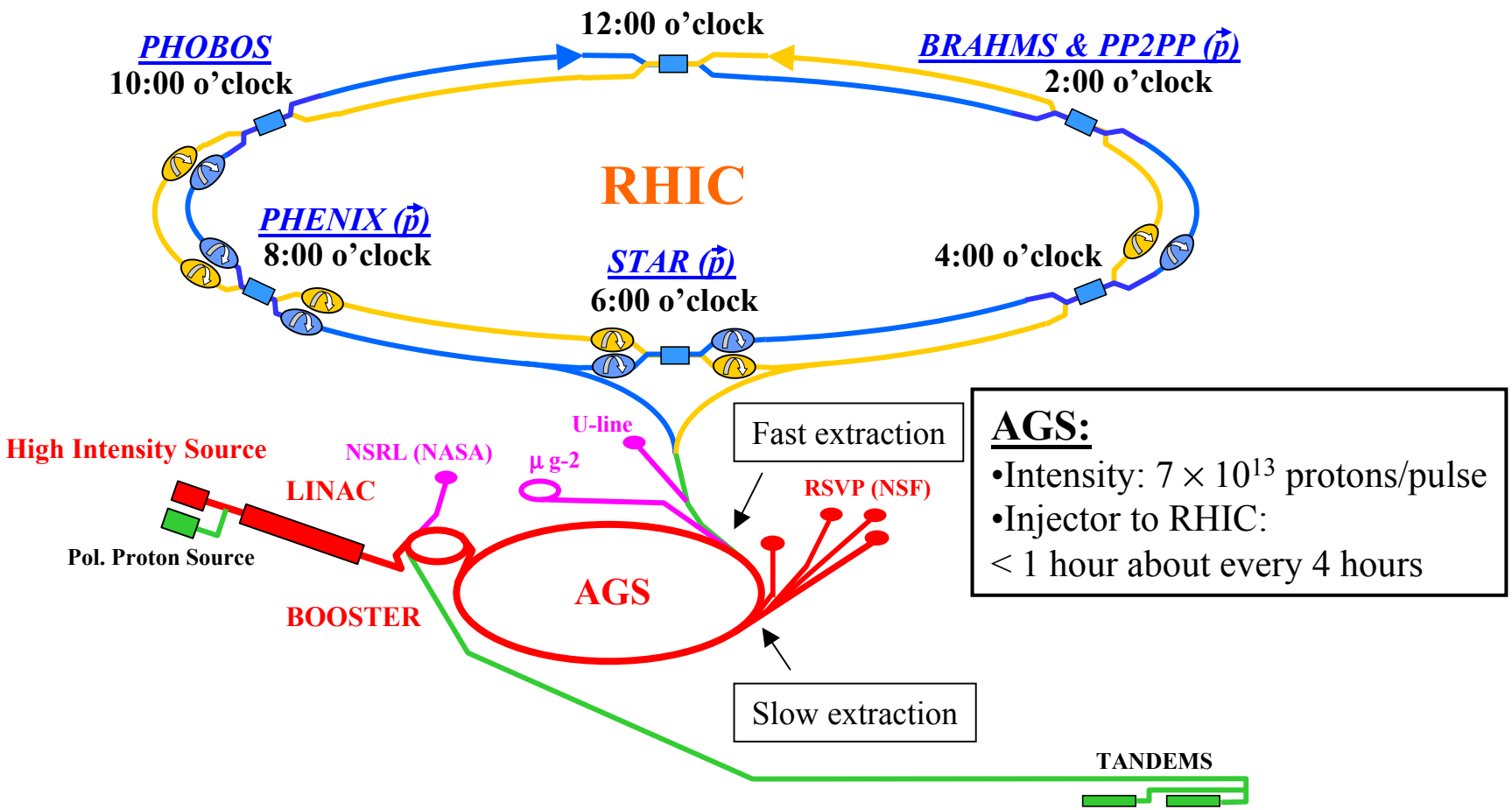
Project Manager:
B. Smith (MIT/PSFC)



PS	TS	DS
Cryostat 55,800 kg Iron 613,000 kg	TSu cryostat 38,200 kg TSd cryostat 36,600 kg TS base frame 13,900 kg	Cryostat 56,200 kg Iron 794,000 kg
SSC inner cable 31,300 m	SSC outer cable 24,900 m	SSC outer cable 20,700 m

AGS Upgrades

See talk by P. Pile



AGS:

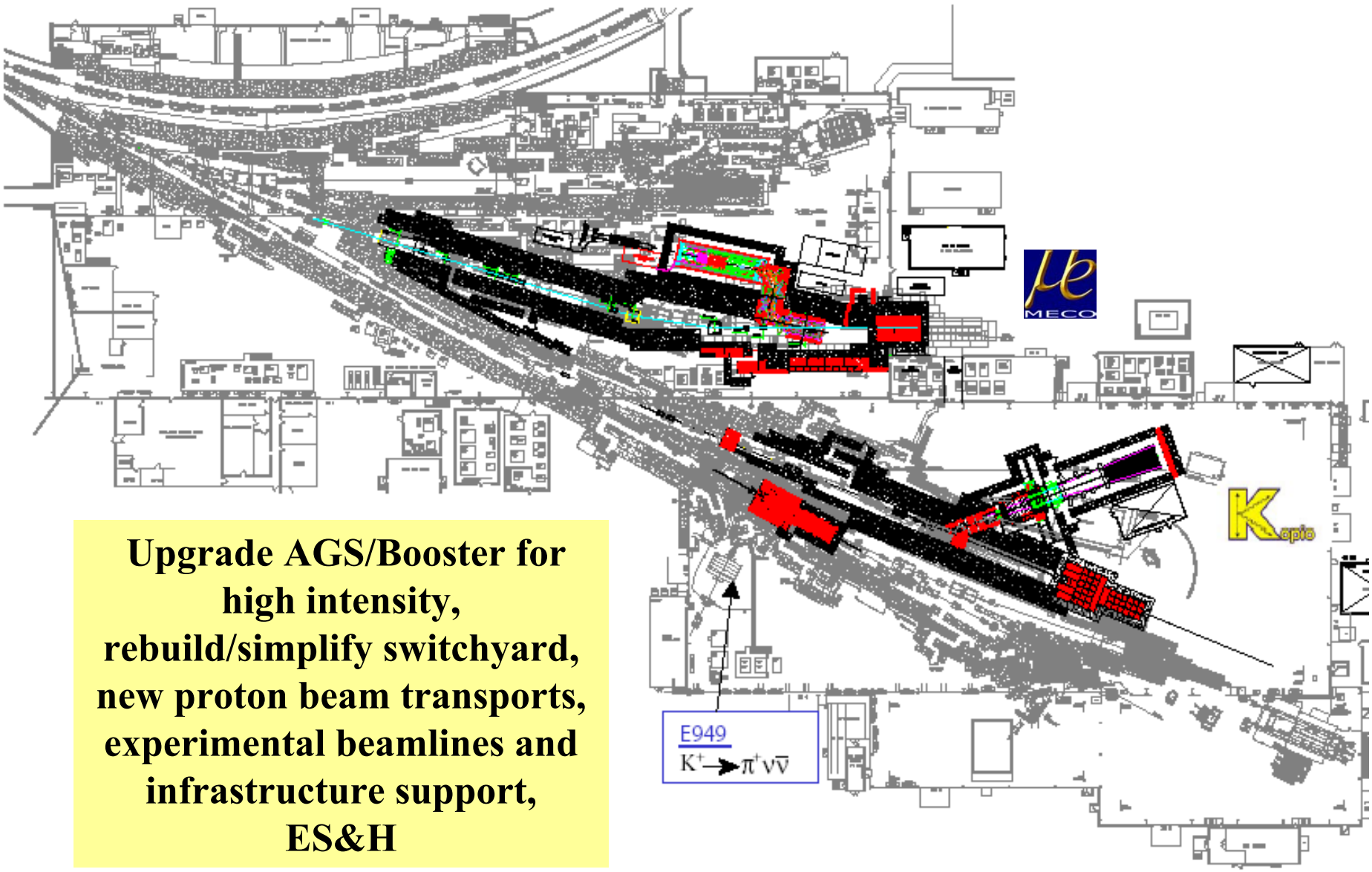
- Intensity: 7×10^{13} protons/pulse
- Injector to RHIC:
  < 1 hour about every 4 hours

Experiment Beam Specifications

- **K0PI0:**
  - Momentum = 25.5 GeV/c
  - Spill length = 4.9 sec
  - Rep rate (AGS cycle time) = 7.2 sec
  - Intensity = 100 TP/spill
  - Time between bunches = 40 nsec
  - Beam bunch width = 200 (260) psec RMS baseline goal
  - Extinction between bunches = 1×10^{-3}
- **MECO:**
  - Momentum = 7.5 GeV/c
  - Spill length = 0.5 sec
  - Rep rate (AGS cycle time) = 1.0 sec
  - Intensity = 20 (40) TP/sec base (stretch)
  - Time between bunches = 1350 nsec
  - Beam bunch width < 50 nsec full width
  - Extinction between bunches = 1×10^{-9}

Upgrades to the AGS are driven by experimental requirements to achieve physics goals.

AGS Upgrades for RSVP



Upgrade AGS/Booster for high intensity, rebuild/simplify switchyard, new proton beam transports, experimental beamlines and infrastructure support, ES&H

WBS Overview

System	WBS	Fractional Base Cost	Description
Project Office	1.1	11%	Management, oversight of RSVP project, supporting offices at Columbia University and BNL.
K0PI0	1.2	25%	Design, construction, installation and technical commissioning of K0PI0 detector
MECO Detectors	1.3	13%	Design, construction, installation and technical commissioning of external extinction, proton target, muon beam line, and sensitive detector elements for the MECO detector
AGS	1.4	23%	Design, construction, installation and technical commissioning of accelerator upgrade components, beam lines, experimental areas, and integration and infrastructure support
MECO Magnet	1.5	28%	Design, fabrication, installation and technical commissioning of superconducting solenoid system for MECO

Describes construction project only

RSVP Timeline: Overview

- 10/96 – BNL Scientific Approval for KOPIO
- 10/97 – BNL Scientific Approval for MECO
- 11/99 – Submission of RSVP to NSF as MRE candidate
- 07/00 – NSF External Cost Verification Review
- 10/00 – NSF National Science Board authorizes RSVP for inclusion in President's Budget "for funding in FY02 or later"
- 06/01 – NSF External Panel Review (science, cost, technical, management)
- 2001 – HEPAP Subpanel endorses physics goals of RSVP
- 03/02 – NSF External Panel Review (R&D progress, budgets, roadmap)
- 01/04 – DOE (Lehman) Review of RSVP impact on RHIC operations
- 02/04 – NSF proposes RSVP to Congress for FY2006 funding as MREFC
- 09/04 – NSF creates RSVP Project Office, W. Willis, Project Director
- 08/04 – DOE/NSF Interagency MoU signed regarding RSVP
- 12/04 – Congress appropriates $15M MREFC & construction start for FY05
- 02/05 – President's Budget requests FY06 MREFC funding for RSVP at $42M
- 03/05 – HEPAP Subpanel on RSVP science value, R. Cahn, LBL, Chair
- 04/05 – NSF RSVP Baseline Review, S. Wojcicki, Stanford, Chair

