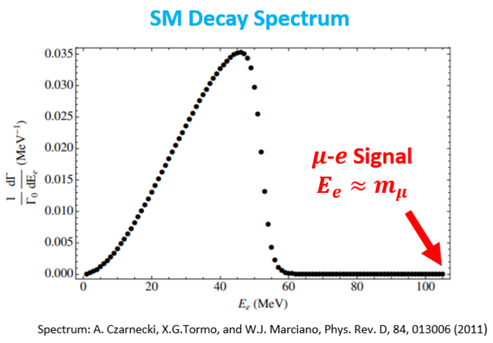
COMET experiment

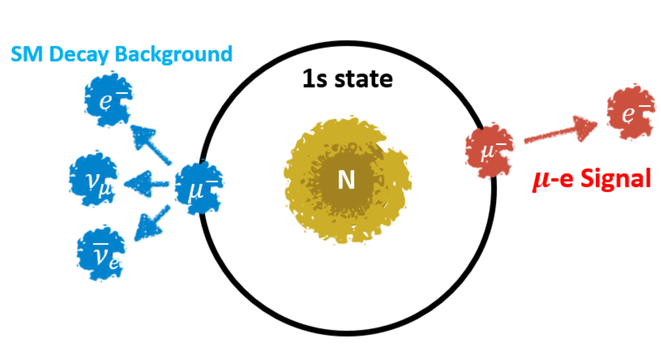
School of Physics and Astronomy, Monash University

Charged Lepton Flavour Violation (CLFV)

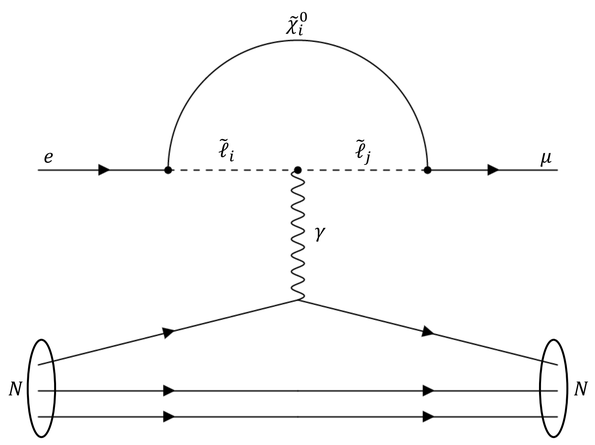
- In the Standard Model (SM), particle "flavour" (e,μ,τ) is conserved in the charged lepton sector
- Therefore any discovery of a CLFV process provides evidence of new physics beyond the Standard Model (BSM)!
- A muon to electron (μ-e) conversion is an example of a CLFV process in which a muon is captured by an atomic nucleus and produces a mono-energetic electron - this signal electron can be separated from SM muon decay electrons by its high momentum



Spectrum: A. Czarnecki, X.G.Tormo, and W.J. Marciano, Phys. Rev. D, 84, 013006 (2011)

