Lepton Flavour

WIFAI 2024
Workshop italiano sulla Fisica ad Alta intensità
Bologna 12-15 novembre 2024

M. De Gerone - S. Giovannella

Lepton Flavour Violation

- Neutrino masses imply charged Lepton Flavour Violation, but at what rate?
- Considering only SM including m_ν, LFV rates are too tiny to be measured…
- An observation of cLFV would be a clear indication for new Physics!
- There are many models which try to address unresolved SM puzzles that foresee LFV processes at measurable level.
- A large number of channels to be investigated!

A wide and complementary zoology…

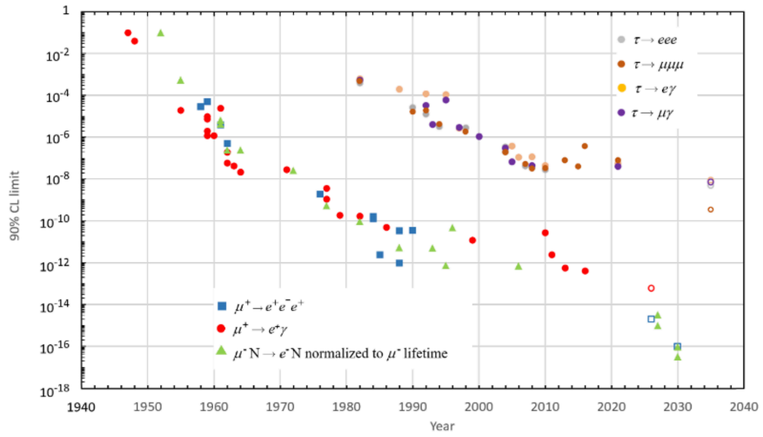
Process	Limit
$\mu^+ \to e^+\gamma$	3.1 x 10^{-13}
$\mu^+ \to e^+e^-e^+$	1.0×10^{-12}
$\mu^-\mathrm{Ti} \to e^-\mathrm{Ca}^*$	8.9×10^{-11}
$\mu^-\mathrm{Pb} \to e^-\mathrm{Pb}$	4.6×10^{-11}
$\mu^-\mathrm{Au} \to e^-\mathrm{Au}$	7×10^{-13}
$\tau^- \to e^-\gamma$	3.3×10^{-8}
$\tau^- \to \mu^-\gamma$	4.2×10^{-8}
$\tau^- \to e^-e^+e^-$	2.7×10^{-8}
$\tau^- \to \mu^-\mu^+\mu^-$	2.1×10^{-8}
$\tau^- \to \mu^-e^+e^-$	1.8×10^{-8}
$\tau^- \to \mu^-\mu^+e^-$	2.7×10^{-8}
$\tau^- \to e^-\mu^+e^-$	1.5×10^{-8}
$\tau^- \to \mu^-e^+\mu^-$	1.7×10^{-8}
$B^0 \to \mu^\pm e^\mp$	1.0×10^{-9}
$B_s^0 \to \mu^\pm e^\mp$	5.4×10^{-9}
$B^0 \to K^{*0}\mu^+e^-$	5.7×10^{-9}
$B^0 \to K^{*0}\mu^-e^+$	6.8×10^{-9}
$B_s^0 \to \phi\mu^\pm e^\mp$	1.6×10^{-8}
$B^+ \to K^+\mu^+e^-$	6.4×10^{-9}
$B^+ \to K^+\mu^-e^+$	7.0×10^{-9}
$B^0 \to \tau^\pm\mu^\mp$	1.5×10^{-5}
$B_s^0 \to \tau^\pm\mu^\mp$	4.2×10^{-5}
$B^0 \to \tau^\pm e^\mp$	1.6×10^{-5}
$B^0 \to K^{*0}\tau^+\mu^-$	1.0×10^{-5}
$B^0 \to K^{*0}\tau^-\mu^+$	8.2×10^{-6}
$D^0 \to \mu^\pm e^\mp$	1.3×10^{-8}
$D^+ \to \pi^+\mu^+e^-$	2.2×10^{-7}
$D^+ \to \pi^+\mu^-e^+$	2.1×10^{-7}
$D^+ \to K^+\mu^+e^-$	1.0×10^{-7}
$D^+ \to K^+\mu^+e^-$	7.5×10^{-8}
$K_L^0 \to \mu^\pm e^\mp$	4.7×10^{-12}
$K_L^0 \to e^\pm e^\pm \mu^\mp \mu^\mp$	4.12×10^{-11}
$K_L^0 \to \pi^0\mu^\pm e^\mp$	7.56×10^{-11}
$K_L^0 \to \pi^0\pi^0\mu^\pm e^\mp$	1.64×10^{-10}
$K^+ \to \mu^-\nu e^+e^+$	8.1×10^{-11}
$Z \to e^\pm\mu^\mp$	7.5×10^{-7}
$Z \to e^\pm\tau^\mp$	5.0×10^{-6}
$Z \to \mu^\pm\tau^\mp$	6.5×10^{-6}
$H \to e^\pm\mu^\mp$	6.2×10^{-5}
$H \to e^\pm\tau^\mp$	2.0×10^{-3}
$H \to \mu^\pm\tau^\mp$	1.5×10^{-3}

