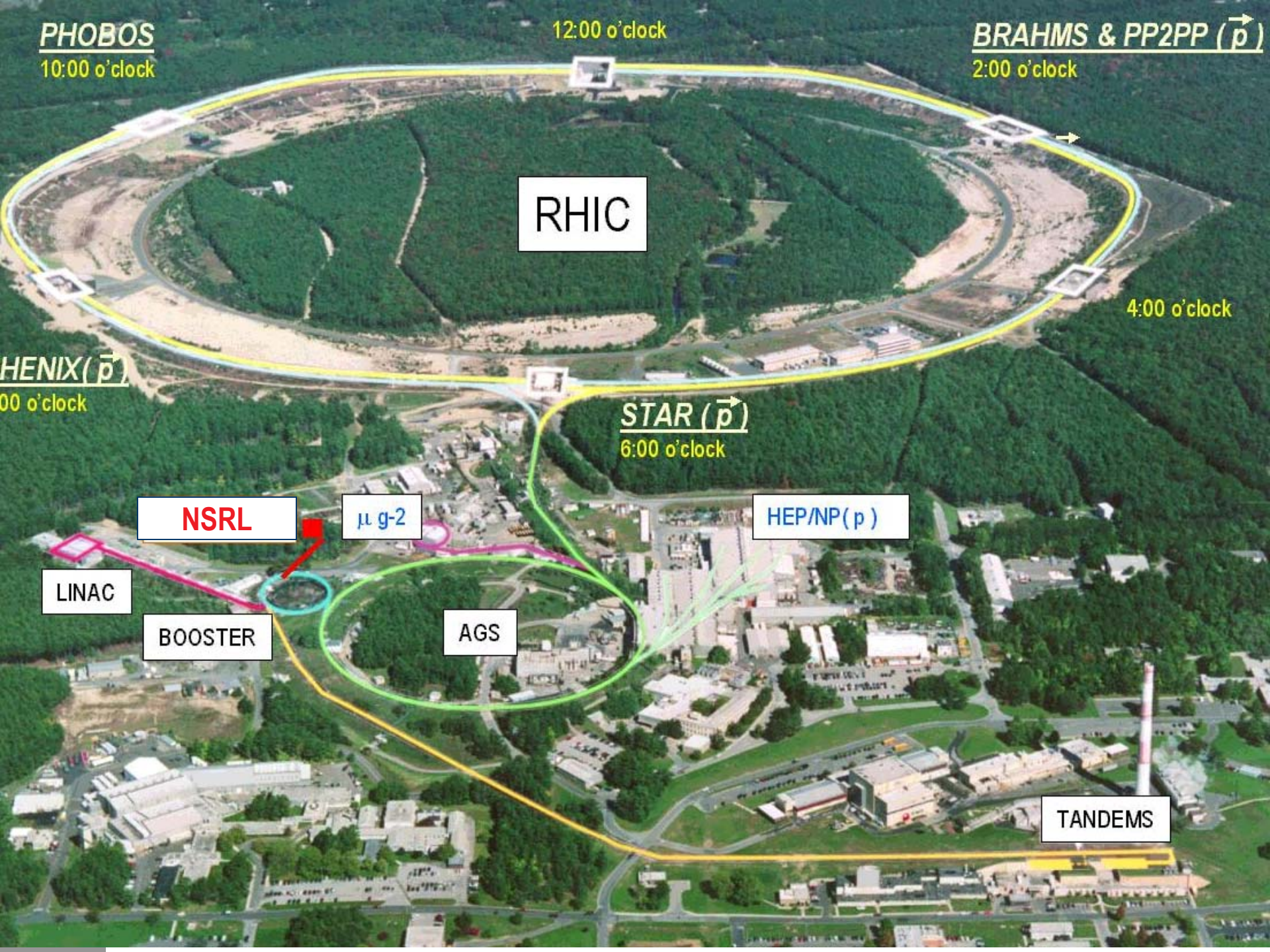
Work - For - Others Experience and Impact on RHIC Operations

Derek I. Lowenstein
Collider-Accelerator Department
January 27, 2004

Office of Science
U.S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY


PHOBOS
10:00 o'clock
12:00 o'clock
BRAHMS & PP2PP (p)
2:00 o'clock
RHIC
4:00 o'clock
HENIX (p)
00 o'clock
STAR (p)
6:00 o'clock
NSRL
μ g-2
HEP/NP (p)
LINAC
BOOSTER
AGS
TANDEMS

Charge:
Assess the the risks and impacts(positive and negative) to RHIC.

- **Recent applicable history**

- **BAF / NSRL**
  - Construction was completed on schedule (6/03) and below budget of $34M
  - Booster synchrotron modifications **did not interfere** with RHIC operations
    - Completed during RHIC shutdown periods
  - Tandem modifications (partial NP support) provided a spare RHIC preinjector and made d-Au possible. A **positive impact**.
    - This has been used several times during RHIC operations
  - Beam and experimental area construction was decoupled from accelerator operations
  - NSRL operations was rapidly brought online with the base C-A and new staff, and was shown to be operable in a pulse-to-pulse mode of operation with downstream AGS and RHIC operations.
  - **Additional positive impacts**
    - Matrix RHIC and new hires to support BAF construction and C-A operations
    - NASA supported operations staff increase allows for enhanced RHIC support
    - NSRL commissioning resolved a long standing Booster performance problem

NSRL Work For Others

- MOU between NASA and DOE
- DOE BAO provided oversight for both NASA and DOE
- Joint NASA and DOE 'Lehman' reviews
- BNL, DOE, NASA JSC and Headquarters close cooperation
- Applied DOE rules for structuring, reporting etc.
  - WBS structure
  - Schedule
  - ARR
  - Procedures

