2000/5/26
N. SASAO

Summary of WG2

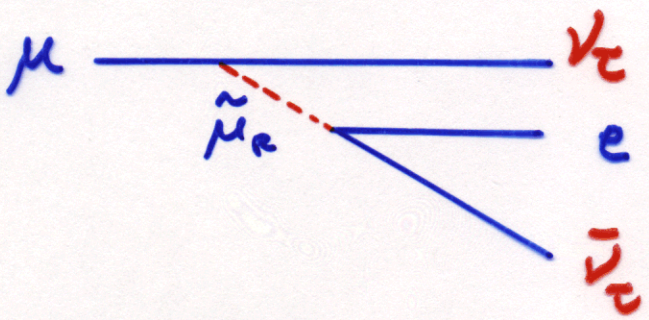
– Physics Beyond Standard Model –

(1) ν-beam — 2 talks

(2) μ-beam — 5 talks

(1) ν-beam

a. Exotic process at the ν source (F. DeJongh)



~~R~~ SUSY

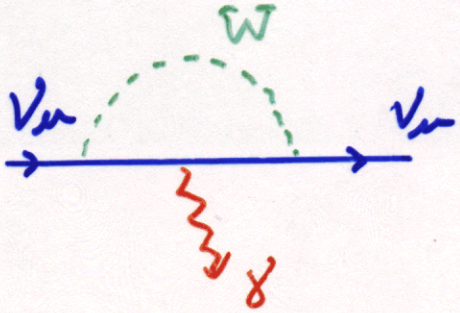
Allowed at

BR = 0.5%

b. Neutrino magnetic moment (J. Krane)

present limit $< 10^{-10}\mu_B$

SM $10^{-19}\mu_B$



New approach : Time varying B-field

(2) μ-beam

a. Theoretical review (M. Mangano)

→ see fig.

B1 $\mu^- N \to e^- N$ (MECO, J. Popp)

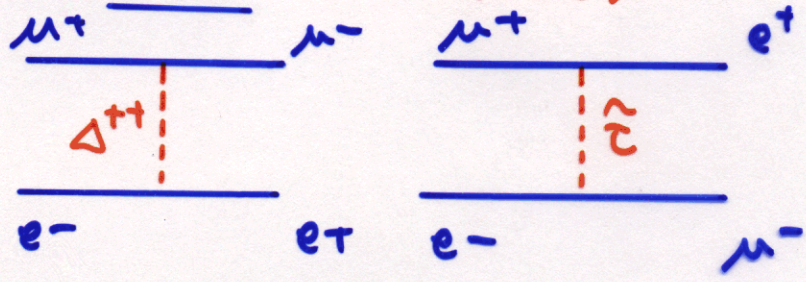
→ see fig $R_{\mu e} < 10^{-16}$

B2 $\mu^- N \to e^- N$ (PRISM, Y. Kuno)

→ see fig $R_{\mu e} < 10^{-18}$

c. Muonium → Anti-muonium (M. Aoki)

$\Delta L = 2$



$P_{\mu\bar{\mu}} < 8 \times 10^{-11}$ (Now)

Rivàval of activation method + PRISM

→ $P_{\mu\bar{\mu}} < 3 \times 10^{-14}$ (1 year)

d. Precise measurement of Fermi Coupling Constant (S. Nakamura)

· $\Delta G_F / G_F \sim 17$ ppm (Now)

Multi-event in one time window + PRISM

→ $\Delta G_F / G_F \sim 0.1$ ppm (1 year) c.f. $\Delta M_t / M_t \sim 20$ ppm.

OTHER POSSIBILITIES

- $\mu^+e^- \leftrightarrow \mu^-e^+$ OSCILLATIONS
- $\mu^+ \to e^+X$, X is "HEAVY" SCALAR
- $\mu \to e^+\nu X$ "KARMEN ANOMALY"
- IMPROVE μ g-2 MEASUREMENT
- ...

