C-A DEPARTMENT ALL HANDS MEETING

D.I.LOWENSTEIN

JANUARY 3, 2003

- Funding and staffing
- Physics: The end product
- Accelerator performance
- Future possibilities: Looking into the crystal ball

C-A Department Funding History

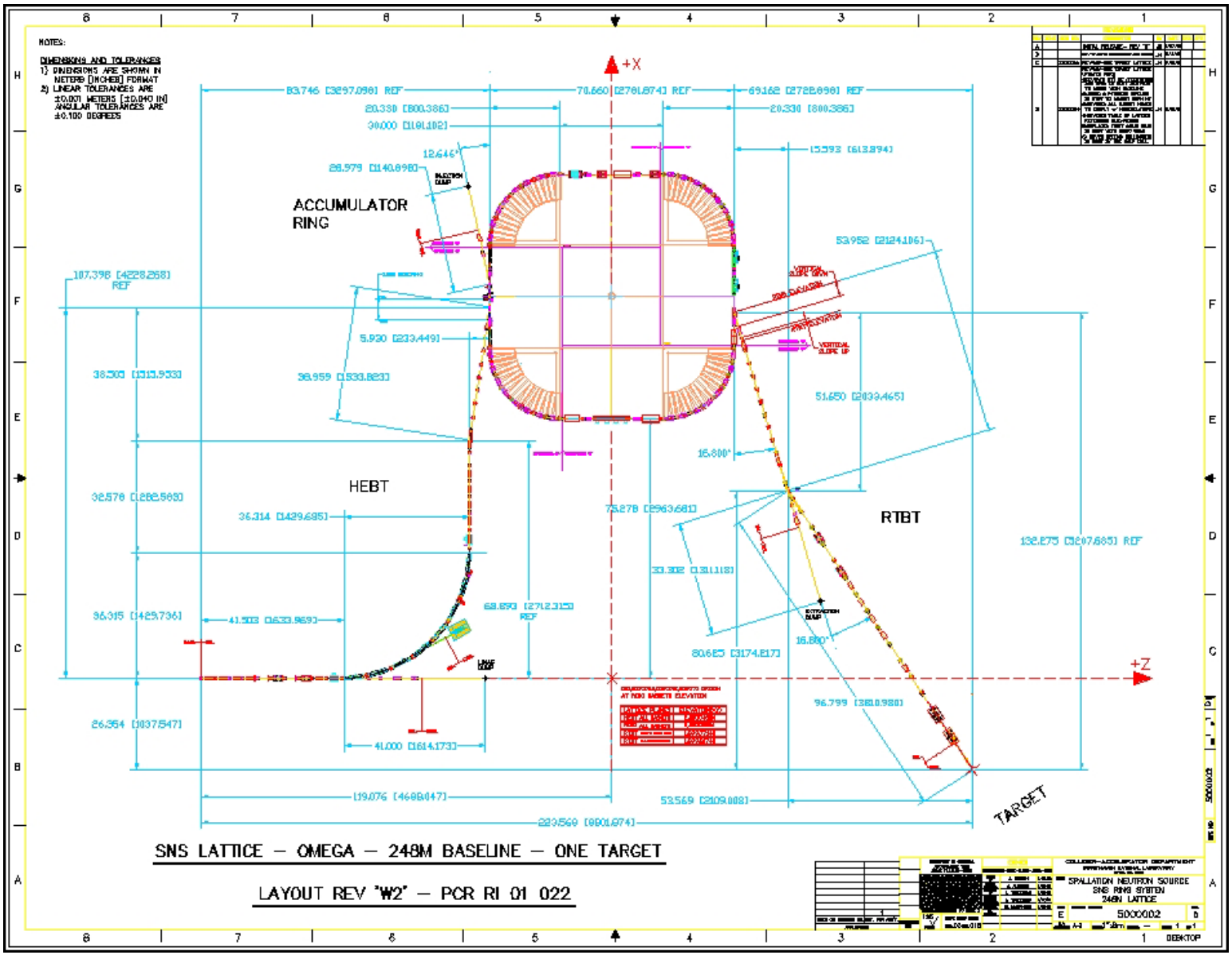
Fiscal Year	2000	2001	2002	2003P
Nuclear	83.2	83.5	84.2	96.4
High Energy	2.9	5.8	6.2	0
SNS	17.2	26.9	29.4	28.1
NASA	11.9	9.3	10.9	7.1
Other	0.9	1.4	0.8	0.1
Total ($M)	116.1	126.9	131.5	131.7
Total FTE	521	517	520	512
Cryo Weeks	33	22	17	29
Beam weeks	26	17	16	24

Staffing Projection FY03->FY04

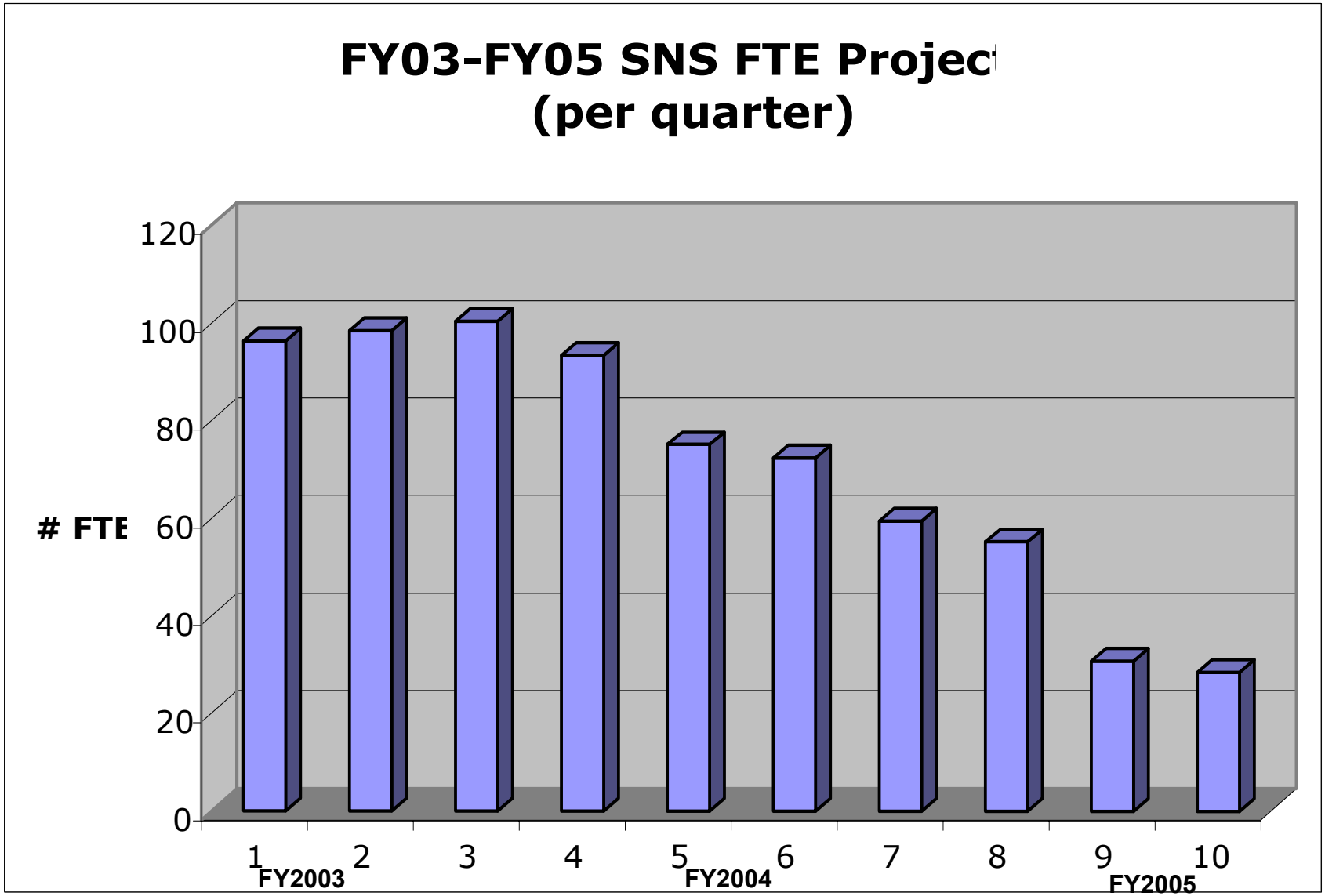
- FY03 funding creates an over-staffing problem of 10-15 FTE. Therefore the call for volunteers. 5 volunteers to date.
- RHIC manpower growth balances the loss of AGS fixed target manpower.
- There are several new possible starts in FY04
  - EBIS, CIRC,RSVP, NSF AGS fixed target
- BAF construction is ending and BAF operations support will begin in June. This results in a net loss of personnel.
- SNS construction is beginning to turn down. This will reduce our effort in FY03 for selected job categories and then substantial decreases in FY04.

