

# Chicken chicken

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- $\Sigma$  Chicken = chicken

# Testing CP violation in MSSM via $\tau$ decays at ILC



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# Start-up

- CP(Negative helicity particle ) -> Positive helicity particle
- Measuring CP violation needs memory of helicity states of particles
- Phases lead to CP violation
- Remembering helicity - helicity amplitudes

$$u(p, \lambda)\bar{u}(p, \lambda) = \frac{1}{2}(1 + \gamma_5 \not{\epsilon}) (\not{p} + m),$$

$$v(p, \lambda)\bar{v}(p, \lambda) = \frac{1}{2}(1 + \gamma_5 \not{\epsilon}) (\not{p} - m).$$

# Asymmetry

$$|\mathcal{M}|^2 \propto \Im\{a_{mi}(b_{mi})^*\} \epsilon_{\mu\nu\rho\sigma} p_{\tilde{\tau}}^{\mu} p_{\ell_1}^{\nu} p_{\tau}^{\rho} s_{\tau}^{a,\sigma}$$

$$\mathcal{P}_2 \equiv \frac{N(\uparrow) - N(\downarrow)}{N(\uparrow) + N(\downarrow)},$$

$$\mathcal{P}_2 \equiv \mathcal{A}^T = \frac{\sigma(\mathcal{T} > 0) - \sigma(\mathcal{T} < 0)}{\sigma(\mathcal{T} > 0) + \sigma(\mathcal{T} < 0)},$$

# What do we do?

- Take (your favorite )MSSM – introduce phases
- Use helicity amplitudes to construct observables

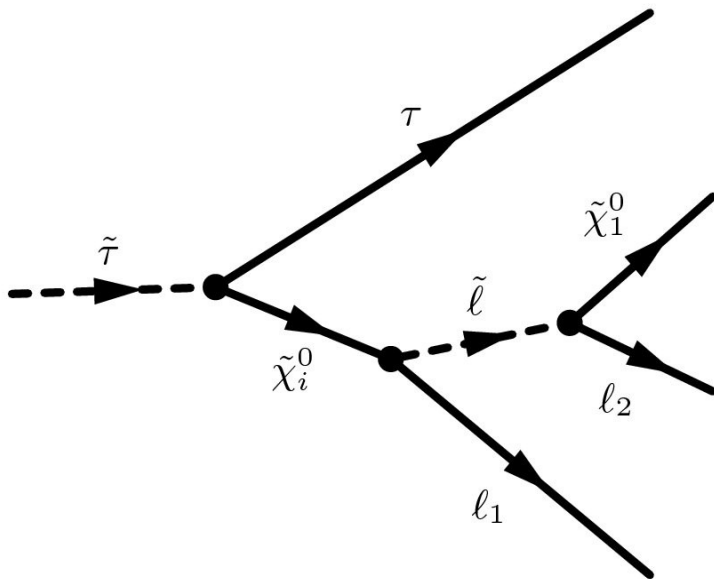


FIG. 1: Schematic picture of stau decay.

