Two-fermion final states at International Linear Collider

T. Suehara*
Department of Physics, Faculty of Science, Kyushu University

Snowmass 2021 Letter of Interest, Energy Frontier

1 Introduction and status

Precise measurement of electroweak processes is one of the important challanges for energy frontier lepton colliders. Total and differential cross section of two-fermion final states ($e^+e^- \to e^+e^-, \mu^+\mu^-, \tau^+\tau^-, b\bar{b}, c\bar{c}$ etc.) are one of the most precise measurements for Higgs factories, which have sensitivity of new Z'-like bosons up to multi-TeV (depending on machine parameters and models). It is also sensitive to Weakly-Interacting Massive Particles (WIMPs) as a loop contribution.

A full-simulation study assuming International Linear Collider with $\sqrt{s} = 250$ GeV shows that the expected precision of the total and differential cross section reaches 0.1% level [1]. Mass reach to several Z' models and WIMP models has been calculated. Simple extrapolations to 500 GeV and 1 TeV for Z' models are discussed in [2] (Section 8). Based on those reference, comparison with various Higgs factories and hadron colliders is shown in [3] (Section 8.2).

2 Issues and remaining studies

- Dedicated full-simulation analysis at $\sqrt{s} > 250$ GeV has not been done yet.
- Efficiency and background statistics are considered, but uncertainty of the production angle by detector effect is not considered in [1].
- More realistic estimation of the systematic effects is desired.
- More Z' models can be investigated.
- Utilization of the τ polarization should be further investigated.
- As a mid-long range study, reconstruction of jet charge can still be significantly improved with various techniques including deep learning methods.

References

[1] Y. Deguchi, H. Yamashiro, T. Suehara, T. Yoshioka, K. Fujii and K. Kawagoe, Study of fermion pair events at the 250 GeV ILC, arXiv:1902.05245.

[2] LCC Physics Working Group, Tests of the Standard Model at the International Linear Collider, arXiv:1980.11299.

[3] Physics Briefing Book, Input for the European Strategy for Particle Physics Update 2020, arXiv:1910.11775.

*Contact: suehara@phys.kyushu-u.ac.jp