# Muonium Oscillations: white paper

- Theoretical Letter of Intent

**Physics of muonium and muonium oscillations**

Alexey A. Petrov[1]

[1]*Department of Physics and Astronomy*
*Wayne State University, Detroit, MI 48201, USA*

Precision studies of a muonium, the bound state of a muon and an electron, provide access to physics beyond the Standard Model. We propose that extensive theoretical and experimental studies of atomic physics of a muonium, its decays and muonium-antimuonium oscillations could provide an impact on indirect searches for new physics.

- Experimental Letter of Intent

*Search for Muonium to Antimuonium Conversion*

**RF Topical Groups:** (check all that apply ☐/■)

☐ (RF1) Weak decays of b and c quarks
☐ (RF2) Weak decays of strange and light quarks
☐ (RF3) Fundamental Physics in Small Experiments
☐ (RF4) Baryon and Lepton Number Violating Processes
■ (RF5) Charged Lepton Flavor Violation (electrons, muons and taus)
☐ (RF6) Dark Sector Studies at High Intensities
☐ (RF7) Hadron Spectroscopy
☐ (Other) *[Please specify frontier/topical group(s)]*

**Contact Information:**(authors listed after the text)
Name and Institution: Jian Tang/Sun Yat-sen University
Collaboration: MACE working group
Contact Email: tangjian5@mail.sysu.edu.cn

**Abstract:** It is puzzling whether there is any charged lepton flavor violation phenomenon beyond standard model. The upcoming Muonium (bound state of $\mu^+e^-$) to Antimuonium ($\mu^-e^+$) Conversion Experiment (MACE) will serve as a complementary experiment to search for charged lepton flavor violation processes, compared with other on-going experiments like Mu3e ($\mu^+ \to e^+e^-e^-$), MEG-II ($\mu^+ \to e^+\gamma$) and Mu2e/COMET ($\mu^-N \to e^-N$). MACE aims at a sensitivity of $P(\mu^+e^- \to \mu^-e^+) \sim \mathcal{O}(10^{-13})$, about three orders of magnitude better than the best limit published two decades ago. It is desirable to optimize the slow and ultra-pure $\mu^+$ beam, select high-efficiency muonium formation materials, develop Monte-Carlo simulation tools and design a new magnetic spectrometer to increase S/B.