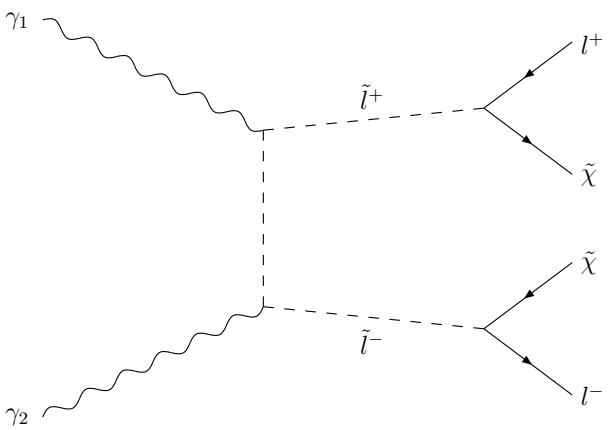
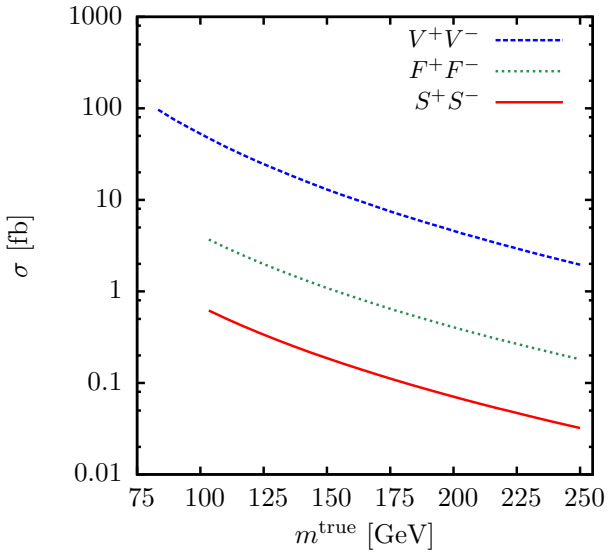
Exclusive production of semi–invisibles[1]

- As well as *gg*–mediated exclusive processes, an exclusive final state can be produced via the $\gamma\gamma$ subprocess

$$pp \to p + \gamma\gamma + p \ ,$$
$$\gamma\gamma \to X^+X^- \ ,$$

  where $X =$ W–boson, lepton, slepton, chargino...
- If particle decays semi–invisibly, then additional information from tagged proton momenta can be used to measure masses and discriminate BG.
- But take a (e.g. $\sim 1/100$ for $\tilde{l}^+\tilde{l}^-$ production) hit by demanding exclusivity.





[1] F. Brümmer, LHL, VAK, C. H. Kom, A. D. Pilkington, K. Sakurai, WJS.

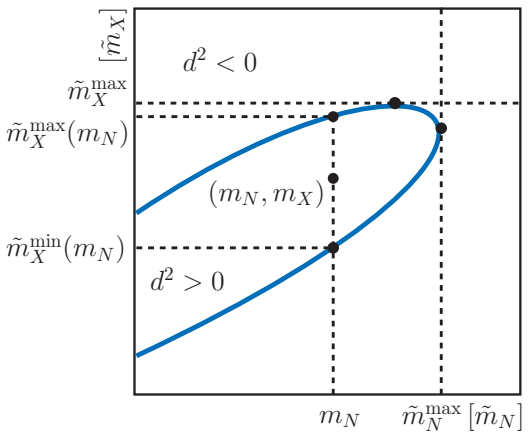
Exclusive production: sleptons

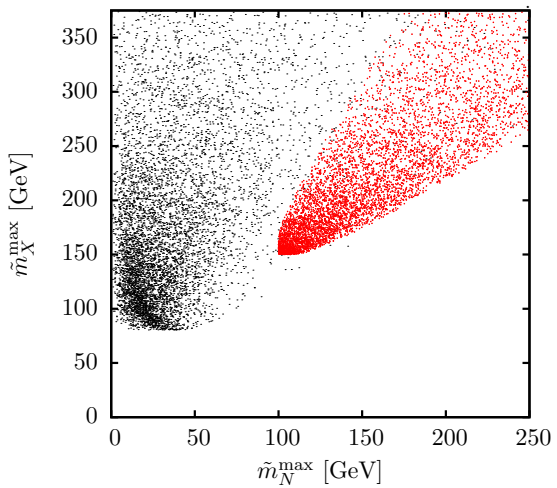
- Consider e.g. exclusive production of slepton pair $\tilde{l}^+\tilde{l}^-$, decaying via

