# Possible ionization cooling experiment by using proton beam

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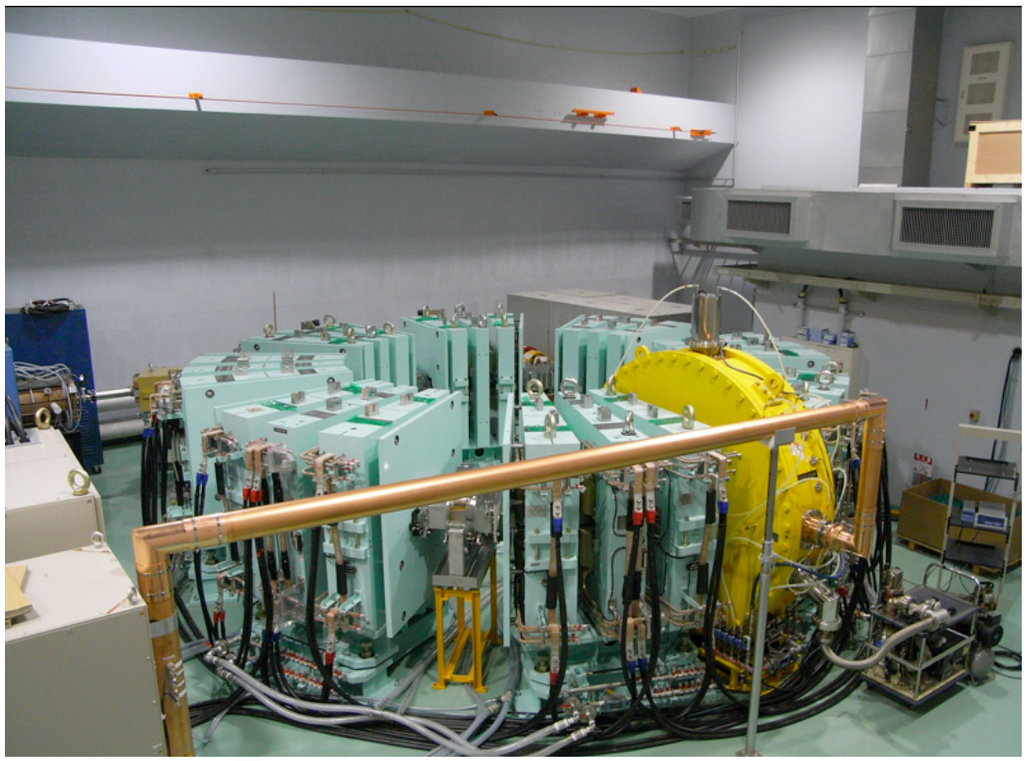
# Introduction