Spallation Neutron Source

- 60 Hz repetition rate, 1.5×10^{14} per pulse, 1.4 MW proton facility
- In its 5th year of a 7-year construction cycle
- H^- Source, RFQ, DTL, CCL, SRF linac, Accumulator, Hg-target

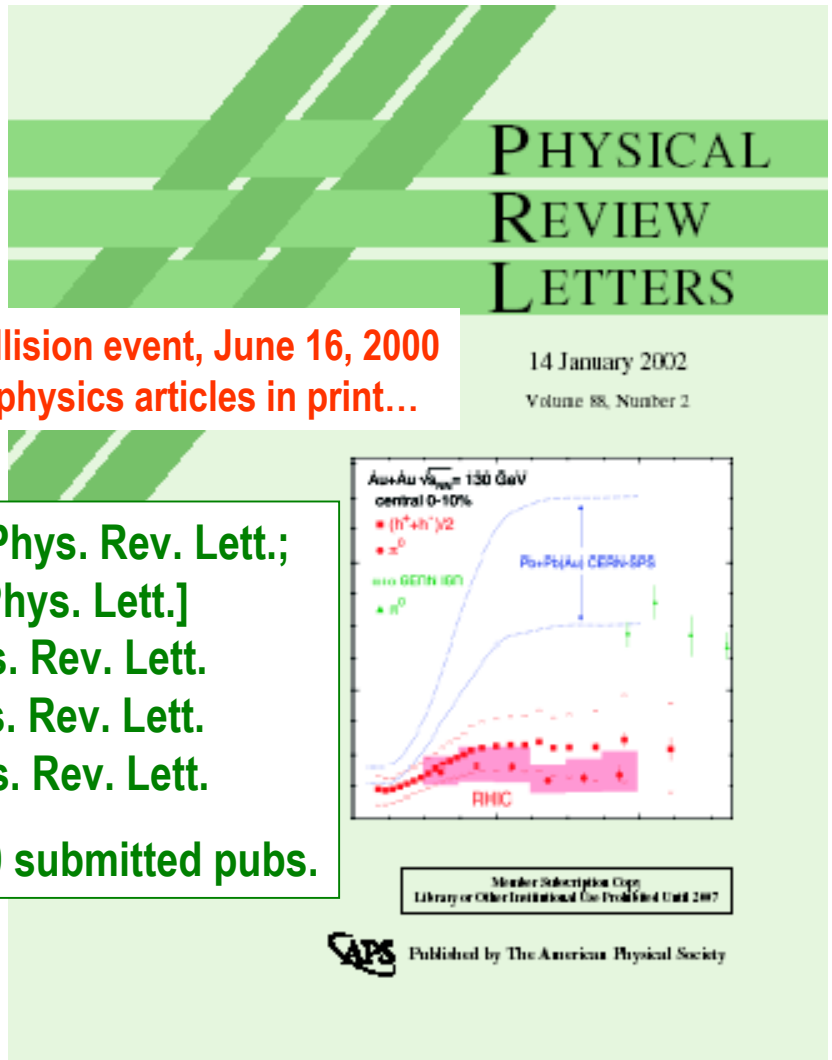

NOTES:
DIMENSIONS AND TOLERANCES
1) DIMENSIONS ARE SHOWN IN METERS [INCHES] FORMAT
2) LINEAR TOLERANCES ARE ±0.001 METERS [±0.040 IN] ANGULAR TOLERANCES ARE ±0.100 DEGREES
+X
+Z
ACCUMULATOR RING
HEBT
RTBT
TARGET
83.746 [3297.0961 REF
70.660 [2781.874] REF
69.162 [2722.8661 REF
20.330 [800.386]
30.000 [1181.102]
20.330 [800.386]
12.646
28.979 [1140.8981
15.393 [613.894]
107.398 [4228.268] REF
53.952 [2124.106]
5.930 [233.449]
38.300 [1515.933]
38.959 [1533.823]
51.650 [2033.465]
16.880
32.578 [1282.5681
36.314 [1429.685]
75.278 [2963.681]
132.275 [5207.685] REF
33.302 [1311.118]
96.315 [3429.736]
41.503 [1633.969]
68.893 [2712.315] REF
16.880
80.685 [3174.817]
96.799 [3810.980]
26.364 [1037.547]
41.000 [1614.173]
19.076 [469.8047]
52.569 [2109.008]
223.569 [8801.874]
SNS LATTICE – OMEGA – 248M BASELINE – ONE TARGET
LAYOUT REV 'W2' – PCR RI 01 022
SPALLATION NEUTRON SOURCE
SNS RING SYSTEM
248N LATTICE
5000002
DESKTOP

First Half-Cell before Shipment to ORNL (Nov. 2002)


FY03-FY05 SNS FTE Projec
(per quarter)
FTE
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
FY2003
FY2004
FY2005

PHYSICS PRODUCTIVITY

RHIC Scientific Productivity Continues at a Rapid Pace



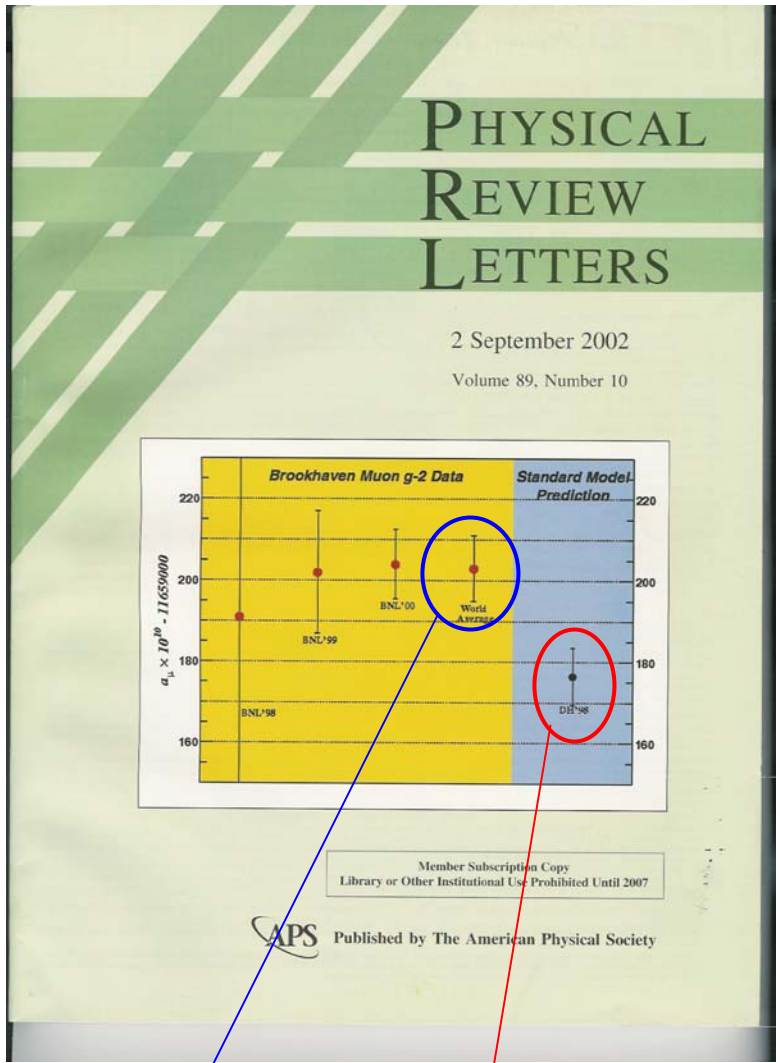
Since the first collision event, June 16, 2000
24 Letter-Journal physics articles in print…

BRAHMS: 3 [2 Phys. Rev. Lett.;
1 Phys. Lett.]
PHOBOS: 5 Phys. Rev. Lett.
PHENIX: 8 Phys. Rev. Lett.
STAR: 8 Phys. Rev. Lett.

Plus 6 PRs and 10 submitted pubs.

- Important HI physics results
  - HBT pion interferometry
  - jet quenching
  - strong elliptic flow signals
  - first J/ψ events
- RHIC dominant at QM 2002
  - 6 plenary session talks
  - 36 parallel session talks
  - featured in Summary Talk
- Spin Physics starts in FY02
  - polarized beams in RHIC
  - RHIC polarimetery works
  - first physics data taken

Muon (g-2) E821 – Important New Result



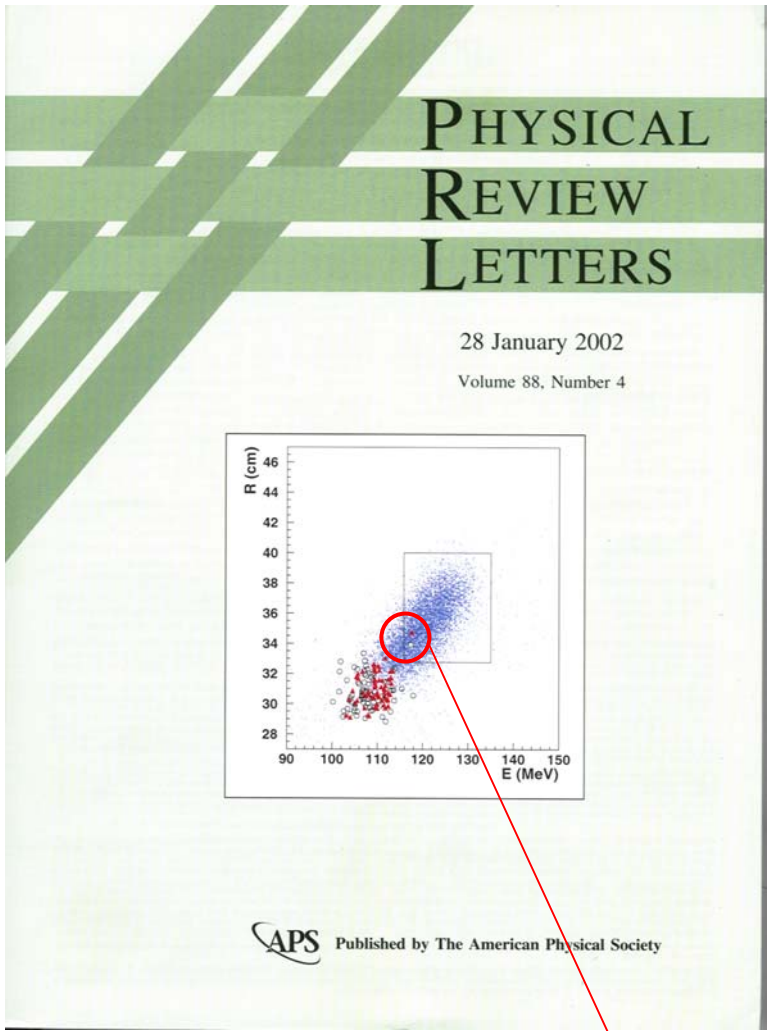
- New (g-2) result published in PRL
  - error bars smaller by x2
  - disagrees with theory by 2.6σ
  - theory itself has uncertainties*
  - more analyzed data soon
- If theory result is sustained
  - (g-2) indicates non-SM physics
  - SUSY models are compatible
  - more data would be important
- This result is important to HEP
  - cover article for PRL, Sept. 2002
  - featured by Summary speaker at 2002 Intl. HEP Conf., Amsterdam
  - news articles in Science, NYT etc.