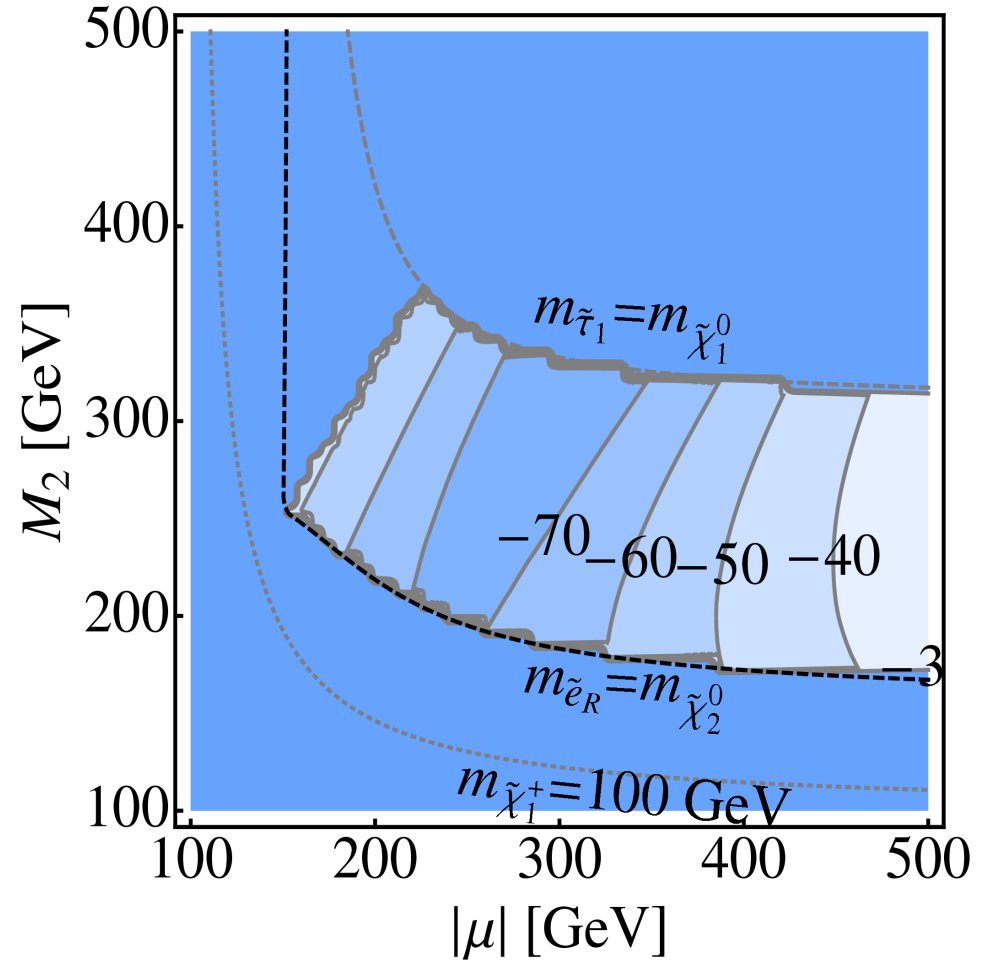
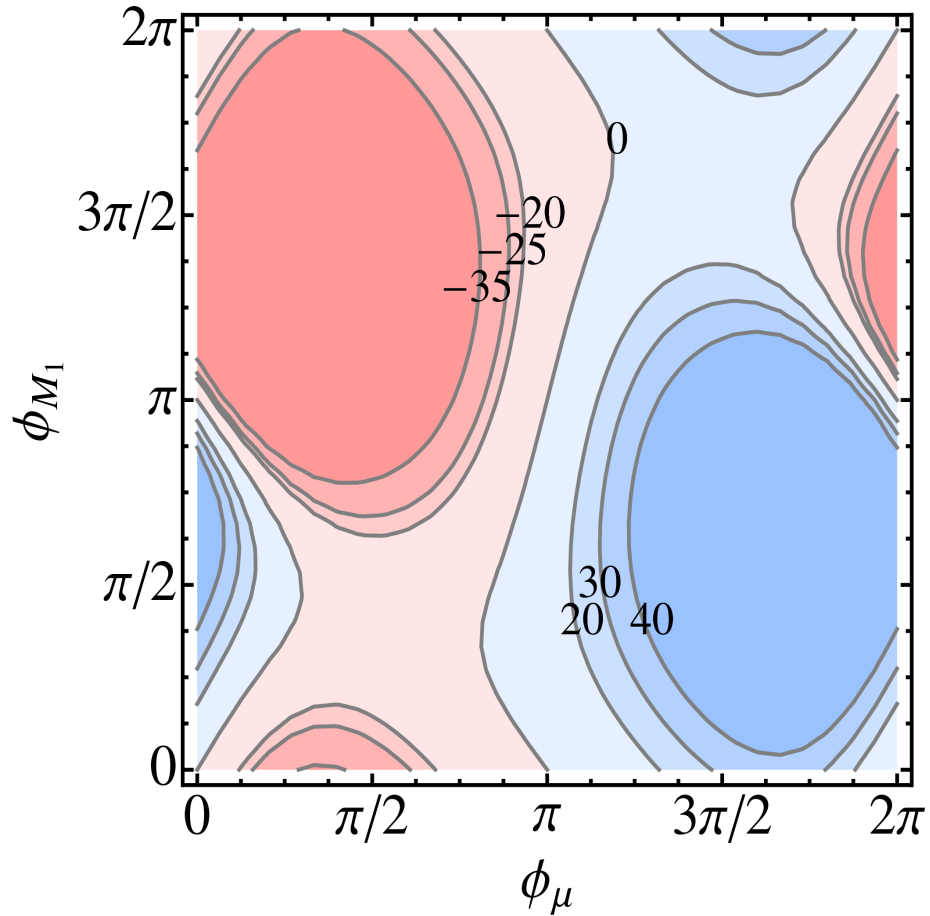
- Stau – scalar particle
- Production and decay independent
- Study only decay

# MSSM

$$\mathcal{M}_{\tilde{\tau}} = \begin{pmatrix} m_{\tilde{\tau}_L}^2 & e^{-i\varphi_{\tilde{\tau}}} m_{\tau} |\Lambda_{\tilde{\tau}}| \\ e^{i\varphi_{\tilde{\tau}}} m_{\tau} |\Lambda_{\tilde{\tau}}| & m_{\tilde{\tau}_R}^2 \end{pmatrix}.$$

$$\mathcal{M}_{\tilde{\chi}} = \begin{pmatrix} M_1 e^{-i\phi_{M_1}} & 0 & -M_z s_w \cos\beta & M_z s_w \sin\beta \\ 0 & M_2 e^{-i\phi_{M_1}} & M_z c_w \cos\beta & -M_z c_w \sin\beta \\ -M_z s_w \cos\beta & M_z c_w \cos\beta & 0 & -\mu e^{-i\phi_{\mu}} \\ M_z s_w \sin\beta & -M_z c_w \sin\beta & -\mu e^{-i\phi_{\mu}} & 0 \end{pmatrix}$$

# The wallpaper



Non – GUT scenario with  
M1 = 250 GeV  
Stau phase =  $\pi/2$

Atau = 2000  
tan(beta) = 3