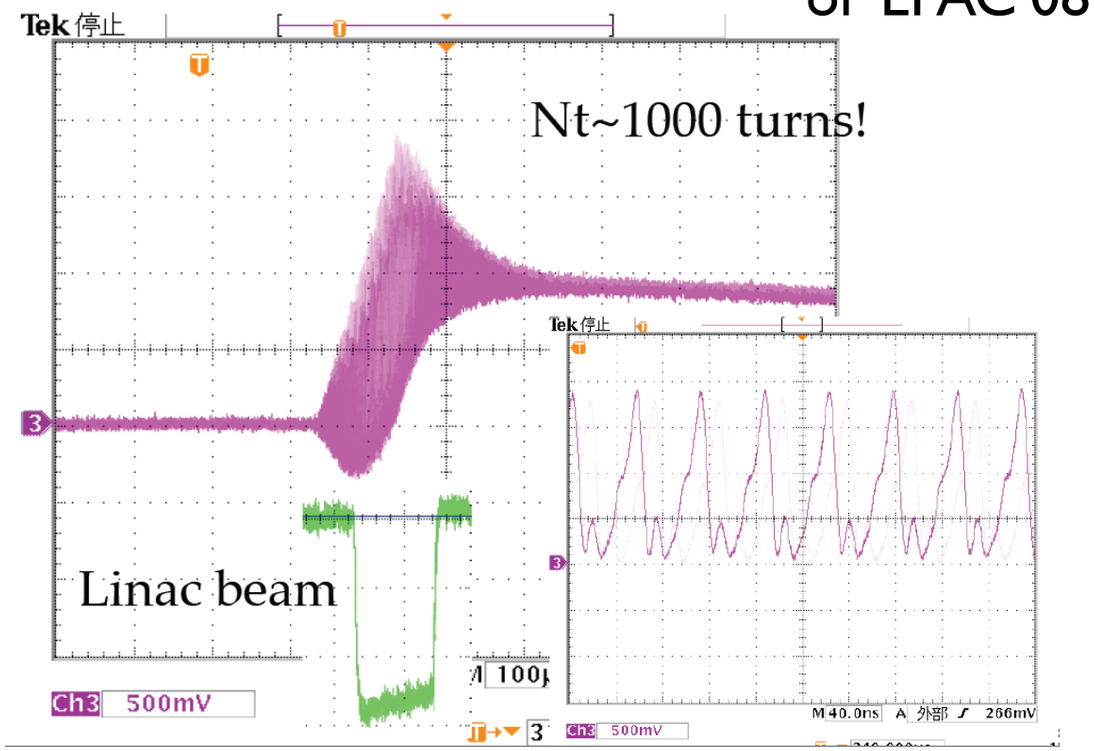
- During EPAC'08, I heard one Japanese group succeeded to measure ionization cooling effect in their FFAG ring
- I was asked people to search the possibility of collaboration with them
- As many people have pointed out, they observed the cooling effect indirectly
- Furthermore, we do not have strong motivation IF we join this experiment
- We may be able to have our own machine (see Milorad's talk)
- IF we collaborate with them, I would intend to study:
  - ionization cooling effect with more diagnostics
  - AND characteristic of FFAG for other applications