Experiment

Theory

* e^+e^- analysis disagrees with τ-decay analysis
both results cannot be right (but both could be wrong!)

Rare Kaon Decay E787 – Important Result

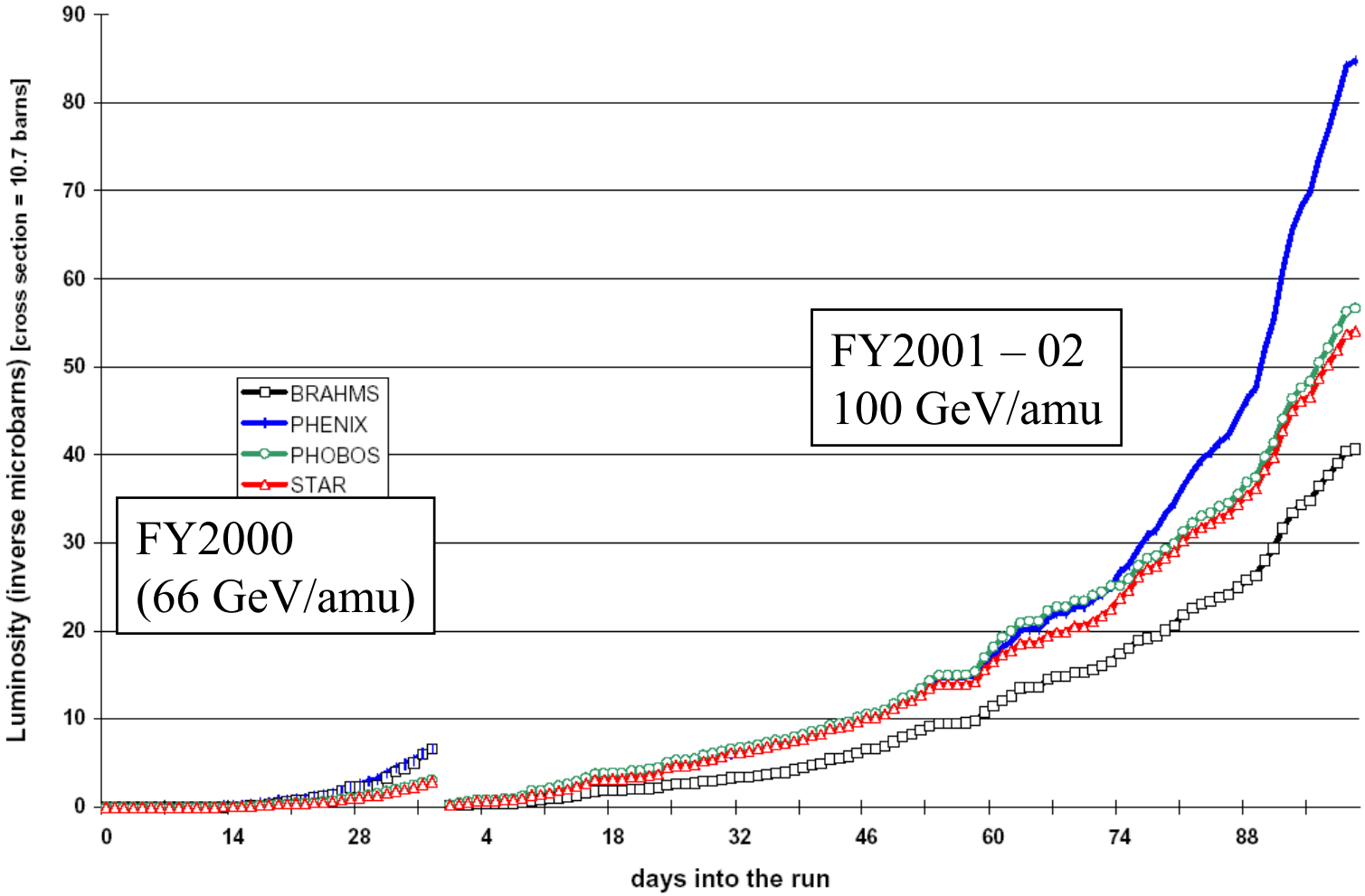


- 2nd Event published in PRL
  - confirms this key rare decay
  - current decay rate above SM
  - completes analysis of E787 data
- Future progress requires E949
  - E949 ran successfully in FY02
  - the experiment needs much more data, about a factor of 8
  - FY03 running for E949 was terminated by a DOE decision
- This result is important to HEP
  - cover article for PRL
  - featured result in several HEP conferences, worldwide

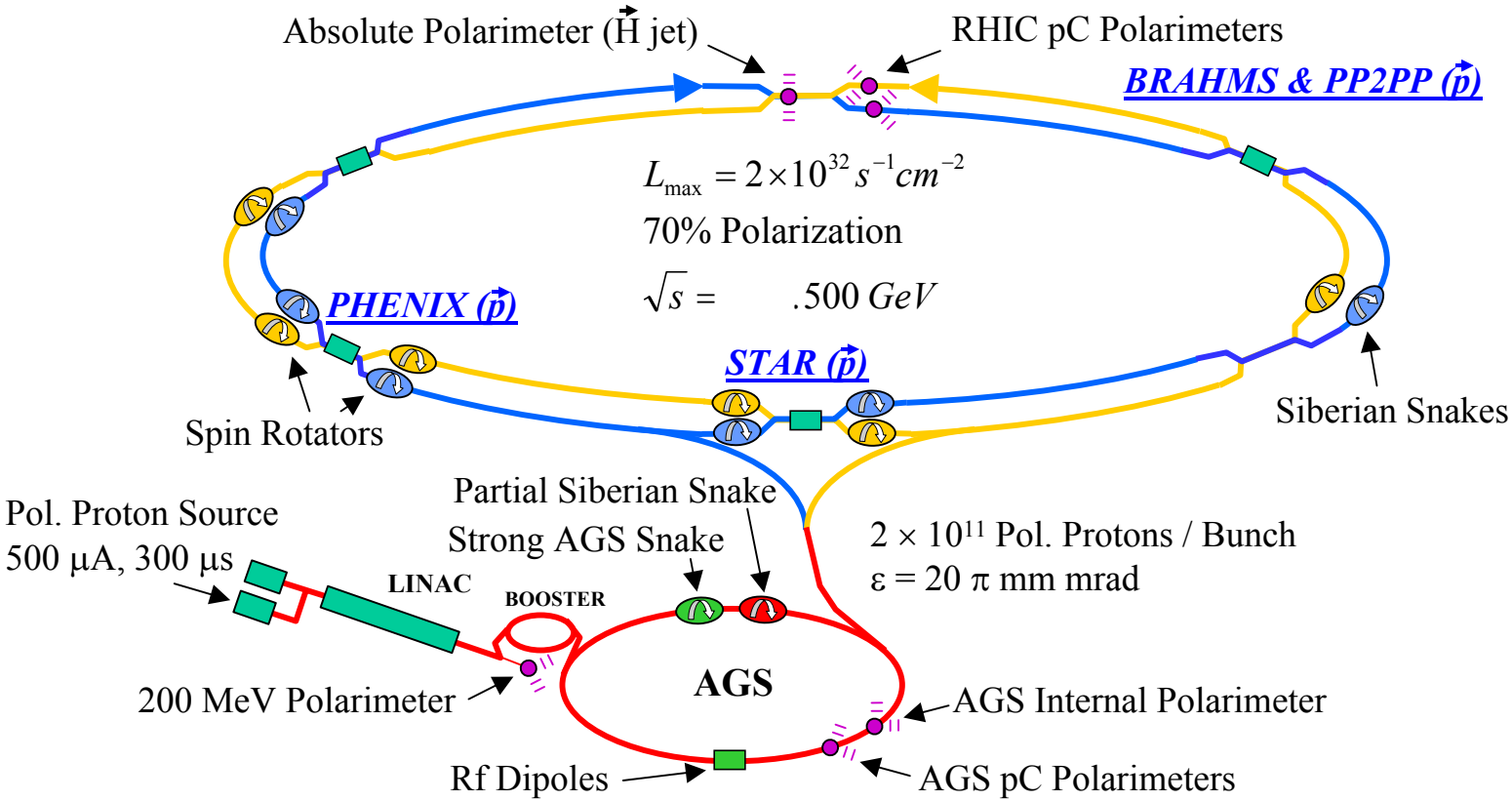
The two (red & white) events in the box are data; the blue dots are monte-carlo generated signal

