

Plans* for other programs

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* *or dreams!*

Other Accelerator Programs

- Tandems

- Primary mission: HI (d to Au) injector to Booster for RHIC
- NSRL (NASA Radiobiology) injector, p and HI
 - Issues:
 - Runs concurrent with and outside RHIC operations
 - RHIC HI injection has priority, NSRL off during RHIC HI injection
 - » EBIS solves this problem
 - NSRL can run only protons or RHIC ions if RHIC needs both Tandems
 - » EBIS solves this problem
- Industrial users – electronics upsets, ion implantation etc.
 - Issues:
 - RHIC HI injection and NSRL have priority
 - Will be replaced with EBIS in about 2009
 - Will be decommissioned (~2010) if users can't support operations

Other Accelerator Programs (cont')

- **LINAC**

- Primary mission: Polarized proton injector to Booster for RHIC
- BLIP
 - Medical Isotopes
 - Radiation damage studies
 - Issue: High costs if operated outside RHIC pp operations
 - If CIRC (Cyclotron Isotope Research Center) is built, BLIP will cease to operate
- Protons to NSRL if Tandem not available
 - Issue: High costs to NASA if run outside RHIC pp operations

Other Accelerator Programs (cont')

Booster

- Primary mission: HI and proton injector to the AGS for RHIC
- Secondary mission: Provides p and HI beams for NSRL (NASA Radiobiology)
 - RHIC HI injection has priority, NSRL off during RHIC HI injection
 - EBIS construction partially supported with NASA funds, promises ppm (of fast mode switch) for all ions
 - Possible construction of second beam line, NSRL-II