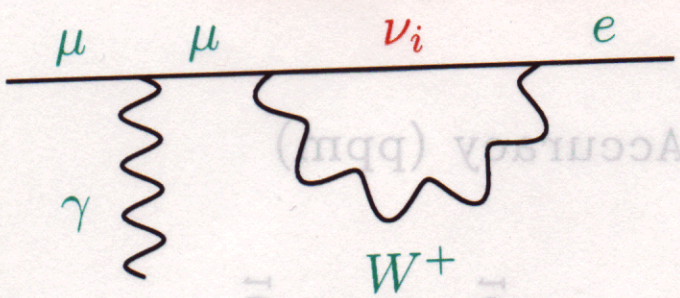
CONCLUSIONS

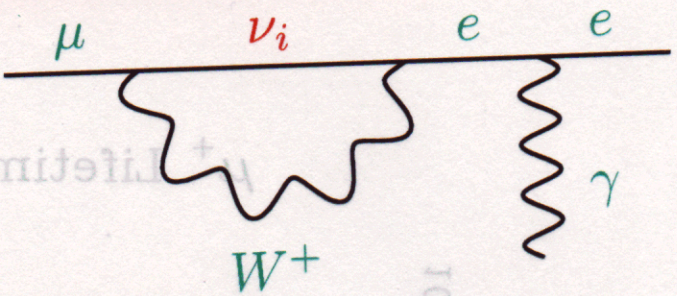
PHYSICS WITH A LARGE # OF STOPPED MUONS IS VERY EXCITING

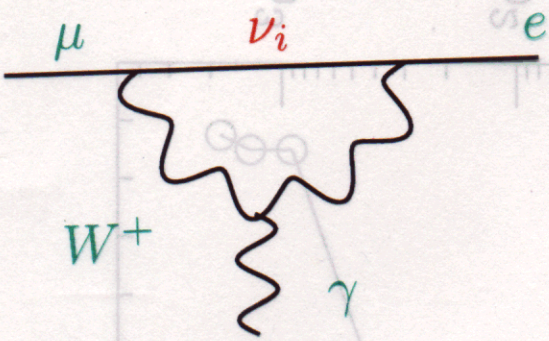
THERE IS PLENTY OF MOTIVATION FROM BOTH THE S.M. PRECISION MEASUREMENT POINT OF VIEW AND FROM THE P.O.V. OF NEW PHYSICS

LEPTON FLAVOUR VIOLATION IS A NICE, CLEAN WINDOW TO NEW PHYSICS, AND WE SHOULD EXPLORE AS MANY CHANNELS AS POSSIBLE
i.e.
ONE SHOULD NOT "DISMISS" $\mu^+ \to e^+e^-e^+$

1. $\mu \to e\gamma$ in the SM with $m_{\nu_i} \neq 0$







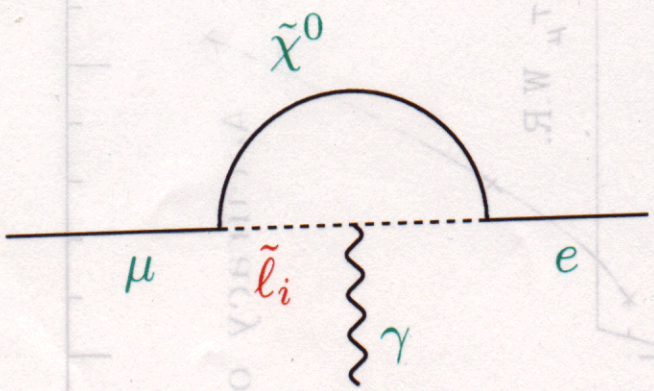
$$\nu_i = \nu_\mu \cos\theta + \nu_e \sin\theta$$

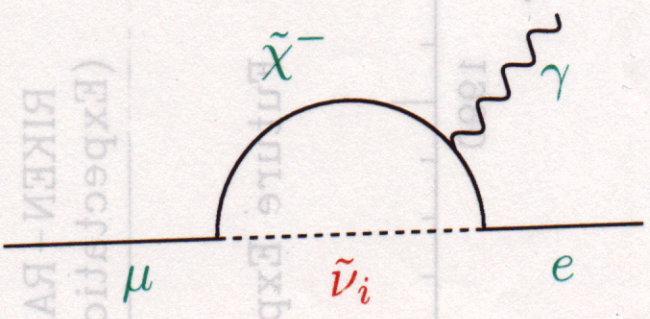
$$\Gamma \propto \left(\frac{m_2^2 - m_1^2}{m_W^2}\right)^2 \sin^2\theta \cos^2\theta$$

Neutrino data: $BR \leq 10^{-50}$!!

