(S)PYTHIA 2001

Preparing for the Future

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Overview

- (S)PYTHIA is built into the successful PYTHIA framework
- No longer a stand-alone program, but evolves with PYTHIA
  - Showering improvements for heavy particles
  - charm/bottom hadronization tunings
  - evolution to other computing frameworks

    (C and Java interfaces upon request)

Susy Simulation

Constructed from $\mathcal{L}_{eff}$@M_{Weak} ~ 1 TeV

Susy + soft breaking (mass) parameters

- tan $\beta, M_i, \mu, m_{\tilde{q}}, m_{\tilde{\ell}}, A_i, M_{A/H^+}, M_{\tilde{G}}$
- 2-loop effective Higgs potential
- 2→2 sparticle production (no $\tilde{G}$)
- 1→2 ($\tilde{G}$), 1→3 R^+ decays
- No RGE's *(Isasusy interface available)*

Trivial Example

"pythia < input.dat"

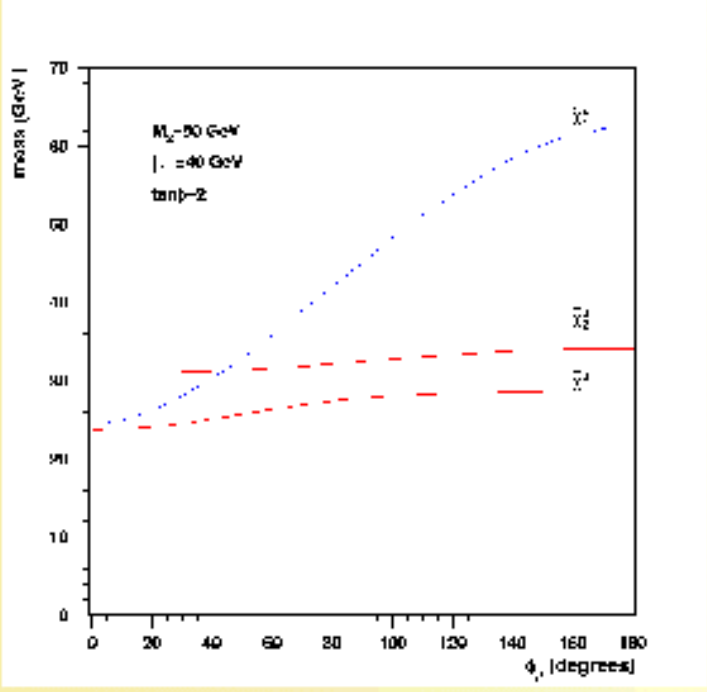
```
DO I=1,1000
  READ(*,*) STRING
  CALL PYGIVE(STRING)
ENDDO
CALL PYINIT('CMS','p','pbar',2000D0)
CALL USRINIT
DO I=1,NEV
  CALL PYEVNT
  CALL USREVNT
ENDDO
CALL USRDONE
CALL PYSTAT(1)
STOP
```

Example Input File

```
PMAS(6,1)=174.
IMSS(1)=1          ! Turn on SUSY
RMSS(1)=100.       ! M1
RMSS(2)=200.       ! M2
RMSS(3)=300.       ! M3
RMSS(4)=-150.      ! μ
RMSS(5)=10.        ! tanβ
RMSS(19)=400.      ! MA
```

