Long-lived Stau

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Wataru Yamaura

Intention

- I study supersymmetric scenario with a long lived stau at the ILC.
 If LSP is neutralino,
  -can't interact with detector
   and is only measured missing momentum

If stau is lighter than lightest neutralino
   and is long lived,
  -Its lifetime is long enough to escape the detector.
   Stau interacts with detector and can be discovered
   with a good accuracy.

Long-Lived Stau

Decay mode

$$\tilde{q} \rightarrow q \, \chi_1^0$$

$$\chi_1^0 \rightarrow \tau^\pm \tilde{\tau}_1^\mp \qquad \chi_1^0 \rightarrow l^\pm \tilde{l}_R^\mp \ , \ \tilde{l}_R^\mp \rightarrow l^\mp \tau \tilde{\tau}$$

Mass of slepton and nutralino

$$m_{\tilde{\tau}_1} < m_{\tilde{e}_R, \tilde{\mu}_R} < m_{\chi_1^0}$$

Right-handed slepton is lighter χ_1^0
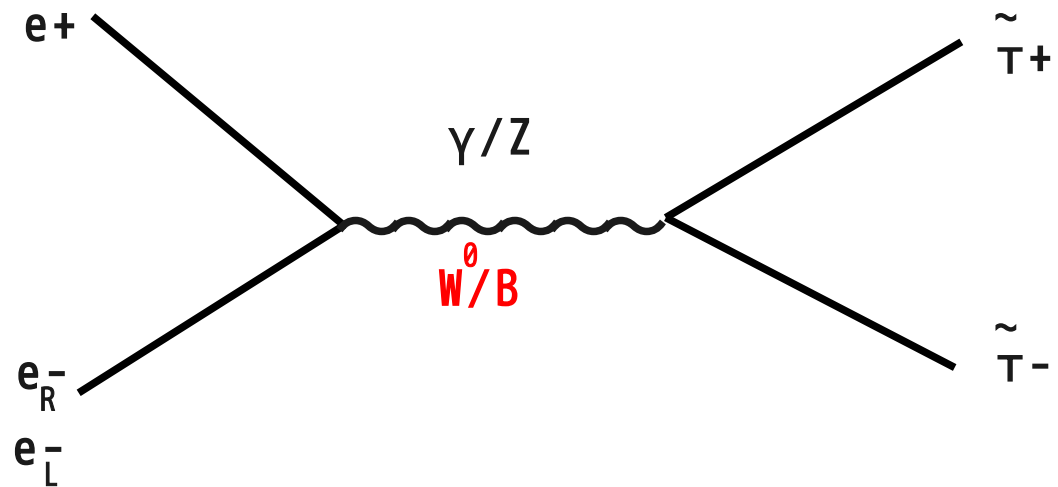Left-handed slepton is heavier than