2/24/04

NSRL

NSRL-II

SUBSTATION

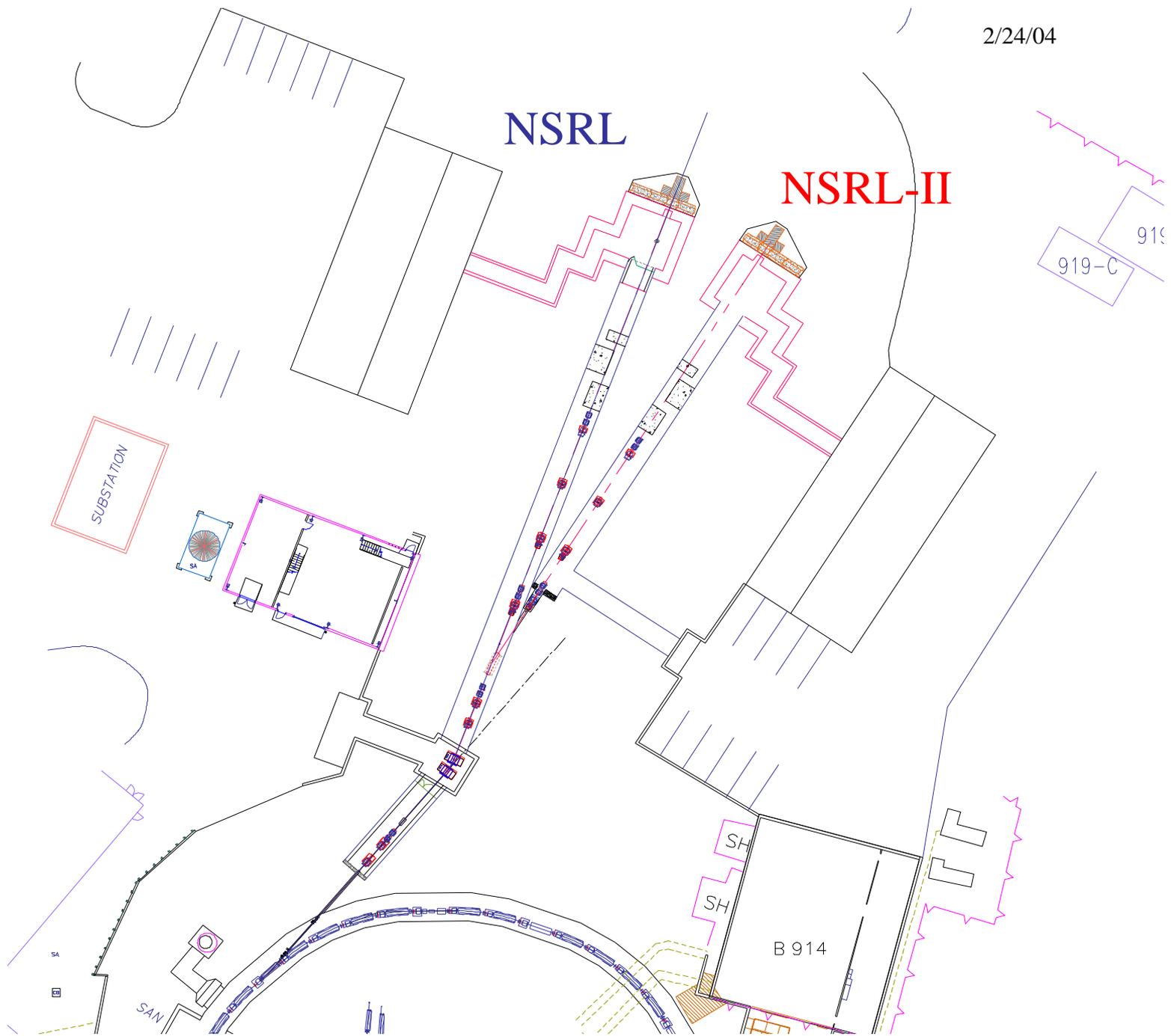
919-C

SH

SH

B 914

SAN



Other Accelerator Programs (cont')

AGS

- Primary mission: HI and polarized proton injector for RHIC
- Past utilization **outside RHIC operations** for dedicated experiments
 - 2000: g-2 experiment, NASA
 - 2001: g-2 experiment, NASA, BES, NNSA and HEP slow beam experiments
 - 2002: NP and HEP slow beam experiments, NASA, NNSA
 - 2003: NASA
 - 2004: HEP and US Atlas tests
 - 2005: NASA
 - 2006-8: none
 - 2009: possible DTRA experiment
- Utilization **concurrent with RHIC** operations for fixed target experiments
 - 2001-2002: NP and HEP slow beam experiments
 - 2003-present: none
 - Possible Future-new improved g-2 experiment, d edm experiment, NASA galactic cosmic ray facility
 - **Issues:**
 - Operations cost
 - Risk to RHIC injector chain if high proton intensity
 - Legacy radiation damage (Cost)

Nov 07 **V1 – E969, μ g-2 (DOE)**
(P5 report favorable, DOE NP interested,
awaiting action)

Happening / Possibilities

d EDM LOI (DOE)
(proposal in 2008)

V1, π μ Beam Line

DTRA
(nuclear material detection)

U Line

RHIC Transfer Line

D6 beam line components to JPARC

PHENIX RPC Factory

CIRC (NIH..DOE??)