μ, τ decays

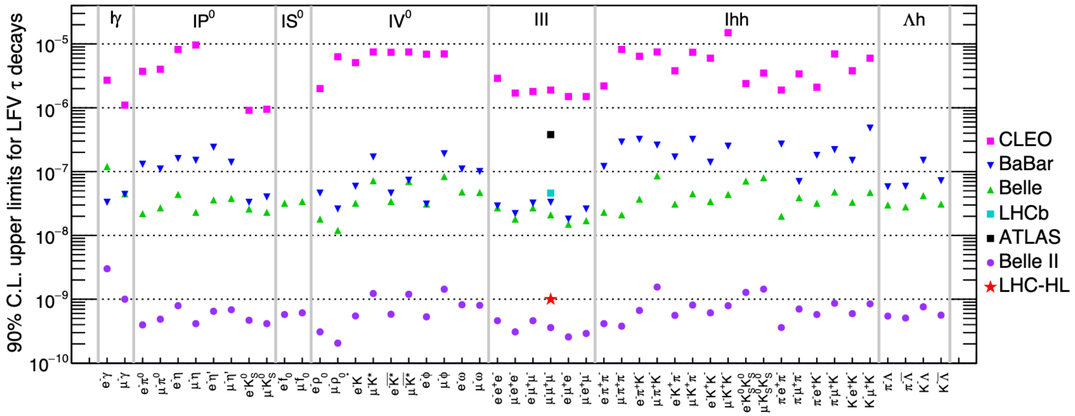
Hadron decays

Heavy bosons

history of μ, τ → l transition



UL on τ LFV decay



Timetable

Introduction *Aula Poeti, Palazzo Hercolani*	*Simona Giovannella et al.* 14:00 - 14:05
Theory overview *Aula Poeti, Palazzo Hercolani*	*Paride Paradisi* 14:05 - 14:30
Lepton Flavour at Atlas and CMS *Aula Poeti, Palazzo Hercolani*	*Chiara Basile* 14:30 - 14:55
Lepton Flavour at Belle2 *Aula Poeti, Palazzo Hercolani*	*Laura Zani* 14:55 - 15:20
Search for Lepton Flavour Violation at LHCb *Aula Poeti, Palazzo Hercolani*	*Simone Capelli* 15:20 - 15:45

Theory overview

LFV at colliders

Results on the X-17 search with the MEG II apparatus *Aula Poeti, Palazzo Hercolani*	*Hicham Benmansour* 16:15 - 16:40
Mu2e: status and perspectives *Aula Poeti, Palazzo Hercolani*	*Gianantonio Pezzullo* 16:40 - 17:05
MEG II and the perspectives of Lepton Physics at PSI *Aula Poeti, Palazzo Hercolani*	*Antoine Venturini* 17:05 - 17:30
Crystal calorimetry for cLFV *Aula Poeti, Palazzo Hercolani*	*Ivano Sarra* 17:30 - 17:55

An interesting “intruder”…

LFV in muon channel

A Hardware point of view