NSF Elementary Particle Physics

NSF EPP Program

Presentation for AGS Users' Meeting

Workshop on Future Kaon Experiments

BNL, May 13, 2004

Jim Whitmore

Marv Goldberg

Jim Stone

The Rare Symmetry Violating Processes Project: Fundamental Physics at the Sensitivity Frontier

RSVP is an NSF-supported, university-led particle physics project, using accelerator facilities developed by DOE

- Complementary to **Energy Frontier** Science such as the Tevatron and LHC (Large Hadron Collider)
- RSVP is an **MREFC** project for two new AGS experiments that could profoundly change our understanding of physics

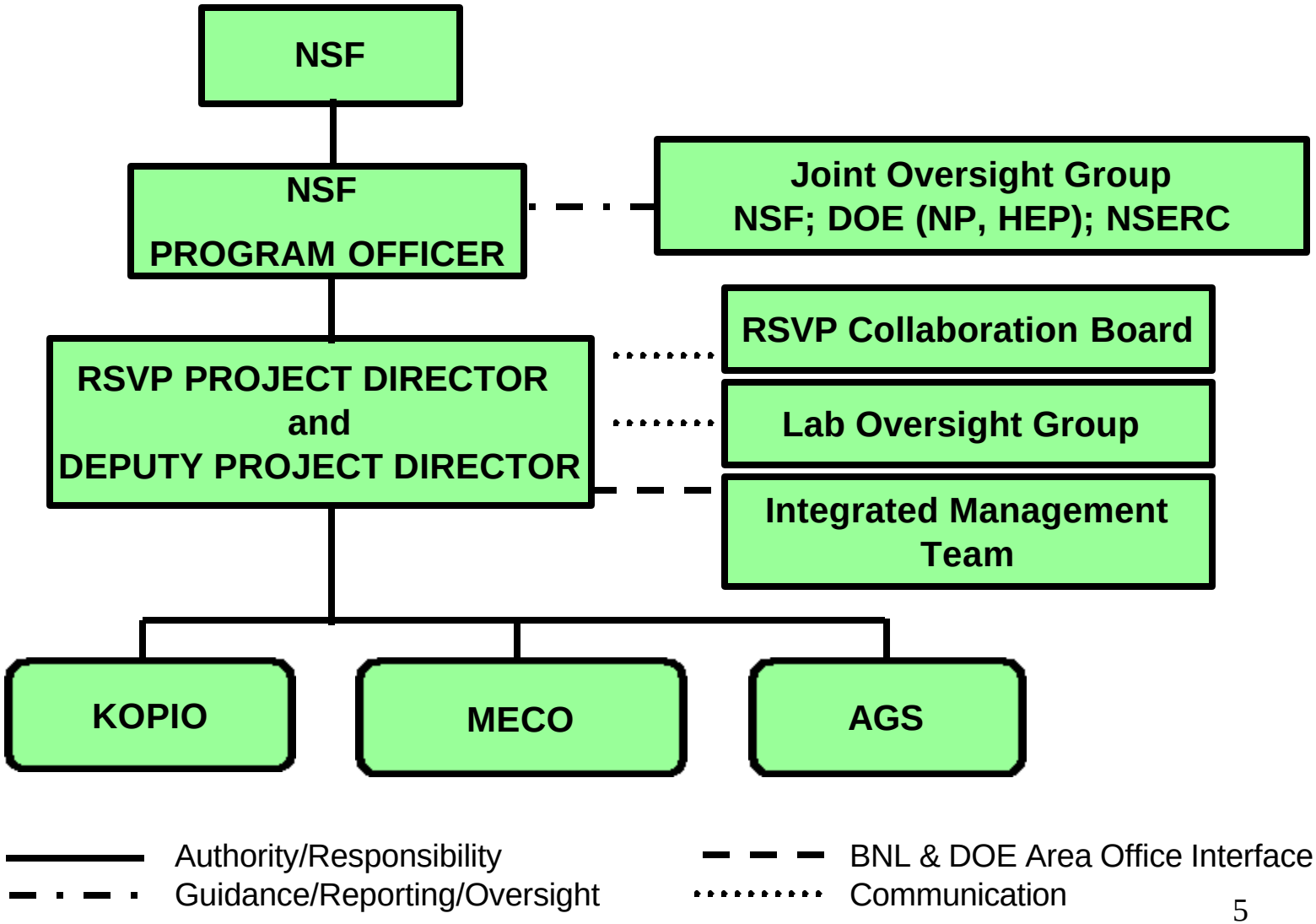
E949 Considerations

- We recognize that there are experimenters who wish to continue E949