Invariant mass

$$M_{j_\tau \tilde{\tau}} \equiv \sqrt{\left(p_{j_\tau} + p_{\tilde{\tau}} \right)^2} = m_{\chi_1^0}$$
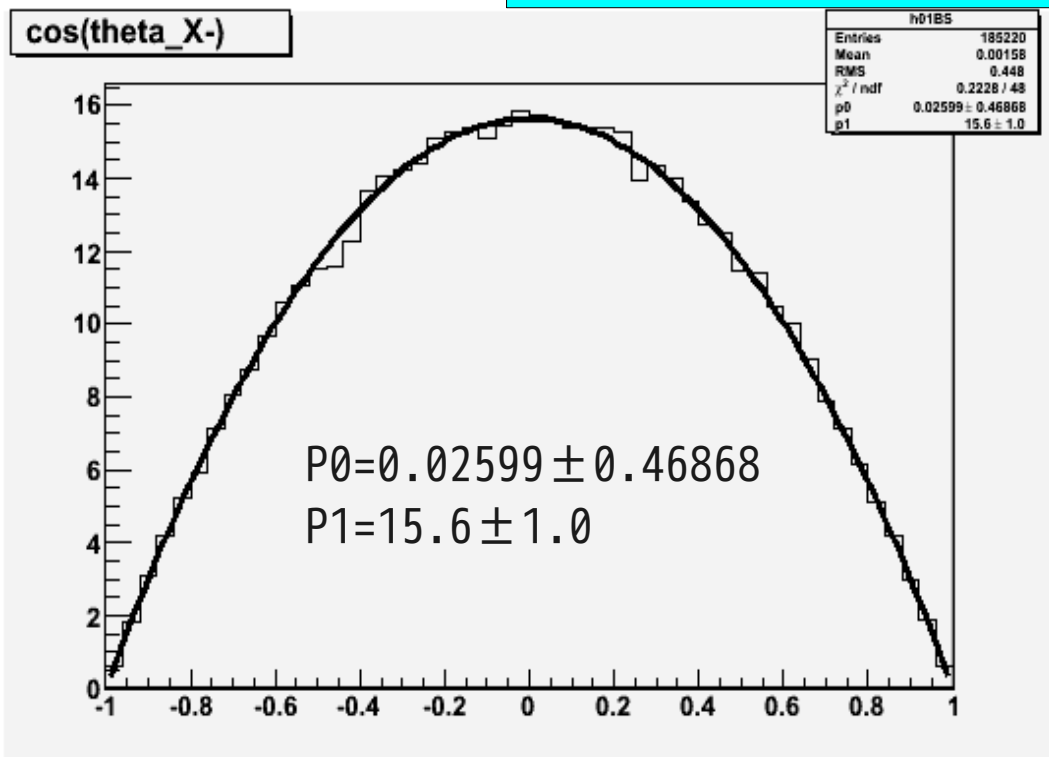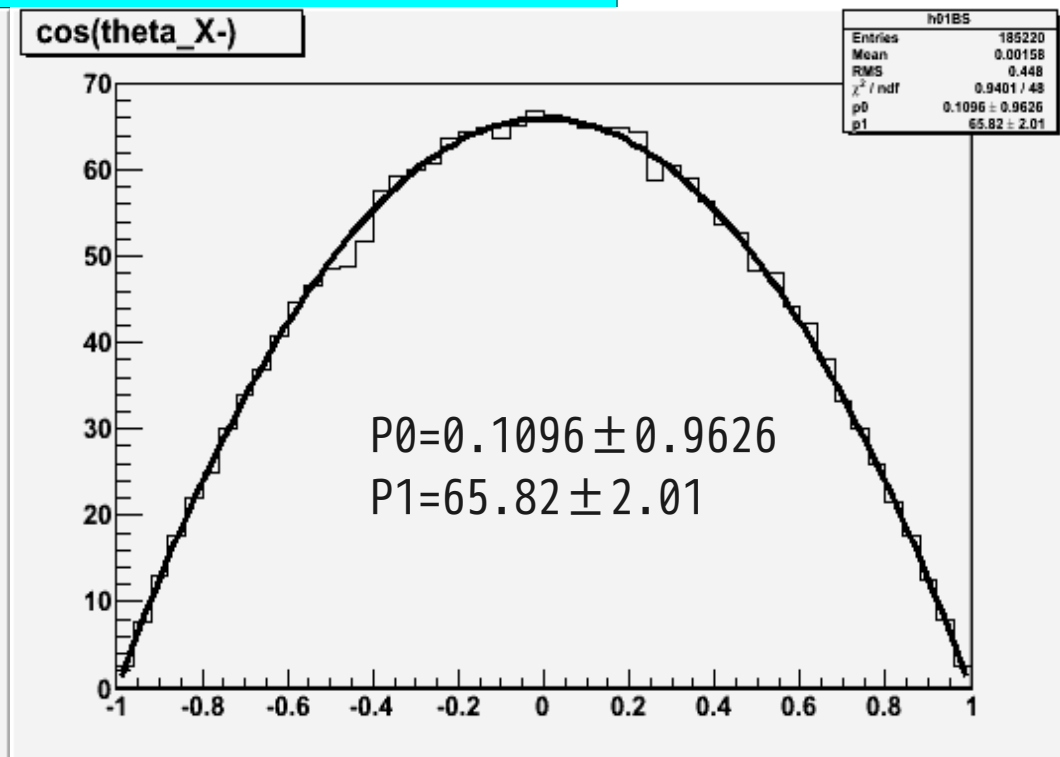
Event Generation