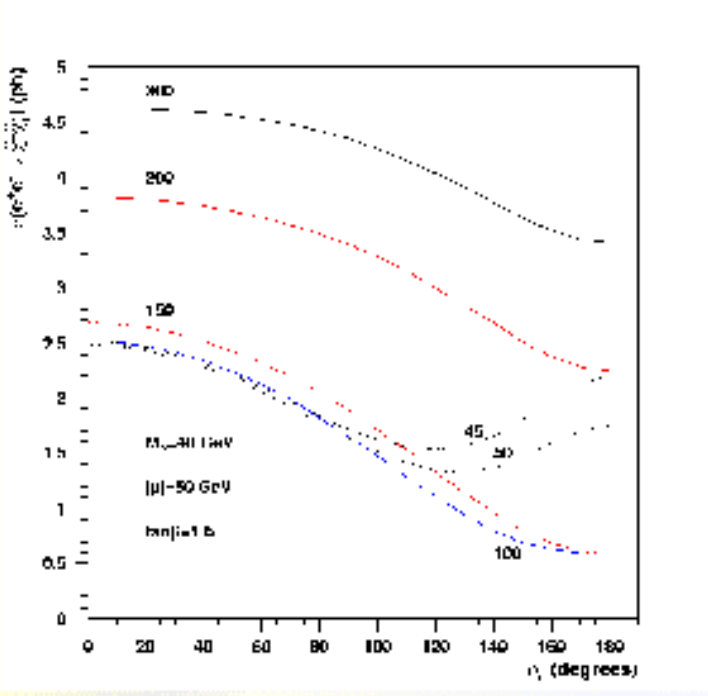
Upgrades

- Complex (φ_i, φ_μ) $\widetilde{C}_i, \widetilde{N}_j$ sector

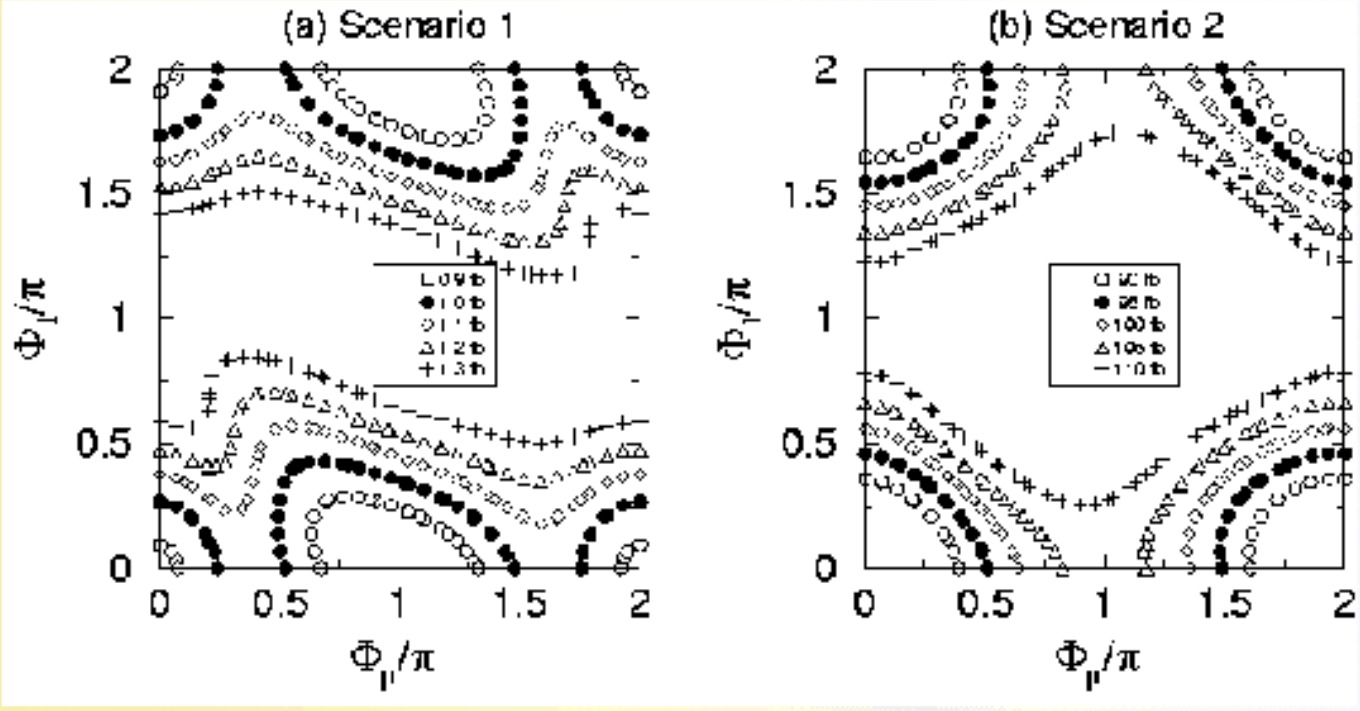


- More variation in mass relations

- Production σ affected



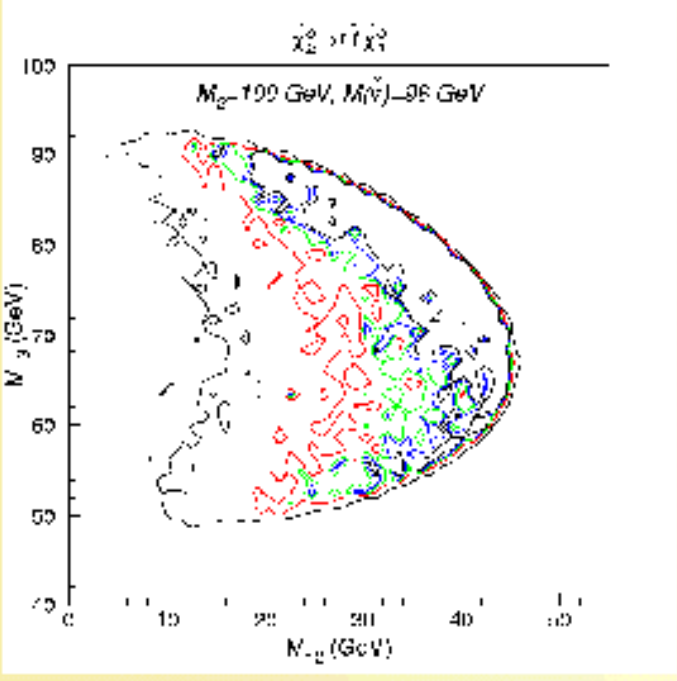
Dependence of $\tilde{N}_1\tilde{N}_2$ Production on Φ_1, Φ_μ



