Summary

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MUTAC FNAL

Jan 2003

Charge

1) Review and comment on the R&D progress achieved during the last year

2) Review and give advice on the R&D plans and corresponding budgets for fiscal year 2003, as well as on the long-range R&D directions

3) Assess and give advice on plans for the international Muon Ionization Cooling Experiment (MICE), and comment on the relationship between MU-COOL and MICE

4) Assess and give advice on plans for the Targetry program

5) Assess the status of the beam simulation effort, especially that aimed at 6D cooling scenarios (e.g., cooling rings)

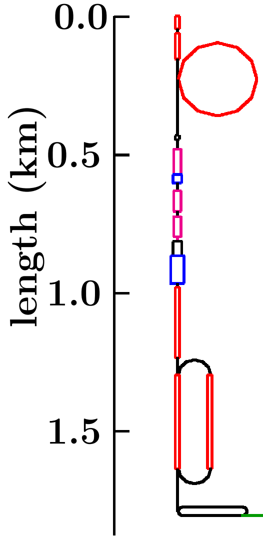
6) Evaluate both the NSF-sponsored and the ICAR-sponsored muon activities and comment on how each fits into the overall MC R&D program.

Each will be addressed, but not in this order

Beam simulation efforts (#5)

- Study I   Emphasized Feasibility
- Study II   Emphasized Performance   6 times flux
- Current Work   Emphasize Lower Cost
- Future Study 3   (In about 2 Years)
- Collider Study   (later)

Cost Reduction



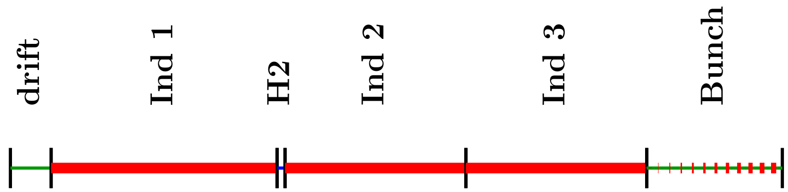
	% of Cost (≈ 1.7 B$ without driver or target)	
p Driver		
Hg Target		
Phase Rotation	(29 %)	***
Cooling	(23 %)	***
Pre-Acceleration	(14 %)	
RLA Acceleration	(26 %)	***
Storage Ring	(8 %)	

*** Reasons for substantial savings on these items

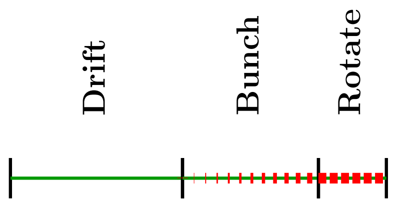
Work on the other items soon

Cost Reduction of Phase Rotation

- Study 2



- e.g. Bunch Beam Rotation



	Study 2	Now	Factor
Tot Length (m)	328[1]	166	51 %
Acc Length (m)	269[2]	35	13 %
Acc Type	Induction[3]	Warm RF	

1. 18+100+3.5+80+80+47=328
2. 100+80+80+9=269
3. 260 m induction + 9 m RF

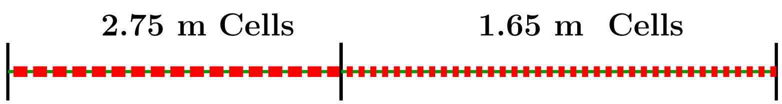
- **EXPECT SUBSTANTIAL SAVINGS**

  BUT

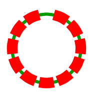
- Not yet matched into cooling
- Not Engineered
- Other options

Cost Reduction of Cooling Rings

- Study 2 Cooling



- e.g. RFOFO Cooling Ring



	Study 2	Now	Factor
Tot Length (m)	108	33	30 %
Acc Length (m)	54	37	21 %
Acc Grad	16 MV/m	12 MV/m	66 %

- Similar transmission
- Similar Trans emittance
- Less Long Emittance

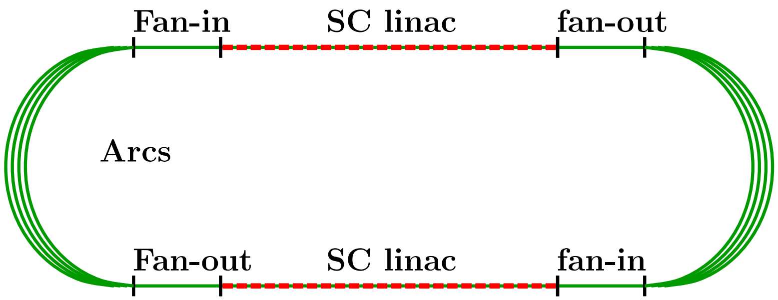
- **EXPECT SUBSTANTIAL SAVINGS**

  BUT

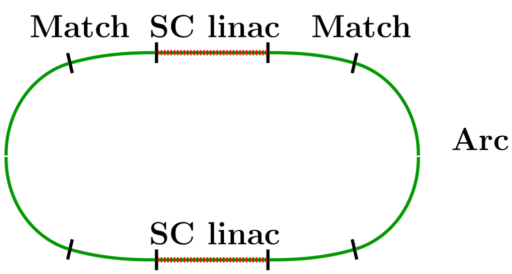
- Need R&D on absorber heating
- Need R&D on thin windows
- Need R&D on kicker
- Not engineered
- Other options

