The COMET Experiment Status and Prospects

Matthias Dubouchet High Energy Physics Group Imperial College London February 26, 2019

The COMET experiment





The COMET experiment







Muon-to-electron conversion:

$$\mu^- + N(A,Z) \rightarrow e^- + N(A,Z)$$

- Individual lepton flavours are not conserved, which contradicts Standard Model.
- Mono-energetic electron \rightarrow very clean signal, very low background.
- Observing a single event would be evidence of more BSM physics.



- Measure, or set a limit on, the rate of μ -e conversion: $\mu^- + N(A, Z) \rightarrow e^- + N(A, Z).$
- End goal: improve current limit on μ -e conversion by a factor of at least 10⁴ compared to current limit.





Source: COMET TDR



Key dates:

- May 2019: beam campaign with Phase-I Cylindrical Drift Chamber at Kyoto University's Reactor Research Centre.
- Late 2019: Phase-I is being brought online, through calibration and cosmic background measurements.
- Early 2020: proton beam from Main Ring is delivered. Beam diagnostics, more calibration, followed by first data-taking and analysis. After 150 days of data-taking, expect sensitivity increase by a factor of 100.
- Mid-2020s: Phase-II deployed and running, expected to yield another factor 100 or more on the sensitivity.



Ewen Gillies: Cylindrical Drift Chamber Hit Filter Combine Hough transform with Gradient Boosted Decision Tree classifier to automate track identification.

Allows us to push the intensity by filtering out undesired hits.





Siyuan Yan: Optimising the stopping target geometry Generate new geometries and use genetic algorithms to automatically select the best one.

Optimisation problem between the number of muons captured by the aluminium target and the total target mass.





Ideas for future research:

- Picking up on Ewen's work: can we use the third dimension to improve classification?
- Can we parallelise the classification process and use FPGAs for *online* hit filtering?
- High level analysis framework needs to be chosen and implemented this year.
- Can we use modern machine learning, e.g. (convolutional) neural networks, for track identification and other purposes?



There are still many ways in which COMET can be pushed to achieve the best sensitivity. With Ewen leading the way with his machine learning application, many more possibilities are now open.



There are still many ways in which COMET can be pushed to achieve the best sensitivity. With Ewen leading the way with his machine learning

application, many more possibilities are now open.

Thank you!



Hit filter performance evaluation

