# *Neutrino Factory and Beta Beam*
# *Experiments and Development*

## Working Group Summary
## (Machine Aspects)

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*CENTER FOR BEAM PHYSICS*

Neutrino Physics Study Meeting–ANL
December 14, 2003

# Outline

- Attendees
- Neutrino Factory discussion
- Beta beams discussion
- Summary

# Attendees

- Machine discussion was attended by:

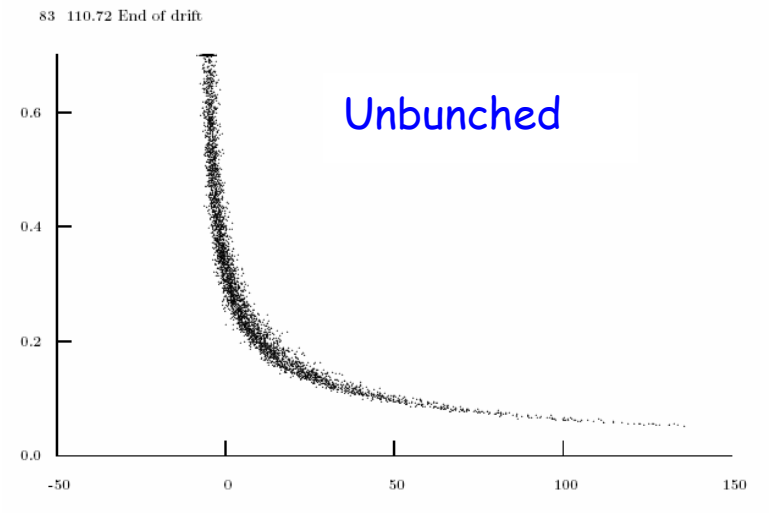
Daniel Galehouse (U. Akron)
David Finley (Fermilab)
Steve Geer (Fermilab)
Jim Norem (ANL)
Bob Palmer (BNL)
Petros Rapidis (Fermilab)
Yağmur Torun (IIT)
Mike Zisman (LBNL)

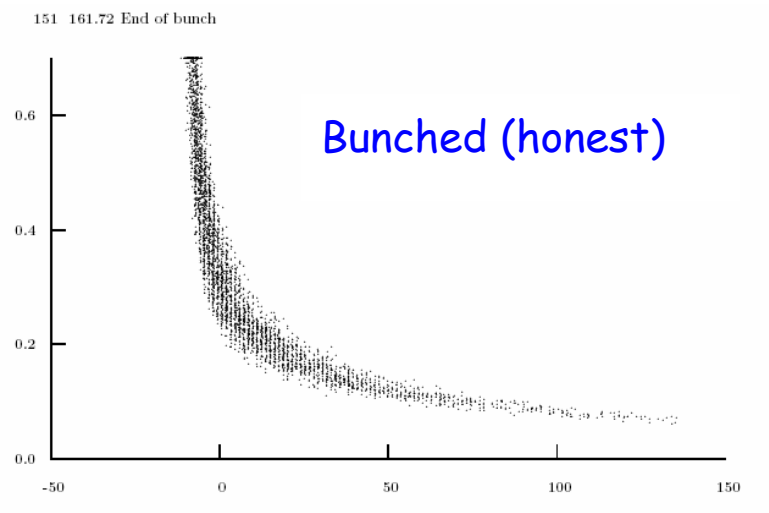
- We will recruit more participants

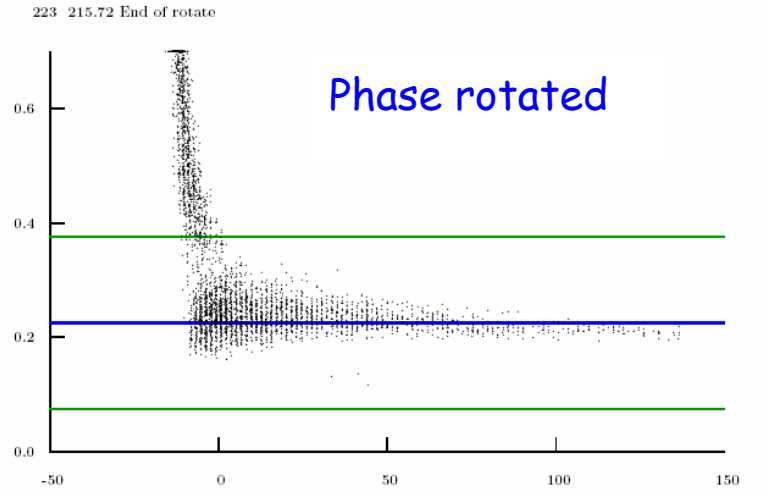
# Neutrino Factory Discussion

- Palmer reported on status of attempts to improve on the Study II
  - cost drivers (each ≈25%) are known to be
    - bunching and phase rotation
    - cooling
    - acceleration
- Palmer has begun to look at the first two, with encouraging results
  - phase rotation and bunching
    - applied Neuffer scheme with RF bunching and phase rotation
    - RF ranges from 330 MHz to 201 MHz along channel
      - presently unrealistic smooth variation of RF; need to go to "stepped" scheme with, say 10 steps