RHIC Performance Rapidly Improving

Integrated Au-Au luminosity



A First
Polarized Proton Collisions in RHIC

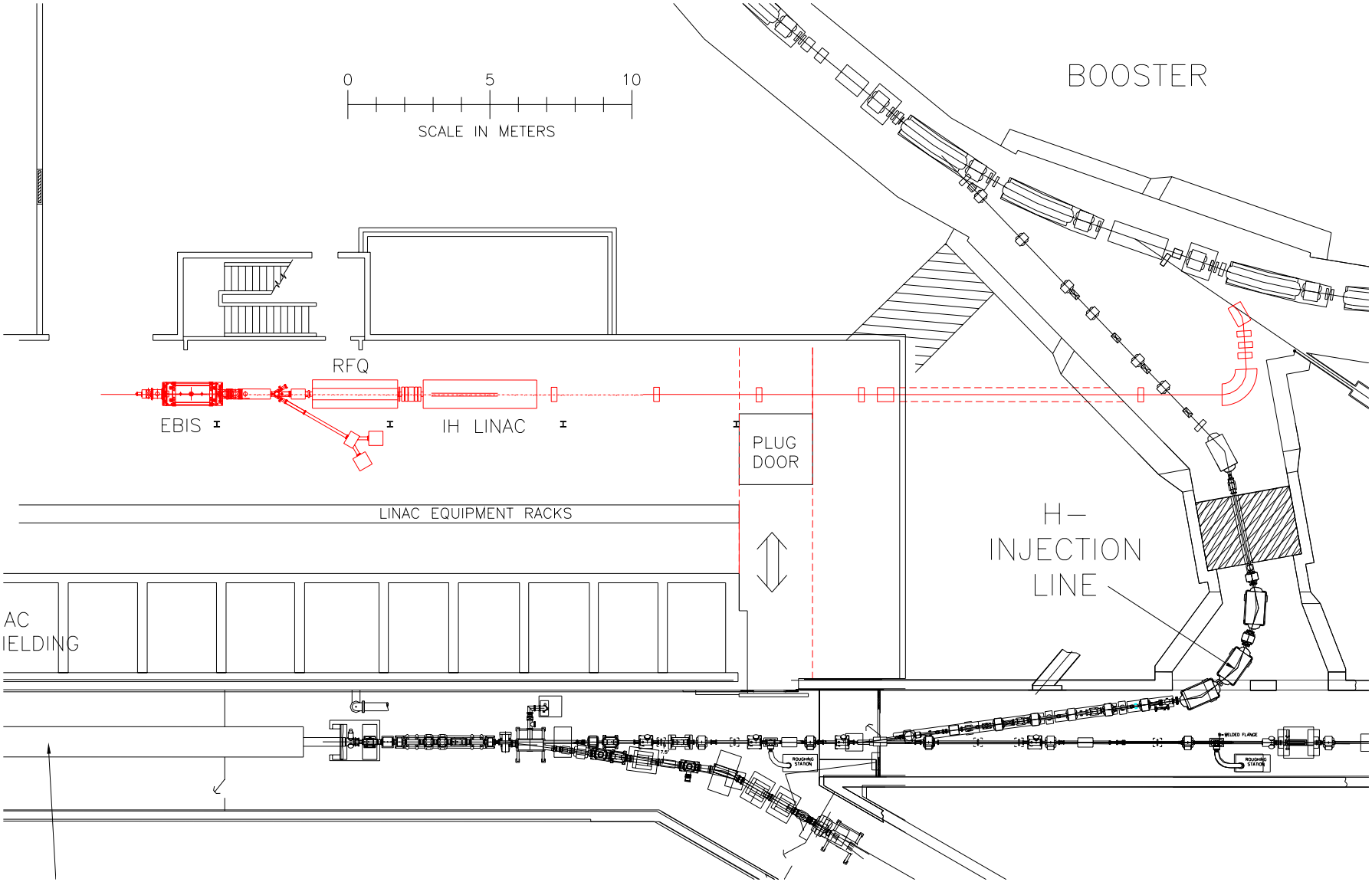


Future Possibilities

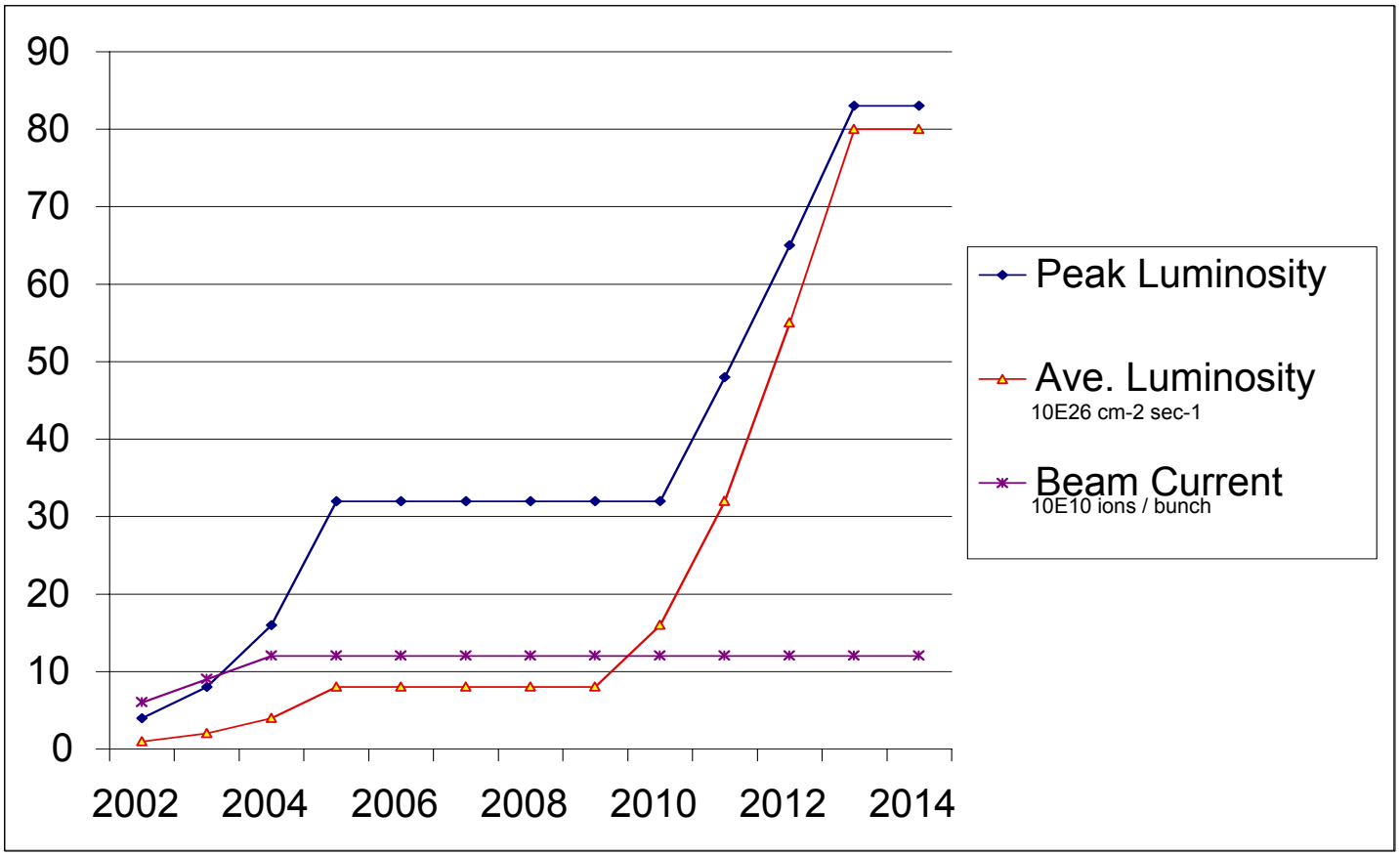
RHIC (eRHIC) (~$500M for accelerators)

- EBIS preinjector ($15-20M) FY04?
  - replace Tandems
  - improve capability, all species to uranium, polarized He^3
- RHIC luminosity upgrade
  - increase bunches (x2), ongoing
  - decrease β* (x2), ongoing
  - electron cooling (x10)($~70M) FY06-07?
    R&D is underway.
- Electron-Ion Collider (~$400M) FY09-10?
  - search for color glass condensate state of matter

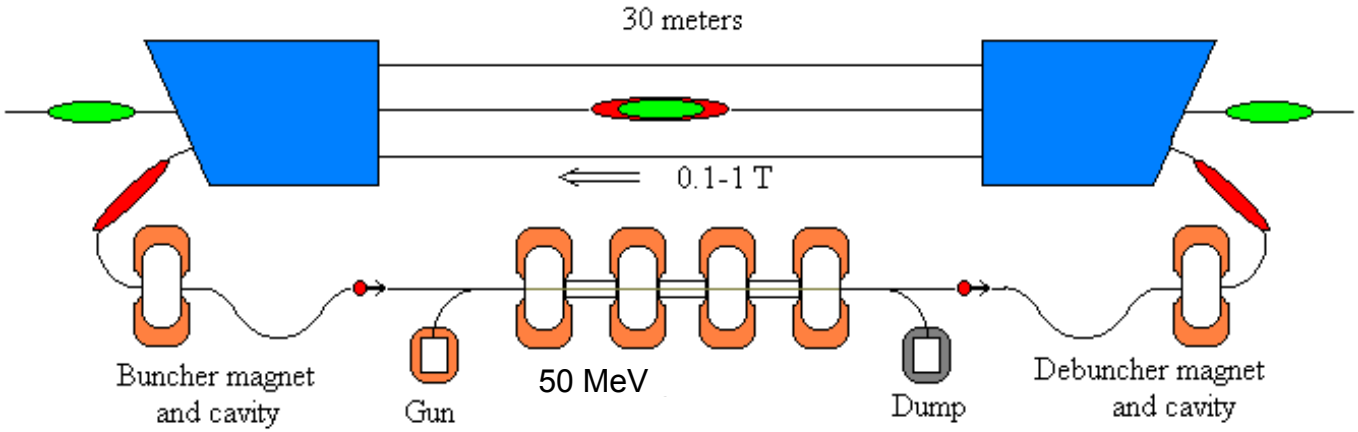
***Dates are possible construction start**


0
5
10
SCALE IN METERS
BOOSTER
RFQ
EBIS
IH LINAC
PLUG
DOOR
LINAC EQUIPMENT RACKS
H−
INJECTION
LINE
AC
IELDING
ROUGHING
STATION
WELDED FLANGE
ROUGHING
STATION

