Di-tau production at ILC

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Introduction

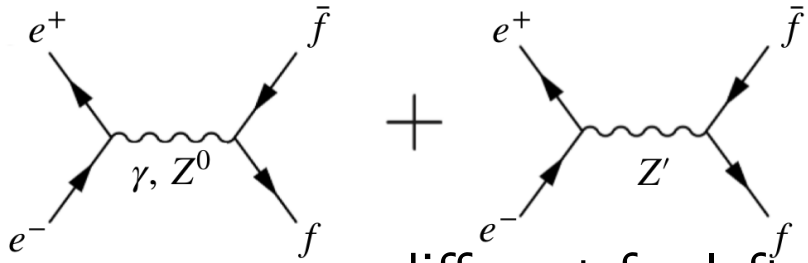
Collision of e^+ and e^- generates tau lepton pair in ILC

Tau-lepton is the heaviest lepton and is the only lepton that can decay to hadrons.
The tau lepton, with its rather short lifetime allows reconstruction of its spin direction by the distribution of its decay products.

Maximum sensitivity to the spin orientation requires reconstruction of the tau decay mode and the kinematics of its decay.

Motivation 1

In the ILC, forward-backward asymmetry $A_{FB} = \frac{3}{4} A_e \cdot A_f$ can be measured



couplings to Z boson g_R, g_L are different for left- and right-handed fermions and left-right polarisation asymmetry A_f are expected in the Standard Model.

$$A_f = \frac{g_R^2 - g_L^2}{g_R^2 + g_L^2}$$

Thanks to ILC's polarised beams ($e^-_{L80} e^+_{R30}$) A_e can be measured
$\rightarrow A_f$ can be extracted from A_{FB}

Motivation 2

by measuring A_{FB} precisely and looking for deviations from SM predictions it is possible to search for new physics, such as those caused by heavy gauge boson Z'

we can also directly measure A_τ by measuring tau polarisation $P(\tau)$

$$\frac{dP(\tau)}{d\cos\theta} = \alpha A_e(1+\cos^2\theta) + \beta A_\tau \cos\theta$$

where α, β: coefficients predicted by SM.

this polarisation of tau $P(\tau)$ depends on tau decay mode.

The aim of this study is reconstruction of tau spin in order to measure polarisation to investigate new physics.

Current status

- Signal event sample were generated using WHIZARD ver 2.8.2
- The decay of the polarised tau was done using TAUOLA
- Full simulation of ILD detector based on Geant4 and realistic reconstruction were performed.

	$\pi^0 \to \gamma\gamma$ #photons
$\tau \to \pi\nu$	0
$\tau \to \rho\nu \to \pi\pi^0\nu$	2
$\tau \to a_1\nu \to \pi\pi^0\pi^0\nu$	4