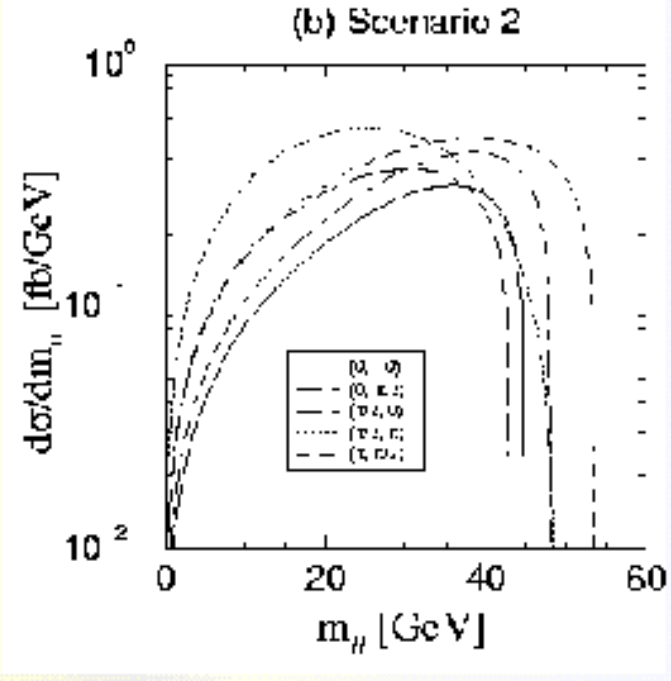
- Also alters branching fractions

- Matrix Element weighting of decays
  - Provides transition from 3- to 2-body decays
    - $\int ds_{12} ds_{13} 1 \Rightarrow \int ds_{12} ds_{13} |\mathcal{M}(s_{12}, s_{13})|^2$