RHIC ERL R&D

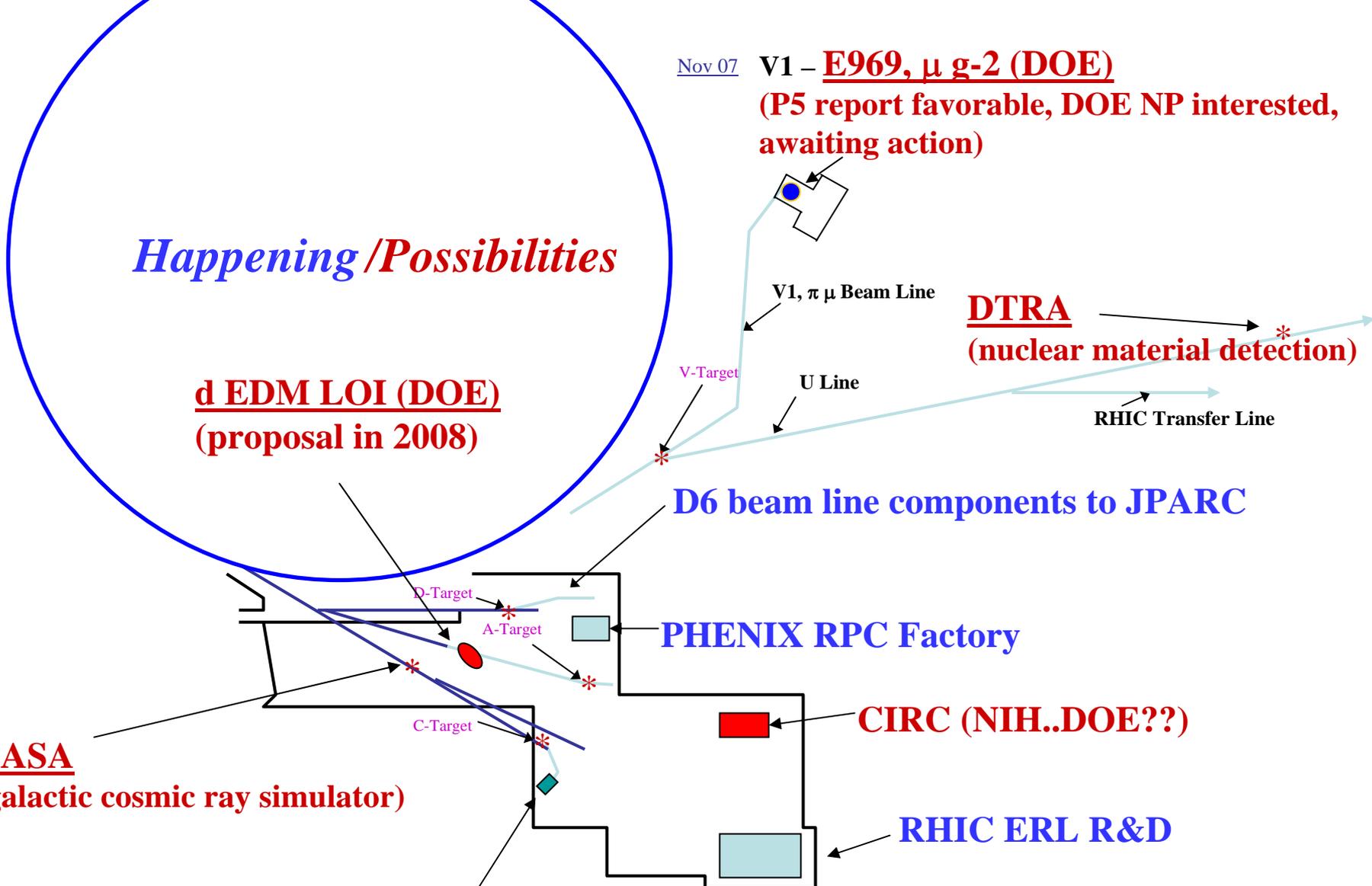
D-Target

A-Target

C-Target