RSVP Recent Timeline (1)

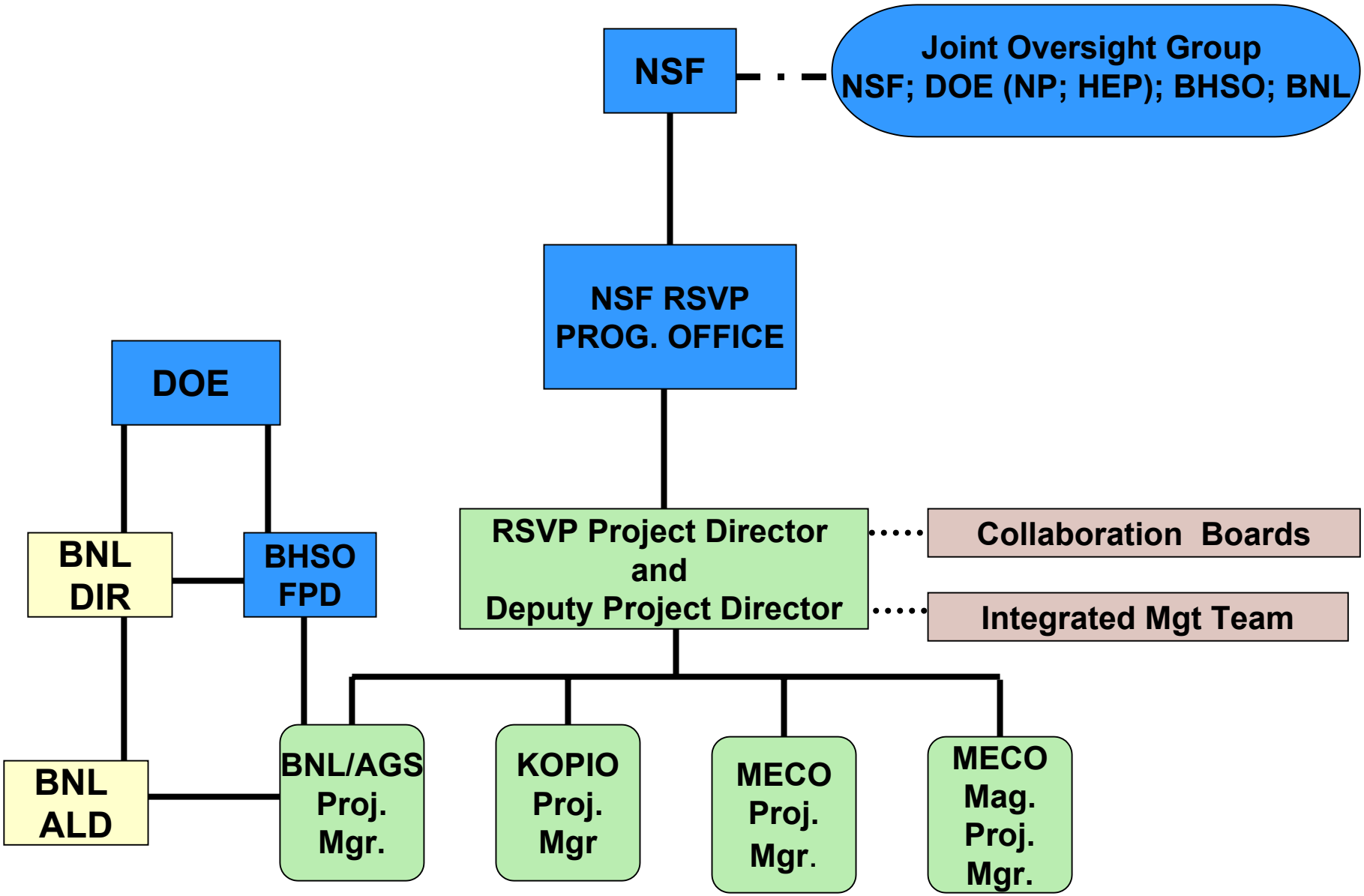
Milestone	Date	Status, Comments
Discussion of Baseline Expectations, Timeline with Experiments	September 13, 2004	Completed
MECO Magnet Review	Sun-Tue, Oct 10-12, 2004	Held at Columbia U., MOG, Tom Taylor (CERN), Chair
AGS Review	Thu-Fri, Nov 4-5, 2004	Held at BNL, Ray Larsen (SLAC), Chair
Internal discussion of resource-loaded schedules (RLS) for all projects	Thu, Dec 9, 2004	Held at BNL – Project Office, NSF PM, & experiments
Simulations & Backgrounds Review	Tue-Thu, Jan 11-13, 2005	Held at NYU, Jack Ritchie (UTexas), Chair
Initial review of RLS for all projects	Tue-Thu, Jan 18-20, 2005	Reviewed by LOG, Tom Kirk (BNL), Chair

RSVP Recent Timeline (2)

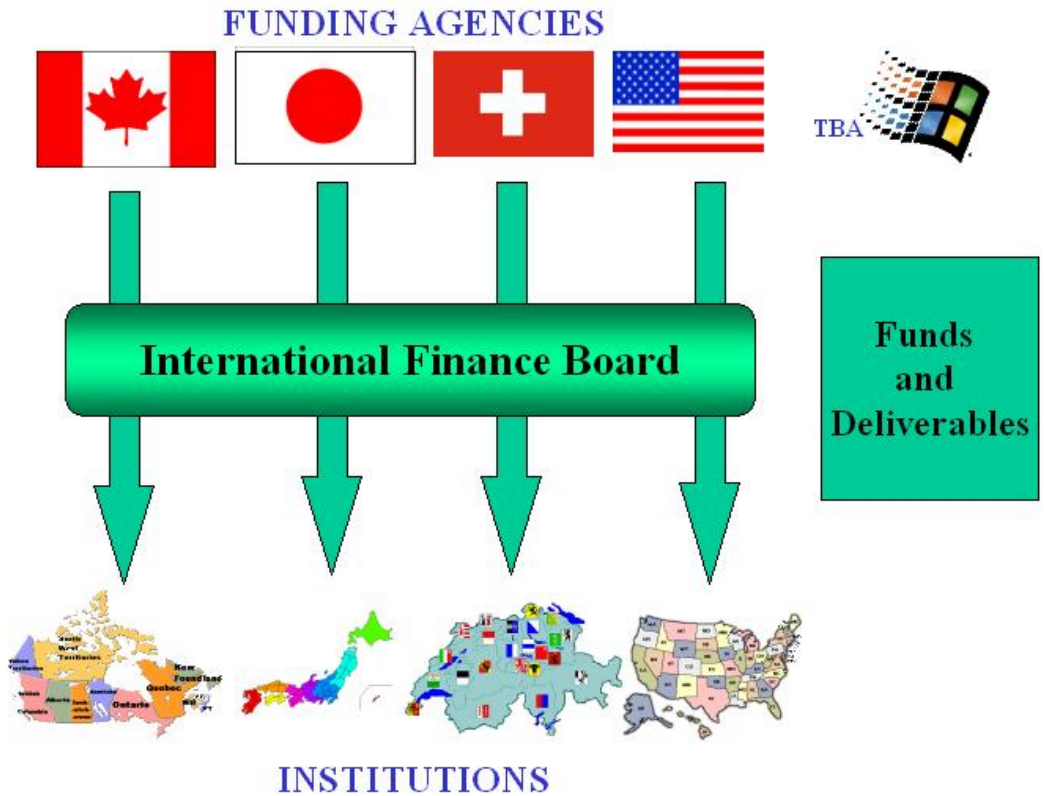
Milestone	Date	Status, Comments
All-Hands Baseline Preparation Kickoff	Feb 17, 2005	Focus projects on spring '05 baselining
HEPAP subpanel on RSVP science value convened	March, 2005	R. Cahn, LBL, Chair
Preliminary Baseline Review (Project Office)	Wed-Fri, April 6-8, 2005	Held at BNL, E. Temple (FNAL), Chair
NSF Baseline Review	Wed-Fri, April 20-22, 2005	Held at BNL, S. Wojcicki (Stanford), Chair
Submission of RSVP Project Plan to NSF	May 2005	Package will include initial report from HEPAP subpanel
NSB Decision on RSVP Startup	August 2005	

This intensive series of reviews represents initial preparatory phase toward achieving a project baseline

RSVP Organization & Oversight



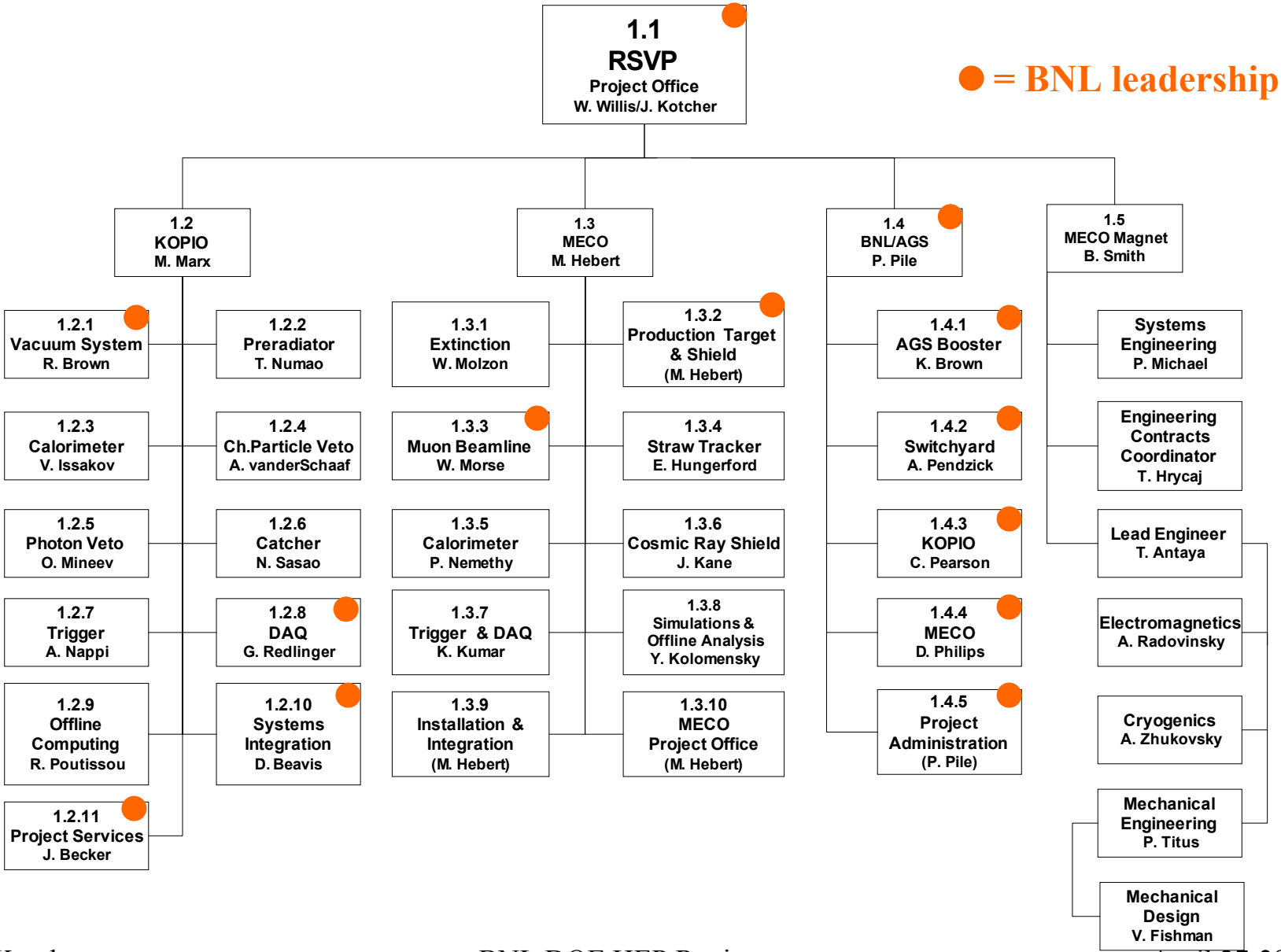
International Finance Board (IFB)