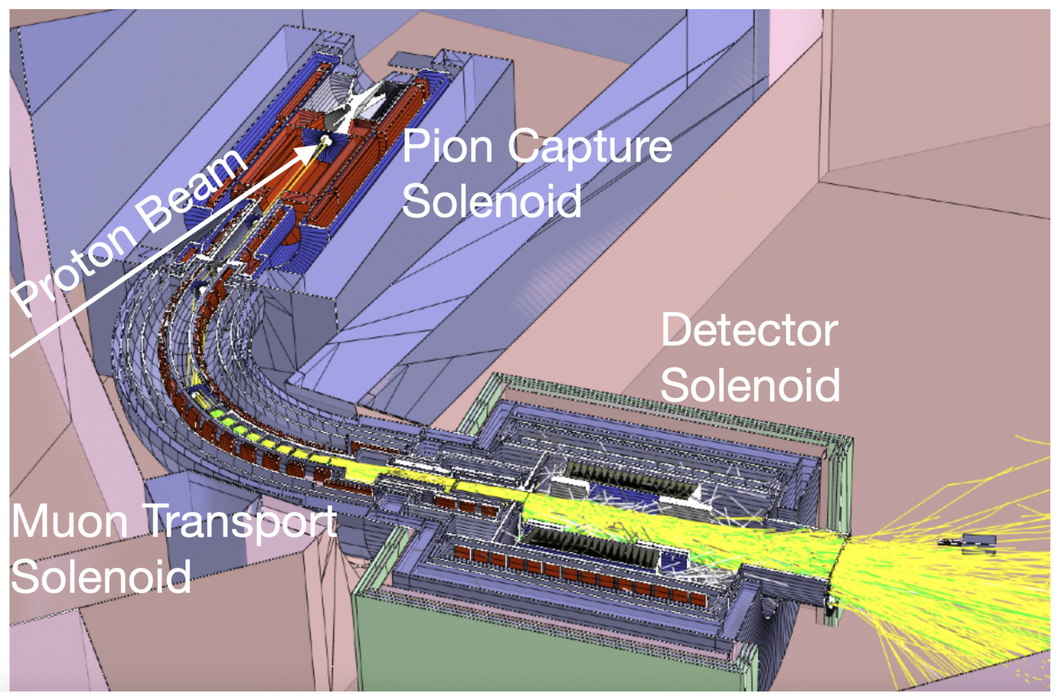


- Many BSM models exist that describe μ-e conversion such as the supersymmetric (SUSY) process shown in the diagram below



COMET Experiment

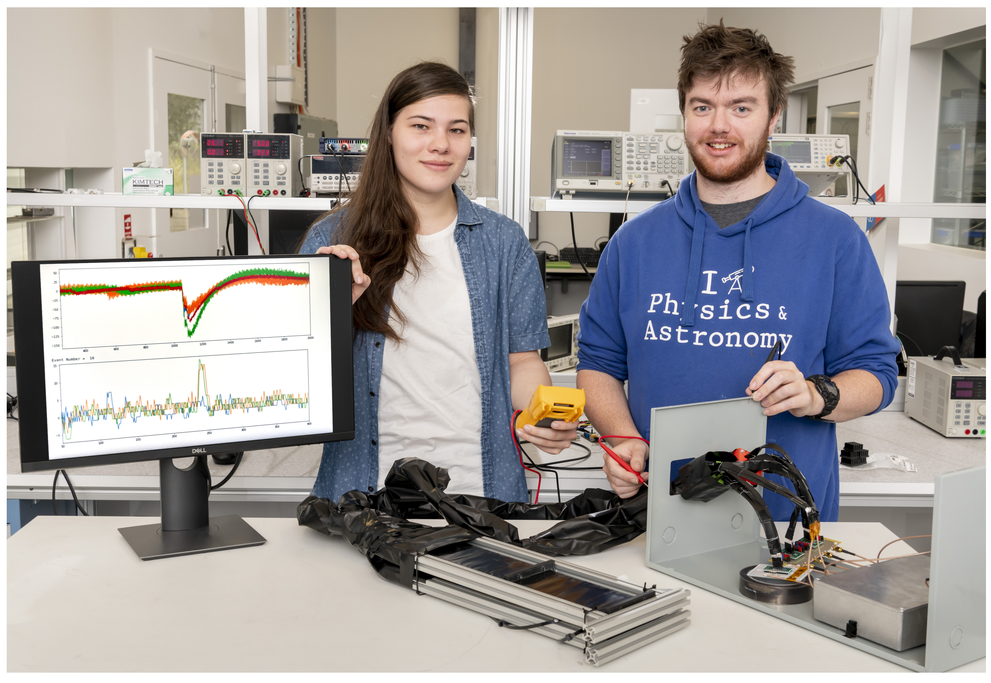
- The COMET (COherent Muon-to-Electron Transition) collaboration consists of more than 200 people from 20+ countries
- COMET will search for μ-e conversion with 10,000 times better sensitivity than past experimental searches
- Many specific BSM models predict μ-e conversion to occur within COMET's experimental sensitivity reach
- Uses the world's highest intensity muon beam produced by the proton accelerator at J-PARC (Japan Proton Accelerator Research Complex), Tokai village, Japan