# Neutrino Factory Discussion

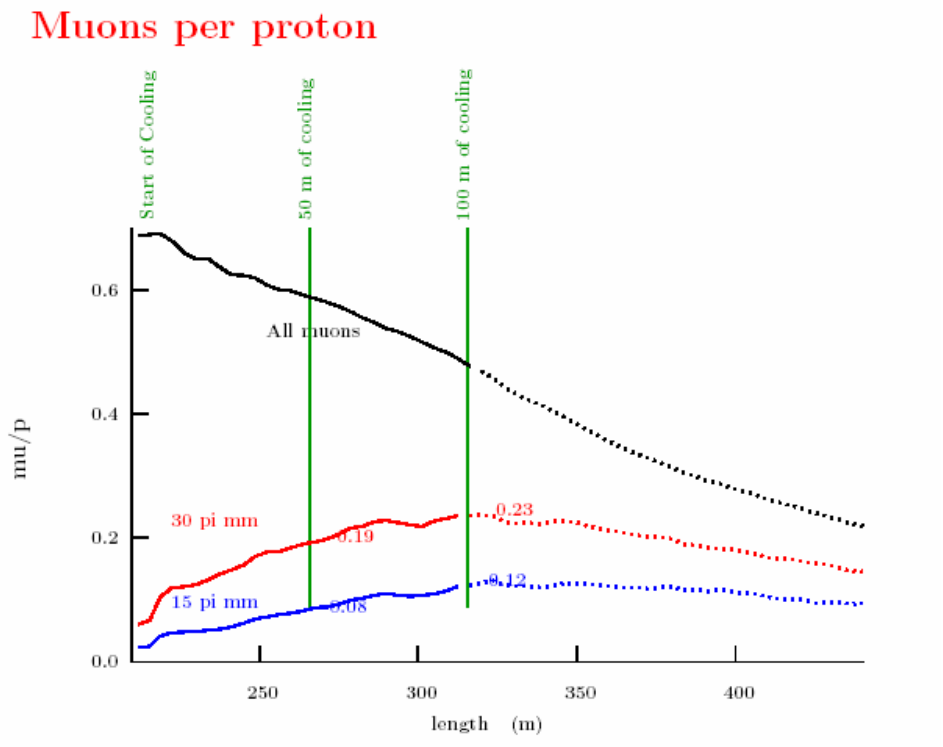


# Neutrino Factory Discussion

- **Bottom line**
  - **can get better performance than Study II with same cooling channel or same performance with shorter channel**



# Neutrino Factory Discussion

- Still lots of variables to adjust and optimize
  - need to add some realism to the simulation
    - window thicknesses and materials, etc.
  - need to decide how to handle both $\mu^-$ and $\mu^+$
    - is it a blessing or a curse?
- We decided it would be prudent to focus mainly on "front-end" system, and cover acceleration only as time permits

# Neutrino Factory Discussion

- The plan
  - since completion of Study II, MC has done a lot more work on optimizing pieces of a Neutrino Factory
  - we plan to put this all together and see if we are indeed on track for a more cost-optimized design
- In particular, we hope for
  - improvements in collector and decay channel
  - updated phase rotation and bunching system
  - more optimal cooling channel
- If possible, we would like to revisit the preacceleration section, between cooling channel and main accelerating system
  - we think we know how to make acceleration acceptance bigger
  - need to do the same here for it to matter

# Beta Beams

- There are many technical challenges of beta beams that would benefit from further study
  - production target and ion source to give required intensity
    - multiple targets required for $^{18}Ne$ intensity of $1.3 \times 10^{13}$
    - pulsed ECR source to give bunch train of fully stripped ions
  - space-charge blowup and radiation losses in various rings
  - stacking multiple turns in decay ring without cooling the beam
- Generalizing the scenario beyond CERN-specific design would also be of interest

# Beta Beams

- For beta beams, we agreed to aspire to modest goals
  - assess progress of CERN design
    - attend design meetings in Europe, if any are held during our tenure
  - identify and understand outstanding technical issues and time scale for dealing with them
- Experts from nuclear physics facilities or projects, e.g. RIA, have the right expertise
  - have a volunteer (Finley) to look into these matters
  - need to get some RIA folks interested in helping

# Summary

- We have ideas how to proceed with Neutrino Factory and Beta Beam investigations
- We anticipate having one or more "mid-course" in person meetings
  - MC meeting January 27-31, 2004 will be opportunity to review progress
  - we would also like to meet in conjunction with Superbeams group
    - there are technology issues (as well as physics) in common
      - proton driver and target considerations
- We think it is important that the case for continued accelerator R&D in support of the physics program be part of the roadmap
- For this study, we have a lot to do, and not that much time available to do it

…let the race begin!