- **RSVP International Finance Board (IFB):**
  - **Provides oversight for project funding**
  - **Coordinates, integrates plans for funding and deliverables, as defined through institutional MoU's**
  - **Review of project funding, governance**
  - **Functions, roles spelled out in RSVP PMP**

RSVP Project Organization

● = BNL leadership role



BNL RSVP Representation (1)

- **KOPIO (1.2):**
  - **D. Beavis, I.-H. Chiang, A. Etkin, J.W. Glenn, A. Hanson, D. Jaffe*, S. Kettell, D. Lazarus, K. Li, L. Littenberg, G. Redlinger, C. Scarlett, M. Sivertz, R. Strand**
  - **Deeply involved in most activities, including leadership & oversight roles:**
    - **WBS Level 3 Subsystem Managers: Redlinger (DAQ - 1.2.8), Beavis (Systems Integration - 1.2.10)**
    - **KOPIO liaison to AGS, expt'l oversight of AGS modifications: Sivertz**
    - **Simulations: Jaffe**
- **MECO (1.3):**
  - **J. M. Brennan, K. Brown, G. Greene, L. Jia, W. Marciano, W. Morse, P. Pile, Y. Semertzidis*, P. Yamin**
    - **WBS Level 3 Managers: Morse (Muon Beamline - 1.3.3)**
    - **Extinction (Semertzidis), Production Target and Shield, Background Studies (Yamin)**

Personnel in black are supported off of DOE HEP base funds
(* = presenting for experiments in afternoon session)

BNL RSVP Representation (2)

- **AGS (1.4):**
  - **AGS upgrades dominated by BNL personnel**
    - **Canadian participation providing major portions to this upgrade**
  - **WBS Level 2 Project Manager: Pile (1.4)**
  - **WBS Level 3 Subsystem Managers:**
    - **AGS/Booster (Brown – 1.4.1)**
    - **Switchyard (Pendzick – 1.4.2)**
    - **KOPIO (Pearson – 1.4.3)**
    - **MECO (Phillips – 1.4.4)**
  - **Preceding months have seen major effort associated with development of AGS technical, project plan**
    - **Project plan now quite mature**

***Presenting for AGS in afternoon session**

BNL RSVP Representation (3)

- **MECO Magnet (1.5):**
  - **MIT is principal institution for MECO Magnet (B. Smith, PM)**
  - **MOG strongly recommended increasing BNL role in magnet, being pursued**
  - **C-AD developed baseline cost estimate for cryogenic cooling system**
    - **Presented by Tuozzolo (C-AD Chief M.E.) at NSF Baseline Review**
    - **Developed by many, including:**
      - **Bruno, Jia, McIntyre, Nicoletti, Phillips, Tallerico, Tuozzolo**
  - **Broader C-AD role under development**

    ment

    ossible role for SMD also under consideration. Initial deration. Initial discussions begun in late '04 between Project ffice, Project Manager/MIT, and SMD

    of cryogenic design, coil/cryostat integration, testing

    coil/cryostat integration, testing

    , Sondericker, Wanderer, others

Project Status (1)

- To date $12.3M in R&RA funds have been provided to RSVP
  - $6.0M in FY04
  - $2.3M in FY05 supports new Project Office, MECO Magnet
  - No substantial sustained support for engineering, etc.
- Congressional Omnibus Appropriations bill of Nov '04 provided $15M in MREFC funds and construction start in FY05
- President's Budget request for FY06 contains $42M for RSVP, and total six-year construction budget of $158M (FY05$)
- Release of FY05 funds, and construction start, awaits decision from NSB in August. Dependent most heavily on outcome of NSF Baseline Review & HEPAP Subpanel.

Project Status (2)

- Projects have not had benefit of extensive R&D funds
  - No opportunity for detailed engineering designs
  - Some systems more advanced than others, but all are still either in conceptual stage, or slightly beyond – "between CD1 and CD2"
- Construction outlay is understood to include funds for engineering design and development
- Given this, approach has been to develop a project plan that includes all currently anticipated needs and costs
- Contingencies have been applied that attempt to take into proper account the maturity of the designs
  - Risk assessments integrated wherever possible
  - Back-up designs considered wherever resources, time permit
- All cost, contingency, schedule, and manpower estimates shown are extracted from fully resource-loaded schedules
- While these experiments are very challenging, none of the proposed detector or accelerator systems push current limits of technology

Magnet Oversight Group (MOG)

- MECO Magnet is cost and schedule driver for RSVP
  - Single most expensive, technically demanding item
- Standing Magnet Oversight Committee (MOG) established to serve in ongoing advisory capacity to Project Director:
  - Elwyn Baynham (Rutherford Appleton Laboratory)
  - Gene Fisk (Fermilab)
  - Herman ten Kate (CERN)
  - Tom Taylor, Chair (CERN)
    - Now serves as technical advisor to Project Office on magnet
  - Akira Yamamoto (KEK)
- First review held October 10-12, 2004 at Columbia University
- Comments, recommendations geared toward reduction of risks of all kinds
- Recommendations being considered, integrated by Magnet Project Team

Guidance for Project Development

- Jan '05: Project Office agrees to NSF directive to prepare for April baseline
- Project Office proposed cost target for RSVP detector construction, which was accepted by agency:
  - $240M in FY05$, includes 45% total contingency
- Cost envelope target based on estimates from individual Project Managers as presented to Project Office in early CY05
- Final guidelines to projects from Project Office (burdened FY05$):
  - Project Office: $20M
  - K0PI0: $55M (NSF portion)
  - MECO Detectors: $24M
  - AGS: $40M
  - MECO Magnet: $56M
- Guidance for cost targets includes weighted, risk-based assessment of contingency, based on Lockheed guidelines
  - Schedule, cost, technical, design

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Total RSVP MREFC Cost (AYk$)

Total RSVP MREFC in AYk$ (NSF Funding Required)										
	WBS	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
RSVP Project Office	1.1	0.0	3029.2	3107.9	3213.5	3284.3	3369.8	3457.3	0.0	19,462.1
KOPIO	1.2	0.0	7102.3	12377.9	13827.5	7486.1	3526.9	657.7	0.0	44,978.4
MECO Detector	1.3	0.0	4669.1	6952.0	6812.8	2591.7	1478.2	834.7	0.0	23,338.6
AGS	1.4	0.0	9557.0	15284.0	9270.2	5077.8	1875.7	935.3	0.0	42,000.1
MECO Magnet	1.5	0.0	5194.9	9126.6	19484.2	11473.8	4156.0	1733.5	0.0	51,169.0
TOTAL RSVP BASE COST (AYk$)		**0.0**	**29552.5**	**46848.4**	**52608.2**	**29913.8**	**14406.6**	**7618.6**	**0.0**	**180948.1**
Contingency		0.0	7766.2	19978.6	25567.2	21314.2	8241.1	2895.1	0.0	85,762.4
Contingency (%)		0.0	26.3	42.6	48.6	71.3	57.2	38.0	0.0	47.4
SUB-TOTAL		**0.0**	**37318.6**	**66827.0**	**78175.5**	**51228.1**	**22647.7**	**10513.7**	**0.0**	**266,710.6**
Pre-operations		0.0	0.0	0.0	0.0	0.0	4934.5	0.0	0.0	4,934.5
Engineering & commissioning		0.0	0.0	0.0	0.0	0.0	0.0	5378.6	5124.9	10,503.5
TOTAL RSVP MREFC (AYk$)		**0.0**	**37,318.6**	**66,827.0**	**78,175.5**	**51,228.1**	**27,582.1**	**15,892.3**	**5,124.9**	**282,148.5**
escalation rate		1	1.0280	1.0547	1.0822	1.1103	1.1392	1.1688	1.1991	

- **NSF exposure for RSVP construction - in-kind, other contributions removed**
- **Total MREFC (AY$) = $282.15M**
  - **Detector Construction: $266.71M**
  - **Pre-operations, Commissioning: $15.44M**
- **Total project contingency includes contingency on in-kind contributions**
- **MREFC only, R&RA not included (beam and detector R&D, operations)**

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Operating Beams for RSVP

- **Recommendations from Executive Summary of Simulations & Background Review (NYU, Jan 18-20, 2005, J. Ritchie, Chair):**
- **K0PI0 should "as soon as possible":**
  - **Develop a fully engineered design for the barrel photon veto, build a full-scale prototype, and subject it to beam tests to validate that it achieves the required performance.**
  - **Perform tests with the AGS to measure beam microbunch width and inter-bunch extinction at full intensity (at least 70 Tp/spill) and to demonstrate the necessary bunch widths and extinction are achieved.**
  - **Design the neutral beam and shielding, install it, and perform beam tests (using specialized detectors) to establish that the properties of the beam (e.g., n halo) meet the requirements of the experiment.**
- **MECO should "as soon as possible":**
  - **Perform tests with the AGS to demonstrate the required extinction when running at 8 GeV with intensity of at least 20 Tp/spill.**
- **Overall recommendation:**
  - **Also, both KOPIO and MECO should benefit if data-taking is structured to provide the longest possible runs in alternate years, rather than shorter runs based on an equal division of available running each year.**
- **We agree with and accept these recommendations, and have included it as an integral part of our project plan**
- **The plan is constructed in order to allow us to quantitatively characterize AGS beams (neutral beam, extinction) as quickly as technically and logistically feasible**