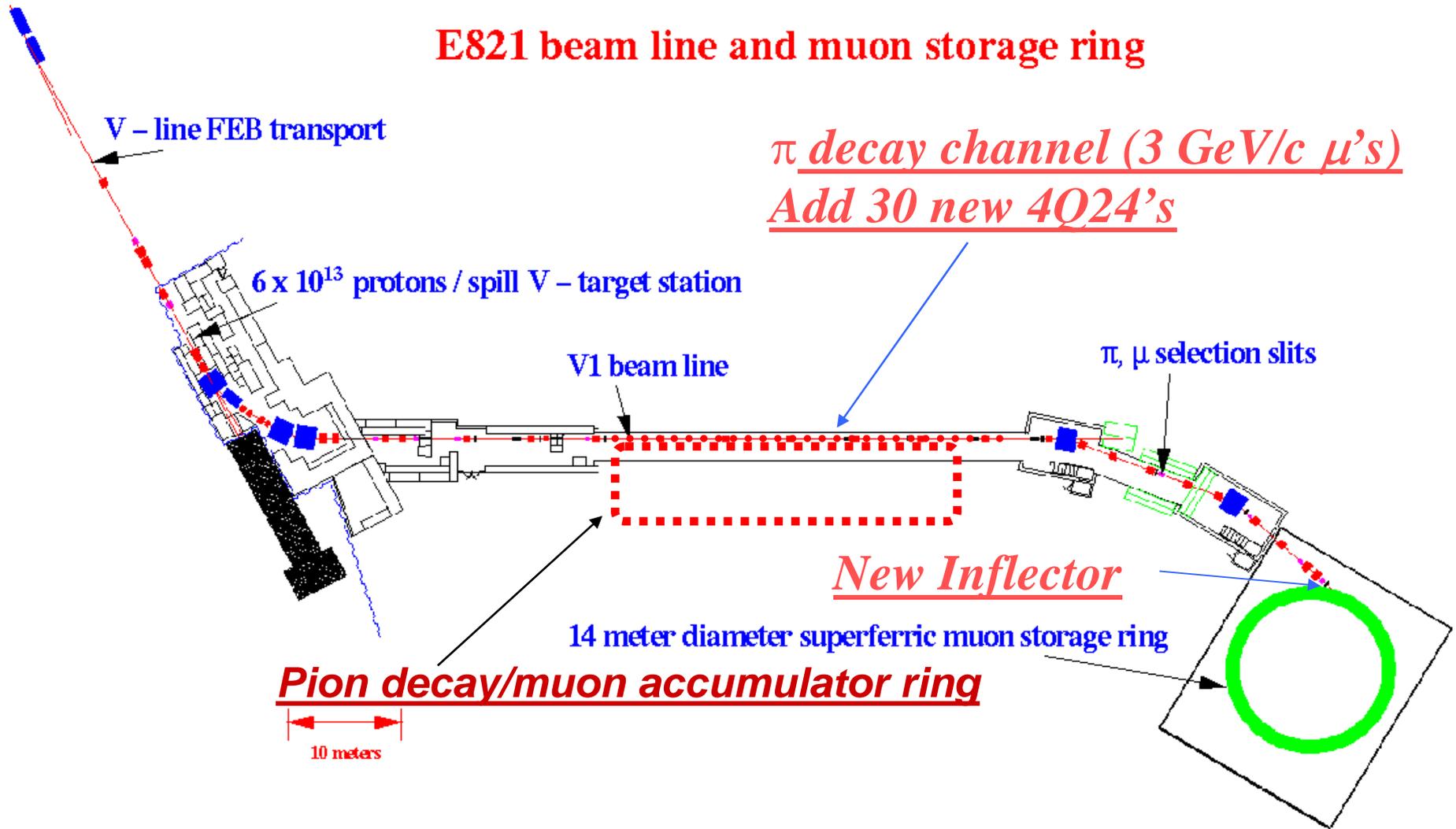
NASA
(galactic cosmic ray simulator)