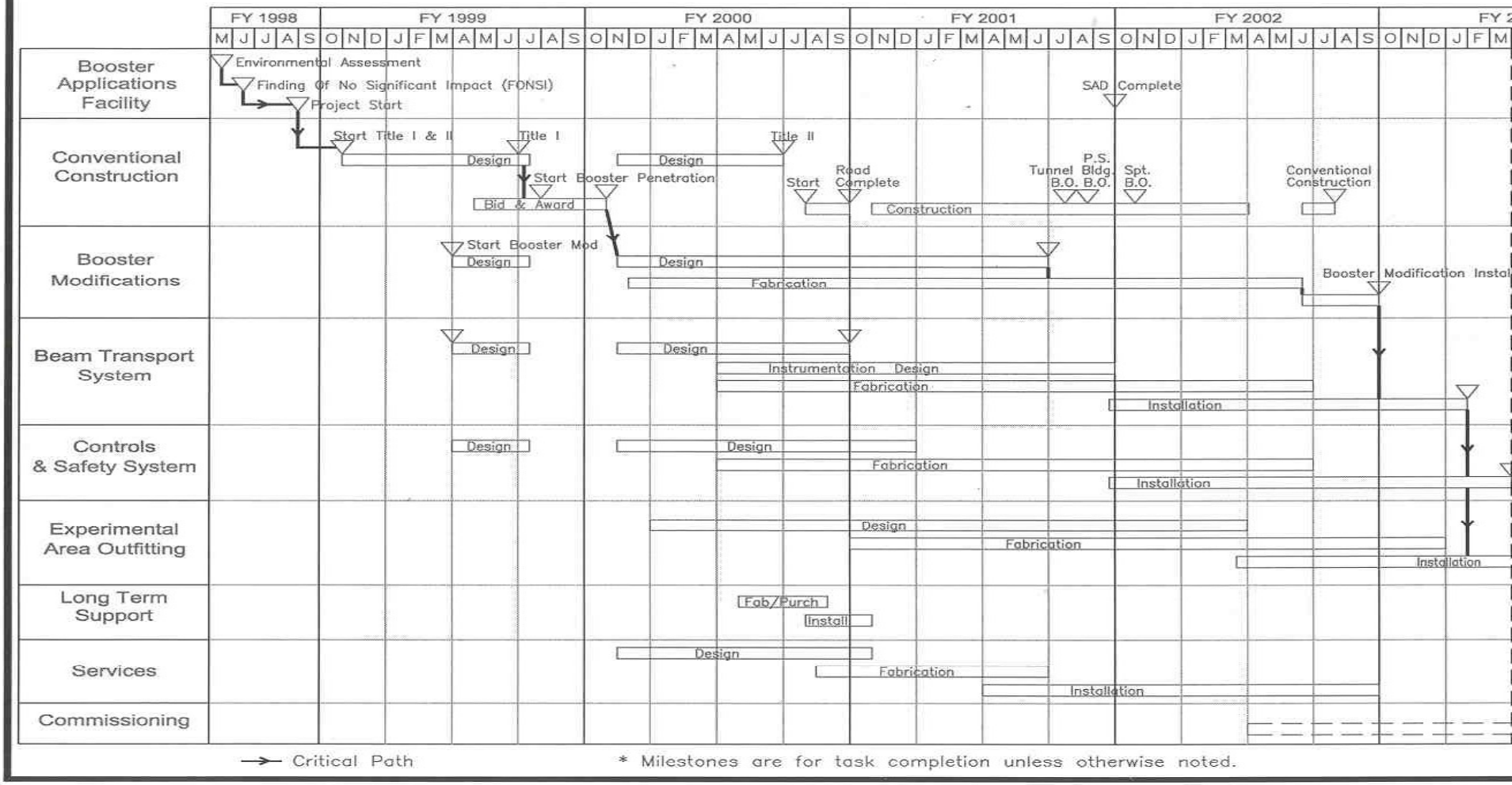
BAF Budget History

WBS	ELEMENT	TOTAL	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
1.1	Conventional Constr.	6,648	290	80	4,628	989	648	0
1.2	Booster Modifications	6,066		282	1,747	1,886	2,074	100
1.3	Beam Transport System	5,706		56	961	2,547	1,927	180
1.4	Controls & Personnel Safety System	1,782		8	497	579	563	135
1.5	Exp. Area Outfitting	3,624		0	1,200	679	1,385	360
1.6	Long Term Support Lab	456		0	343	0	113	0
1.7	Installation & Services	3,681		9	1,237	1,117	1,293	15
1.8	Project Services	3,464	10	165	985	650	1,329	450
		31,427	300	600	11,598	8,447	9,332	1240
	Contingency	100	0	0	0	0	0	250
1 (TEC)	BAF Construction (BA AY $)	31,527	300	600	11,598	8,447	9,332	1,490
	Spares	1,084			50	266	337	191
	Commissioning	1,294					175	1,119
1 (TPC)	Total Project Cost (BA AY $)	33,905	300	600	11,648	8,713	9,844	2,800
1 (TPC)	BAF Construction (BO AY $)	33,905	300	600	5,348	11,932	12,644	3,081