Beams Operations Considerations

- Three relevant running scenarios:
  - Without RHIC running
  - With RHIC running heavy ions
  - With RHIC running polarized protons
- Cost and requirements for running in each of these scenarios is different, and has been considered in great detail. Every attempt has been made to include all relevant items:
  - C-AD personnel
  - Cryogenics, power, waste disposal, etc.
  - Maintenance of MECO magnet
  - Experiment-specific running costs
    - Tapes, media, cables, chamber gases, supplies, shipping, etc.
  - Maintaining scaled-back Project Office in post-construction years
- While out years cannot be predicted with any accuracy, project plan has assumed running scenarios that are as reasonable as any other

RSVP Beam Operating Scenario

- **Beam and detector R&D (R&RA):**
  - 8 weeks in each of FY08 and FY09
    - Neutral beam/halo
    - Extinction tests for MECO
    - Beam tests for completed portions of detectors
- **Beam Pre-operations (MREFC):**
  - 8 weeks in FY10
  - Neutral beam/halo with micro structure
    - 25 MHz cavity installed summer 2009
  - Pushing extinction tests to higher intensity for MECO
  - Beam tests for completed portions of detectors
  - Prepare for engineering/commissioning and operations running
- **Engineering and commissioning (MREFC)**
  - 8 weeks in FY11 (K0PI0)
  - 8 weeks in FY12 (MECO)
- **Operations, data-taking (R&RA):**
  - 17 weeks in FY11 (K0PI0) and FY12 (MECO)
  - 25 weeks in FY13-16 (alternating K0PI0, MECO)

Funding categories follow NSF guidance

Summary of RSVP Beam Costs

	Exp't	Weeks	Cost (Ayk$)
R&D			
FY08	Both	8	4,687.6
FY09	Both	8	4,809.3
TOTAL R&D		**16**	**9,496.9**
Pre-ops & Eng/Comm			
FY10	K0PI0	8	4,934.5
FY11	K0PI0	8	5,378.6
FY12	MECO	8	5,124.9
TOTAL Eng/Comm		**16**	**15,438.0**
Operations			
FY11	K0PI0	17	13,666.2
FY12	MECO	17	13,185.7
FY13	K0PI0	25	22,864.2
FY14	MECO	25	21,462.9
FY15	K0PI0	25	23,600.2
FY16	MECO	25	22,112.9
TOTAL Operations		**134**	**116,892.1**

Operations cycle provides 3.7E20 integrated TP to MECO, 5700 hours running time at 100 TP equivalent for K0PI0. Takes into account losses due to startup times, intensity build up, etc.

Start of commissioning and operations takes into consideration nominal detector readiness dates.

RSVP Cost Summary (AY$)

- **Detector and AGS construction (MREFC):**
  - **TOTAL: $266,711k**
- **Pre-operations and engineering (MREFC):**
  - **Pre-operations: $4,934k**
  - **Engineering & commissioning: $10,504k**
  - **TOTAL: $15,438k**
- **Total MREFC = $282,149k**
- **Beam and detector R&D, operations and D&D (R&RA):**
  - **Beam and detector R&D: $9,497k$**
  - **Operations: $116,892k**
  - **D&D: $19,600k**
  - **TOTAL: $145,989k**
- **Total R&RA = $145,989k**

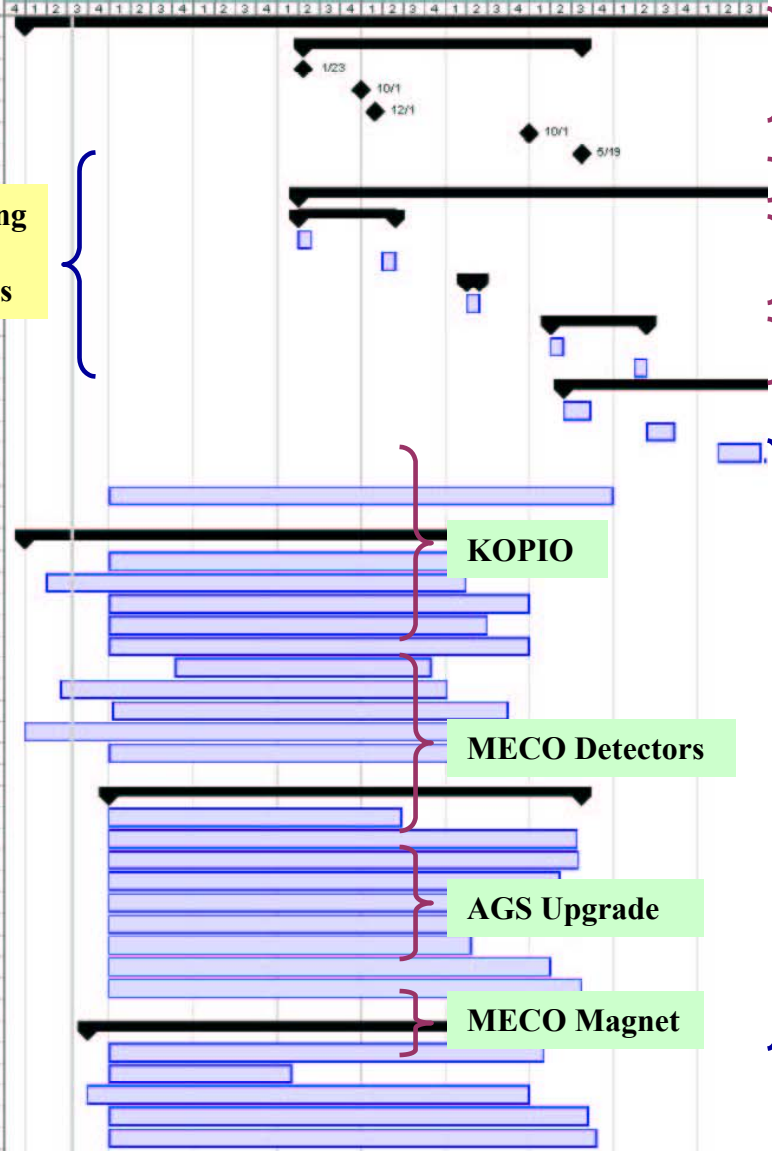
RSVP Summary Schedule

RSVP
rare symmetry violating processes

NSF

RSVP Summary Schedule

ID	WBS	Task Name	Start	Finish
1	1	RSVP	Fri 10/1/04	Wed 6/1/16
2		Level One Milestones	Wed 1/23/08	Thu 5/19/11
3		All Solenoid Procurements Placed	Wed 1/23/08	Wed 1/23/08
4		MECO A Line Ready for Tests	Wed 10/1/08	Wed 10/1/08
5		KOPIO Neutral Beam Line Complete	Mon 12/1/08	Mon 12/1/08
6		KOPIO Experiment Ready for Beam	Fri 10/1/10	Fri 10/1/10
7		MECO Experiment Ready for Beam	Thu 5/19/11	Thu 5/19/11
8				
9		RSVP Beam Running	Wed 1/2/08	
10		Beam & Detector R&D	Wed 1/2/08	
11		FY08	Wed 1/2/08	
12		FY09	Fri 1/2/09	
13		Beam Pre-operations	Mon 1/4/10	
14		FY10	Mon 1/4/10	
15		Engineering & Commissioning	Mon 1/3/11	Fri 2/24/12
16		FY11 (KOPIO)	Mon 1/3/11	Fri 2/25/11
17		FY12 (MECO)	Mon 1/2/12	Fri 2/24/12
18		Operations, Data-taking	Mon 2/28/11	Wed 6/1/16
19		FY11 (KOPIO)	Mon 2/28/11	Fri 6/24/11
20		FY12 (MECO)	Mon 2/27/12	Fri 6/22/12
21		FY13 - FY16 (KOPIO & MECO alternate)	Wed 1/2/13	Wed 6/1/16
22				
23	1.1	RSVP PO	Mon 10/3/05	Fri 9/30/11
24				
25	1.2	KOPIO	Fri 10/1/04	Fri 10/1/10
26	1.2.1	Vacuum Subsystem	Mon 10/3/05	Wed 6/23/10
27	1.2.2	Preradiator	Mon 1/3/05	Wed 12/30/09
28	1.2.3	Calorimeter System	Mon 10/3/05	Fri 10/1/10
29	1.2.4	Charged Particle Veto	Mon 10/3/05	Wed 3/31/10
30	1.2.5	Photon Veto	Mon 10/3/05	Fri 10/1/10
31	1.2.6	Catcher	Mon 7/17/06	Thu 7/30/09
32	1.2.7	Trigger	Mon 3/7/05	Wed 10/7/09
33	1.2.8	DAQ	Mon 10/17/05	Thu 7/1/10
34	1.2.9	Off-line Computing	Fri 10/1/04	Fri 10/1/10
35	1.2.10	Systems Integration	Mon 10/3/05	Fri 10/1/10
36				
37	1.3	MECO	Sat 10/1/05	Mon 5/16/11
38	1.3.1	Extinction	Sat 10/1/05	Tue 3/24/09
39	1.3.2	Production Target and Shield	Sat 10/1/05	Mon 4/25/11
40	1.3.3	Muon Beamline	Sat 10/1/05	Mon 5/2/11
41	1.3.4	Straw Tracker	Sat 10/1/05	Thu 2/10/11
42	1.3.5	Electron Calorimeter	Sat 10/1/05	Thu 3/31/11
43	1.3.6	Cosmic Ray Shield	Sat 10/1/05	Thu 3/31/11
44	1.3.7	Trigger and DAQ	Sat 10/1/05	Fri 1/22/10
45	1.3.8	Simulations and Offline Analysis	Sat 10/1/05	Fri 12/31/10
46	1.3.9	Integration and Installation	Sat 10/1/05	Mon 5/16/11
47				
48	1.4	AGS Upgrade Project	Fri 7/1/05	Wed 7/20/11
49	1.4.1	Booster/AGS Modifications	Mon 10/3/05	Fri 12/3/10
50	1.4.2	Switchyard	Mon 10/3/05	Mon 12/3/07
51	1.4.3	KOPIO	Fri 7/1/05	Thu 9/30/10
52	1.4.4	MECO	Mon 10/3/05	Mon 6/13/11
53	1.4.5	AGS Project Office	Mon 10/3/05	Wed 7/20/11