BASES/SPRING
e+e-collider

Angular distribution

cos(theta_X-)

h01BS	
Entries	185220
Mean	0.00158
RMS	0.448
χ^2 / ndf	0.2228 / 48
p0	0.02599 ± 0.46868
p1	15.6 ± 1.0

P0=0.02599±0.46868
P1=15.6±1.0

cos(theta_X-)

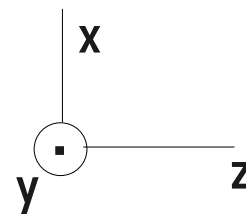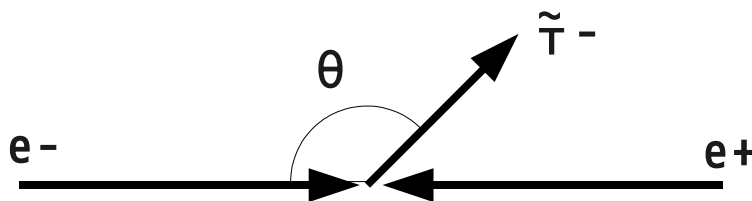| h01BS	
Entries	185220
Mean	0.00158
RMS	0.448
χ^2 / ndf	0.9401 / 48
p0	0.1096 ± 0.9626
p1	65.82 ± 2.01