Office of Science
U.S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY

Booster Applications Facility
Master Milestone Schedule



Office of Science
U.S. DEPARTMENT OF ENERGY

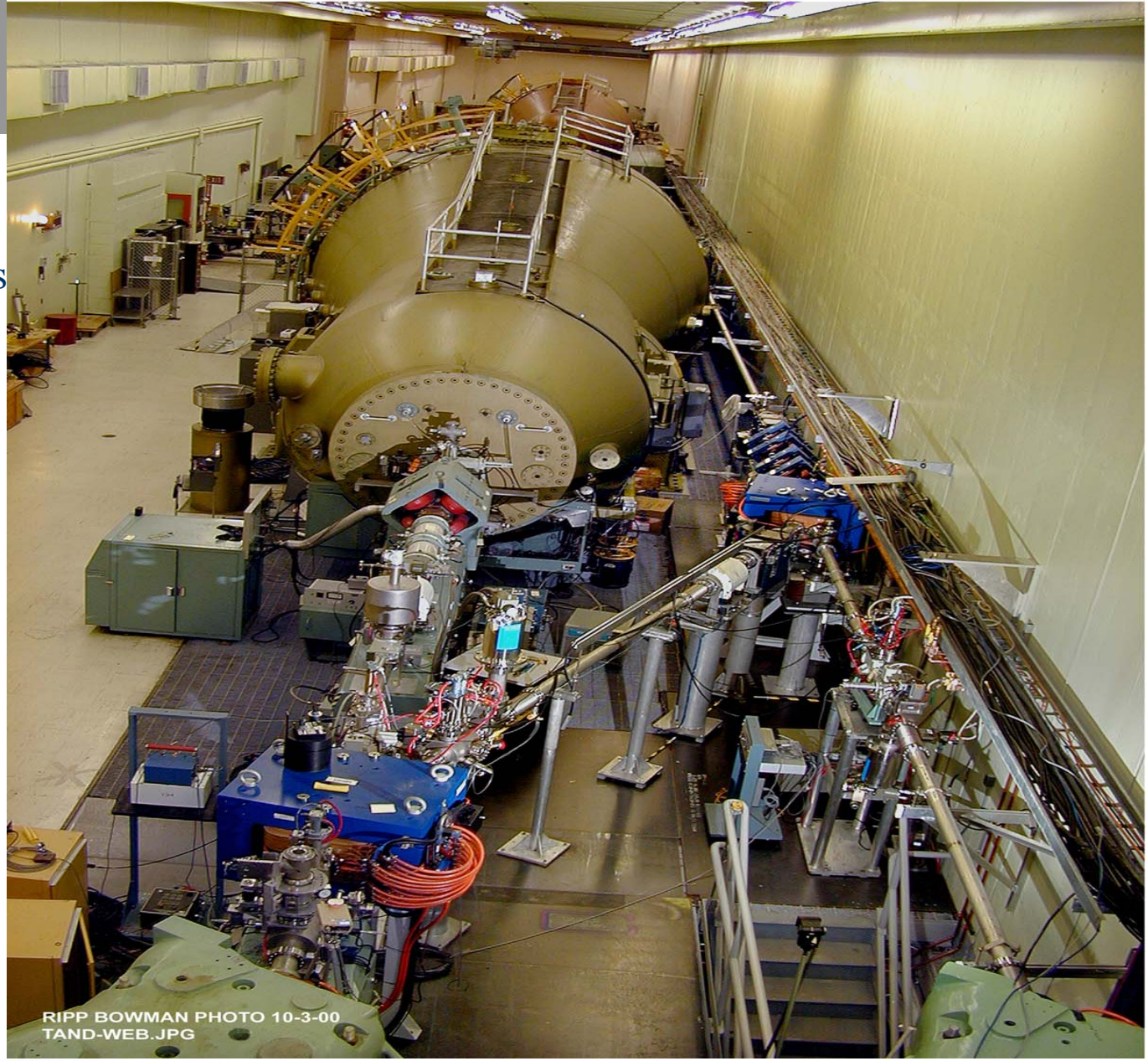
BROOKHAVEN NATIONAL LABORATORY

NASA Space Radiation Laboratory

Office of Science
U.S. DEPARTMENT OF ENERGY

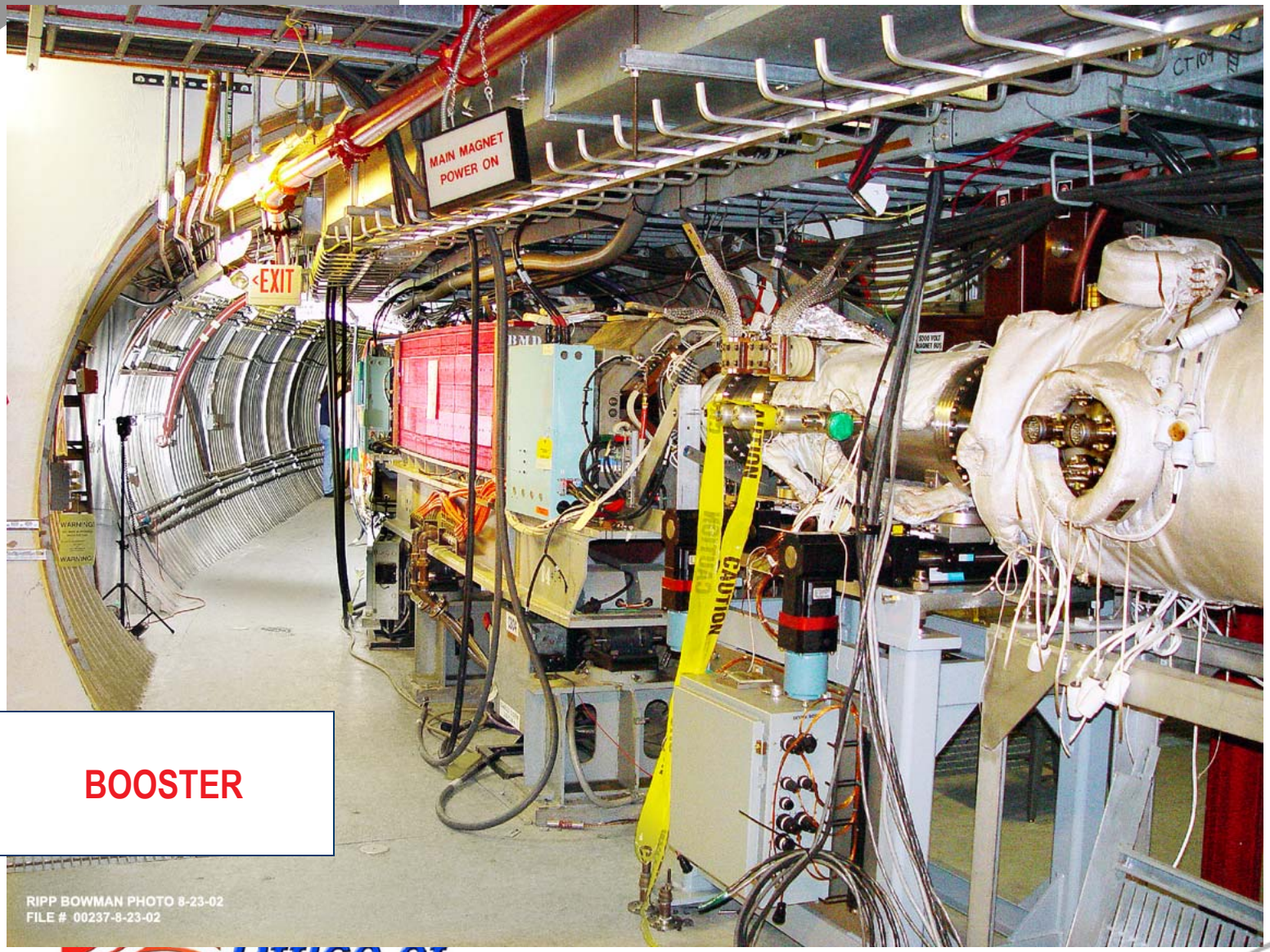
BROOKHAVEN
NATIONAL LABORATORY

Tandem Injectors



Office of Science
U.S. DEPARTMENT OF ENERGY

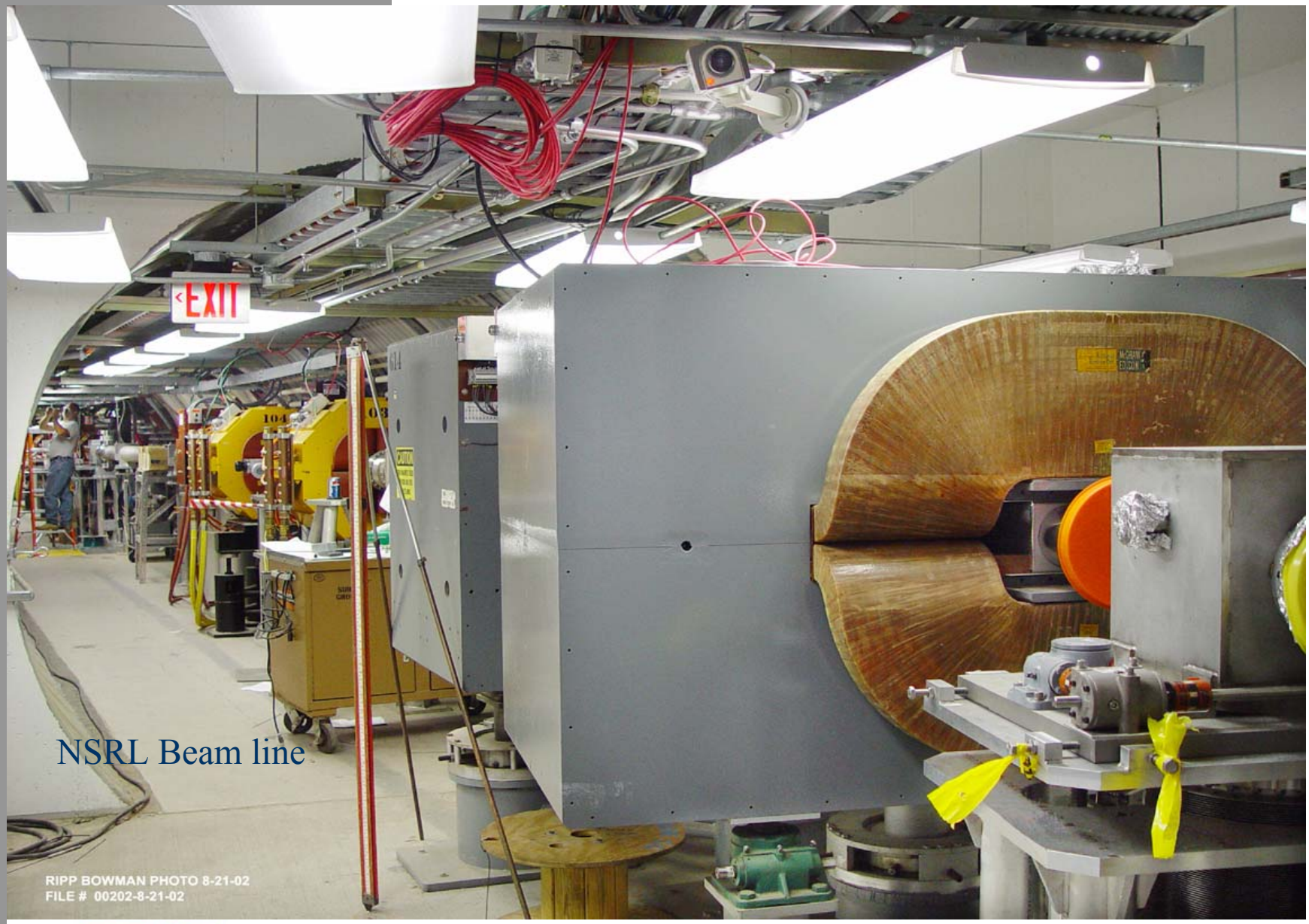
BROOKHAVEN
NATIONAL LABORATORY



BOOSTER

Office of Science