Cost Reduction of Acceleration

- Study 2 RLA



- e.g. Racetrack FFAG



	Study 2	Now	Factor
Vac Length[1]	3261	1094	34 %
Tun Length[2]	1494	1094	49 %
Acc Length[3]	288	102	35 %
Acc Grad.	16	8	50 %
Acc Type	SC RF	SC RF	

1. 2 linacs + 4 switch-yards + 7 arcs
2. 2 linacs + 4 switch-yards + 2 arcs
3. $2 \times 24 \times 4 \times 1.5$ m

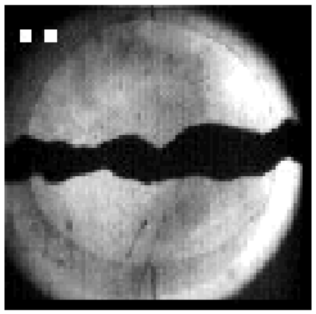
- EXPECT SUBSTANTIAL SAVINGS

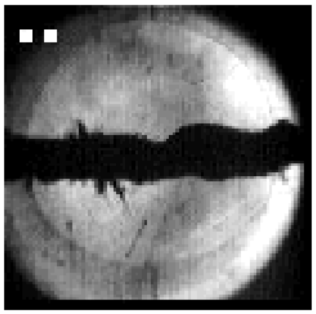
  BUT

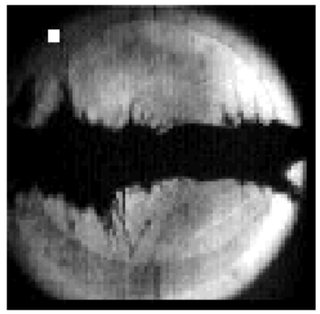
- Match not yet Designed
- More Pre-acceleration required
- Inject/extract not designed
- Other Options

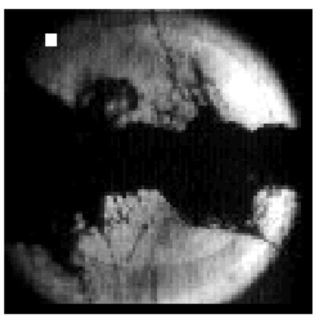
Targetry program (#4)