RHIC Luminosity upgrade goals



The RHIC Electron Beam Cooler



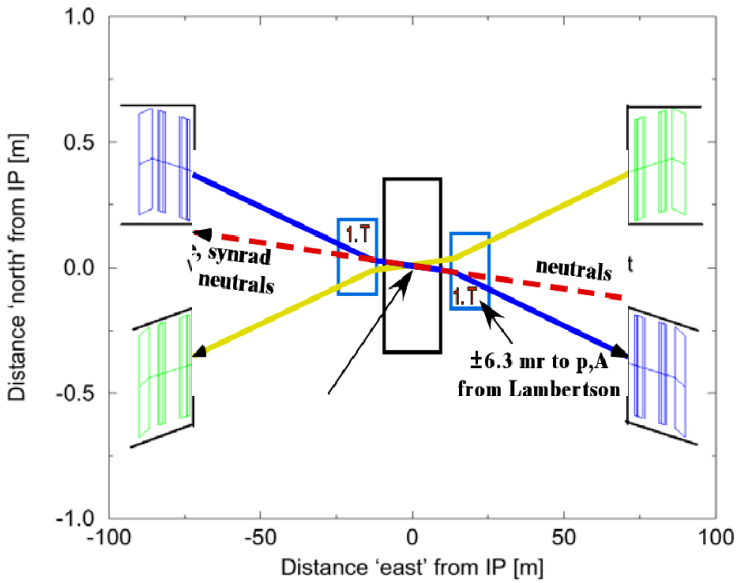
R&D issues:

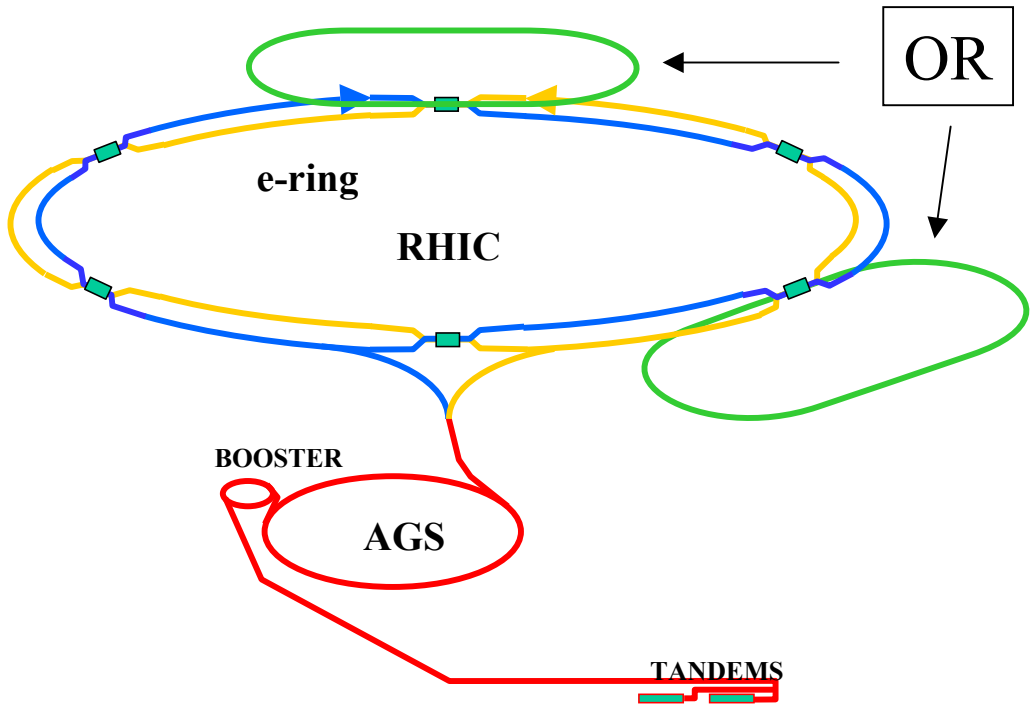
- Demonstrate high-brightness, high-current CW photocathode electron gun
- Demonstrate high precision (10 ppm) solenoid for 30 m cooling section.

- Full simulation (space charge, non-linearities, wake fields, beam stability) of transport of magnetized electron beam from cathode to dump
- Develop and benchmark cooling simulation codes

Ring – ring option

- Collisions only at one interaction region
- e-ring outside of RHIC tunnel (Collaboration with MIT Bates and BINP)
- e-ring built to support polarization build-up





eRHIC: Electron Ion Collider @ RHIC

- Collider geometry capable of e-A and polarized e-p collisions
- $s^{1/2}$ for e-A : 63 GeV/u
- $s^{1/2}$ for e-p: 100 GeV

  $(\text{Beam Energy})_{\text{Max}}$: (E_e)10 GeV, (E_p) 250 GeV, (E_A) 100GeV/u
- Range of Ion Species: p to U
- Polarization: 70% × 70%

- Luminosity: ~ 10^{33} $cm^{-2}s^{-1}$ per nucleon
- Need electron cooling of RHIC beam
- Need 10 GeV, ~ 500 mA electron beam

Future Possibilities

AGS

- Rare Symmetry Violating Processes (RSVP) ($129M) FY04?
  - -KOPIO
  - -MECO
- NSF support of rare K^+ decay experiment (E949) FY03?
- Very Long Baseline Neutrino Oscillations(~$250M) FY10?

***Dates are possible construction start**

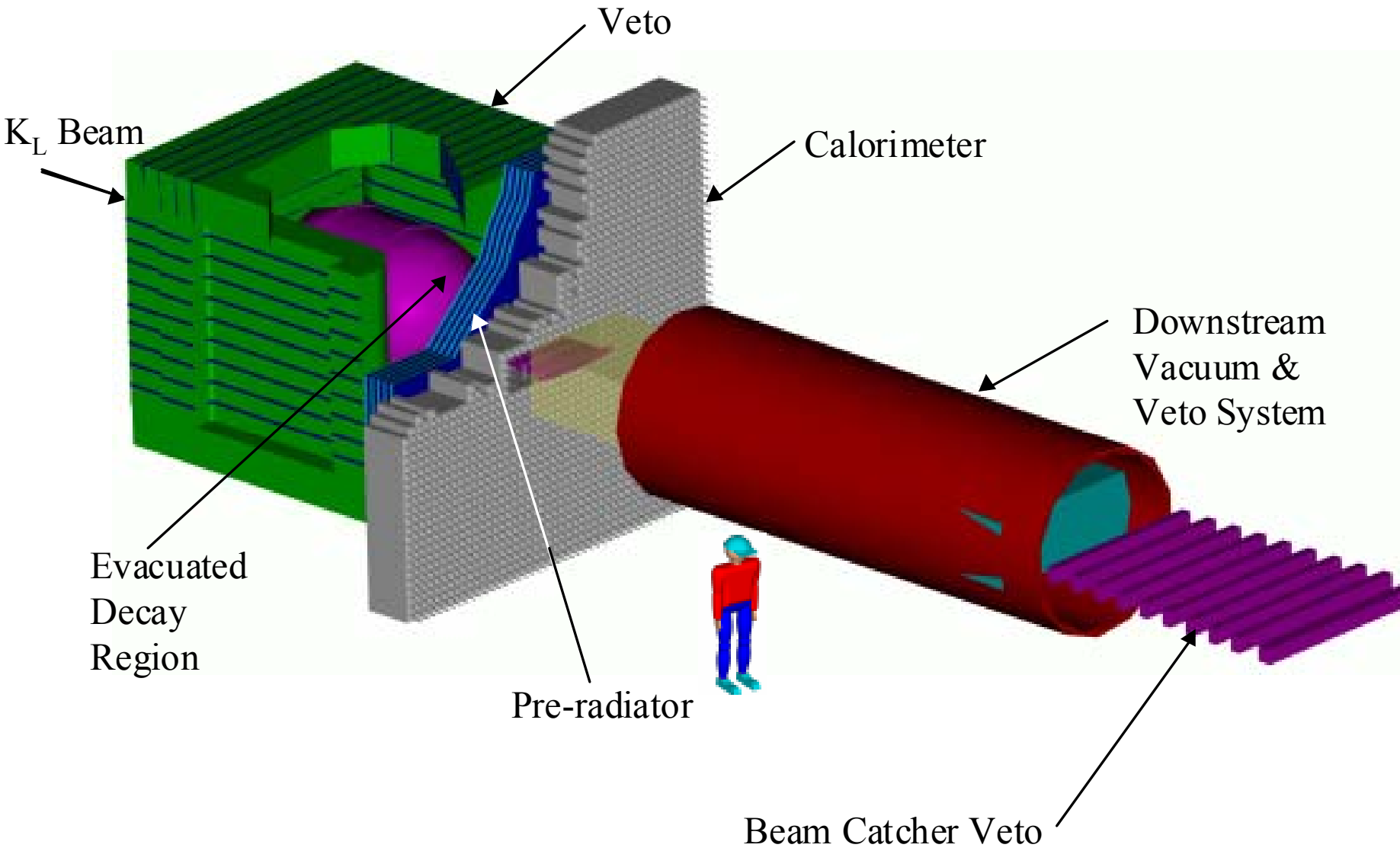
NSF Initiative – RSVP

- **Scientific Motivation and Benefits**
  - AGS experiments, ***KOPIO and MECO***, explore important rare processes
  - KOPIO will **measure the CP-violation parameter** η in the kaon system in the very rare $K^0 \rightarrow \pi^0 \nu$ νbar decay
  - MECO will seek **evidence of non-SM physics** through lepton-violation via the process $\mu^- \rightarrow e^-$ directly in the field of a nucleus (forbidden in the SM)
  - both experiments will make unique new contributions to particle physics, MECO for non-SM physics; KOPIO for CP-violation in the quark sector