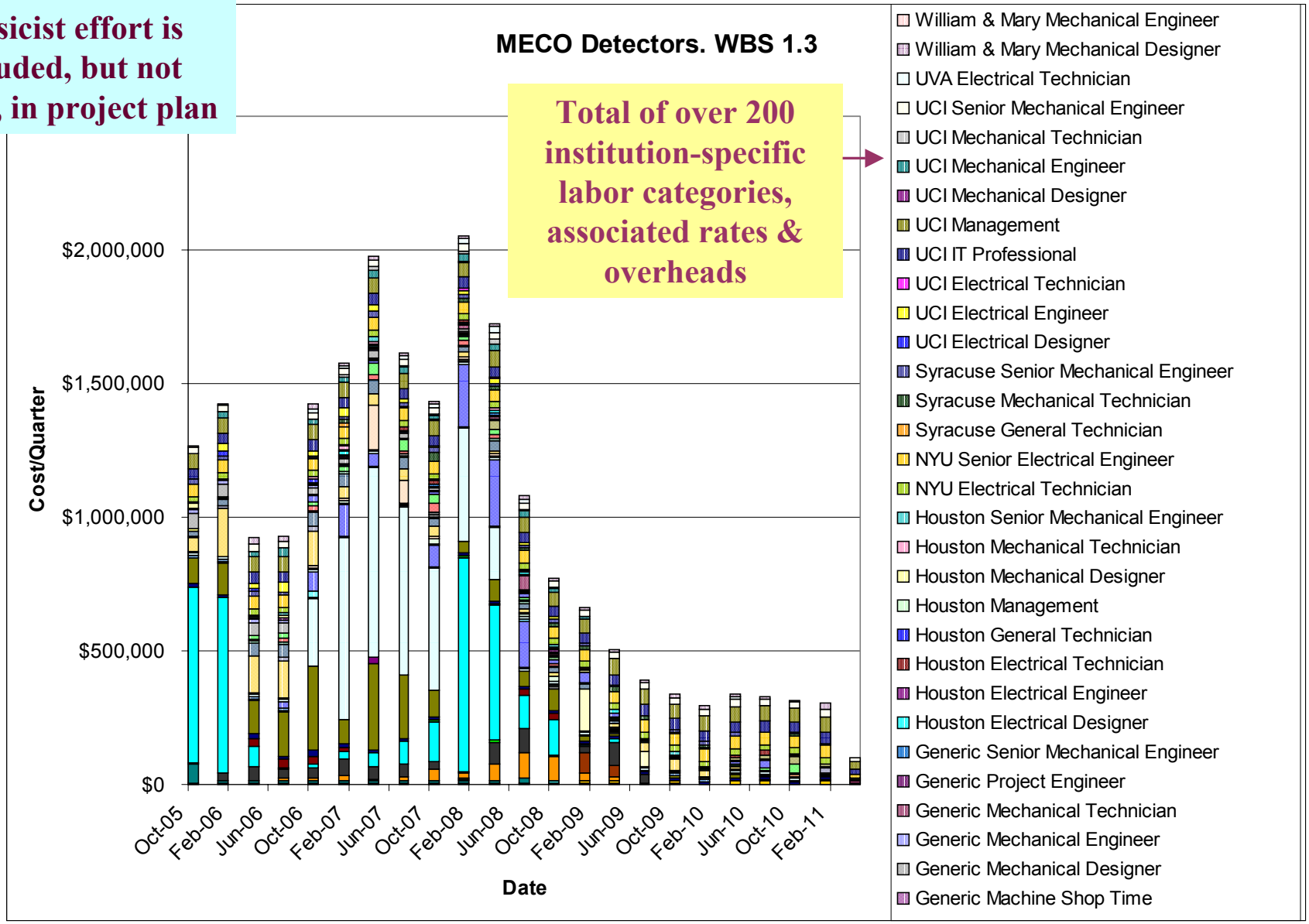
RSVP Level 1 Milestones

RSVP Level 1 Milestones		
Milestones	**Baseline Date**	**Date with Contingency**
All Solenoid Procurements Placed	01/23/08	07/23/08
MECO A Line Ready for Tests	10/01/08	04/01/09
K0PI0 Neutral Beam Line Complete	12/01/08	06/01/09
K0PI0 Experiment Complete and Ready for Beam	10/01/10	05/01/11
MECO Experiment Complete and Ready for Beam	05/19/11	01/19/12

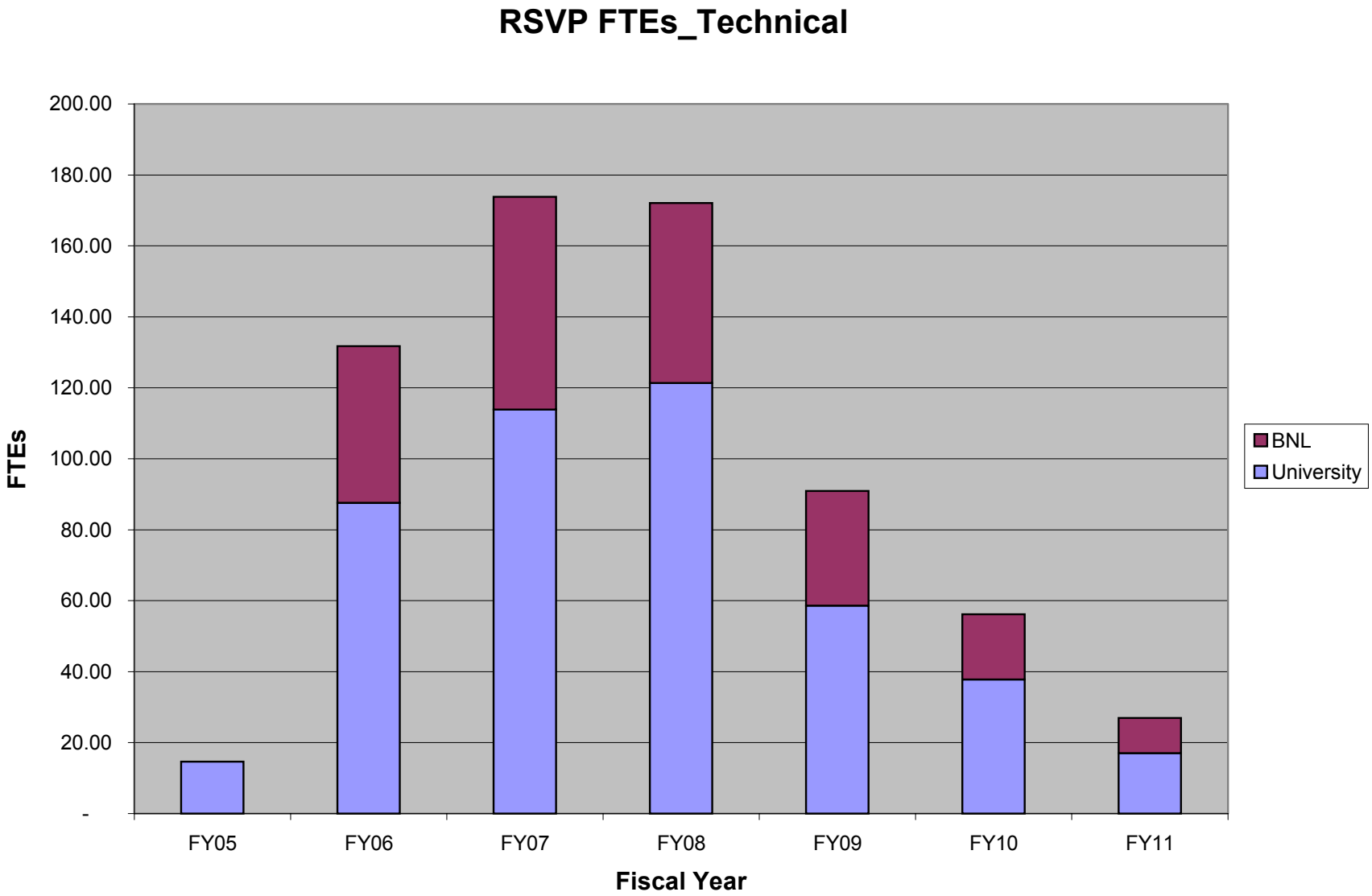
MECO Magnet is critical path item for RSVP

Labor Profile by Resource Category

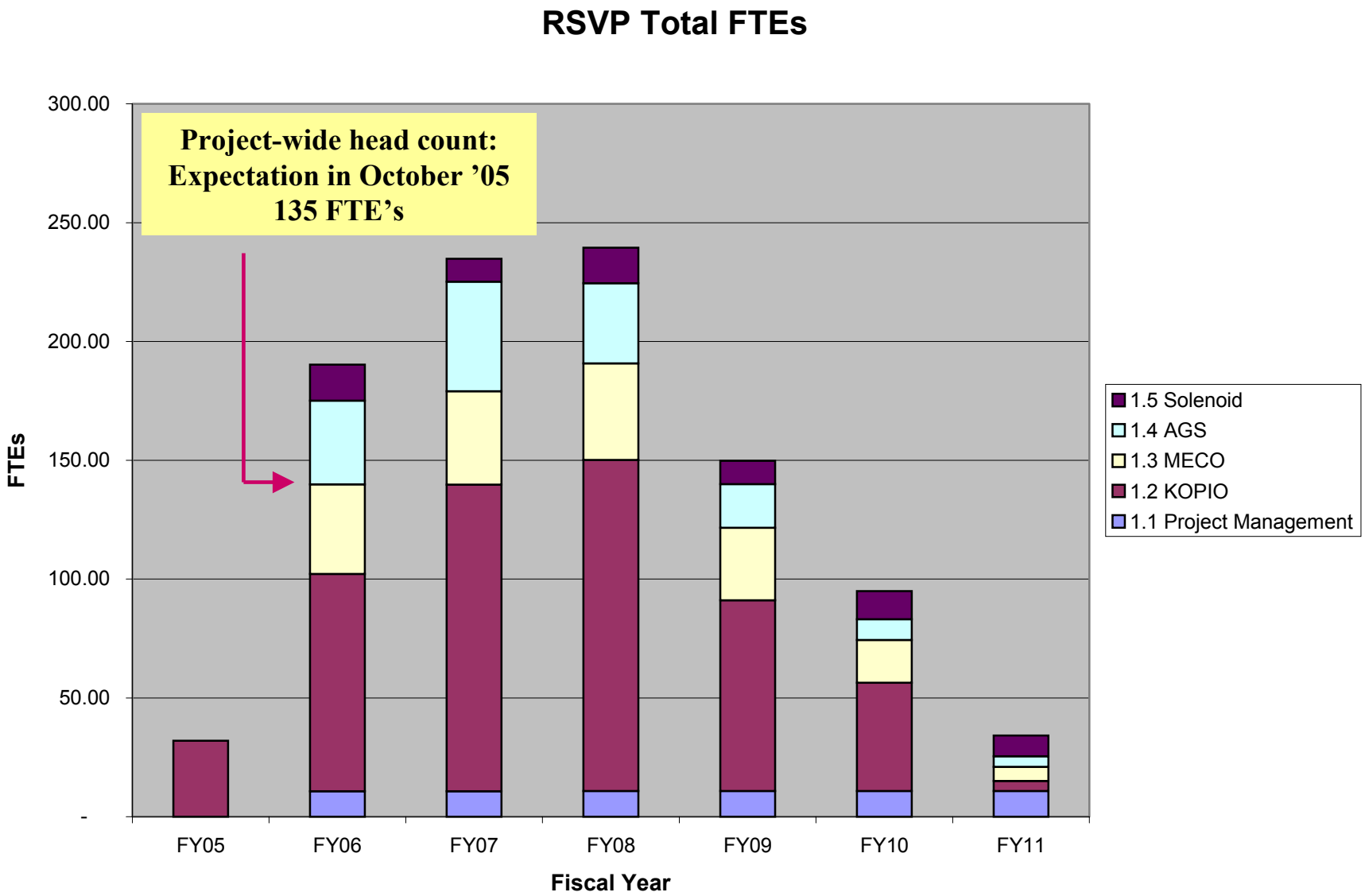
Physicist effort is included, but not costed, in project plan