U.S. DEPARTMENT OF ENERGY

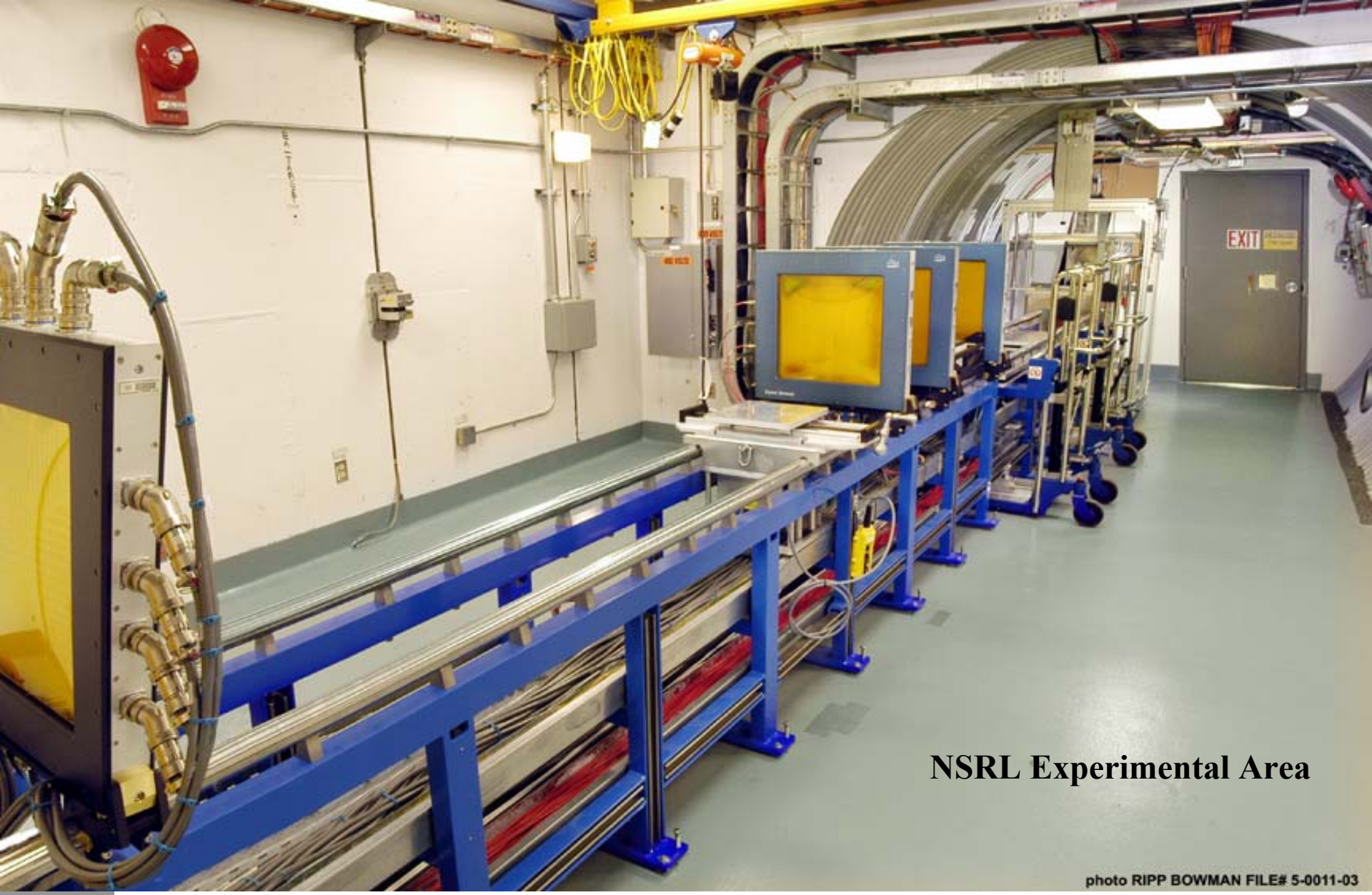
BROOKHAVEN
NATIONAL LABORATORY



NSRL Beam line

Office of Science
U.S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY



Office of Science
U.S. DEPARTMENT OF ENERGY

BROOKHAVEN
NATIONAL LABORATORY

NSRL Experimental Support Building

Office of Science
U.S. DEPARTMENT OF ENERGY

BROOKHAVEN
NATIONAL LABORATORY

- NSRL operational demands are unlike that of nuclear or high energy physics

- Accelerators are capable of very flexible operations and satisfying unusual requirements