- At the present time, NSF considers RSVP to be the highest priority project
- Given the funding constraints, at present, we are unable to provide any funding for the continuation of E949.

NSF-DOE MOU

- “Both agencies, through this MOU, agree to the goal of successful implementation of the RSVP project with no negative impact on current research activities at RHIC”
- DOE operates the BNL AGS for RHIC
- NSF would pay “incremental” costs for modifications, operating costs, decommissioning expenses (similar to the way NASA uses the AGS)
- Discusses management and oversight responsibilities
- Has been submitted to OGC (OK)

RSVP PROJECT MANAGEMENT



Authority/Responsibility
Guidance/Reporting/Oversight
BNL & DOE Area Office Interface
Communication

Reviews of RSVP

- Originally proposed to PHY in Oct 1999
- NSF panel in Nov 1999 recommended proceeding
- Oct 2000: NSB concurred as potential MREFC
- Nov 2000: External panel reviewed management
- June 2001: NSF held scientific and tech review
- Mar 2002: External review (tech, cost & sched)
- Jan 2003: External review (constr. readiness)
- Jan 2004: Lehman BNL impact review
- Mar 2004: External panel reviewed plans, readiness

Endorsements of RSVP

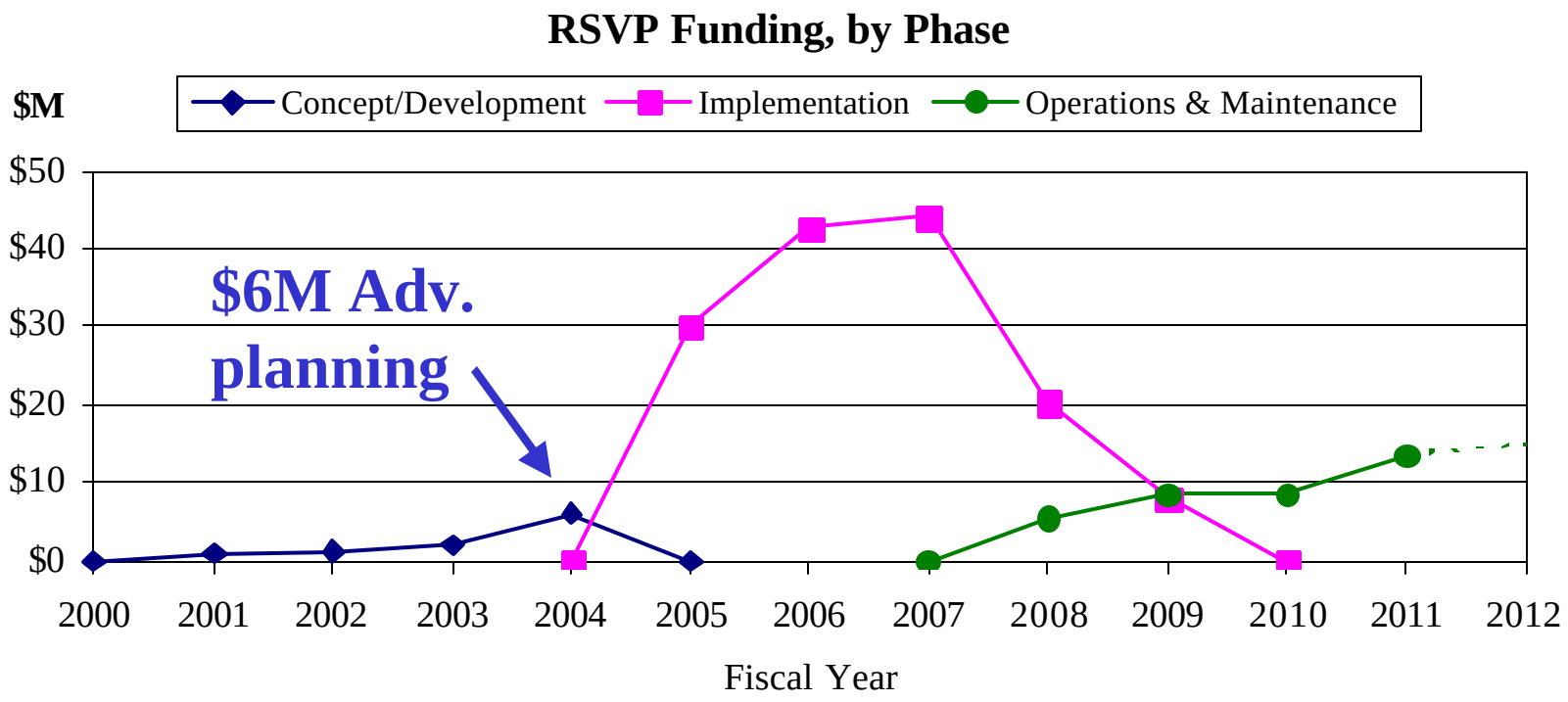
- HEPAP: 1998, 2001 (20-yr plan); 2002
- 2004: “Quantum Universe” (P. Drell, Chair)
- KOPIO is listed in the table of “Primary US Physics Program of Smaller Facilities”
- KOPIO addresses one of 9 questions:
- “Where did the antimatter go?”