$$\tilde{N}_2 \to \tilde{N}_1 f \bar{f}$$

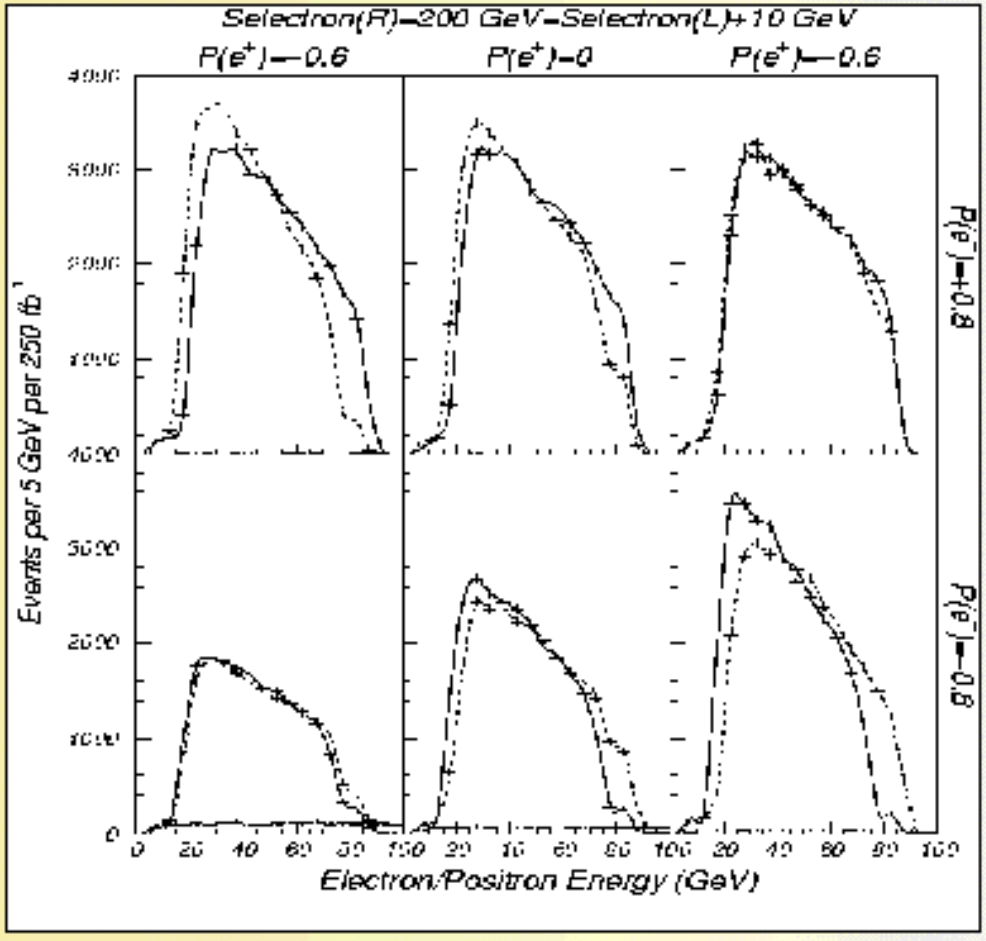


Phase dependence of M_{ff}



- Initial Parton Polarization

  ⇨ Important for NLC studies



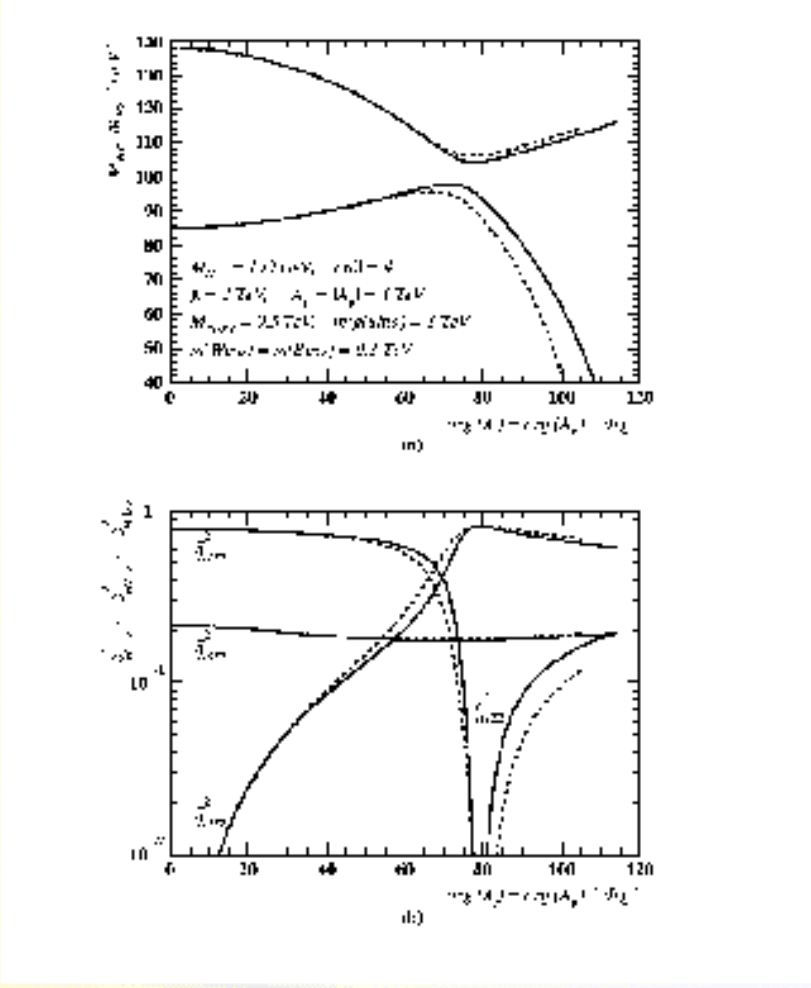
$\tilde{\ell}\tilde{\ell}$

$\tilde{C}_i\tilde{C}_j, \tilde{N}_i\tilde{N}_j$

- WW→4 fermions (full correlations)

•Phases in the Higgs sector

- $\mu=|\mu|e^{i\varphi}, A_t=|A_t|e^{i\phi}$ mix CP-properties
- h, H, A $\rightarrow H_1, H_2, H_3$
- $1 = g^2_{ZZH_1} + g^2_{ZZH_2} + g^2_{ZZH_3}$



- Large tanβ Yukawa corrections
  - gluino dependence

Future (wishes/expectations)

- Background Upgrades
  - γ^*/Z^* W (trilepton search)
  - polarization for ZZ (NLC studies)
- Signals
  - Consistency of phases
  - Decay correlations for SUSY decays
    - e.g $\tilde{C}\tilde{C} \rightarrow 6\,\text{fermions}$
- Manual Update