- Specially bent superconducting solenoid allows us to select for low momentum muons that can be transported to the detector solenoid, then they decay inside the detector solenoid
- Signal electron from muon decays will be measured by a drift chamber and a trigger hodoscope detector for momentum and timing information respectively

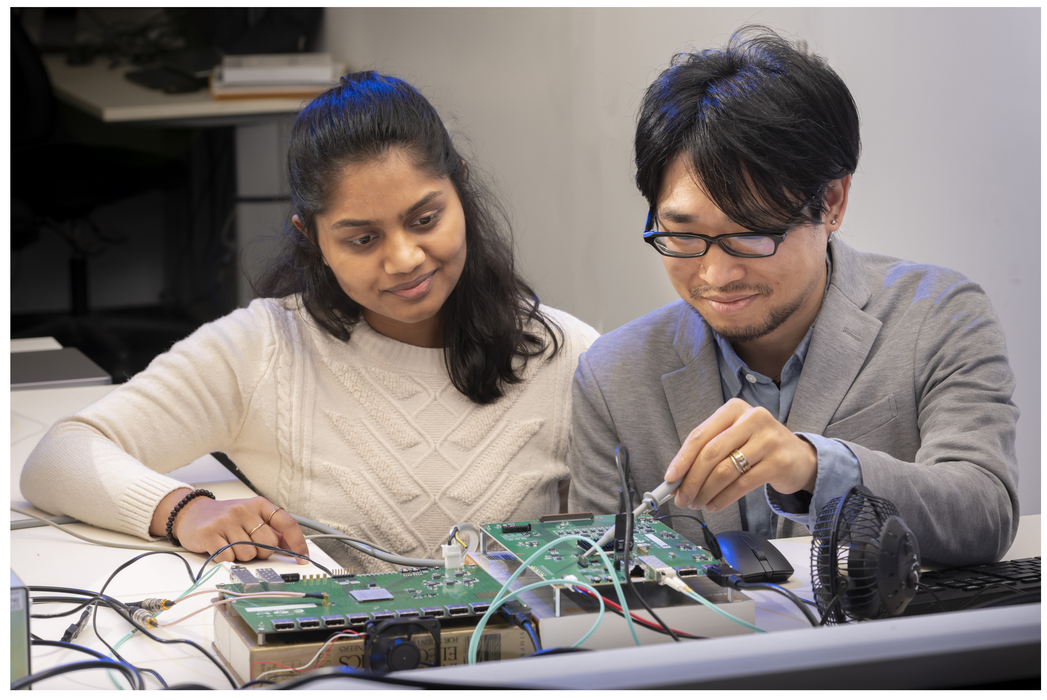
Cylindrical Trigger Hodoscope (CTH)

- The CTH detector is one of the main detectors in COMET to measure the precise timing of the signal electrons.
- Comprised of plastic scintillation counters read out by silicon-based photo sensors.
- The Monash group is testing its prototype detectors and electronics, designing the actual detector, and leading the construction in COMET.



Testing a prototype CTH counter system

Machine Learning Based Trigger Electronics



Probing trigger electronics board

- The COMET experiment will adopt machine-learning boosted intelligent real-time electronics
- Ultra fast decision tree and neural network algorithms inside FPGA to perform event classifications less than 7 μsec
- Development is led by the Monash group

Opportunities

- Interested in the COMET experiment? Opportunities for undergraduate research projects as well as Masters and PhD projects!
- For more information please contact Jordan Nash (jordan.nash@monash.edu)