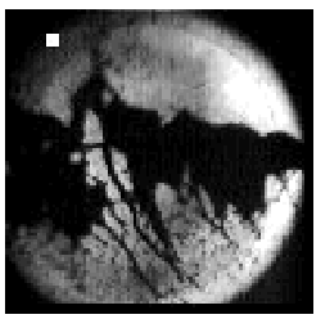
AGS Experiment E951


0 ms


0.75 ms


2 ms


7 ms


18 ms

- **4 Tp/bunch** $(4\ 10^{12})$
- **Non-Explosive Dispersion**
- **Good Result**

But 1 MW Nu-Factory requires:
16 Tp/bunch $(1.6\ 10^{13})$

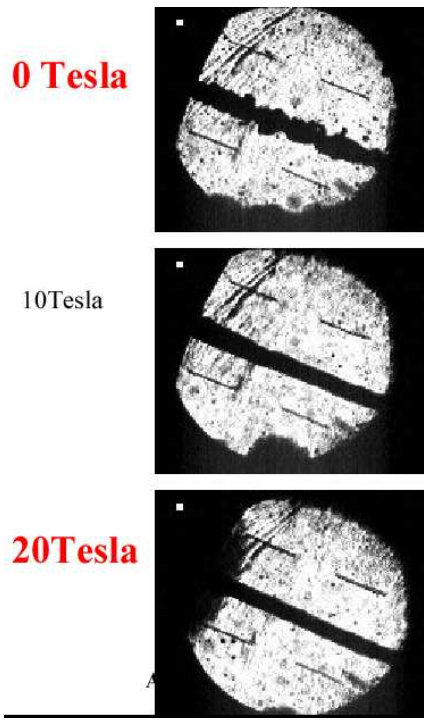
SO

- **NEED FURTHER EXPERIMENT**

Target Simulation

Stabilization From Magnetic Field

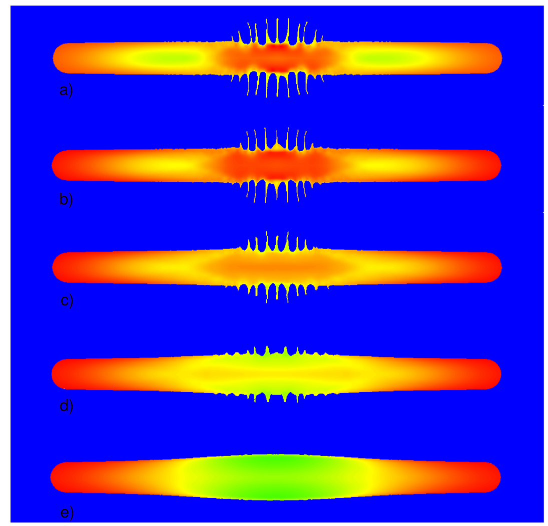
Cern Observation without beam



Simulation with beam

R. Samulyak

Stabilizing of the mercury jet by the longitudinal magnetic field



a) B = 0 ; b) B = 2T

c) B = 4T ; d) B = 6T ; e) B = 10T

Magnet changes dynamics: suppresses breakup, increases T

- NEED EXPERIMENT WITH MAGNET

R&D progress and Plans (#1 & #2)

- **SC Cavity Progress (at Cornell)**
  - **Build new test pit**
  - **Design, build, and test 201 MHz SC cavities**
    8 MV/m achieved
    limited by drop in Q c.f. FS2 spec = 16 MV/m
    Note acceleration designs now below this gradient

- **SC Cavity Plans**
  - **Explore ways of raising the operating gradients**
    Note above: this may not be critical

- **MuCool Progress**
  - Design of hydrogen absorbers
  - Design, build, and test absorber windows
  - exploring safety requirements
  - Construction, and safety testing, of absorber windows

  - High power testing of 805 MHz cavities
  - High power testing in a magnetic field
  - Measurement of X-rays and dark currents
    Particularly relevant to MICE experiment

  - Construction and radiant heat testing of Be windows for RF

  - Design of 201 MHz cavities

  - Design and start Test Area

- **MuCool R&D plans**
  - Build, and test hydrogen absorbers (needs Test Area)
    Prototype for MICE
  - Test with heating from linac p beam (needs Test Area)
    Particularly relevant for cooling rings
  - Continue radiant heat study of thin Be windows for RF
    as needed for cooling rings
  - Continue 805 MHz work on breakdown and dark current
  - Test 805 MHz cavities with Be windows
  - Design, build, and test 201 MHz cavities (needs Test Area)
    Prototypes for the MICE experiment and for a cooling ring
  - Design and construct large SC coil to fit over cavities (needs Test Area)
    Prototype for MICE
  - Test 201 MHz cavities in magnetic field (needs Test Area)
    Prototype for MICE
- **Long range R&D Plan:**
  - Build and run "Muon Ionization Cooling Experiment" MICE

Muon Ionization Cooling Experiment (MICE) (#3)

- **From last MUTAC:**

"The Cooling demonstration is the key systems test for a neutrino factory"

- **Solid Design based on Study-2 channel**
  (very similar components to RFOFO cooling ring)
- **International Collaboration:**
  (US, Europe, Japan)
- **An enthusiastic host lab:**
  RAL (UK)
- **Funding proposal sent to NSF,**
  (and similar requests in Europe)
- **Finished Proposal**

ICAR & NSF Involvement (#6)

The Muon Collaboration provides a model for pursuing accelerator R& D involving many University & Laboratory groups, including both accelerator and particle physicists. We believe this way of pursuing accelerator R& D is succeeding. The support for the University groups from NSF and ICAR has been important for this success.

NSF

- SCRF R& D activity entirely supported by NSF
- Significant results during FY02
- Critical R& D to establish achievable parameters for muon acceleration

ICAR

- Substantial component of the collaboration (15 FTEs !)
- Primary groups spearheading the LH 2 absorber R& D $\rightarrow$ Substantial progress
- Groups are seamlessly integrated into the collaboration
- Source of (Ph. D. and summer) students !
- Important component of MICE

Conclusion

- **The KamLAND's determination of the "Large Mixing Angle" (LMA) solution raises the possibility of measurable CP violation effects and their possible GUT implications. A neutrino factory for their study may become crucial.**
- **Our design and technical studies, if actively pursued, should lead to an affordable design on a reasonable time scale.**
- **Even before the KamLAND result, the B&B Sub-Panel had recommenced:**

  "We support the decision to concentrate on intense neutrino sources, & recommend continued R&D near the present level of 8 M$ per year"

- **Since that time our total funding has dropped a factor of two, and the direct DOE funding for the experimental program has dropped a factor of three.**
- **We hope you will recommend that MCOG endeavor to get restitution of our funding**