E949 K^+ spectrometer to JPARC



Really IMPROVED E821 Beam Line

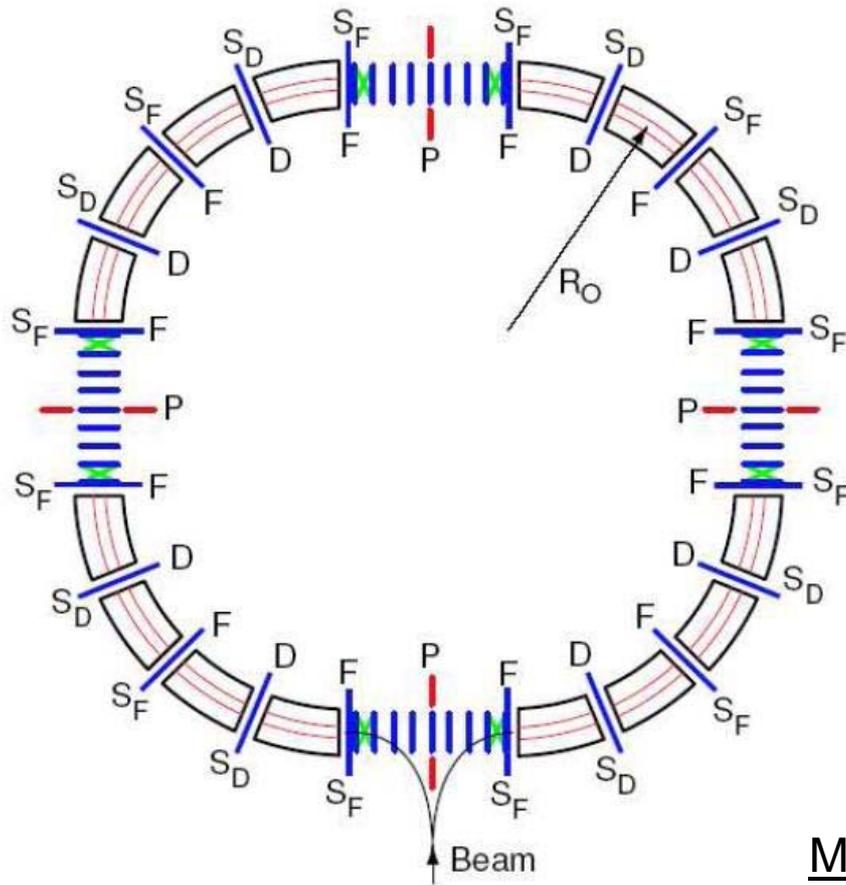
E821 beam line and muon storage ring



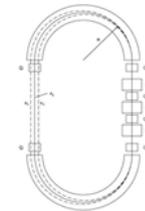
g-2, a few comments

- Operations history:
 - First operations in 1996
 - Last operations in 2001
 - Total operations time:
 - setup = 20 weeks, ~500 hours
 - physics = 41 weeks, 3525 hours
 - 1.7×10^{20} protons on target
 - g-2 to 0.54 ppm
- New Proposal
 - Baseline (improved muon beam line, open inflector and a few other things)
 - X5 muons stored
 - g-2 to 0.25 ppm
 - 0.7×10^{20} protons on target
 - CD0 to CD4 estimate: 6 years
 - Enhanced proposal (baseline plus pion decay/muon accumulator ring)
 - X15 muons stored
 - g-2 to ~ 0.15ppm or so

~1 GeV/c d EDM rings, 2004 to 2006



2006 design



~ 6 meters

~ 40 meters

March 2007, HENP Program Committee

dEDM LOI, a few comments

- **First proposed in Sept 2004 with 10^{-27} e·cm sensitivity** – rejected by BNL PAC, cost/scientific competitiveness were cited as issues
- **LOI submitted in Sept 2006** – new, smaller storage ring, with **10^{-29} e·cm sensitivity** – encouragement given by PAC to develop R&D plan
- **Revised LOI submitted in March 2007 – R&D plan presented**
Encouragement given by PAC for BNL to support planned R&D and tests at KVI/COSY. Recommended a technical review in about 1 year.
 - LDRD funds were made available and tests scheduled (2008)
- **On track for 2008 proposal submission – storage ring specs still evolving!**
- **Good match to operations concurrent with RHIC**
 - Low beam intensity so no AGS rehabilitation issues
 - Plenty of room to build a ring on the AGS experimental floor.
- **Some CAD Issues**
 - Presently there's no base support for AGS fixed target experiments
 - AGS experimental floor is slowly being decommissioned so we'll need to resurrect old/build new equipment, install new security systems, upgrade electrical distribution etc..
 - Need to develop plan for polarized deuteron beam source/transport to the experiment.
 - Optimum operation of experiment requires modifications to the AGS to allow fast switching (ppm) between operation of the AGS for RHIC and the experiment.

Summary

- **Coming up during Run8**

- BLIP, concurrent with RHIC with some stand-alone running
- NSRL, ~ 1 March through mid-June

- **Future**

- NSRL in the EBIS era will continue, possible new beam line off Booster (under consideration by NASA)
- AGS Fixed Target Possibilities
 - DTRA (4 GeV FEB protons to U-Line, awaiting proposal from LANL)
 - NASA (new beam line and facility, NASA is considering this)
 - Muon g-2, final chapter? (upgraded experiment, awaiting guidance)
 - Deuteron edm (new beam line and storage ring - proposal planned for 2008)

