



The charged lepton flavor violating process $\tau \rightarrow \gamma\mu$ at STCF

Teng Xiang¹, Xiaodong Shi², Dayong Wang¹, Xiaorong Zhou²

¹Peking University, ²University of Science and Technology of China
Workshop on future Super c-tau factories 2021

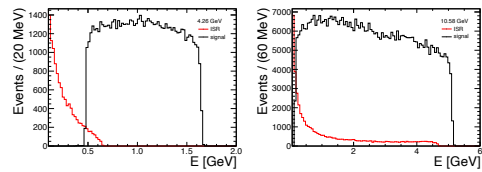
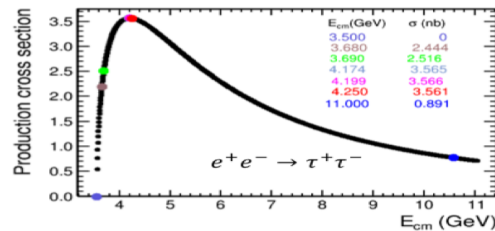


Introduction

- cLFV forbidden in SM \Rightarrow unambiguous signature of NP
- Theoretically Predicted in a wide variety of NP scenarios With rates close to current experimental limits
- Experimentally Belle: $\mathcal{B} < 4.2 \times 10^{-8}$
Babar: $\mathcal{B} < 4.4 \times 10^{-8}$
- τ cLFV Heaviest lepton, many cLFV decay modes $\tau \rightarrow \gamma\mu$ as golden channel

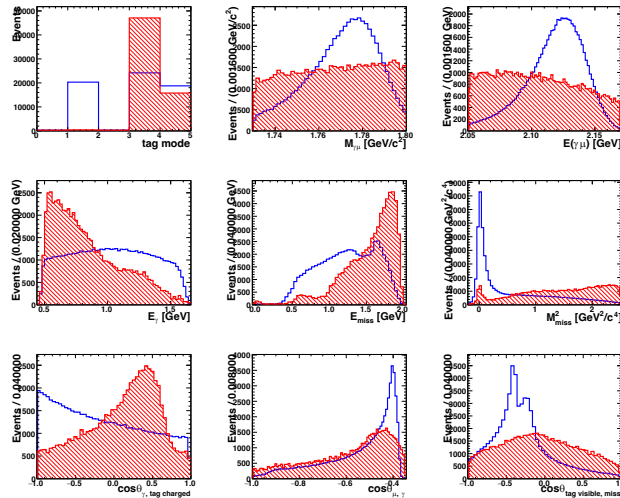
Advantages at STCF

- Pair production \Rightarrow tag and probe
- Max $\sigma(e^+e^- \rightarrow \tau^+\tau^-)$ in tau-charm region
- Known initial kinematic, low multiplicity, full reconstruction \Rightarrow high eff. and low bkg.
- Better separation of signal photon and radiative photon



Analysis

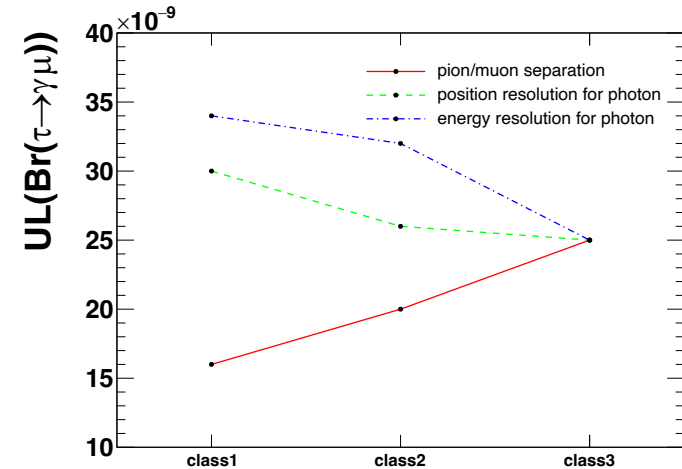
- Tag side: $e\nu_\tau\nu_e, \pi\nu_\tau, \pi\pi^0\nu_\tau$
- Sig side: $\gamma\mu$
- Global Punzi FOM optimization



- $\mathcal{B}_{UL}^{90}(\tau \rightarrow \gamma\mu) = \frac{N_{UL}^{90}}{2\epsilon N_{\tau\tau}}$
- Main background
 - $e^+e^- \rightarrow \mu(\text{sig})\mu(\text{mis-id as tag})$
 - $e^+e^- \rightarrow \tau(\rightarrow \mu)\tau(\rightarrow \text{SM})$
 - $e^+e^- \rightarrow \tau(\rightarrow \pi \text{ mis-id as sig } \mu)\tau(\rightarrow \text{SM})$

Detector response optimization

	class1	class2	class3
π/μ separation	3%	1.7%	1%
γ pos. reso.	6mm	4.2mm	3mm
γ ene. reso.	2.5%	2.25%	2.0%



- moderate π/μ separation: balance between bkg. and eff.
- γ pos. reso.: as good as possible
- γ ene. reso.: as good as possible

Summary

With the expected performance of detector and the luminosity of 1ab^{-1} in one year, the sensitivity is estimated to be 1.6×10^{-8}
 Bkg. clean \Rightarrow with ten-year of data taking, the sensitivity is estimated to be 1.6×10^{-9}
 25 times improved upon the current best result