P0=0.1096±0.9626
P1=65.82±2.01

Left-handed electoron500GeV   Right-handed electoron500GeV

Fitting: $P0 + P1 \times \sin^2\theta$
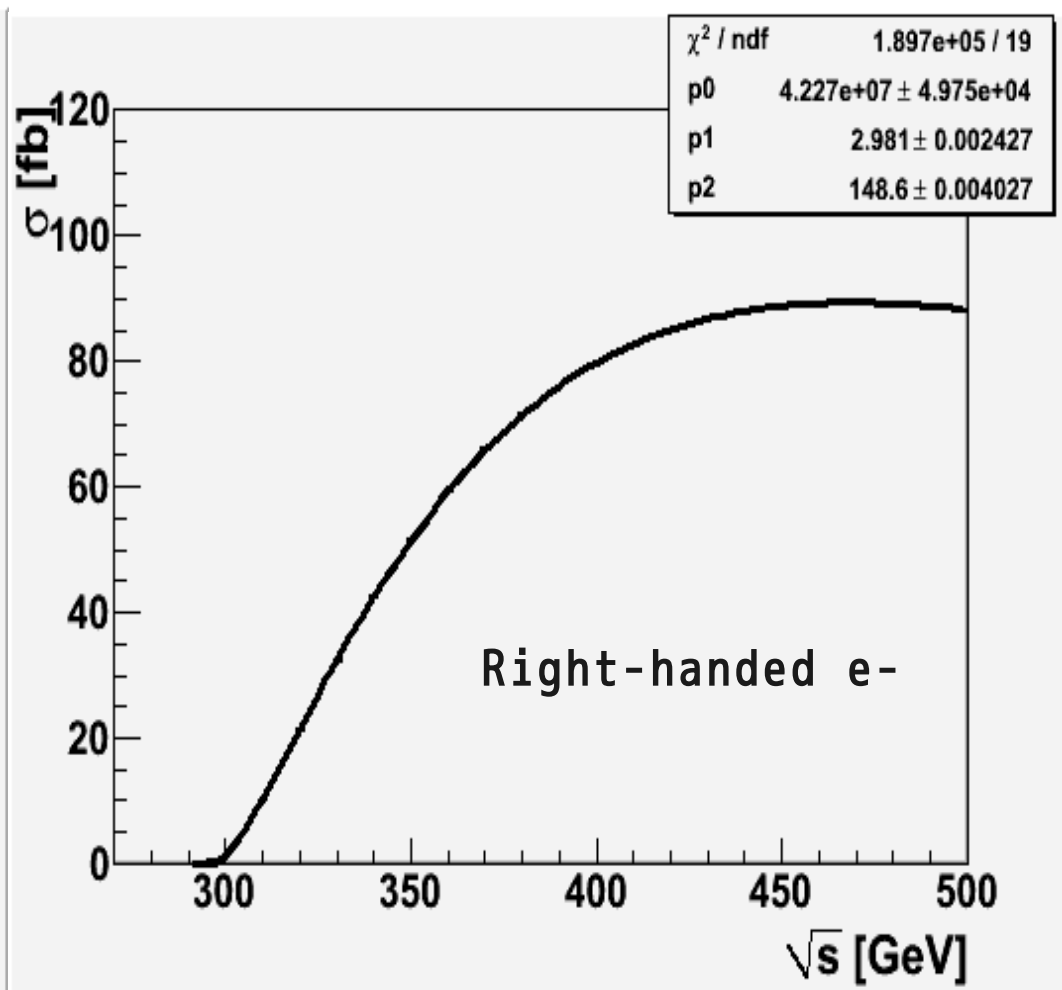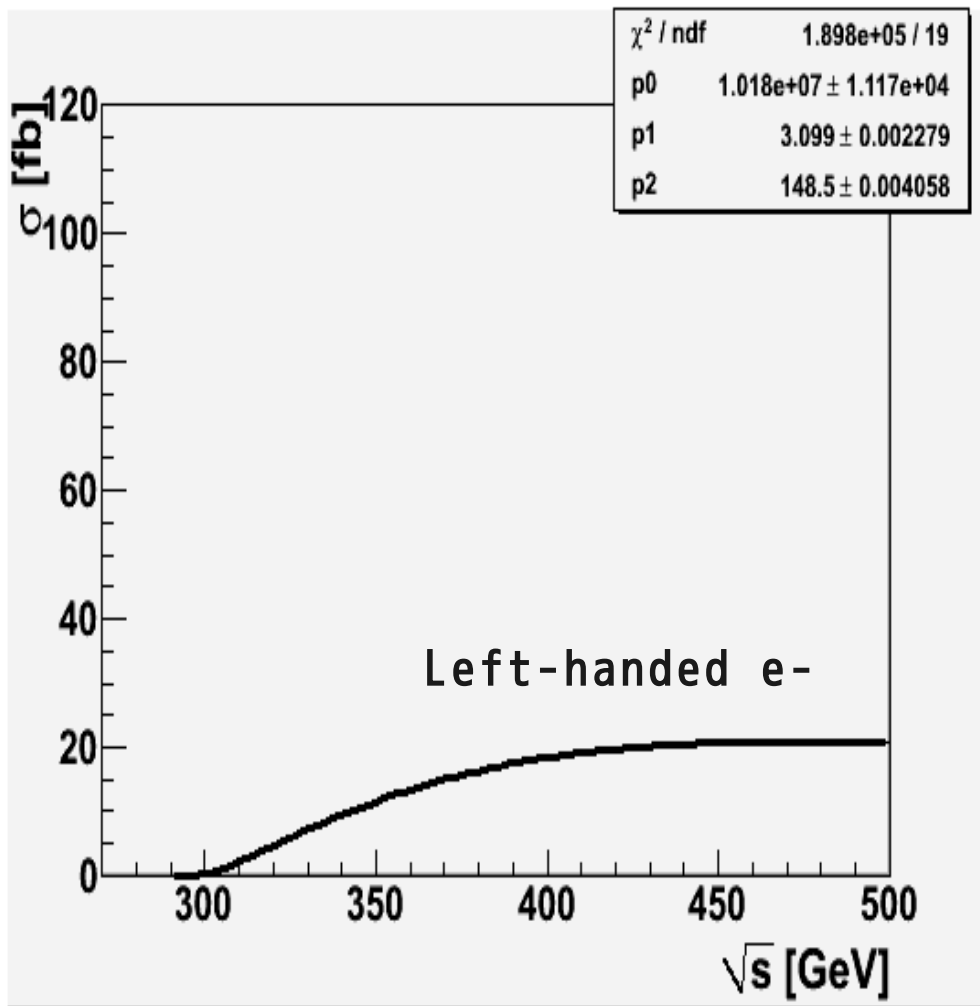
Measurement of Mass