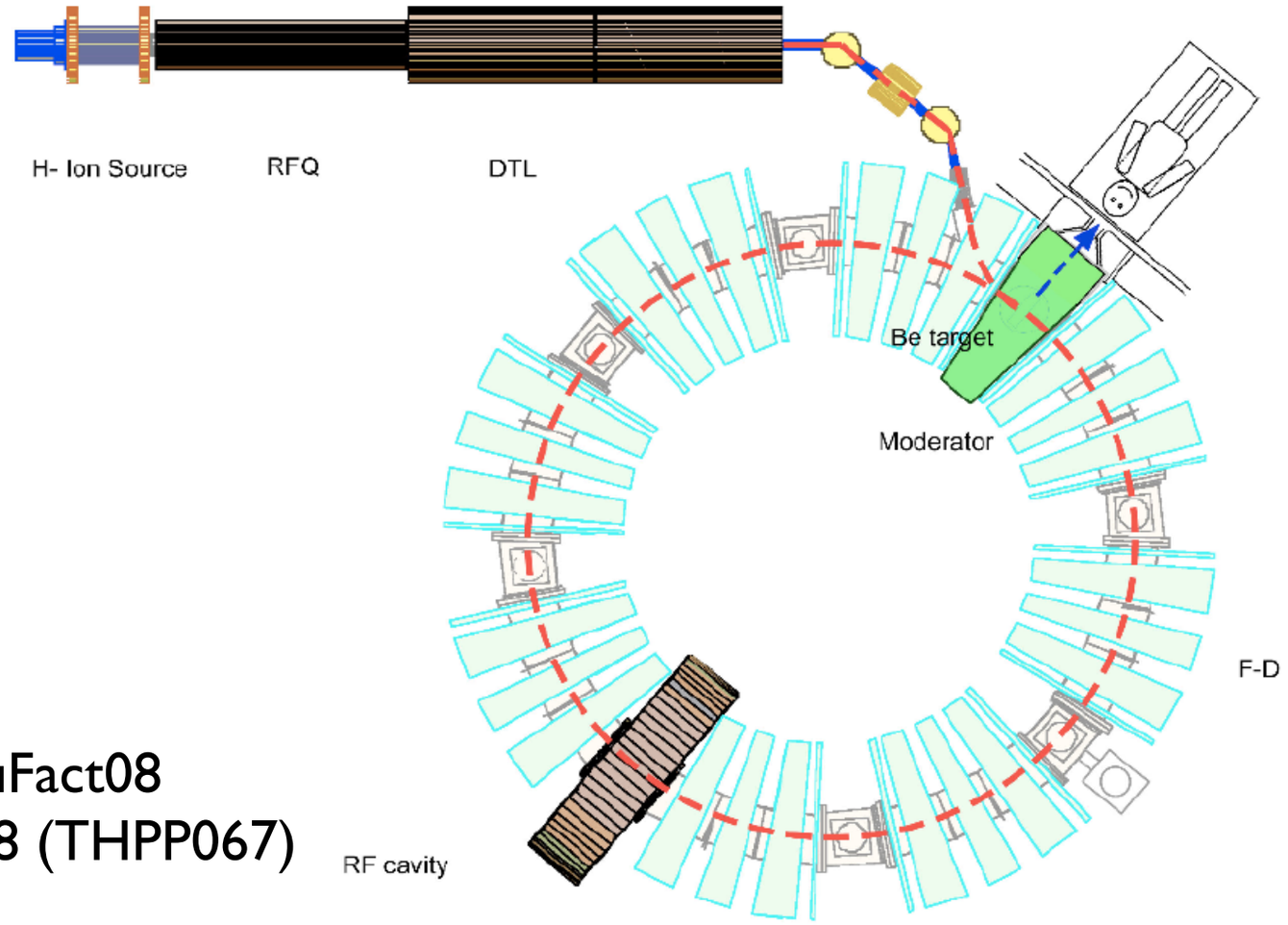
# Ionization cooling experiment in FFAG



Beam storage

Y. Mori, NuFact08
or EPAC'08 (THPP067)




- 11 MeV proton beam
- 5 mm Be foil
- Re-accelerate by RF
- Observe longer beam life time due to ionization cooling

# Considerable issue

- Assume no beam loss mechanism except for charge exchange process
- Use proton beam
- No emittance measurement

# Task for our interest

- Investigate beam loss mechanism
- Design detector system for emittance measurement
- Design wedge absorber

# What can we learn from this experiment?

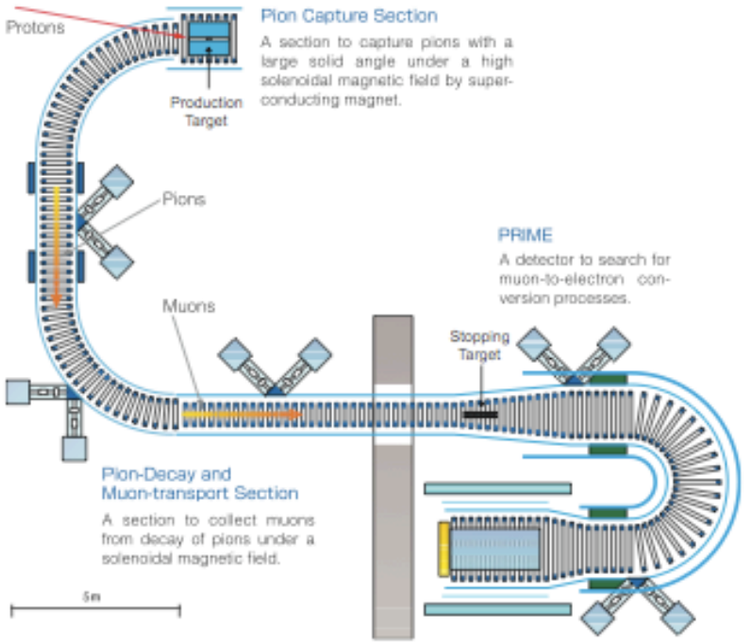
- Ionization cooling mechanism (?)
- Characteristics of FFAG ring (!) to apply for...
- Beta beam target
- mu2e conversion experiment

