

Study of Atmospheric Muons and Their Impact to Low Energy Background in Rare Process Experiments

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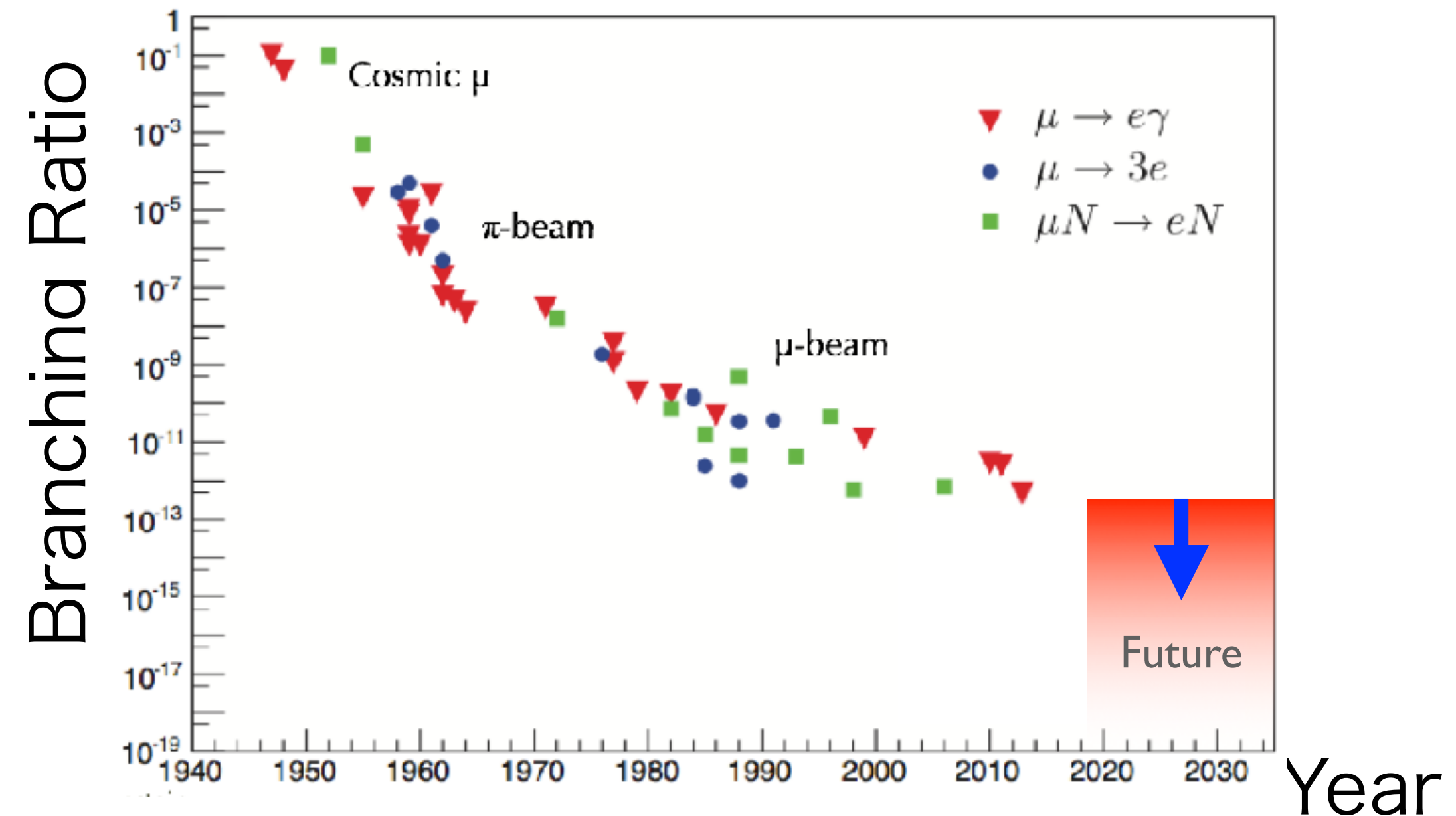
大阪大学
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All members are collaborating in the COMET experiment at J-PARC

Scope of the Project

- LFV searches using muons
 - Progress of detector technology and muon beam improved sensitivities of experiments
 - Stringent constraints on the new physics
 - Background sources
 - Accidental overlaps (coincidence type experiments: $\mu \rightarrow e\gamma$, $\mu \rightarrow eee$)
 - Cosmic-ray induced (μ -e conversion)
- **Understand the cosmic-ray induced background as rare as the μ -e conversion signal**
 1. **Detailed study with “Inverse MC approach” by the French Group**
 2. **Precise flux measurement on site (J-PARC) by the Japanese Group**



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Backward Monte-Carlo applied to muon transport

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ABSTRACT

We discuss a backward Monte-Carlo technique for muon transport problem, with emphasis on its application in muography. Backward Monte-Carlo allows exclusive sampling of a final state by reversing the simulation flow. In practice it can be made analogous to an adjoint Monte-Carlo, though it is more versatile for muon transport. A backward Monte-Carlo was implemented as a dedicated library: PHIMAS, providing a detailed muon transport engine down to a few MeV. It is shown for case studies relevant for muography imaging that the implemented forward and backward Monte-Carlo schemes agree to better than 1%. Within these schemes, the achieved accuracy is similar to the one obtained using a detailed Monte-Carlo engine (Geant4) but with a significant speedup, at least two orders of magnitude in backward mode.

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Project Schedule

- French Group

- 2020-2021

- Study CR by the inverse MC approach and comparison of the result with the “analog” MC result
- Development of Glass Restive Plate Chamber (GRPC) for CR measurement
 - Optimization & production protocol
 - Performance against neutron irradiation

- 2022-2023

- Start mass proaction of GRPC
- Shipping to J-PARC

- Japanese Group

- 2020-2021

- Lead on-site CR measurement using plastic scintillator hodoscope & GRPC prototype once it is ready.
 - French student join the measurement
- Cross-check the result with MC predictions
 - Japanese student visit to Clermont

- 2022-2023

- Install GRPC with French group members
- Start of COMET engineering runs

Summary and Budget Requests

- Background study in the COMET experiment at J-PARC to achieve its target sensitivity and improve further
 - Atmospheric muon induced background as rare as the μ -e conversion signal ($< 10^{-14}$)
 - Innovative method to predict extremely rare CR induced processes, “Inverse MC approach”
 - Development of Glass Resistive Plate Chamber (GRPC) for CR veto system in high neutron radiation area in COMET
 - Precise Measurement on site
- Collaborative work of French and Japanese groups
- Budget request in 2020
 - French group: Visit to Japan for CR measurement on site: 4200 Euro
 - Japanese Group: Visit to France to collaborate in GRPC optimization
 - Student visits from/to France to/from Japan