Planned Reviews of RSVP

- Reviews of Critical Items
- Reviews of RSVP components
- Preliminary baseline reviews
- Final baseline early 2005 (optimistic?)

RSVP FUNDING

- Oct 2000: Director included RSVP as a future MREFC (2002+)
- President's FY2004 Budget put RSVP to start in FY2006
- Congress appropriated "$6M for continued advanced planning"



FY 2005 start shown, as in FY 2005 President's budget.

Why do RSVP?

- A little different for NSF
- NSF-funded large project at a DOE lab
- Interagency cooperation
- International collaborations
- SCIENCE:
- Sensitivity frontier as complement to the energy frontier experiments

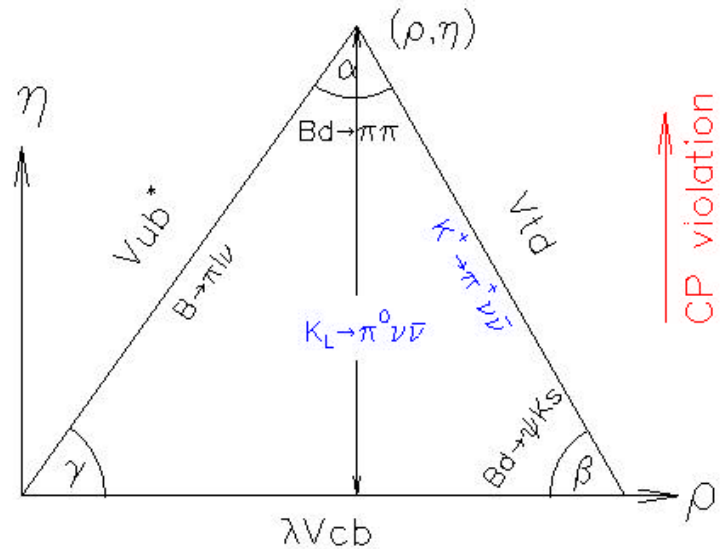
Backup Material

FY2003-2005 MPS Budgets

	FY 2003	FY 2004	FY 2005	FY 2005 / 2004	
	Actual	Actual	Request	Amount	Percent
Astronomical Sciences	187.07	196.55	204.35	7.80	4.0%
Chemistry	181.61	185.22	188.91	3.69	2.0%
Materials Research	241.39	250.89	253.18	2.29	0.9%
Mathematical Sciences	178.79	200.41	202.25	1.84	0.9%
Physics	224.50	227.67	235.76	8.09	3.6%
Multidisciplinary Activities	27.34	30.77	31.05	0.28	0.9%
Total, MPS	$1,040.70	$1,091.51	$1,115.50	$23.99	2.2%

Standard Model CP Violation

KOPIO seeks to directly measure **h**, the complex phase in the CKM matrix that leads to CP violation in the Standard Model



Four special processes will challenge the Standard Model:

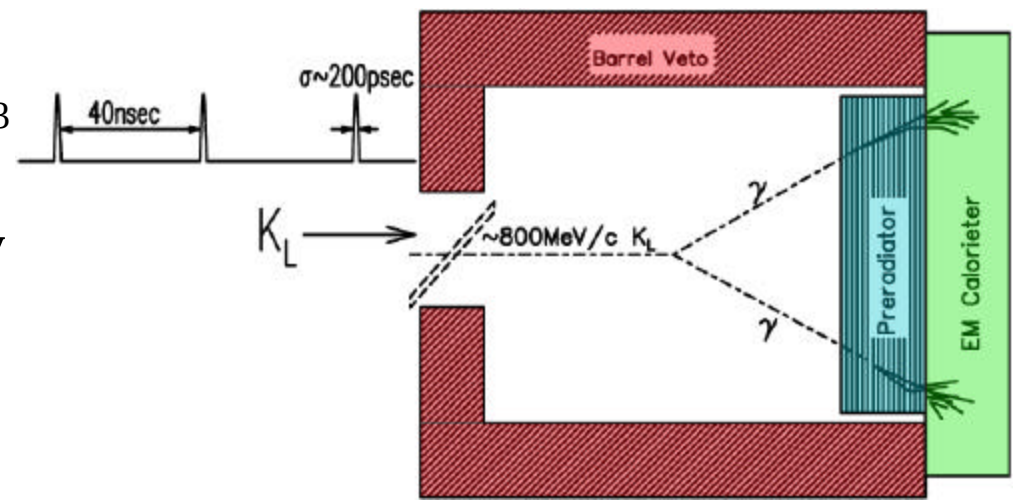
$K_L^0 \to p\, {}^0n\, \bar{n}$	$\mathrm{Im}\,(V_{ts}^* V_{td})$	KOPIO
$K^+ \to p\, {}^+n\, \bar{n}$	$\lvert V_{ts}^* V_{td} \rvert$	E949, CKM
$B_d \to y\, K_S$	$\sin(2b)$	BABAR, BELLE, CDF, D0
$\frac{x_s}{x_d}$	$\left\lvert \frac{V_{ts}}{V_{td}} \right\rvert$	CDF, D0, LHCB, BTEV

