Muons @ NuFact
WG4 Intro at the NuFact 2021 Workshop

Frederik Wauters, Yuri Oksuzian, Yuki Fujii
WG4 conveners
Standard Model\(^+\) CLFV over long distances or \(\ll\) experimental sensitivity: CLFV\(_\mu = \text{New Physics search}\)

Charged \(\leftrightarrow\) Neutral lepton sector

\[\begin{align*}
\pi & \quad \mu \\
\nu_\mu \quad \nu_\mu & \quad \nu_e \\
\nu_e \quad p & \quad e
\end{align*}\]

\[\text{+ } \mu \text{ moments, muonium, muonic atoms, ...}\]
Muons at NeutrinoFact? cLFV

Tuesday

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG II experiment status and prospect</td>
<td>16:00 - 16:30</td>
</tr>
<tr>
<td>Parallel 4</td>
<td></td>
</tr>
<tr>
<td>Search for LFV with the Mu3e experiment</td>
<td>16:30 - 17:00</td>
</tr>
<tr>
<td>Parallel 4</td>
<td></td>
</tr>
<tr>
<td>The Mu3e experiment at Fermilab</td>
<td>17:00 - 17:30</td>
</tr>
<tr>
<td>Parallel 4</td>
<td></td>
</tr>
</tbody>
</table>

Wednesday

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status of the DeeMe experiment to search</td>
<td>12:40 - 12:10</td>
</tr>
<tr>
<td>for $\mu$-$\tau$ conversion at J-PARC MLF</td>
<td></td>
</tr>
<tr>
<td>Parallel 4</td>
<td></td>
</tr>
<tr>
<td>Mu3e-II An Upgrade of the Mu3e for the</td>
<td>13:10 - 13:40</td>
</tr>
<tr>
<td>Fermilab PIP-B Era</td>
<td></td>
</tr>
<tr>
<td>Parallel 4</td>
<td></td>
</tr>
<tr>
<td>Search for Muon to Electron Conversion at</td>
<td>13:40 - 14:10</td>
</tr>
<tr>
<td>J-PARC - COMET Experiment</td>
<td></td>
</tr>
<tr>
<td>Parallel 4</td>
<td></td>
</tr>
</tbody>
</table>

Friday

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lepton flavour physics in the neutrino</td>
<td>14:50 - 15:20</td>
</tr>
<tr>
<td>and muon sector</td>
<td></td>
</tr>
<tr>
<td>Plenary</td>
<td></td>
</tr>
<tr>
<td>muon experiments searching for CLFV</td>
<td>15:20 - 15:50</td>
</tr>
<tr>
<td>Plenary</td>
<td></td>
</tr>
</tbody>
</table>

Lepton sector: gateway to new experimental signals

- Direct searches for New Physics states at high-energy colliders
  - New resonances, SM-forbidden final states
- Rare processes searched for at high-intensities
  - NP discovery (before LHC)
  - Complementary information to direct searches
  - Sensitive to scales beyond collider reach...

"Leptonic" observables: cLFV, LNV, EDMs

Discovery of NEW PHYSICS !!! (beyond SMee)
Complementarity of new physics searches at LHCb, Belle, CMS, NA62, ... and muon CLFV experiments

**Wednesday**

- **Searches for lepton flavour/number violation in K+ and π0 decays at the NA62 experiment**
  - Joel Christopher Swallow
  - Parallel 4
  - 16:00 - 16:30

- **Status of lepton universality tests and searches for charged lepton violation at CMS**
  - Michele Gallinaro
  - Parallel 4
  - 16:30 - 17:00

- **Status and future prospects of lepton universality tests at LHCb**
  - Resmi Puthumanalilam
  - Parallel 4
  - 17:00 - 17:30

**Friday**

- **Lepton flavour physics in the neutrino and muon sector**
  - Sacha Davidsd
  - Plenary
  - 14:50 - 15:20

- **Muon experiments searching for CLFV**
  - Gavin Hesketh
  - Plenary
  - 15:20 - 15:50
In April 2021 a new value for $a_\mu$ was released.