2. LFV in minimal SUSY

For $\tilde{\mu}$-$\tilde{e}$ ($\tilde{\nu}_\mu$-$\tilde{\nu}_e$) mixing:

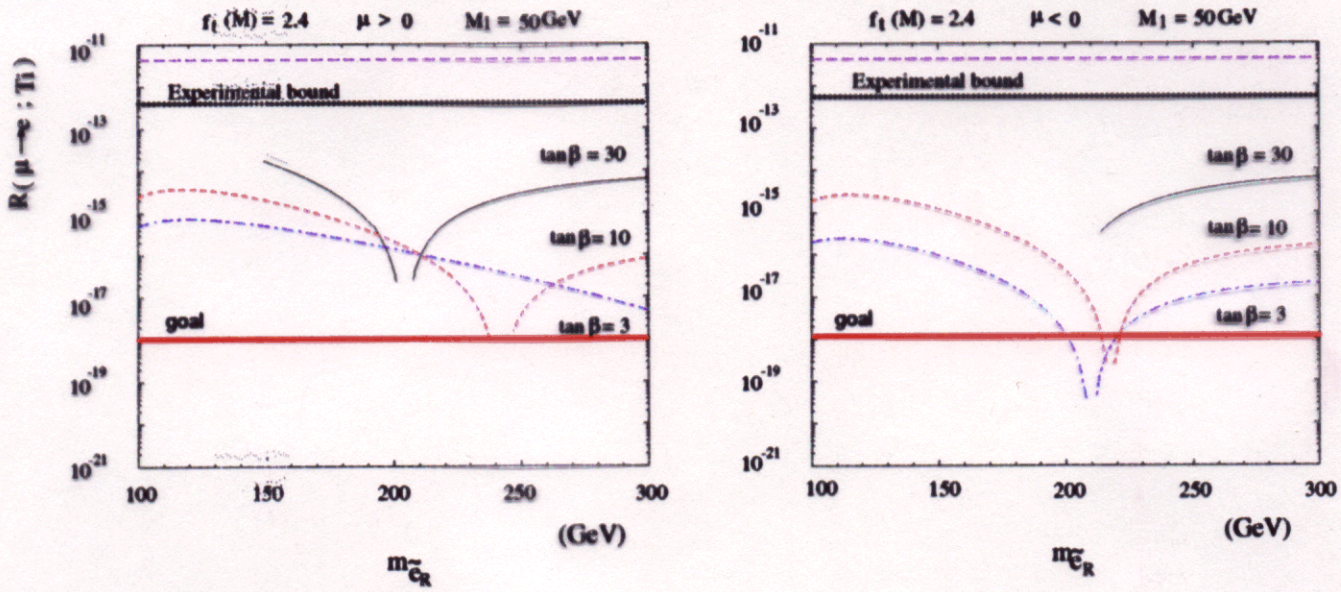




The fermion in the loop is now a neutralino/chargino instead of a neutrino ($m_{\tilde{\chi}^0}, m_{\tilde{\chi}^\pm} \gg m_\nu \Rightarrow$ large rates)