# Apply FFAG for mu2e experiment

## Japanese staging plan of mu-e conversion

PRISM

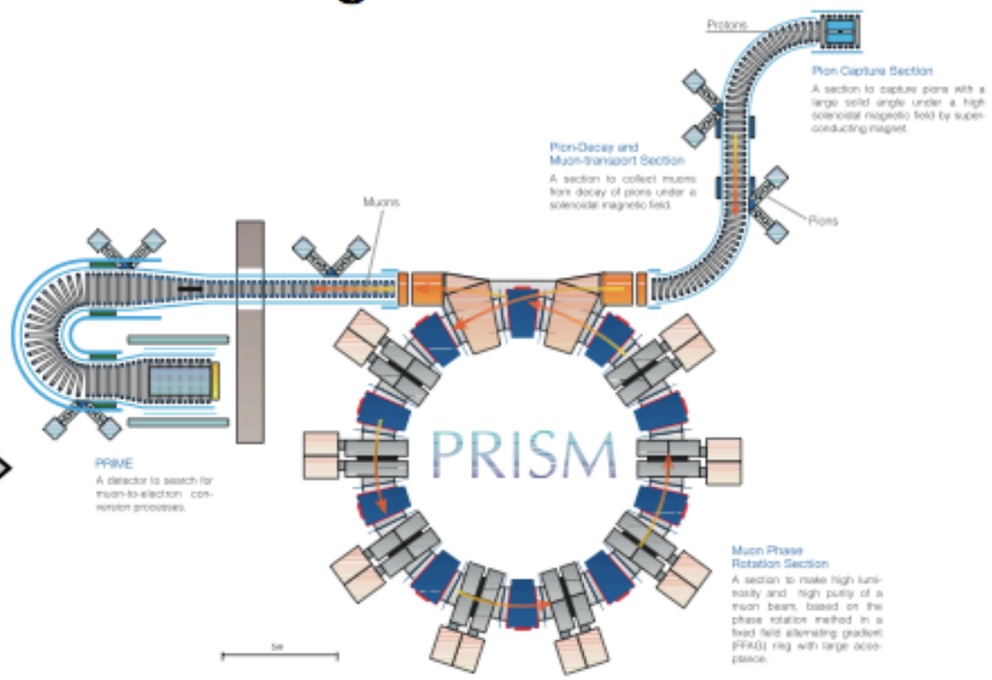
### 1st Stage : COMET




$$B(\mu^- + Al \rightarrow e^- + Al) < 10^{-16}$$

- without a muon storage ring.
- with a slowly-extracted pulsed proton beam.
- doable at the J-PARC NP Hall.
- regarded as the first phase / MECO type
- Early realization