$$\tilde{l}^{\pm} \to l^{\pm} + \chi$$

  where the χ is an LSP neutralino.
- 8 unknowns (4–momenta of χ's) - 4 constraints (4–momentum of $\gamma\gamma$ system from forward proton measurement).
- For a given $(M_{\tilde{l}}, M_{\chi})$ hypothesis get 4 more constraints, solving system.

→ Each event gives an allowed mass region. Can construct variables, e.g. max/min allowed $M_{\chi}, M_{\tilde{l}}$, and these distributions will depend sensitively on the true masses, giving a precise mass determination method.[2].





[2] LHL, C.H.Kom, K.Sakurai, WJS, arXiv:1110.4320, arXiv:1202.4207.

Exclusive production: charginos (1)

- Now consider exclusive production of chargino pair $\tilde{\chi}_1^+\tilde{\chi}_1^-$, decaying via

$$\tilde{\chi}_1^+(\tilde{\chi}_1^-) \to l^+(l^-) + \nu(\overline{\nu}) + \tilde{\chi}_1^0 \ ,$$

  where the $\tilde{\chi}_1^0$ is an LSP neutralino. Cross section is independent of Wino/Higgsino nature of chargino
- For cases that $\Delta M = M(\tilde{\chi}_1^0) - M(\tilde{\chi}_1^\pm)$ is relatively small, can be difficult to observe inclusively.
- Can apply techniques of arXiv:1110.4320, arXiv:1202.4207: construct variables, e.g. max/min allowed $M(\tilde{\chi}_1^0), M(\tilde{\chi}_1^\pm)$, and these distributions will depend sensitively on the true masses.
- **However**: important direct W^+W^- background (as in inclusive case), via decays:
  - $W \to l\nu_l$
  - $W \to \tau\overline{\nu}_\tau \to l\overline{\nu}_l\overline{\nu}_\tau\nu_\tau$
- Gives same l^+l^- (+ MET) signal.

Exclusive production: charginos (2)

- $\tilde{\chi}_1^+\tilde{\chi}_1^-$ cross section is $\sim$ fbs before cuts and branching. However:
  - $\mathrm{Br}(\tilde{\chi}_1^\pm \to l\nu_l\tilde{\chi}_1^0) = 0.23$ is quite small (assumes only decay via W^*, could be bigger with intermediate sfermion/sneutrinos)
  - Must place reasonable $p_\perp$ cuts ($\gtrsim$ 20 GeV) on final–state leptons in order to trigger. Requiring hits in RPs @ $\sim$ 220m is not enough, as these will occur quite frequently under normal LHC conditions.
- Background is sizeable. After lepton cuts[3], for e.g. $M(\chi_1^0) = 90$ GeV, $M(\chi_1^\pm) = 120$ GeV we have, for $\mathcal{L}_{\mathrm{int}} = 300\mathrm{fb}^{-1}$
  - $N[W^+W^- \to l^+l^- + \text{neutrinos}] \approx 1300$
  - $N[\tilde{\chi}_1^+\tilde{\chi}_1^- \to l^+l^- + 2(\nu_l\tilde{\chi}_1^0)] \approx 14$

  giving $S/\sqrt{B} \sim 0.4$.
- By cutting on max/min allowed $M(\tilde{\chi}_1^0), M(\tilde{\chi}_1^\pm)$ variables, we can greatly reduce BG by a factor of $\sim 20-30$, with the signal largely untouched. Giving $N_{\mathrm{signal}} \approx 12-8$ for $N_{\mathrm{BG}} \approx 60-10$ ($= S/\sqrt{B} \sim 1.6-2.4$).

$\to$ Difficult observable, without new experimental/theoretical ideas.

$\to$ Pile–up: can greatly reduce impact with fast–timing detectors, but may still be an important source of BG.

[3] Require both leptons to have $|\eta| < 2.5$, $p_\perp > 3$ GeV and one to have $p_\perp \geq 20$ GeV.