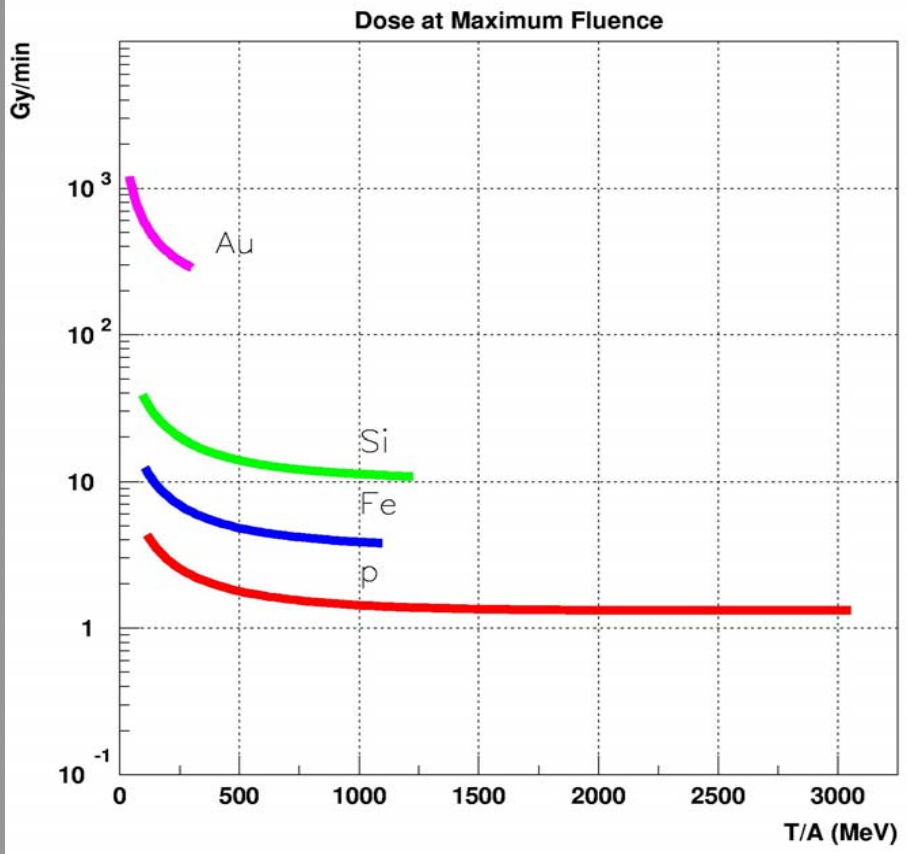
protons to gold

slow extracted

40-3000 MeV / nucleon

A New Language Is Spoken For NSRL Program

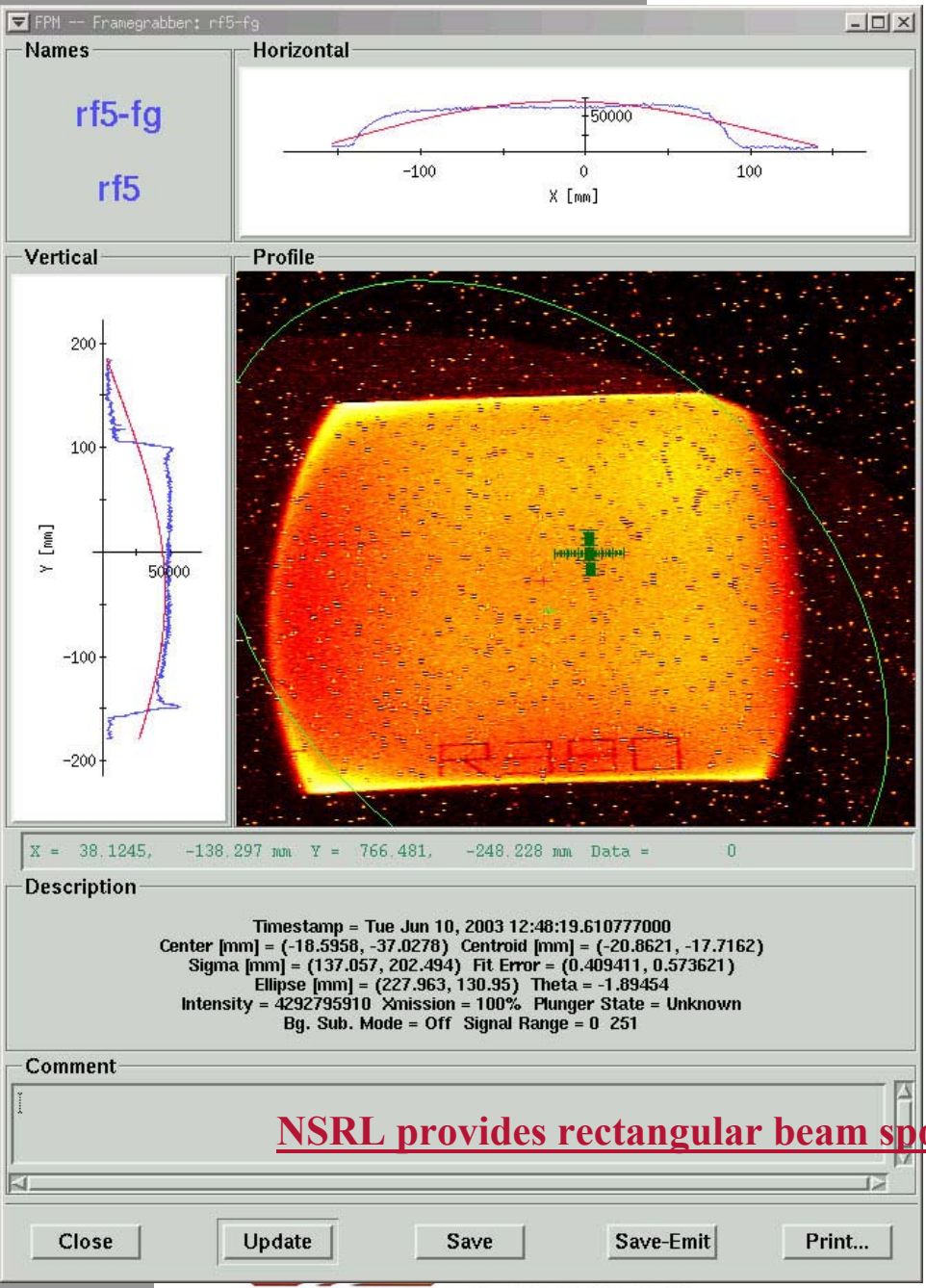
Dose Delivered by Several Ion Species

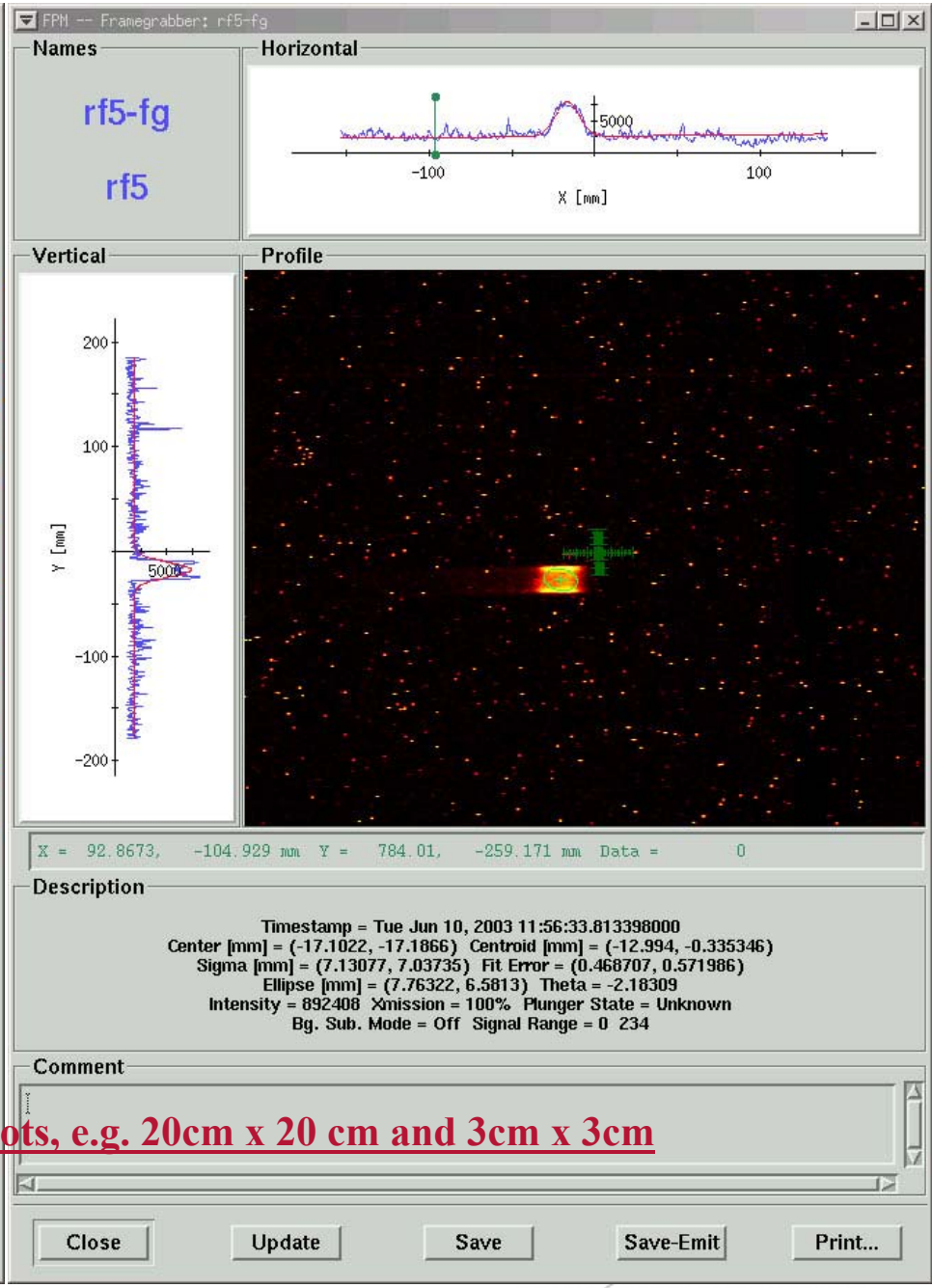


- **Plotted against the kinetic energy per nucleon (T/A).**
- **At maximum fluence for each ion type.**
- **Integrated over 1 minute.**
- **0.5 second spills.**
- **30 spills/minute**

Office of Science
U.S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY





NSRL provides rectangular beam spots, e.g. 20cm x 20 cm and 3cm x 3cm

NSRL Operations and RHIC

- NSRL operations is secondary to RHIC
  - 2 ion species collision mode may preclude NSRL operations
- 3-4 campaigns per year as per NASA RFP call
  - 150-300 hours per campaign
  - coordinated beam species requirements per campaign
    - including protons and ions
- 10-12 hour /day, 5 days /week operation
  - includes beam setup time
  - will entertain physics experiments for other times

NSRL schedule

- First run (NSRL-0) began July 9, 2003
  - 150 hours run
    - carbon (290 MeV), titanium (1.1 GeV), iron (1.0 GeV)
    - no RHIC operations
- Second run (NSRL-1) began October 27, 2003
  - 294 hours run
    - carbon (290 MeV), iron (800 MeV, 1.0 GeV), titanium (1.1 GeV)
    - RHIC injector turn-on concurrent
- Third run (NSRL-2) scheduled for March 15, 2004
  - 458 hours scheduled
    - carbon (290 MeV), iron (600 MeV, 1.0 GeV), silicon (600 MeV), titanium (1.1 GeV)
    - RHIC operations

Summary of NASA DOE WFO

The NASA and DOE interagency project was a major success.

On schedule and below budget.