- Supplementary Slides

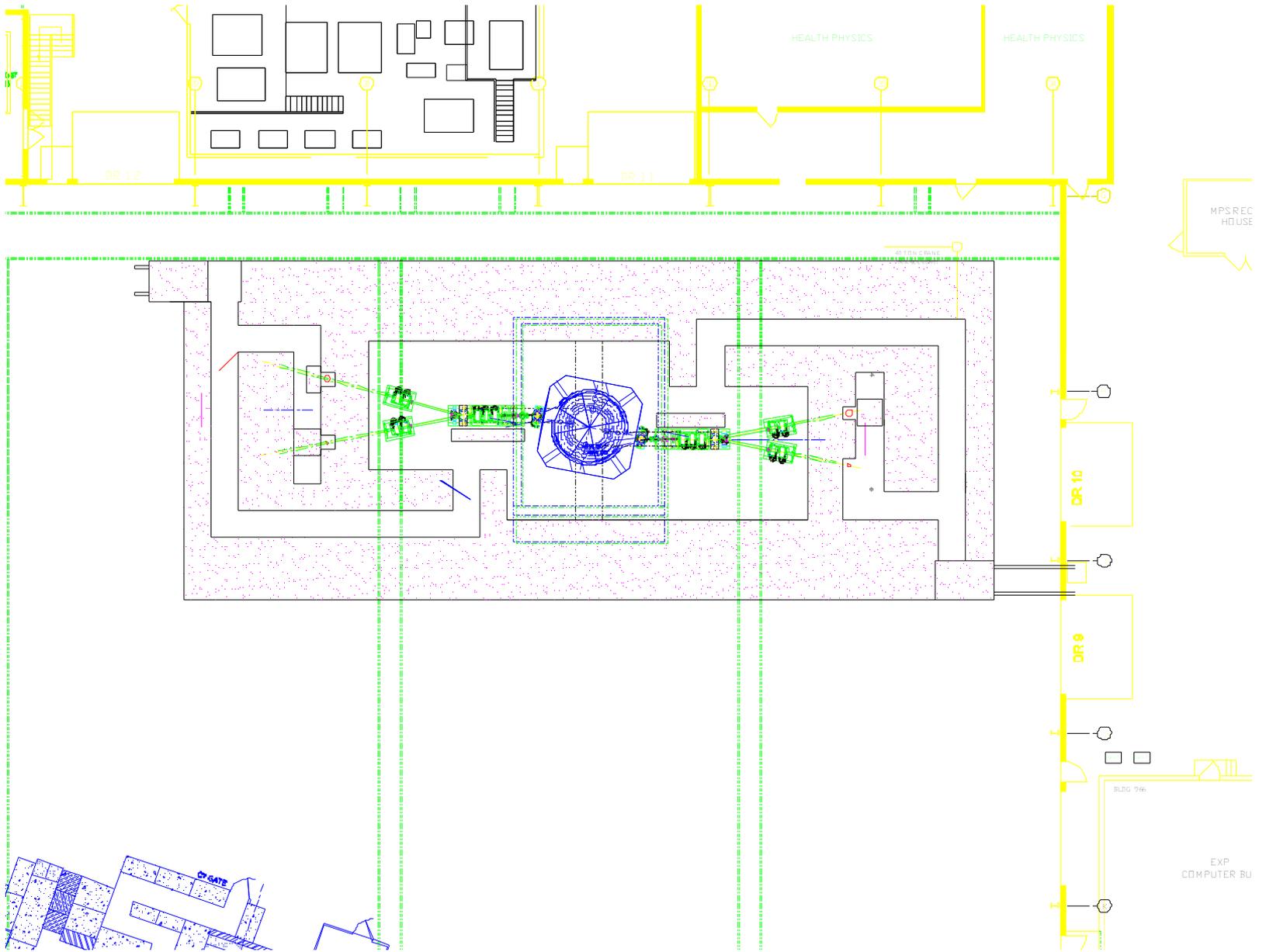
dEDM R&D Plan (revised 3/26/07)

- **C-AD Support ~\$150K**
 - 1 month of Mike Blaskiewicz to develop schemes for RF injection
 - 0.5 month of Anatoli Zelenski for polarized deuteron source to match dEDM requirements
 - 1 month of Vadim Ptitsyn to work on the spin coherence time issues
 - 2.5 months of Alfredo Luccio to do spin tracking for systematics
 - 0.5 month of Nicholas D'Imperio for EM field simulations that include collective effects
 - 0.5 month of Al Pendzick to do the costing of the experiment to be included in the proposal
 - C-AD Impact manageable
- **Other Laboratory Help ~\$535K**
 - 1 FTE Visitors/Consultants \$120K
 - Polarimeter study @ KVI and COSY \$240K
 - Travel support to KVI and COSY \$60K
 - LDRD (approved) for Limited Travel and Post-Doc \$115K
- **Bottom Line the collaboration needs another \$570K**

March 2007, HENP Program Committee

BLIP future

- Continue to operate with limited dedicated runs and concurrent with RHIC pp
- Cyclotron Isotope Research Center (CIRC)
 - 20-70 MeV commercially built cyclotron
 - Locate in bldg 912, AGS fixed target floor
- March 2001 CD 0, Mission Need Established (DOE NE Office of Isotopes for Medicine and Science)
- Present situation:
 - DOE NE lost interest
 - NIH considering building cyclotron facility at Ft. Detrick, MD (“Green field”)
 - There’s a effort to get NIH interested in building CIRC at BNL
 - DOE NP might be interested ??



