

Di-tau production at ILC

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Two-fermion production at the International Linear Collider (ILC) will allow sensitive indirect searches for new interactions, e.g. such as heavy gauge boson Z' [1, 2]. Two tools are available at ILC to measure the chirality of such new interactions. The first is the ILC's polarised beams: the electron beam is 80 % polarised and the positron beam is 30 % polarised, either left-handed or right-handed. The second is the measurement of the tau lepton polarisation (at higher energies, top quark production can be analysed in a similar way).

Tau polarisation is extracted by measuring the distribution of tau decay products, and relies on the correct identification of tau decay mode. Especially for high energy taus, this requires a suitably-designed detector and sophisticated event reconstruction. A recent study of tau reconstruction and polarisation measurement at ILC500 can be found in [3].

Questions about this tau polarisation study are as follows:

- How useful is the information from tau polarisation, given the ILC's polarised beams? Are there models for which this additional information is crucial?
- What energy scale is accessible at ILC for different BSM models?
- How far would such measurements extend beyond the LHC and HL-LHC sensitivity? What is the role of the different ILC energy stages at 250, 500, 1000 GeV?
- How accurately can tau polarisation be measured? Can all tau decay modes contribute? Can machine learning techniques help?
- What are the dominant systematic errors? How can they be minimised?

References

- [1] Howard Baer, et al. The International Linear Collider Technical Design Report – volume 2: physics. *arXiv:1306.6352*, 2013.
- [2] Keisuke Fujii, et al. Tests of the Standard Model at the International Linear Collider. *arXiv:1908.11299*, 2019.
- [3] Daniel Jeans and Keita Yumino. ILD benchmark: a study of $e^-e^+ \rightarrow \tau^- \tau^+$ at 500 gev, 2019. *arXiv:1912.08403*, 2019.