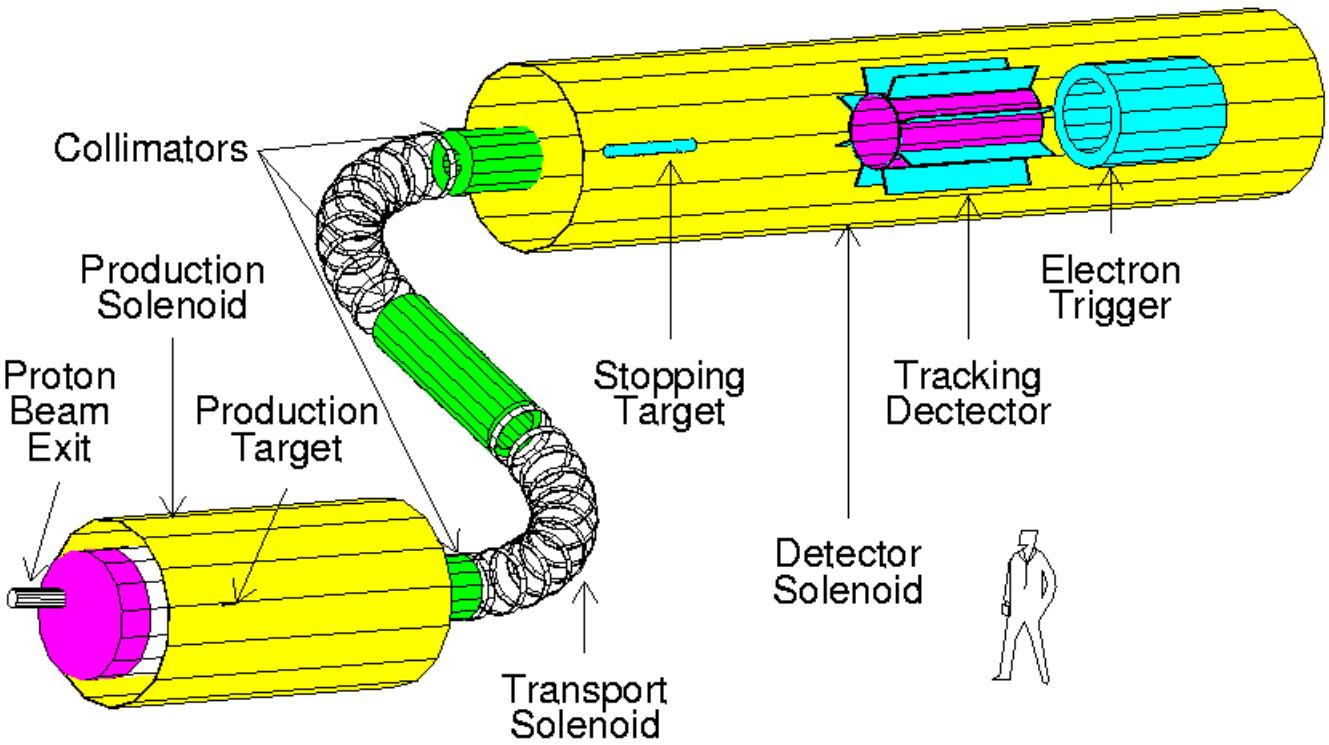
- **Scope & Timing**
  - RSVP is an NSF MRE-FC construction project, expected to start in FY04
  - all approvals thorough the NSF Science Board complete; needs budget
  - international contributions to KOPIO are threatened by the slow start

- **Cost**
  - R&D funding at ~$1.2M/year through FY02; FY03 may double the R&D
  - $129M Construction Project with overhead, contingency and escalation plus three years of AGS operations included in the base project

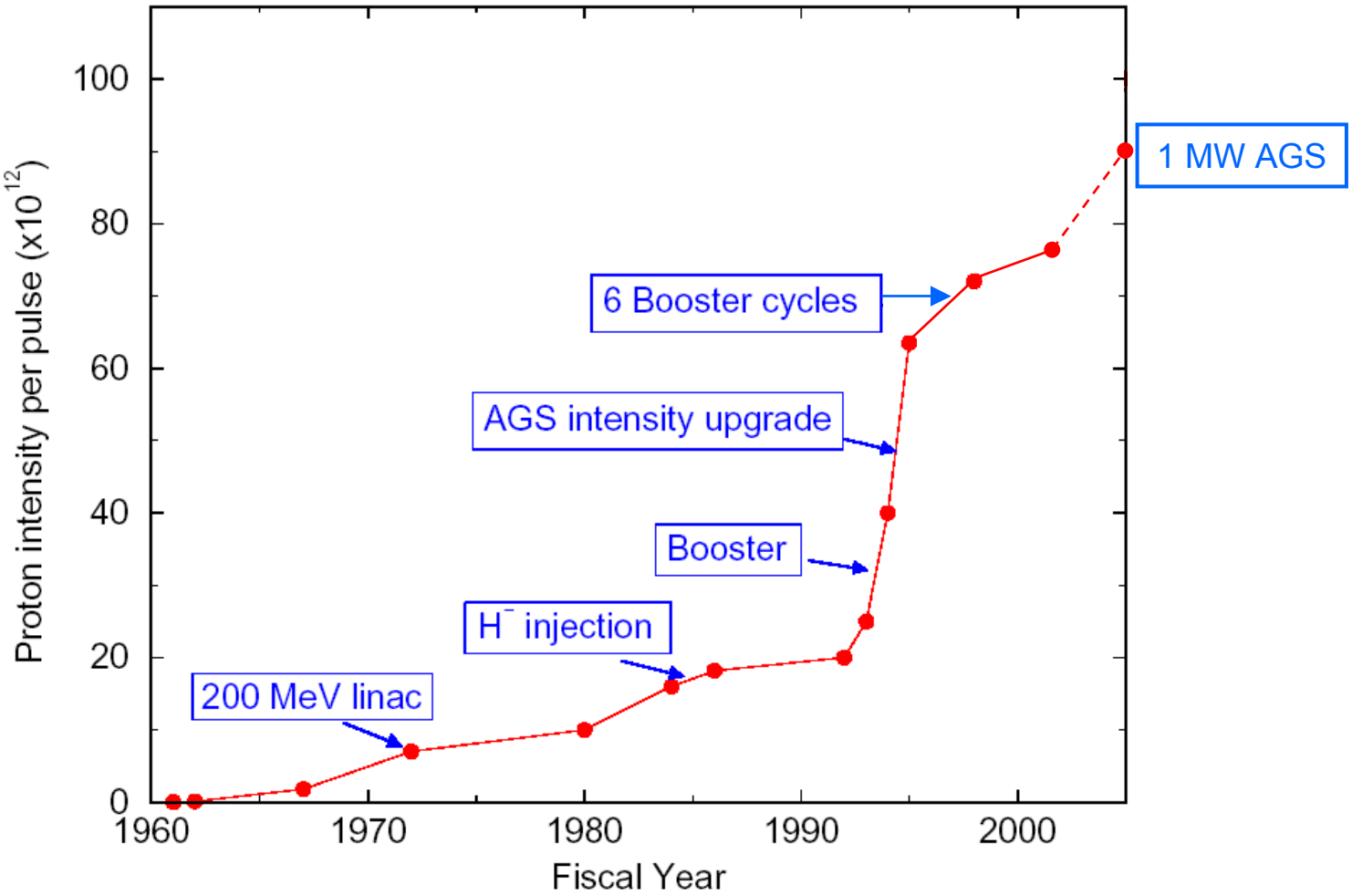
KOPIO


Veto
K_L Beam
Calorimeter
Downstream
Vacuum &
Veto System
Evacuated
Decay
Region
Pre-radiator
Beam Catcher Veto