### Wednesday

Beam dynamics corrections to the Run-1 measurement of the muon anomalous magnetic moment at Fermilab

Alessandra Luca

### Thursday

**Magnetic Field Analysis for Fermilab Muon g-2**

Alec Tewksley-Booth

*Parallel 4*

14:20 - 14:50

**Search for the muon electric dipole moment at PSI**

Prof. Kim Siang Khaw

*Parallel 4*

14:50 - 15:20

**The anomalous precession frequency measurement in the Fermilab Muon Sg-2S experiment**

Matteo Sorbara

*Parallel 4*

15:20 - 15:50

**The SM value of g-2**

Dr. Peter Stoffer

*Parallel 4*

16:00 - 16:30

**Muon g-2/EDM experiment at J-PARC**

Otae Masahiro

*Parallel 4*

16:30 - 17:00

### Friday

**Measurement of the Positive Muon Anomalous Magnetic Moment to 0.46 ppm**

B. Aaij et al. (Muon g – 2 Collaboration)

Phys. Rev. Lett. 126, 141801 – Published 7 April 2021

See Viewpoint:Muon’s Escalating Challenge to the Standard Model

**Results from the g-2 experiment**

Simon Corradi

*Plenary*

14:20 - 14:50
A neutrino factory is a high-intensity muon source

- A Muon beam can be Pulsed (FNAL, J-PARC), or DC (PSI, RAL, Music).
- Muon beams have a mixed material science / particle physics use.
- WG3 + WG4 session
A neutrino factory is a high-intensity muon source

- A Muon beam can be Pulsed (FNAL, J-PARC), or DC (PSI, RAL, Music).
- Muon beams have a mixed material science / particle physics use.
- **NEW!** Cold muon beams for
  - Stored muon experiments, e.g g-2/EDM J-PARC, muEDM PSI, …
  - $\nu$ sources (NuStorm workshop on Thursday)
  - Muon collider (MICE etc.)

Muon collider is WG3 topic?

---

**Thursday**
- Muon Ionization Cooling Experiment (MICE): Results & Prospects
- Parallel 1: 14:30 - 15:10
- Normalized Transverse Emittance Reduction via Ionization Cooling in MICE "HiP Mode"
  - Parallel 3: 15:30 - 16:10
- Transverse Emittance Growth and Canonical Angular Momentum Growth in MICE "Solenoid Mode" with Muon Injection
  - Thursday afternoon
- Analysis of Multiple Coulomb Scattering of Muons in the MICE Liquid H2 Absorber
  - Parallel 3: 16:30 - 17:10

---

**Monday**
- Status of Muon Collider R&D
  - T. Haeusler
  - 17:35 - 18:05
A neutrino factory is a high-intensity muon source

- A Muon beam can be Pulsed (FNAL, J-PARC), or DC (PSI, RAL, Music).
- Muon beams have a mixed material science / particle physics use.
- Cold and high-intensity beam development for muon physics in WG3 + WG4 session
New detectors needed for next generation high-intensity muon beam experiments
Great fit with new WG6

<table>
<thead>
<tr>
<th>Wednesday</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Detectors for future CLFV experiments</td>
<td>Bertrand Echenard</td>
<td></td>
</tr>
<tr>
<td>THotel</td>
<td>14:20 - 14:50</td>
<td></td>
</tr>
<tr>
<td>HV-MAPS</td>
<td>Andre Schoening</td>
<td></td>
</tr>
<tr>
<td>THotel</td>
<td>14:50 - 15:20</td>
<td></td>
</tr>
<tr>
<td>StrECAL system for COMET Phase-I and Phase-II</td>
<td>Hajime Nishiguchi</td>
<td></td>
</tr>
<tr>
<td>THotel</td>
<td>15:20 - 16:50</td>
<td></td>
</tr>
</tbody>
</table>
Muons at NuFact 2021
WG4 program

- Full program on indico
- Slack channel
- Joined WG3 session, great fit with new WG6
- WG zoom room. (-> WG4 + WG4+6 sessions) Use WG3 room for WG3+4 joined session
- 12’ish muon posters
- Q: Overlap and complementarity between $\mu$ and $\nu$ new physics searches?
- Q: Reach of upcoming experiments at current and future facilities?
- Q: What detector technology / R&D is needed for the next push?
- Q: Synergy between future muon sources (Pulsed or DC) and neutrino factories?
- Q: Cold muon beam development for various applications ongoing, which ones are relevant for WG4?

Frederik Wauters, Yuri Oksuzian, Yuki Fujii
fwauters@uni-mainz.de, yokszuzian@anl.gov, yuki.fujii@monash.edu
WG4 conveners