Office of Science
U.S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY

WFO Lessons Learned

DOE WFO, SNS Project, has had difficulties

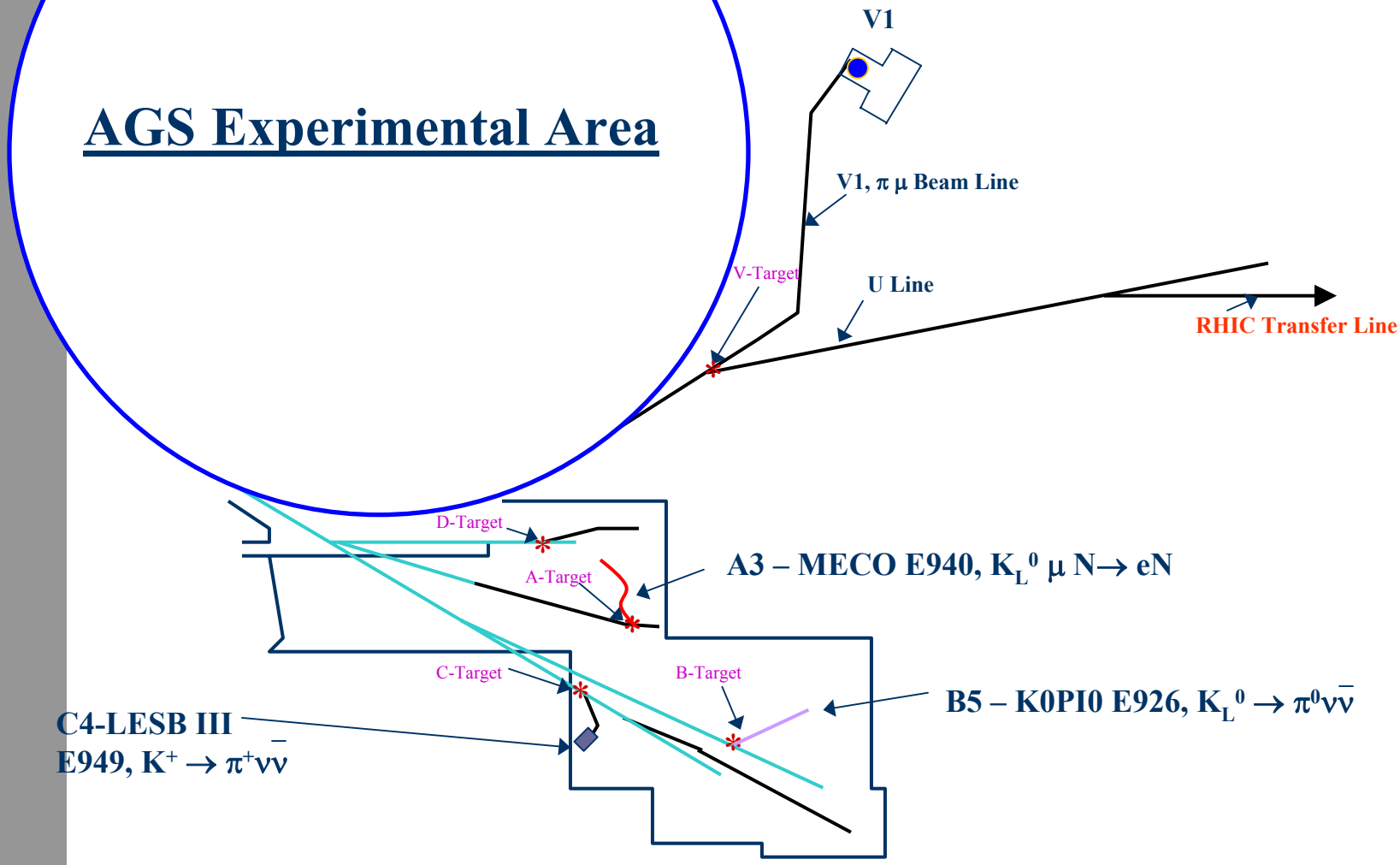
- SNS-BNL MOU has been often ignored by ORNL
- 3 ORNL management team changes
  - Project scope creep
    - Cost containment problems
- Top-down “authoritarian”relationship
  - Collaboration has turned into a subcontracting relationship
  - Allocated funding is constantly being modified
    - SNS reluctant to take ownership and thus the risk for their actions