Total Technical Personnel: BNL, University



Total Manpower Needed, by Project



Comments on RSVP Management

- **As noted in NSF Baseline Management Sub-Committee* closeout report last week, RSVP is embedded in an unusual management situation:**
  - **An NSF project at DOE laboratory using a DOE accelerator facility**
  - **Shared agency responsibility for funding the accelerator facility**
  - **Brookhaven is "host" laboratory but is not a sponsor of project**
  - **DOE is not a direct sponsor of the project**
  - **The RSVP project itself is very complex with project offices at Columbia and BNL and 4 almost "stand-alone" subprojects to be integrated into a unified project**
- **The management of RSVP is an experiment in itself, and has succeeded thus far due in large part to the good will and positive actions on the part of all of the principal partners**

***J. Marx (LBL – Sub-Committee Chair), J. Butler (FNAL), S. Wojcicki (Stanford – Committee Chair)**

Brookhaven Commitment & Base Support

- **BNL has defined and strengthened its commitment to RSVP in recent months. As pointed out by the Baseline Committee:**
  - **BNL management seems engaged and committed to success of RSVP**
  - **Director and AD for HENP working to find ways to enhance likelihood of success**
  - **AGS management is actively engaged in providing for needs of RSVP**
  - **BNL management must continue to be engaged and committed to success over life of RSVP**
- **Project Office agrees, and is encouraged by this development**
- **Baseline Committee also stated that DOE should:**
  - **Assure success of AGS project activities**
  - **Provide adequate support for BNL scientific involvement in RSVP (host lab collaborators bring great value to an experiment)**
- **The Project Office considers strong RSVP scientific and technical presence at Brookhaven to be an integral ingredient for success**
- **We are relying on such support as the project makes the transition through approval to construction start**

Closing Remarks

- RSVP experiments represent exciting physics, among the most cogent probes of the sensitivity frontier the field has to offer
- Will lay the foundation for a first-rate physics program that will operate well into the next decade
- Laboratory has demonstrated its support, and its intention to do whatever it can to ensure its success. This ingredient is essential, and must continue throughout the project's lifetime.
- BNL participation is strong, but will need to grow significantly as the project moves toward construction
- Project personnel, experimenters are extremely enthusiastic and dedicated to this enterprise, eager to begin mounting these projects, building the detectors, extracting the science

Backup Slides

Recommendations from Oct '04 MOG

- **Technical**
  - Change the PS from bath to conduction cooled
  - Reduce the number of coils
  - Make test windings to validate conductor, winding and insulation technologies
  - Reduce the number of power supply circuits, and conductors, if possible
  - An all-analog quench detection system was recommended in place of the digital system proposed
  - Conduct a failure analysis of the magnet
  - Design and start construction of tooling for a full scale model test coil
- **Schedule**
  - Schedule is tight
  - More time should be allocated for the contract process
  - Time for model coil work should be included
  - Time for installation and commissioning appears to be short
- **Cost**
  - Allocation of 10% to profit appears low
  - Labor rates look low
  - Cost is based on 2004 prices; should be changed to 2006 prices
  - Purchasing overhead at 15% appears low
- **Management**
  - Risk in attempting award to a single vendor is too high; buy in parts (greater number of procurements)
  - Carry out industrial studies through an RFI
  - Strengthen the team at MIT for design and procurement; keep the technical work there
  - Increase the role of BNL since the magnet will be installed, commissioned and operated there

Project Tools

- **RSVP using same project tools as US ATLAS**
  - **MS Project for schedule & cost**
  - **For now, using EXCEL for WBS dictionaries, complementary cost information**
    - **ACCESS will be implemented for additional cost tracking, WBS dictionaries/definitions, etc.**
  - **Technical & financial monthly status reports highly automated**
  - **Building web-based interface (including to ACCESS) to facilitate remote project tracking**
- **This has allowed for efficient, timely project ramp up**
  - **Much BNL infrastructure, expertise exists in use of these tools**
  - **Proven successful application in US ATLAS, agencies have signed off on their use, output**
  - **New tools would require major reinvestment in time, money, personnel, gains questionable. Resources more wisely spent elsewhere in project.**
- **Have opted to upgrade from MS Project 2000 to 2003**
  - **Earned value calculated directly in MS Project by Project Office, will be used for reporting**

Development of Project Plan (1)

- Schedules are resource-loaded
- Subsystem (WBS Level 3) and Project (WBS Level 2) Managers have constructed their schedules themselves, integrating guidance from the Project Office
- Appropriate rates and burdening for various labor categories applied inside MS Project, by institution
- Escalation done external to MS Project
  - For this review, Level 2 and 3 Managers will report in FY05$ only
  - AY costs presented by Project Office
- Physicists are included as resources in project plan
  - Used to identify labor need only – not costed in project
- Risk-based contingency analysis is applied
  - Lockheed formula

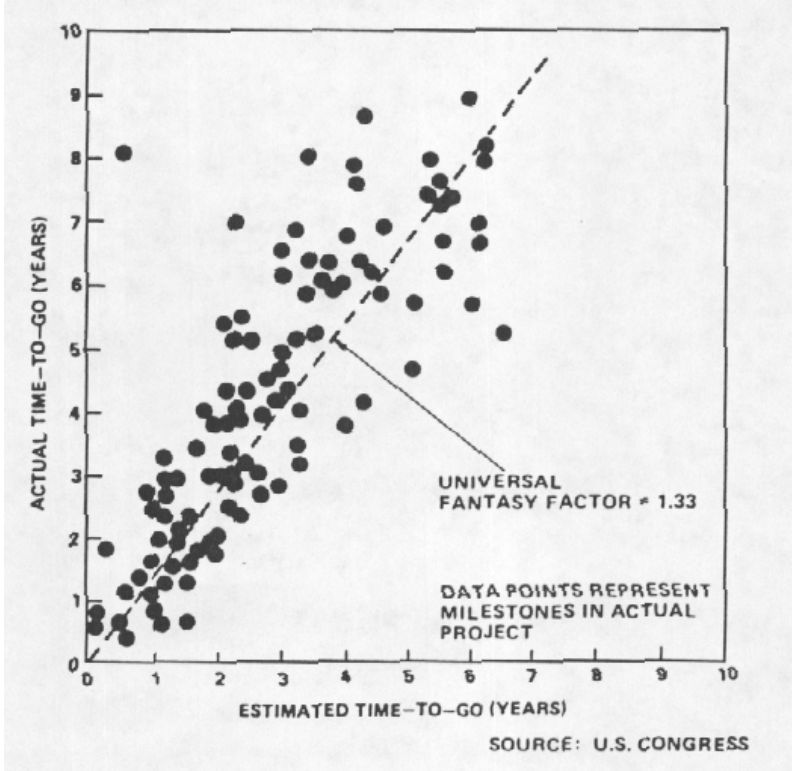
	Project Office	K0PI0	MECO Detectors	AGS	MECO Magnet	TOTAL
Approx. lines in schedule	3	1420	910	3490	970	6793

Development of Project Plan (2)

- **Examples of elements provided to Committee:**
  (http://rsvp.bnl.gov/Project_Office/Reviews/RSVPBRApr2005.htm)
  - Conceptual Design Reports
  - Project Management Plan
  - RSVP MoU Template
  - WBS dictionaries, bases of estimate
  - Backup cost books
  - Risk assessments
  - Cost summaries
  - Schedules in MS Project (mpp) format
  - Plenary and breakout presentations
  - Reports, presentations from previous reviews
- **In addition to the plenary presentations, talks from the WBS Level 3 subsystem managers have been selected for presentation at the breakouts**
  - Some additional talks from the Level 3 Managers are also available for presentation (see Project Managers at breakout sessions)

Contingency Discussion (1)

- Lockheed Guidelines, applied by Level 2 and 3 managers, result in 24% contingency.
- Includes only partial consideration for delays
- Average value for delay in large Federal Projects is 33% (see fig)
  - Funding delays, other difficulties
- Would result in estimated 20% increase in cost for delays alone



Contingency Discussion (2)

- **Preliminary Baseline Review Committee (April 6-8, 2005) could not agree on appropriate contingency for RSVP. Non-management sub-committees felt that 45% overall was appropriate.**
- **However, Management Sub-Committee (G. Bock, T. Elioff, E. Temple [Committee Chair], R. York) disagreed, and recommended 60-70%. Among the reasons unique to RSVP (from report):**
  - **Lack of Laboratory "backstopping"**
  - **Complicated, unproven management and funding structure**
  - **In past, for projects at this early stage (CDR) that were "backstopped" by a Laboratory and mounted in better budget climates, the estimates used to be 50%**
- **U.S. Atlas and DZero Run IIb Upgrade were both held at 45% contingency at baselining. This level of contingency appears to have been sufficient in these cases.**
- **With all of the above in mind, we have proposed 45% contingency, with the expectation that it will be sufficient to subsume a reasonable level of project risk.**

RSVP Construction Costs (FY05k$)

RSVP Detector Construction Costs (FY05k$)						
	Base Cost	Cont (%)	Cont Cost	Sub-Total	In-Kind	TOTAL
RSVP Level 2 Roll Up	**179,281.2**	**23.92**	**42,891.47**	**222,172.62**	**11,395.83**	**210,776.79**
RSVP Project Office	17,737.0	11.00	1,951.07	19,688.06	0.00	19,688.06
K0PI0	53,218.9	28.00	15,043.96	68,262.88	11,395.83	56,867.05
MECO Detector	21,774.7	23.84	5,190.38	26,965.13	0.00	26,965.13
AGS	39,374.2	24.00	9,588.33	48,962.57	0.00	48,962.57
MECO Magnet	47,176.2	23.57	11,117.73	58,293.98	0.00	58,293.98
Project Contingency		**20.60**	**36,138.81**			
TOTAL RSVP (FY05k$)	**179,281.2**	**45.04**	**79,030.3**	**258,311.4**	**11,395.8**	**246,915.6**

- **Level 2 roll ups from Project Managers**
- **Lockheed contingency guidelines applied**
- **Additional project contingency introduced top down from Project Office to realize 45% total**
- **Overall cost within 2% of target**
- **Scrubbing of schedules, reconsideration of designs, further simulations continue in earnest in the effort to realize individual project cost targets**
- **Costs for pre-operations and engineering runs not included**

KOPIO Foreign Contributions (FY05k$)	Base	Cont	TOTAL
Canada	5,899	0	5,899
Japan	3,151	658	3,809
Zurich	864	0	864
Russia - INR	824	0	824
TOTAL	10,738	658	11,396

Decontamination & Decommissioning

- The D&D plan for RSVP is to restore the AGS floor to the pre-RSVP condition within a reasonable number of years after the end of experiment operations
- It is recognized that the experiments will generate significant amount of beam activated components that will have to be disposed of, and a 2-3 year "cool-down" period will be required before D&D can begin:
  - The slow beam transport will decommissioned
  - All commonly reused valuable equipment such as magnets will be stored
  - The cost of removing and disposing of the experiments will be included
  - Shielding under 5mr will be left in building 912
  - All concrete floor areas over 5mr will be removed and replaced, but no radioactive soil remediated
  - Power and water modifications for RSVP will be removed except where considered an upgrade to existing utilities
  - The AGS and Booster will remain operational for RHIC when RSVP is complete
- Current estimate puts cost at $19.6M in AY$, includes 25% contingency.