SUSY-GUT Prediction on μ-e conversion

- ***SU(5) SUSY-GUT prediction***

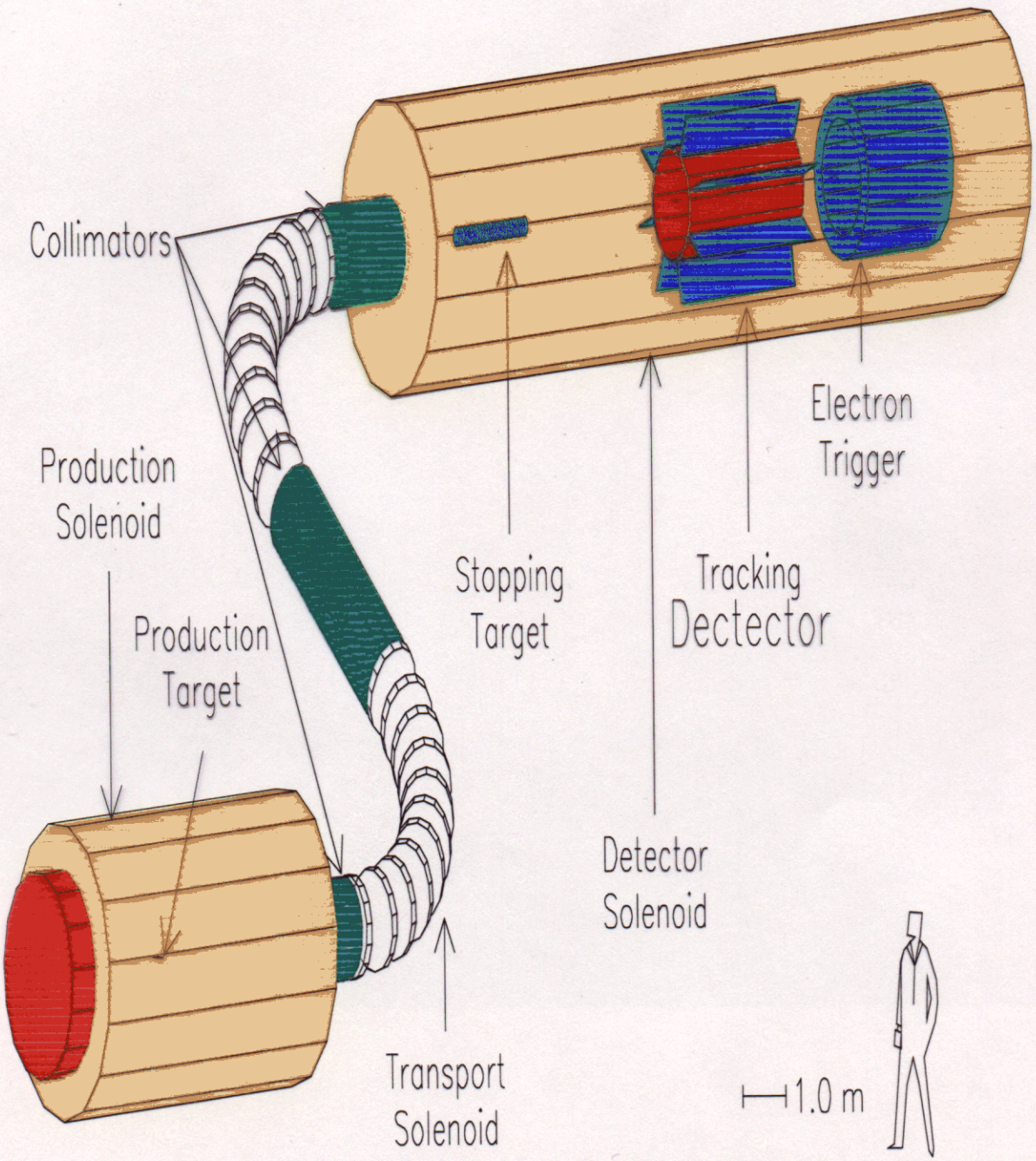


a la J.Hisano

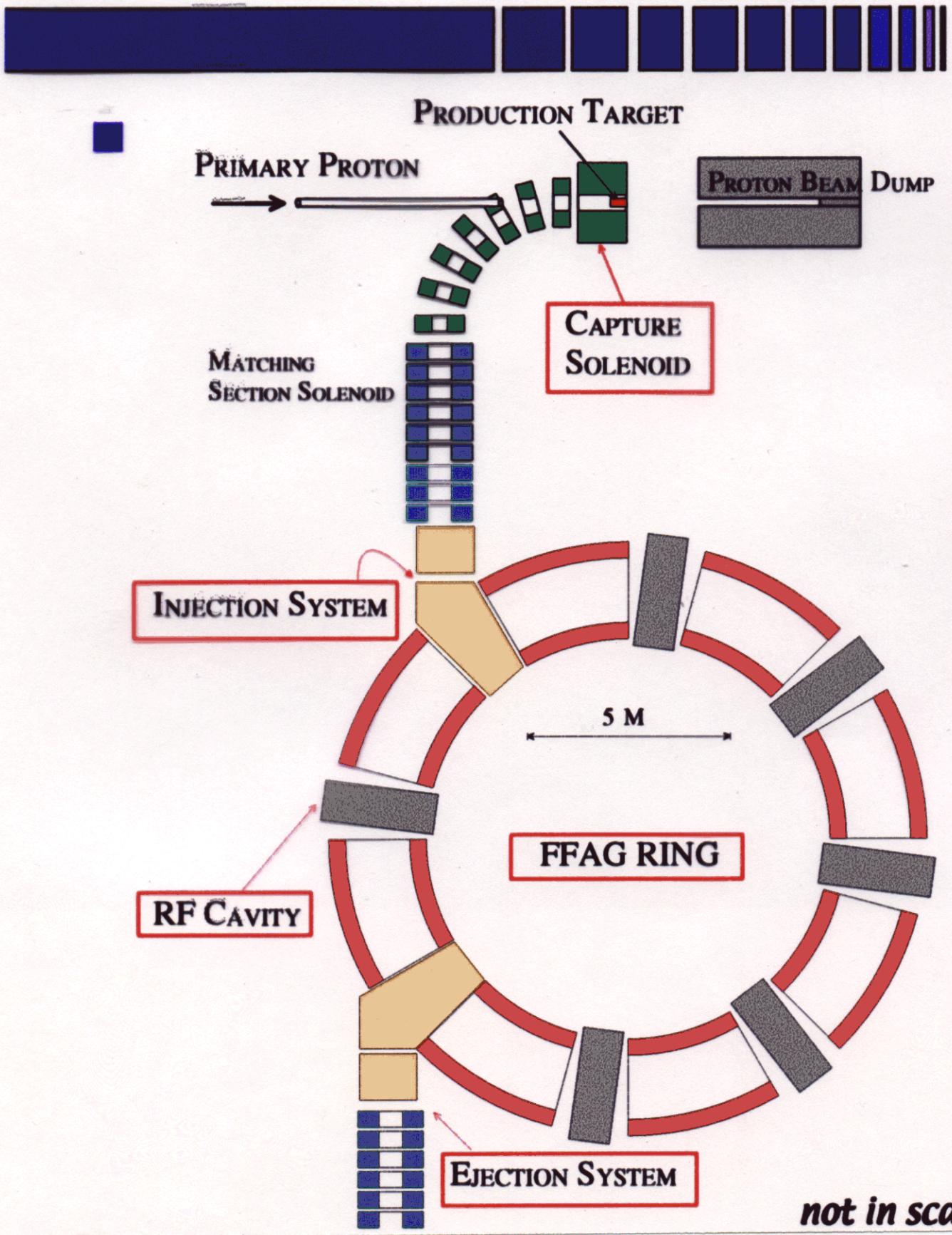
- ***SO(10) SUSY-GUT prediction***
  - *enhanced by $(m_\tau/m_\mu)^2$ (=100) from SU(5) prediction*

The proposed MECO experiment

$\mu^- \mathrm{Al} \rightarrow e^- \mathrm{Al}$



PRISM layout



PRISM
Beam Characteristics

- ***intensity : 10^{11}-10^{12} $\mu^{\pm}$/sec***
- ***muon kinetic energy :***
  20 MeV (=68 MeV/c)
  - *range = about 3 g*
- ***kinetic energy spread :***
  $\pm$0.5-1.0 MeV
  - *$\pm$a few 100 mg range width*
- ***beam repetition :***
  about 1 kHz
  - *in terms of muon lifetime, a 100kHz -1 MHz is ideal.*
  - *increase in future, if technically possible.*

Low Energy Muons

Conclusions

(1) Intense ν/μ beams provide new opportunities to do precision SM tests and/or to look for physics beyond SM.

(2) There are many interesting processes which have not presented here. We need to study each of them and make concrete experimental design.

(3) PRISM ($10^{12}\mu$/sec, 20MeV $\pm$5%)

Low energy, intense muon source has very high physics potentialities. It may be planned as a pre-neutrino factory machine.