KOPIO Design Concept

- **Standard Model Expectation: (2.7 ±0.5) ´ 10^{-11}**

- **Dominant background is due to**

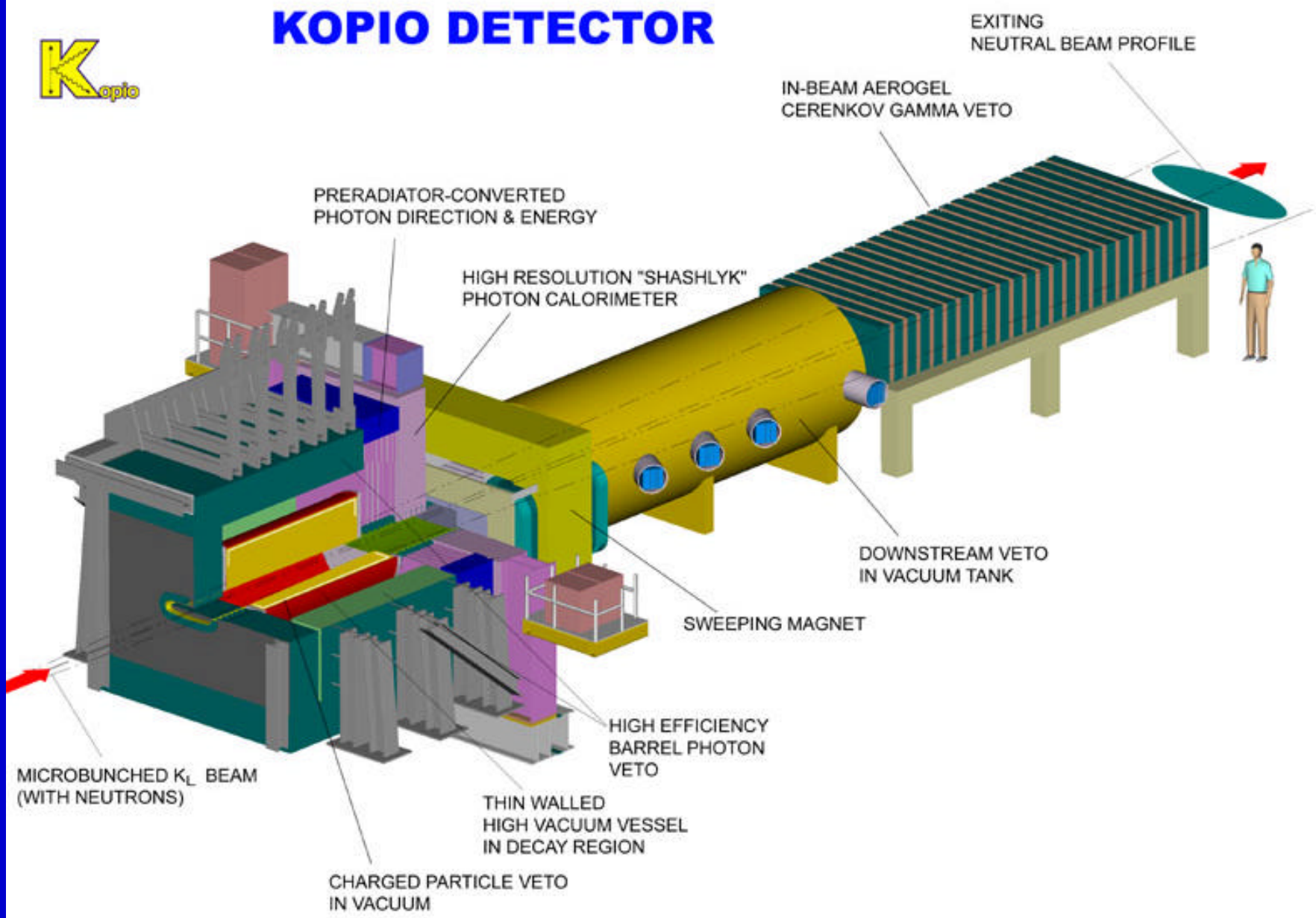
$K_L^0 \rightarrow \pi^0\pi^0$ **with** $B(K_L^0 \rightarrow \pi^0\pi^0) \sim 10^{-3}$



- **Maximally constrain each event by measuring the trajectory, arrival time, and energy of both photons from p^0 decay**

- **Reconstruct p^0 vertex and use Time-of-Flight to determine K^0 momentum**

- **Surround the decay region with an extremely efficient photon 4p veto to minimize missed g**

If $K_L^0 \rightarrow \pi^0\nu\bar{\nu}$ occurs at the SM rate, KOPIO expects to observe ~50 events with S/N ratio > 2

KOPIO DETECTOR