MECO Detector

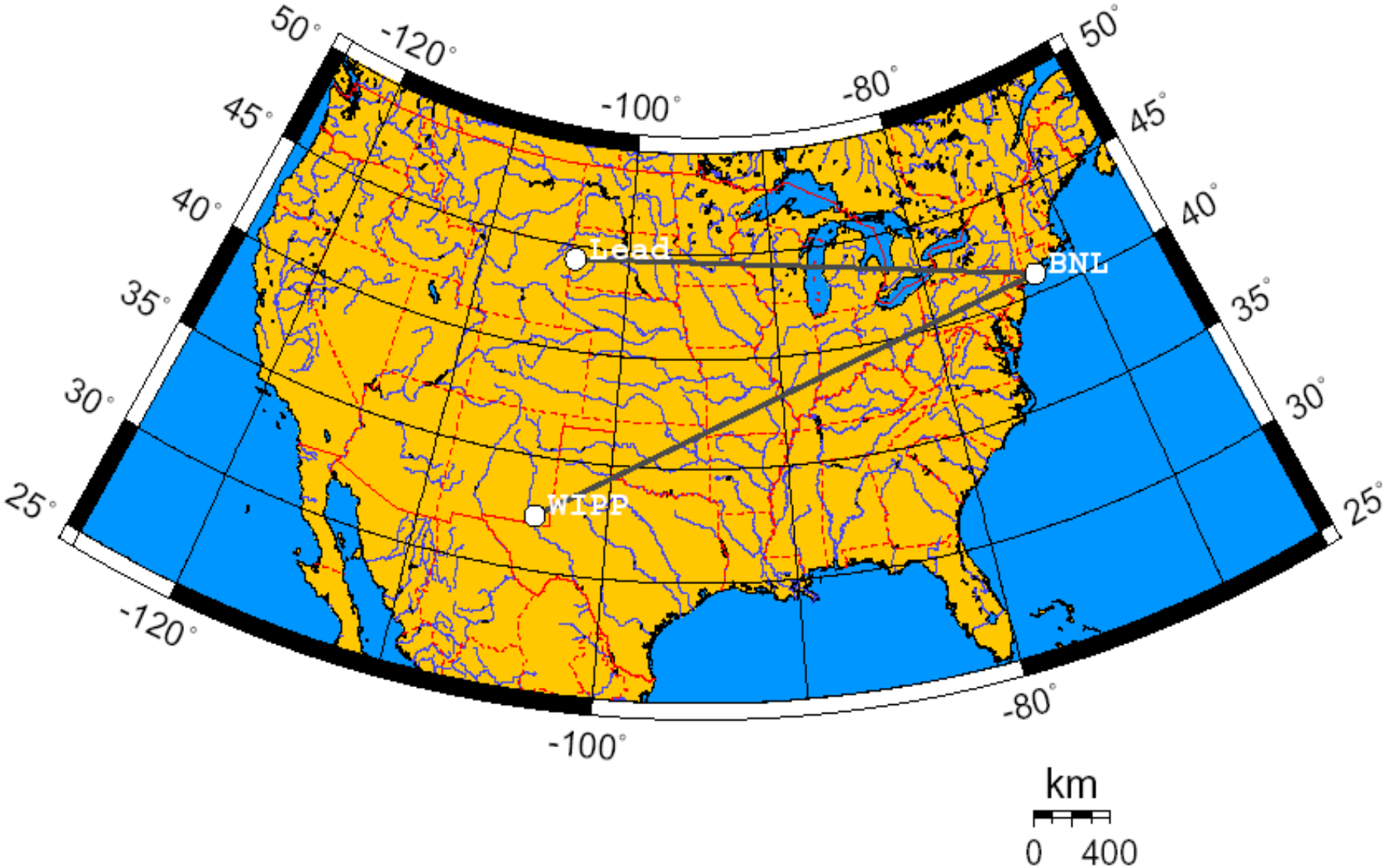


AGS Intensity History

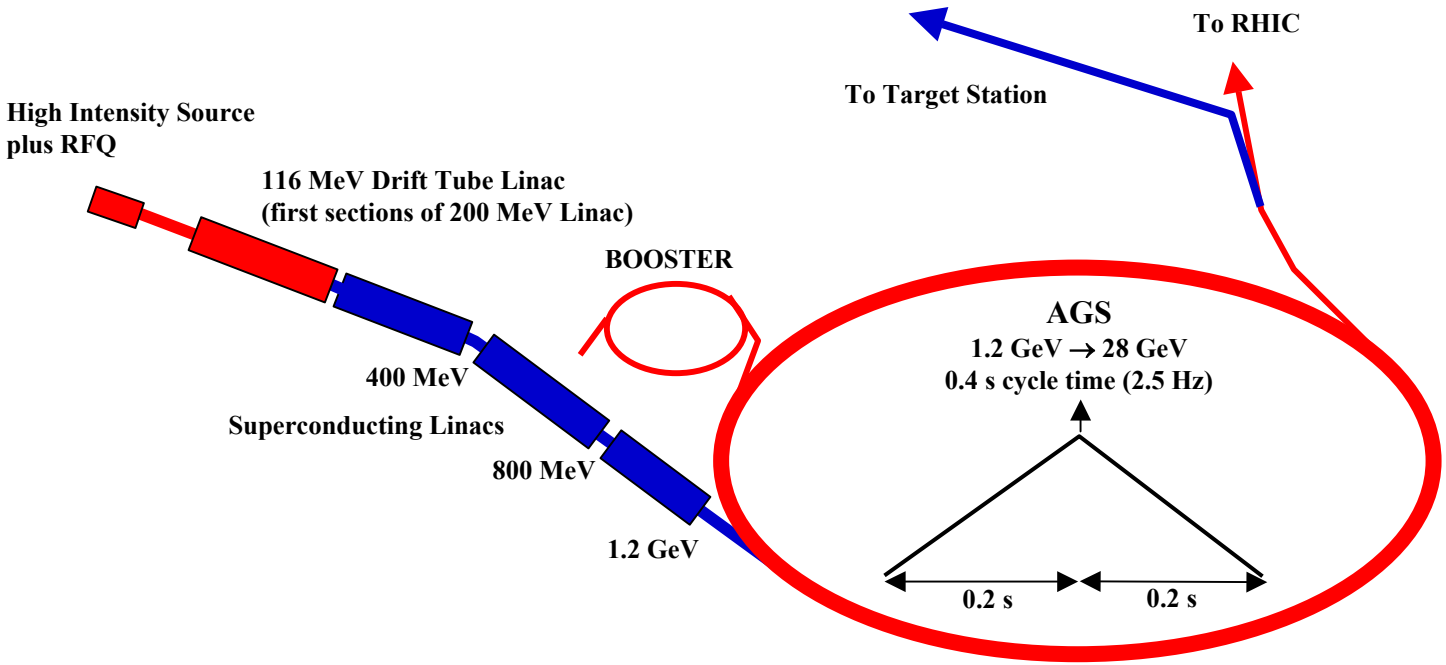


World record proton synchrotron intensity!