RSVP Major Procurements

Major Procurements (FY05k$s)				
Subsystem	Level 3 WBS	Description	Amount	Schedule
KOPIO	1.2.2/Preradiator	Cathode Electronics Readout Cards	1,233.5	January-06
		Anode Electronics Readout Cards	827.6	January-06
	1.2.3/Calorimeter	Photon Calorimeter APD	938.4	October-06
	1.2.6/Catcher	Purchase PMT - 5 inch	735.0	July-06
	1.2.8/DAQ	Trigger Procurement	1,052.4	Apr 2008 (25%), Apr 2009 (75%)
MECO	1.3.2/Production Target and Shield	Tungsten Alloy Billets for the Heat Shield	1,389.0	October-05
		Copper Castings for the Heat Shield	734.6	December-07
	1.3.5/Electron Calorimeter	Large Area Photodiodes	1,247.0	December-06
		Lead Tungstate Crystals	1,070.0	December-06
AGS	1.4.1/Booster/AGS Modifications	ES&H Cap Contract	2,201.6	July-07
		100MHz Cavity Procurement	570.0	June-08
	1.4.3/KOPIO	Steel Shielding	741.0	March-08
		Steel & Coils	537.5	April-07
		Detector Pit Construction Contract	536.9	April-07
Magnets	1.5.2/Magnet System Fabrication	DS Magnet	5,145.6	August-07
		TSu Magnet	4,612.5	November-07
		PS Magnet	4,418.9	January-08
		TSd Magnet	4,237.5	November-07
		Magnet Tooling Fabrication	5,004.0	June-06

Schedule Methodology

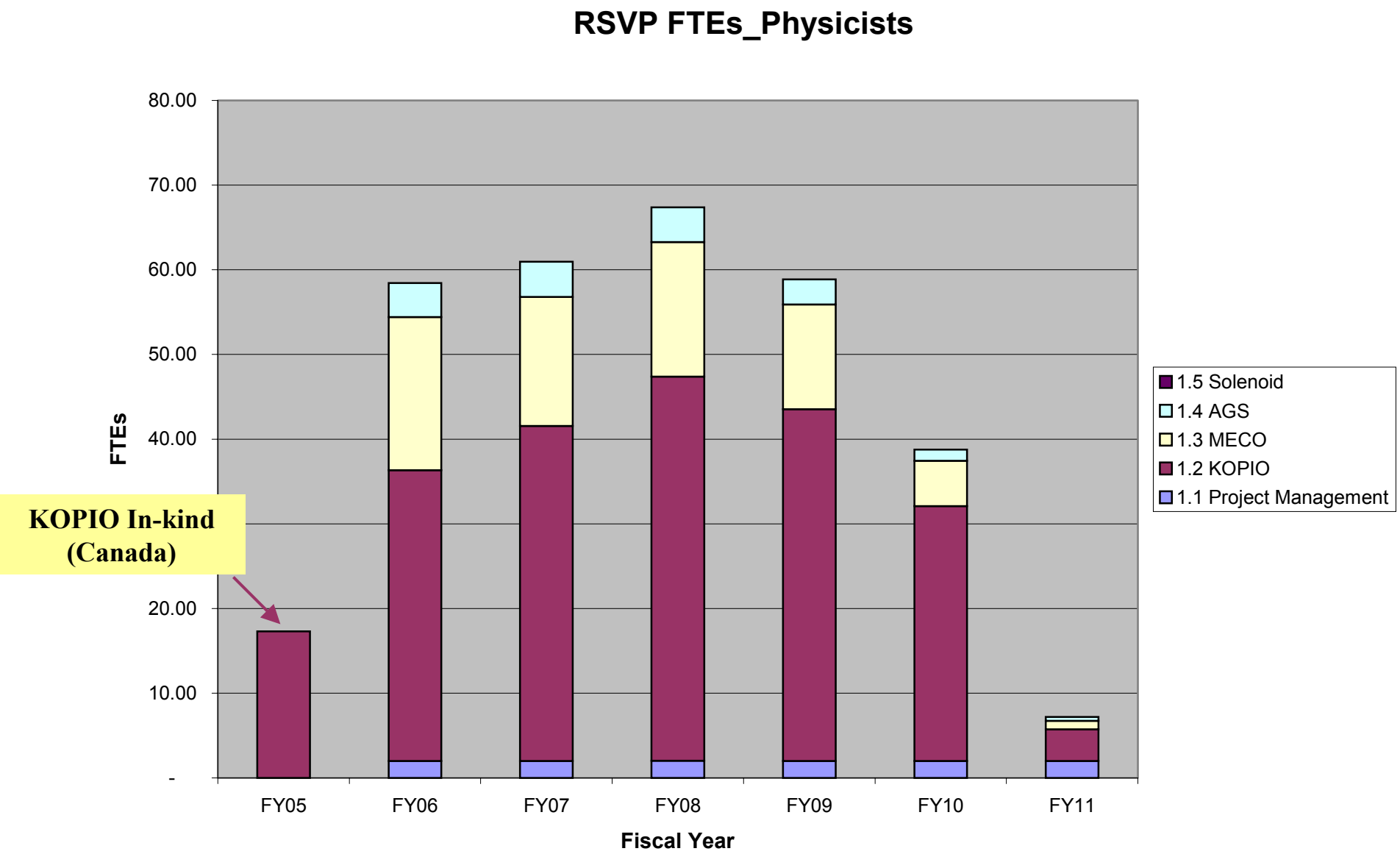
- Schedules contain no explicit float – reflect nominal duration for completion
- In order to do everything possible to keep pace, we intend to manage to this aggressive schedule
- Four tiers of schedule milestones are being constructed:
  - Level 4, held by sub-system managers to track their projects
  - Level 3, held by WBS Level 2 Project Managers
  - Level 2, held by Project Office
  - Level 1, held by NSF
- Milestone selections, and hierarchical assignments, in progress
- Explicit float added to Level 1 milestones that describe anticipated schedule contingency
  - 15%, but not less than 6 months
    - Early ramp up is most difficult period - we will gain in momentum, personnel, understanding how to manage ourselves more effectively
    - Contingency back-end loaded to ameliorate delays
- Production Readiness Reviews also being incorporated

Example Level 2 Milestone Candidates

Candidate KOPIO Level 2 Project Director Milestones		
WBS	**Name**	**Baseline Date**
1.2.1	**KOPIO Vacuum Subsystem**	
	Deliver Vacuum Windows to BNL	7/8/08
	Deliver D-4 Vacuum Box to BNL	4/2/08
	Deliver Veto Vacuum Tank to BNL	7/24/09
1.2.2	**Preradiator**	
	Chamber Production Complete	6/30/09
	Scintillator Proto Sys Complete	12/31/09
	Complete PMT/Base/Preamp/Cable Sys.	12/31/09
	Complete Electronic Readout Sys	9/30/09
	Complete External PV Sys.	12/31/08
	EPV Electronics Install Complete	12/31/09
	Preradiator Install Complete	12/31/09
1.2.3	**Calorimeter**	
	Photon Calorimeter Module Prod Assembly Complete	11/26/08
	Module Instrumentation APD Assy Complete	11/26/08
	Mechanics Fabrication Complete	11/26/08
	Cabling Subsystem Installation Complete	3/31/10
1.2.4	**Charged Particle Veto**	
	Barrel Charged PV Arrival at BNL	5/30/08
	Downstream Charged PV Ready for Installation	6/30/08
	FE Electronics & Cabling System Test Complete	6/30/09
	CPV Complete	3/31/10
1.2.5	**Photon Veto**	
	UPV Cabling Subsystem and Installation Complete	3/31/10
	BPV Cabling Subsystem and Installation Complete	3/31/10
	MPV Mechanics Assemply Complete	4/15/08
	MPV Cabling Subsystem and Installation Complete	3/31/10
	DSPV Cabling Subsystem and Installation Complete	3/31/10
	MCPV Cabling Subsystem and Installation Complete	3/31/10