RSVP

AGS Fixed Target

RHIC

AGS Experimental Area



Office of Science
U.S. DEPARTMENT OF ENERGY

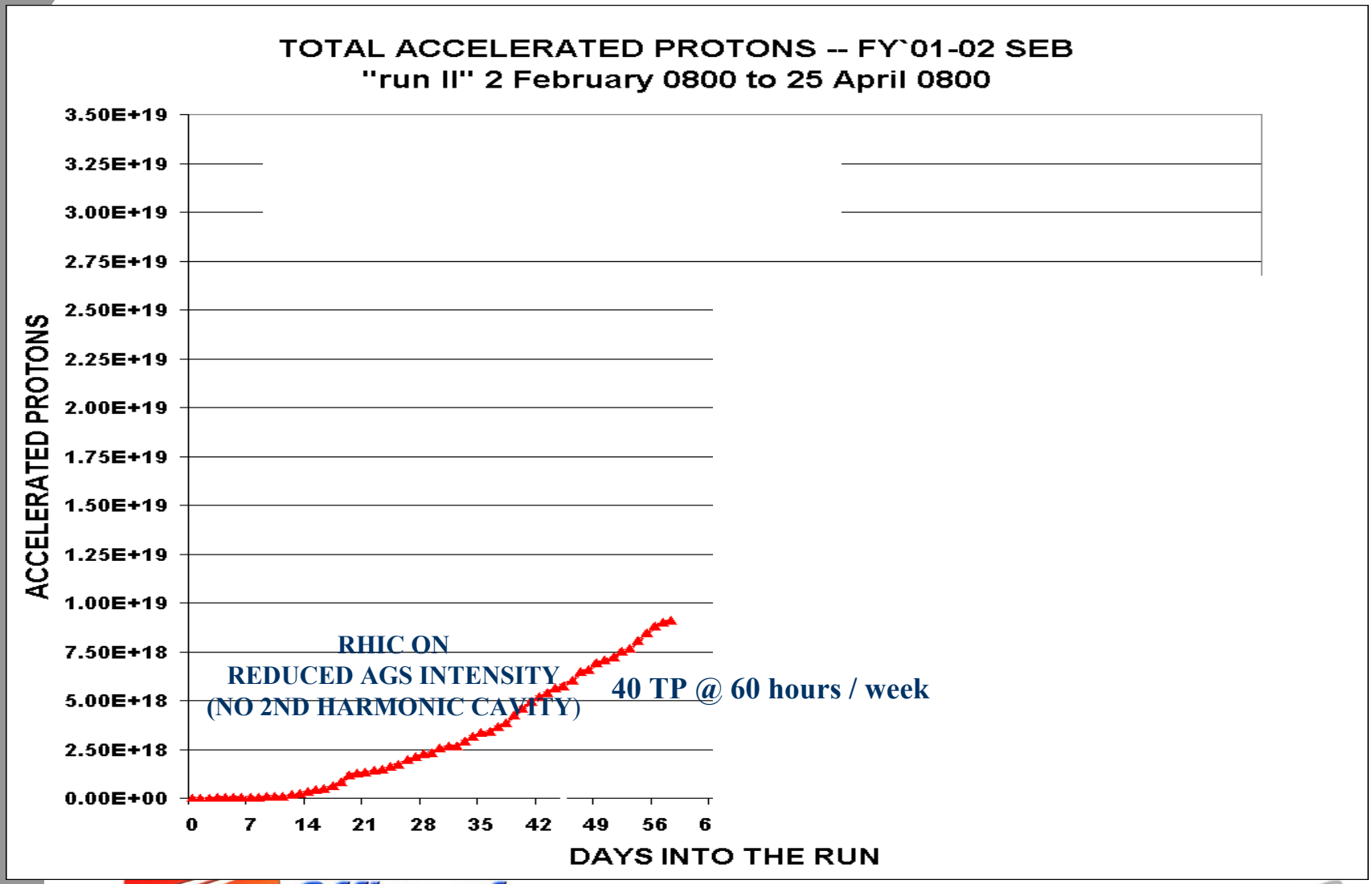
BROOKHAVEN NATIONAL LABORATORY

- **AGS Fixed Target** (details in other presentations)
  - RSVP R&D
    - Beam studies needed to meet MECO and KOPIO beam requirements
      - AGS fixed target has no DOE support. Base support from NSF required to do the R&D during RHIC operations
  - RSVP construction
    - No present DOE HEP support at C-A
      - Manpower could be available from SNS project. Time phasing??
    - AGS modifications installed during normal RHIC shutdowns
    - Beam transport and experiment installation are decoupled from accelerator operations
      - A and B-Line ports from switchyard must be blocked off
      - NASA plans a late FY2005 or early FY2006 AGS run. Possible impact to MECO construction schedule
        - Move NASA exposure area to D-line to avoid conflict
      - E949 operations (C-line) does not impact RSVP construction.
        - New beam dump and shielding required before E949 start

- **AGS Fixed Target** (cont.)

  - RSVP operations
    - Operate either mode switch during RHIC injection or pulse-to-pulse (PPM). PPM is a longer term possibility for RSVP operations.
      - Mode switching during RHIC injection operated for E949 in FY2001-2002 period
      - Booster PPM operations was first accomplished in 1993.
        - PPM used during recent RHIC startup and NSRL ops.

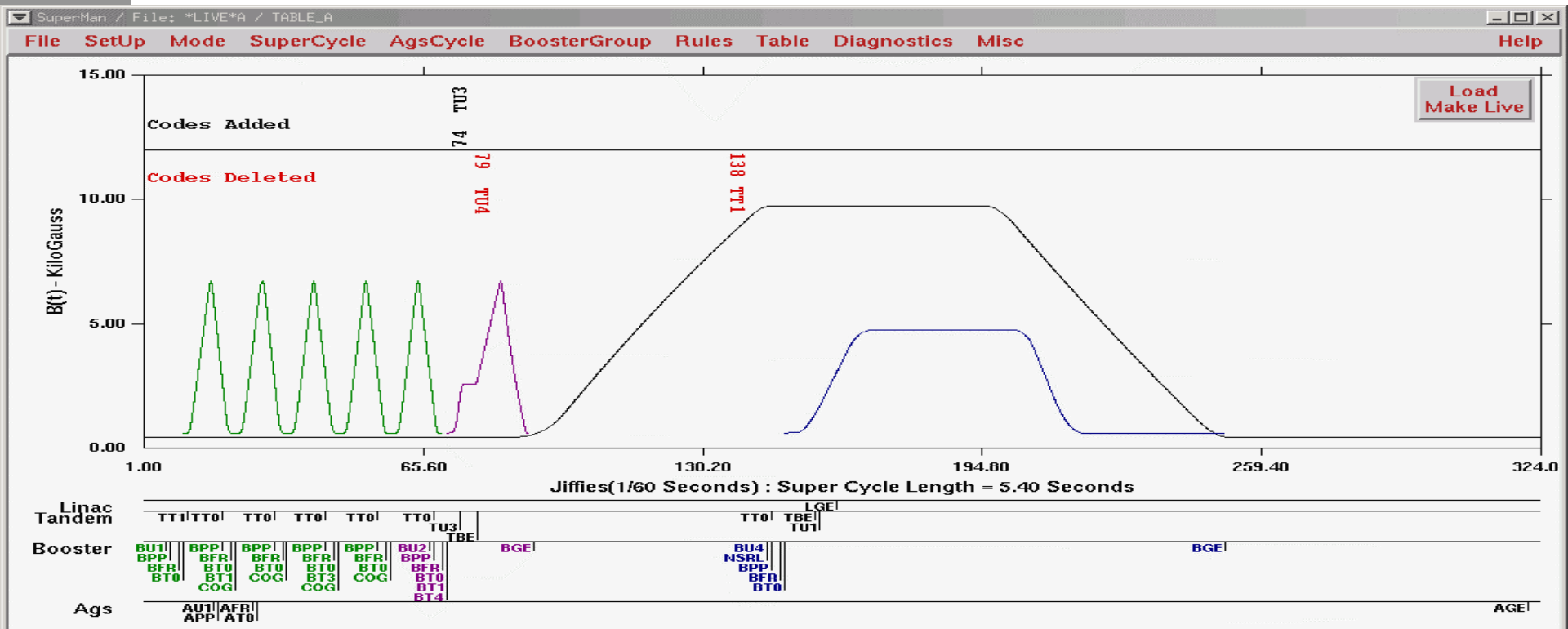
Protons for E949 FY'01



Office of Science
U.S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY

Injector Super cycle, November 2003



The Injector Super cycle showing (green) 5 Booster magnet cycles for RHIC gold (1 conditioning cycle and 4 production cycles), then (purple) 1 Booster cycle for gold merge development, then (blue) 1 Booster NSRL cycle. The black function is the AGS main magnet cycle to accelerate the four gold transfers.

RSVP ESH Authorizations

- AGS Safety Assessment Document (SAD)
  - KOPIO and MECO covered under existing AGS SAD
  - SAD scheduled for routine update/re-issue by 2005
- AGS Accelerator Safety Envelop (ASE)
  - KOPIO and MECO covered under existing AGS ASE
  - ASE scheduled for routine update/re-issue by 2005
- AGS Environmental Assessment (EA)
  - AGS and building 912 modifications covered under AGS EA
  - DOE/BNL NEPA concurrence process initiated
  - 9 mo. process if DOE decides EA must be amended

- C-AD has had ~50 years of experience with fixed target construction and operations.
- RSVP construction and operations will take full advantage of this previous experience.
- RSVP construction is not out of the ordinary.

The NASA and DOE interagency project, was a major success. On schedule and below budget.

The NSF and DOE interagency project should result in the same level of success.

The C-A deliverables for RSVP; beam extraction and transport, and experimental area construction (not experiment installation) are similar in magnitude to the recently completed NASA Space Radiation Laboratory.

Initial shared beam operations with RHIC was successfully accomplished in 2001-2002. More left to be done.