Possible Beamlines from BNL

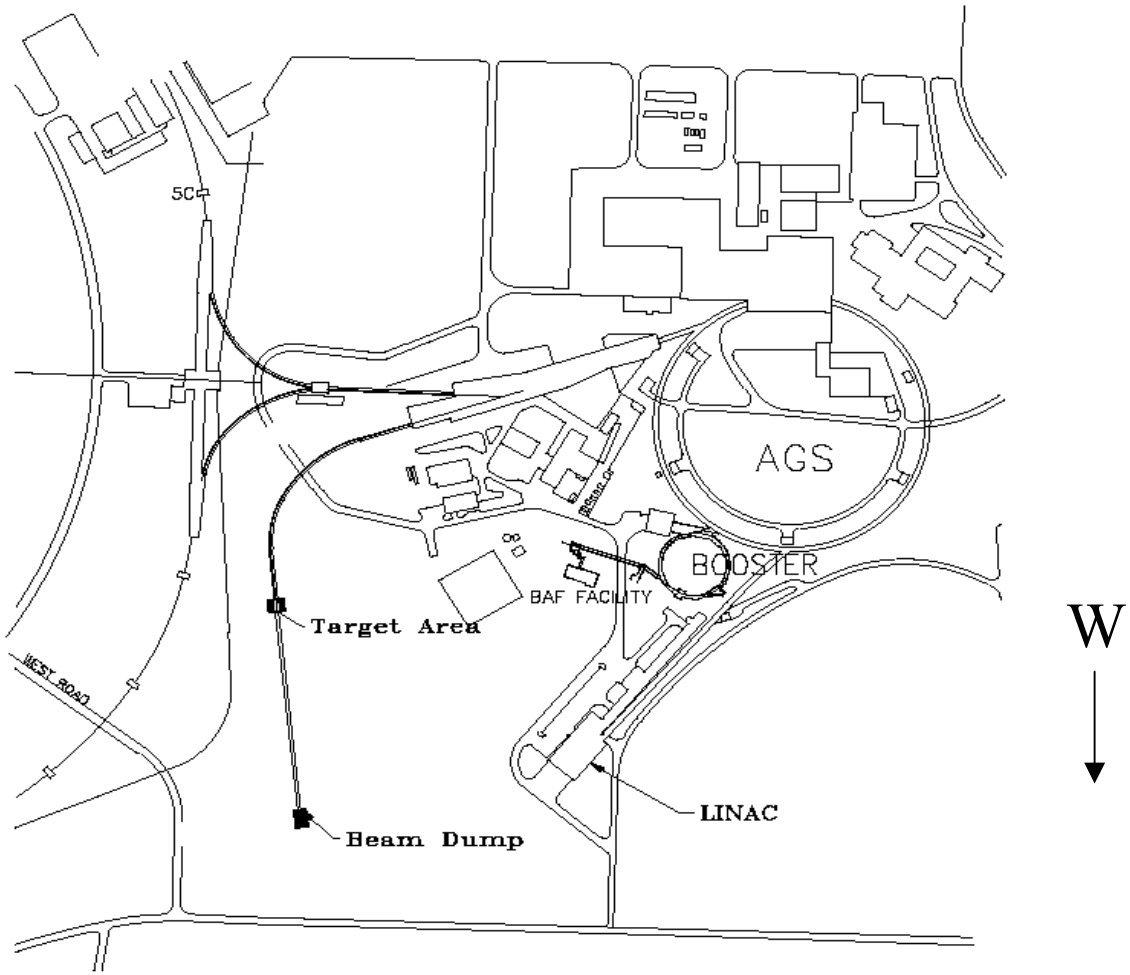


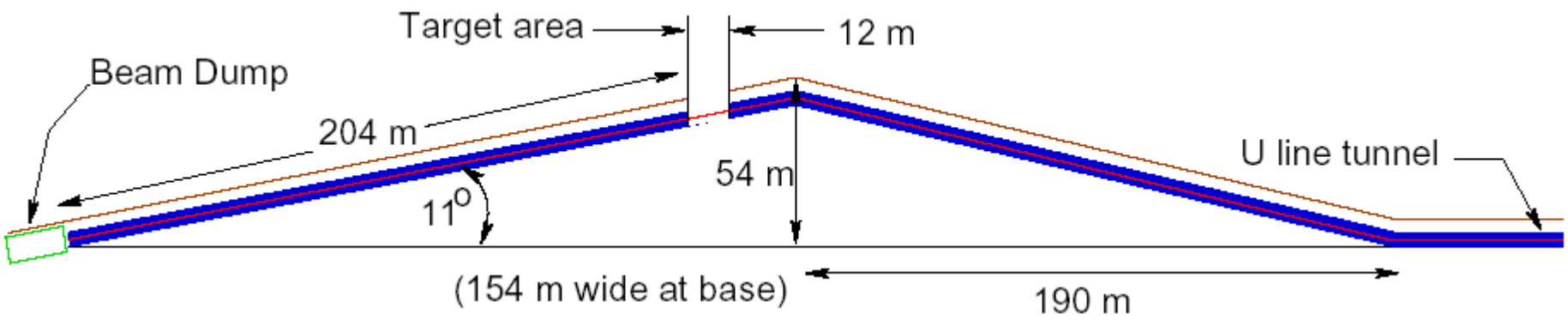
AGS Proton Driver Layout



Ref. T. Roser, July 2002

Beamline to Homestake Mine

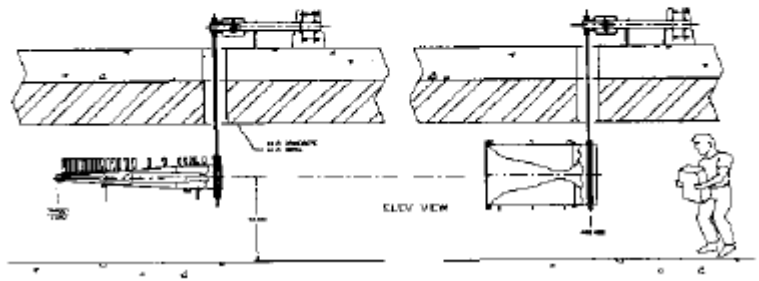




- Two horn design

- Target on down-hill slope for long baseline experiment

- No underground construction to avoid ground water

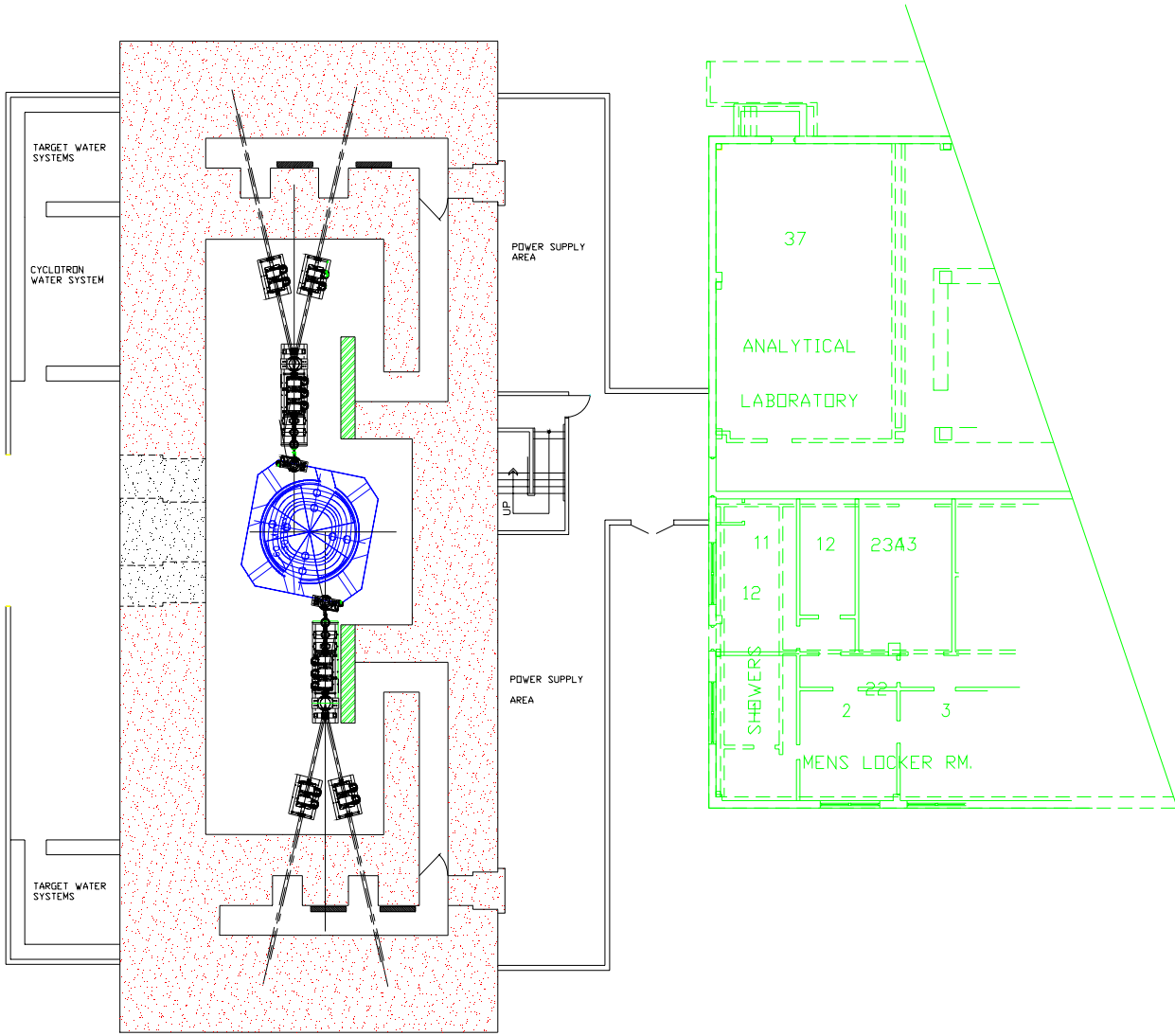


Future Possibilities

OTHER

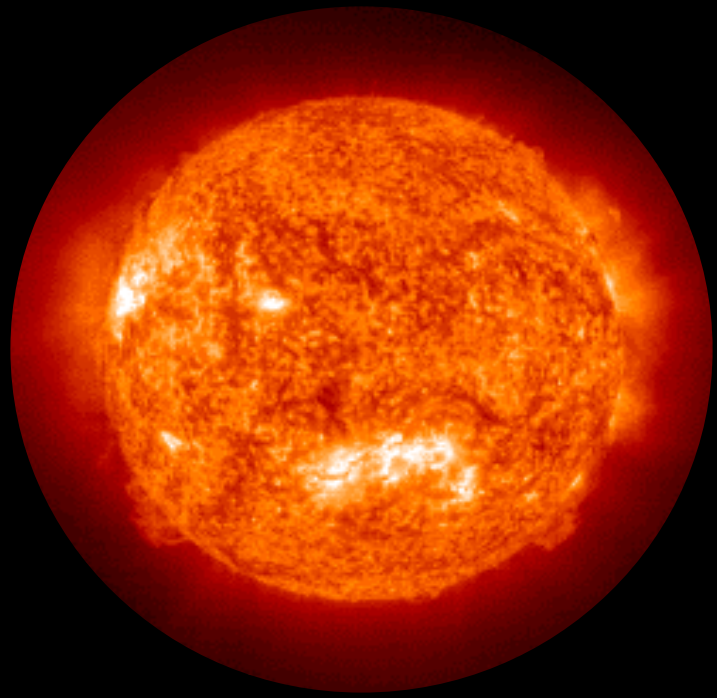
- Cyclotron Isotope Research Center (CIRC) (FY04?)
    - cyclotron replaces BLIP
- Rapidly Cycling Medical Synchrotron (FY04?)

***Dates are possible construction start**


TARGET WATER SYSTEMS
CYCLOTRON WATER SYSTEM
POWER SUPPLY AREA
UP
POWER SUPPLY AREA
TARGET WATER SYSTEMS
37
ANALYTICAL LABORATORY
11
12
12
23A3
SHOWERS
22
2
3
MENS LOCKER RM.

BOOSTER APPLICATIONS FACILITY

THE SPACE RADIATION ENVIRONMENT



AN INHOSPITABLE ENVIRONMENT

WHY RADIATION BIOLOGY RESEARCH AT BNL? AS EXPLAINED BY A PHYSICIST!

- Going into space is not what is portrayed in Star Trek

- What are the space radiation risks for exploration missions?
  - GCR (galactic cosmic rays)
    - Cancer, latent effects such as cataracts, hereditary effects and neurological disorders
    - 3 year mission to deep space, every cell will be struck by at least one GCR particle
  - SPE (solar particle events, protons)
    - Potentially life threatening

- How do you mitigate the space radiation risks?
  - Sensing of solar events: When should you seek shelter?
  - Shielding: What shelter is effective?
  - Chemical and biological countermeasures: What can you ingest etc. to counteract any radiation damage?

RADIATION DOSES ON EARTH AND IN SPACE

1 year in Upton	100 mrem
1 year in Denver	200 mrem
1 year in Kerala, India	1,300 mrem
Apollo 14	1,140 mrem (9-day to the Moon)
Skylab 4	17,800 mrem ((87-day in orbit)
Shuttle mission 41-C	5,600 mrem (18-day in orbit)
Mission to Mars	130,000 mrem
at solar minimum	30,000 mrem in 1.5 y on Mars
	80,000 mrem in 1 y in space,
	+20,000 mrem from a solar flare
Chest X-ray	50 mrem
PET scan	1,000 mrem
Treatment of brain cancer	5,000,000 mrem (to normal brain)

NASA RADIOBIOLOGY PROGRAM AT BNL

A CENTER FOR RADIOBIOLOGY RESEARCH

- ALTERNATING GRADIENT SYNCHROTRON
  - Research program begun 1995
  - 9 experimental runs to date
- TANDEM VAN DE GRAAFF
  - Applications program begun in 1988
- NATIONAL SPACE BIOMEDICAL RESEARCH INSTITUTE
  - Consortium member (1999)
- BOOSTER APPLICATIONS FACILITY
  - Construction begun 1999
  - First beam extracted October 2002
  - Project complete June 2003
  - **Operations begins July 2003**

BOOSTER APPLICATIONS FACILITY IS A JOINT EFFORT OF THE:

- **COLLIDER-ACCELERATOR DEPARTMENT**
  - ACCELERATED ION BEAMS
- **BIOLOGY DEPARTMENT**
  - LIFE SCIENCE LIAISON
  - EXPERIMENTAL AREA SUPPORT
- **MEDICAL DEPARTMENT**
  - ANIMAL CARE FACILITY
  - CELL LABORATORIES


photo RIPP BOWMAN 1-22-02
FILE # BAF-PAN01-22-02WEB2


BAF
EXPERIMENTAL
SUPPORT
FACILITY
958
RIPP BOWMAN PHOTO 8-27-02
FILE # 958-8-27-02

- We have a lot of accomplishments to be proud of this past year
- Some projects are nearing completion
- R&D efforts are expanding
- Several possible new projects are on the horizon
- C-A and Magnet Division staff, and our colleagues from PE etc. continue to make this **THE WORLD CLASS** accelerator facility