Work in progress

Total Physicists Needed, by Project



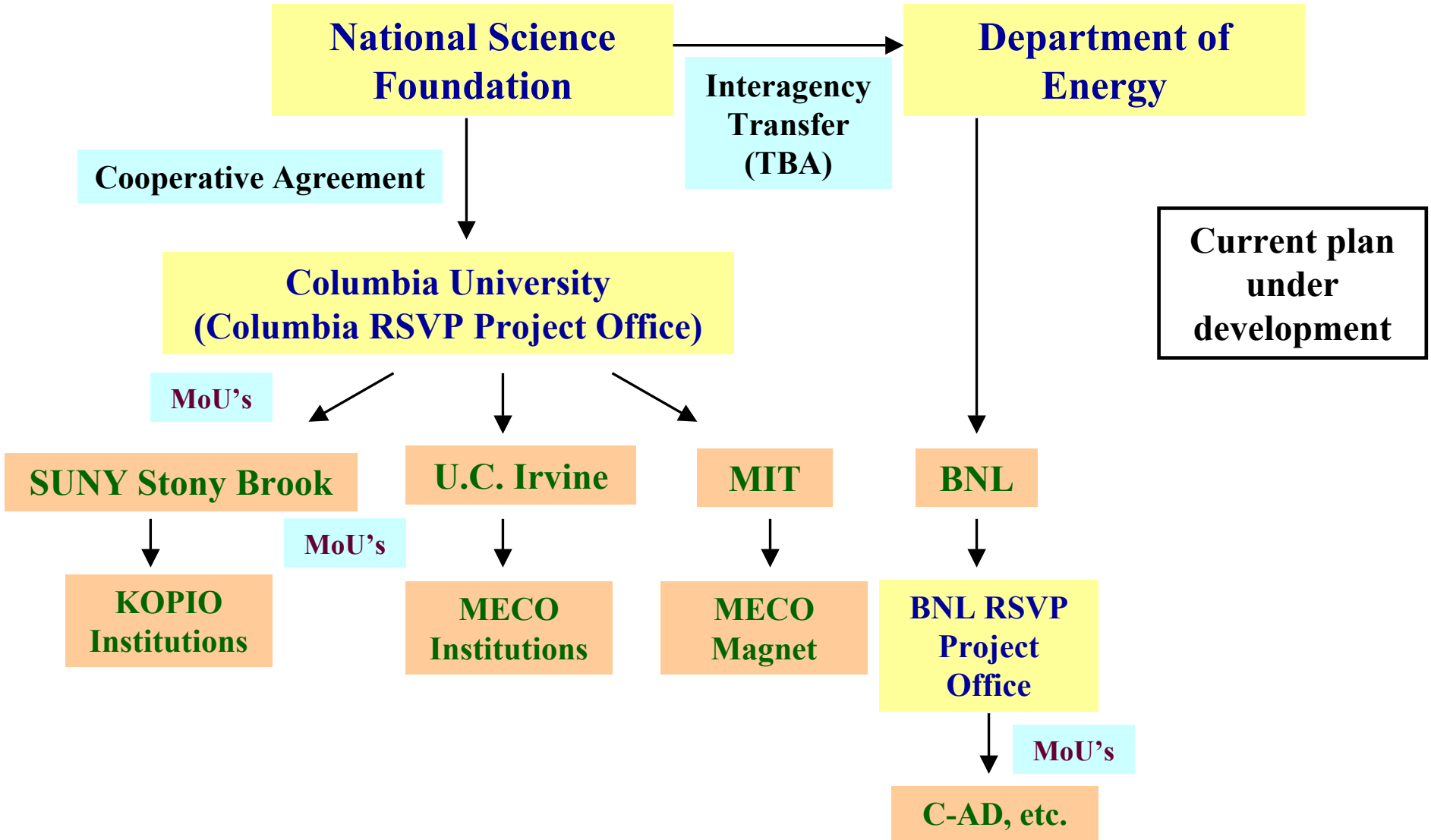
Change Control (from PMP)

	Level 1: DOE/NSF Joint Oversight Group	Level 2 NSF Program Manager	Level 3 RSVP Project Director
Technical	Changes to the project purpose or goals.	Changes to the baseline list of deliverables.	Changes that do not affect a Level 1 or Level 2 control item.
Cost	Changes to the Total Project Cost.	Changes to the Level 2 cost baseline.	Changes to the cost baseline at WBS Level 3.
Schedule	Greater than 6 month change on a Level 1 milestone.	Greater than 3 months on a Level 1 milestone	Any change in a Level 2 milestone.

Outline of Funding Flow for RSVP

- Columbia University is the Host University for RSVP
- Funds for K0PI0 (1.2), MECO Detectors (1.3), and MECO Magnet (1.4) will be written to Columbia via a cooperative agreement between Columbia and NSF
- Funds will be distributed from Columbia to SUNY Stony Brook (K0PI0), University California, Irvine (MECO Detectors), and MIT (MECO Magnet) via MoUs according to the need outlined in the RLS, with final amounts determined by the Project Office
- Subcontracts for the work associated with various sub-detectors will be written from these respective institutions
- Invoices must be approved by Project Office prior to payment
- Preferred transfer of funds for work done at BNL is via direct transfer through a DoE/NSF interagency agreement
- Fallback option would be to treat it in manner identical to the other three primary institutions

RSVP Funding Flow



Cost of an Example Operations Year

- **Example costs for one year of operating MECO for 25 weeks in 2014:**
  - **10 weeks concurrent with RHIC heavy ion running**
  - **5 weeks concurrent with RHIC polarized proton**
  - **10 weeks stand alone (without RHIC)**

EXAMPLE OPERATIONS YEAR: 25 WEEKS MECO RUNNING IN 2014 (FY05k$)		
AGS COSTS		
Personnel	2,026	
Other Costs*	6,439	
Indirects	3,815	
TOTAL AGS	**12,280**	
EXPERIMENT-SPECIFIC COSTS		
Seven Technicians (shared)	1,232	
Three Engineers (shared)	708	
Running costs**	1,050	
TOTAL EXPT-SPECIFIC COSTS	**2,990**	
TOTAL PROJECT OFFICE* **	**1,733**	
TOTAL OPERATIONS (FY05k$)	**17,003**	
Inflation Factor	1.26234	
Inflation (k$)	4,460	
TOTAL COST AYk$	**21,463**	

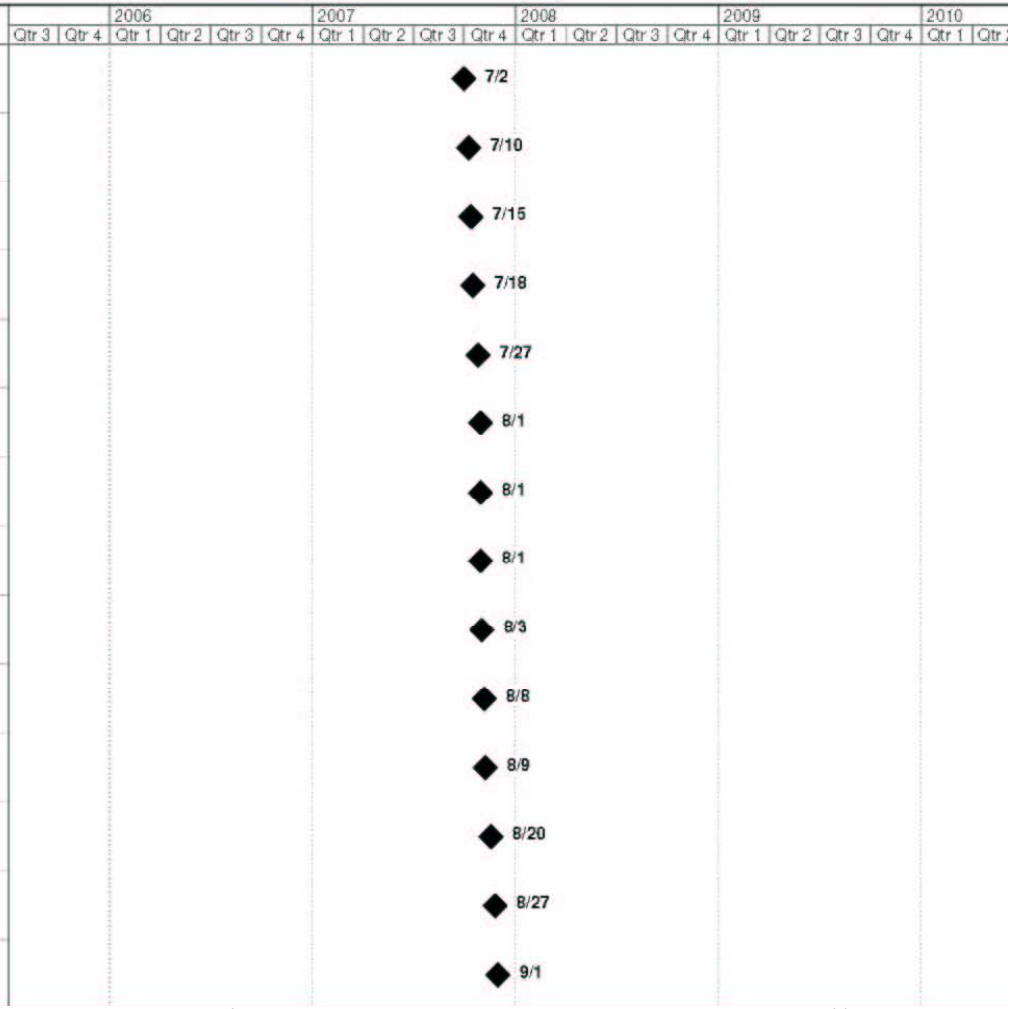
* Shift differential, power, DTS, MSTC, SP, MECO Magnet, etc.
** Tapes, computers, cables, gases, shipping, visitor support, office supplies, etc.
*** PD, Deputy, 1 Budget Officer (shared), 2 AAs, 0.5 Scheduler, travel, reviews, etc.

Subset of Time-Ordered Milestones for AGS

AGS Project contains 252 total milestones
Well cover the time interval, allow for close project tracking

RSVP
AGS UPGRADES PROJECT

ID	WBS	Name
101	1.4.2.6.6.7	A & B line magnets ready
69	1.4.4.5.9	PS controls ready for integration
63	1.4.1.3.4.6	Design complete
334	1.4.4.2.8.4.1	RFMM Hut Requirements Defined
186	1.4.2.9.3.2.19	Final test
104	1.4.1.3.2.1.10	Procurement Complete
35	1.4.4.3.1.2	External Profile Monitors Complete
93	1.4.4.3.1.6	Beam Position Monitors Complete
54	1.4.1.2.2.2.9	Design Frozen
19	1.4.1.3.2.4.7	Procured Parts Delivered
93	1.4.1.2.2.1.10	Procurement Complete
593	1.4.3.7.2.3	KOPIO Detector pit complete
77	1.4.4.4.5.4	Hardware Install
7	1.4.1.4.1.2.5	System Ready for Test in AGS



Beam Operations Program Summary

Program outline, including intensity goals, for beam & detector R&D, pre-operations, commissioning, and operations

Fiscal Year	Running Activity	Duration (weeks)	Begin (end) intensity goals
2008	Beam/Detector R&D	8	0.2 TP/pulse: Limit activation, not all hardware installed
2009	Beam/Detector R&D	8	same as above
2010	Pre-operations: KOPIO neutral beam, MECO extinction	8	15 TP/pulse max KOPIO 10 TP/second max MECO
2011	KOPIO Engineering	8	10 (30) TP/pulse
2011	KOPIO Operations	17	30 (75) TP/p
2012	MECO Engineering	8	2 (10) TP/second
2012	MECO Operations	17	10 (17.5) TP/s
2013	KOPIO Operations	25	75 (100) TP/p
2014	MECO Operations	25	17.5 (20) TP/s
2015	KOPIO Operations	25	100 TP/p
2016	MECO Operations	25	20 TP/s
TOTALS:			
16 WEEKS BEAM/DETECTOR R&D			
8 WEEKS PRE-OPERATIONS			
16 WEEKS ENGINEERING/COMMISSIONING			
134 WEEKS OPERATIONS			