### 2nd Stage : PRISM/PRIME

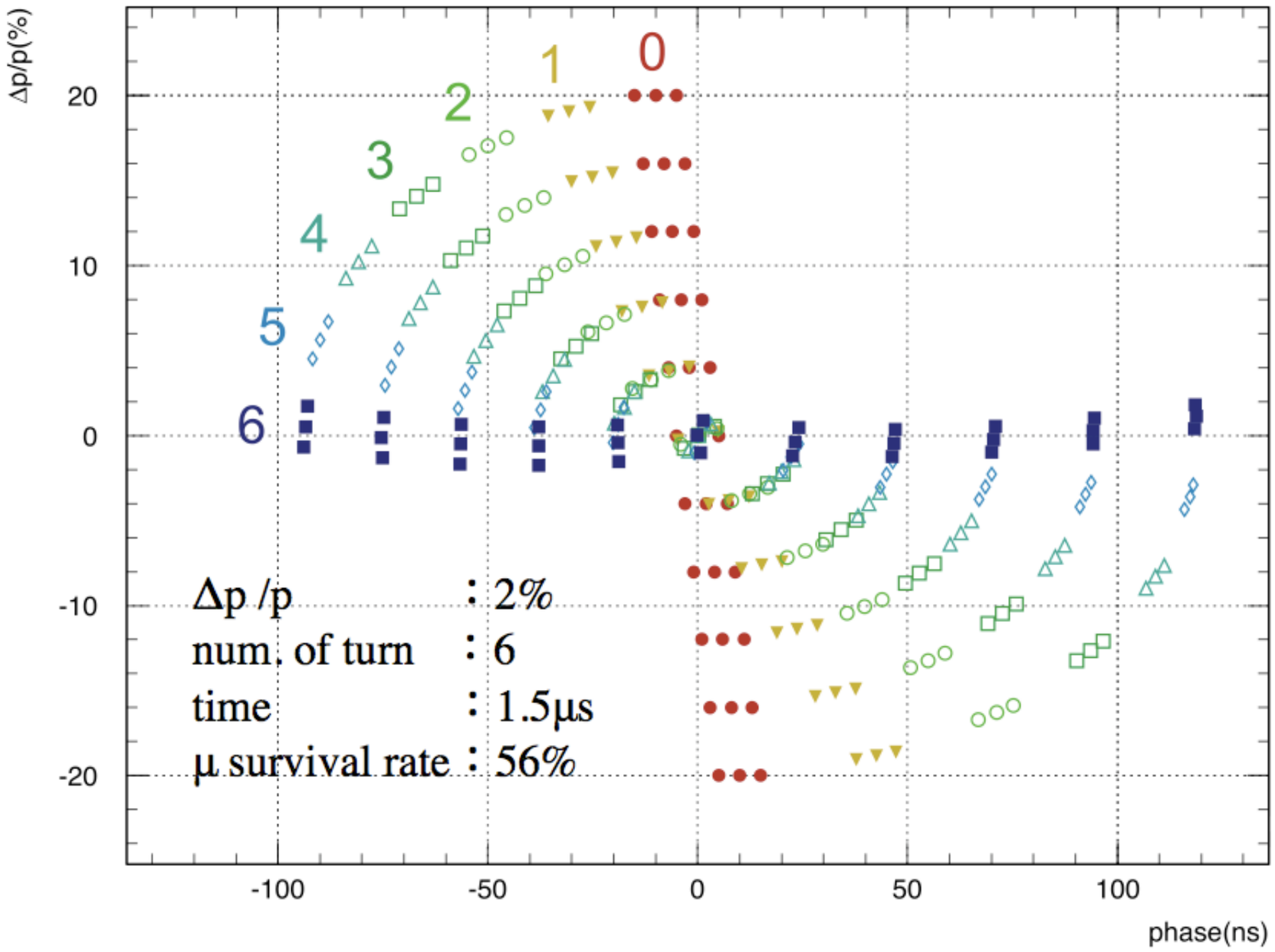



$$B(\mu^- + Ti \rightarrow e^- + Ti) < 10^{-18}$$

- with a muon storage ring.
- with a fast-extracted pulsed proton beam.
- need a new beamline and experimental hall.
- regarded as the second phase.
- Ultimate search

A. Sato et al, NuFact08

# Phase Rotation Simulation for Muons




Mean momentum = 68 MeV/c

A. Sato et al, NuFact08

# Conclusion

- It seems that they succeeded to measure ionization cooling effect in FFAG ring
- But they need additional test
- We have a strong motivation for longitudinal cooling
- FFAG can be a powerful tool for beta beam and mu2e experiments