Fitting function of cross section

$$|T|^2 \times \left(\sqrt{\frac{(\sqrt{s}/2)^2 - M^2}{(\sqrt{s}/2)^2}} \right)^3 \times \frac{1}{s}$$

T:amplitude
√s:center of mass energy
M:mass of stau

Left-handed e-

χ² / ndf	1.898e+05 / 19
p0	1.018e+07 ± 1.117e+04
p1	3.099 ± 0.002279
p2	148.5 ± 0.004058

Right-handed e-

χ² / ndf	1.897e+05 / 19
p0	4.227e+07 ± 4.975e+04
p1	2.981 ± 0.002427
p2	148.6 ± 0.004027

Cross section

M=148.8[GeV]

Fitting: $P0 \times \left(\sqrt{\frac{(\sqrt{s}/2)^2 - P2^2}{(\sqrt{s}/2)^2}} \right)^{P1} \times \frac{1}{s}$

Time of Flight

Measure precision of mass by time of flight at TPC.
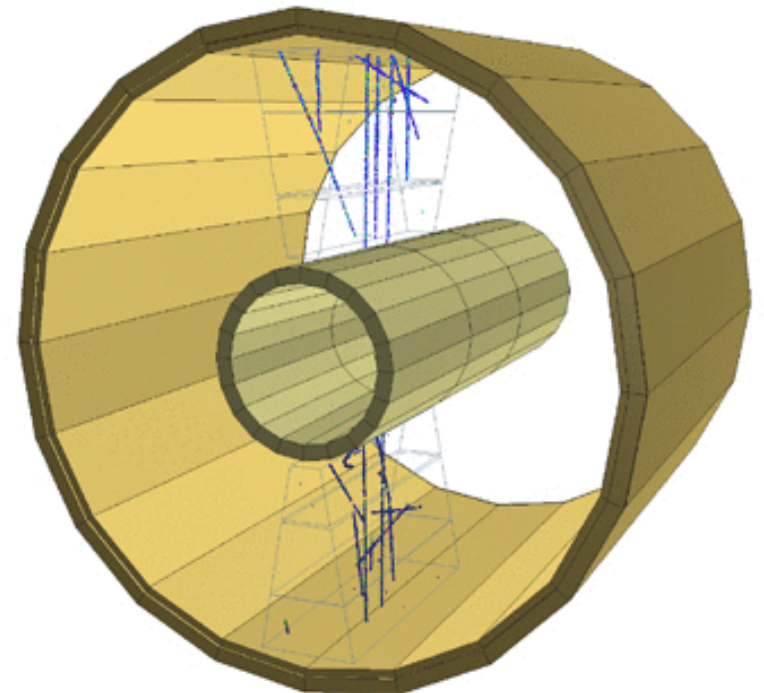It is measured at drift region.
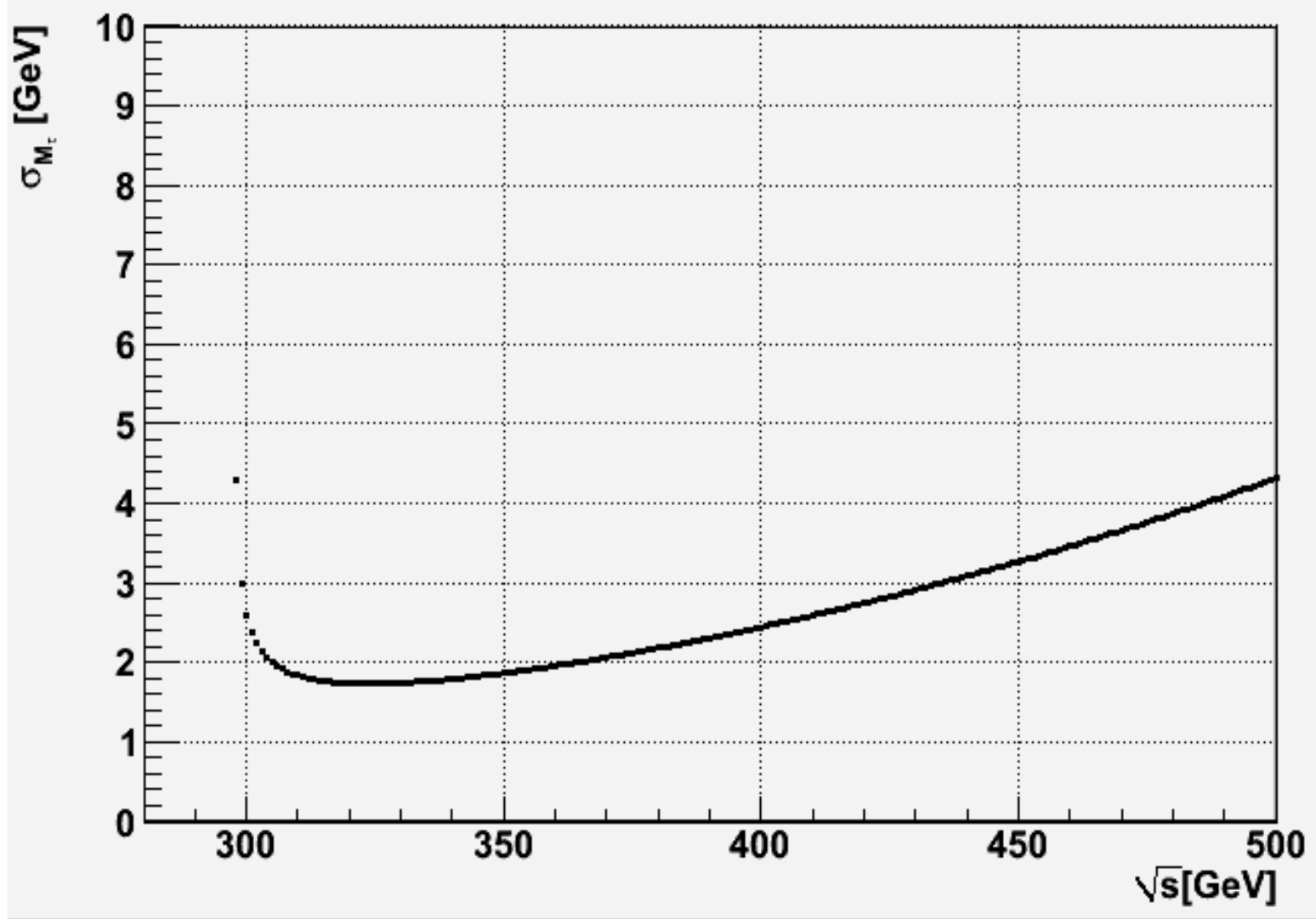
Mass of stau
M=148.83GeV

TPC
内径:0.395m
外径:1.739m
長さ:2.2475m
Time resolution:1ns

presicion of σ_M by TOF

Left-handed electoron

About 320-330GeV,sigma M value is minimum.

Plan

- Make $\chi_1^0 \to \tau^\pm \tilde{\tau}_1^\mp$ generator
- Caluclate dE/dx at TPC