Summary: E821 and E969 Costs

E969 Costs (2006 M\$)

Baselining costs	0.4
AGS/Booster Rehab including ES&H	11.7
Construction (44% contingency)	12.2
Universities (27% contingency)	2.4
Operations (includes FTEs to support cryo and external beam operations)	13.6

- **E821 costs (M\$) (as spent \$)**
 - **Capital** 25.0 1989-1998
 - **Operations** 54.0 1998-2001
 - **Total E821** 79.0

What is needed to baseline g-2 costs

- **1.0 g-2 Ring/Building maintenance**
 - 1 man month to engineer an air conditioning system for bldg 919
- **1.1 V/V1 Beam Lines**
 - 1 man-months engineering
 - 1 man-months physicist
- **1.2 Inflector** (see Meng talk)
 - A quote from the Furukawa Company for superconductor
- **1.3 E Quads**
 - Nothing new, defensible
- **1.8 Kicker**
 - Nothing new, defensible
- **1.11 Cryogenics** (to determine scope)
 - 2 man-months engineering
 - 1 man-month tech
- **1.12 Vacuum System**
 - 1 man-month engineering
- **1.14 Booster/AGS**
 - 0.5 man month engineering
 - 0.5 man month physicist
- **ES&H – review operation within present guidelines**
 - 1 man-month physicist
 - 1 man month engineer
- **Preparation of Cost Books, Resource Loaded Schedules, CD0-1 documents etc**
 - 4 man-months engineering
 - 4 man--months physicist
- **Summary**
 - 11 man-month engineering
 - 7 man-month physicist
 - 1 man-month tech
- **Required Budget ~ \$360K**
- **Calendar Time Required ~ 6-8 months**

Muon g-2 Experiment Construction, Cost Summary

• Experiment Construction, Direct Costs	<u>M\$</u>	<u>Contingency</u>
– G-2 Ring and building	\$ 0.56	21%
– V/V1 Beam Line modifications	\$ 2.59	18%
– Inflector (open ends)	\$ 0.64	19%
– E-Quad rebuild	\$ 0.13	15%
– Additional muon Kicker	\$ 0.41	15%
– Cryogenic plant rehab	\$ 0.74	233%
– Ring Vacuum System	\$ 0.16	29%
– Equipment Testing	\$ 0.63	20%
– Project Office	\$ 0.37	20%
• Sub-Total, direct costs	\$ 6.2	
• Indirects (reduced)	\$ 2.2	
• Contingency (44%)	\$ 3.7	
• Sub-Total, with indirects	\$ 12.1	
• University (Detectors/DAQ)	\$ 1.4	
• Total (DOE)	\$ 13.6	
• University (Detectors/DAQ - NSF)	\$ 1.0	

FY 2006 \$'s

AGS/Booster Restoration to High Intensity, Cost Summary

AGS/Booster, Direct Costs	<u>M\$</u>	<u>Contingency</u>
– ES&H (CAPS)	\$ 2.63	28%
– Electrical Modifications	\$ 2.11	22%
– Mechanical Modifications	\$ 1.25	20%
– RF System Modifications	\$ 0.67	22%
– Instrumentation	\$ 0.34	20%
– Project Support	\$ 0.33	34%
– Controls	\$ 0.16	24%
• Sub-Total, direct costs	\$ 7.5	
• Indirects (reduced)	\$ 1.9	
• Contingency (24%)	\$ 2.3	
• Total	\$ 11.7	

FY 2006 \$'s

g-2 Experiment Operations, Cost Summary

FY 2006 \$'s

- Base Plan (0.25 ppm experiment)

<u>Year</u>	<u>Wks w/RHIC</u>	<u>Wks Stand-Alone</u>	<u>Physics Wks</u>	<u>Cost (M\$)</u>
1 st	12	0	3	\$ 5.8
2 nd	<u>20</u>	<u>0</u>	<u>15</u>	\$ <u>7.8</u>
Total	34	0	18	\$ 13.6

Additional 10-15 week year of running with RHIC adds ~\$6-7M