Comments about ILC running scenario (very preliminary)

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Contents:

- Higgs threshold run
- Comments to scenario by P.Granis

Higgs threshold

- By M.T.Dova, P.G.Abia, W.Lohmann, hep-ph/0302113 (LCWS2002)

✓20 fb^{-1} each at 215, 222, 240 GeV
✓m_h=120 GeV, SIMDET
✓with beamstrahlung.
✓Initial beam energy spread = Tesla ?
✓eeqq/μμqq channels only
✓Background processes:
ee→ eeff, qq(γ), WW, ZZ

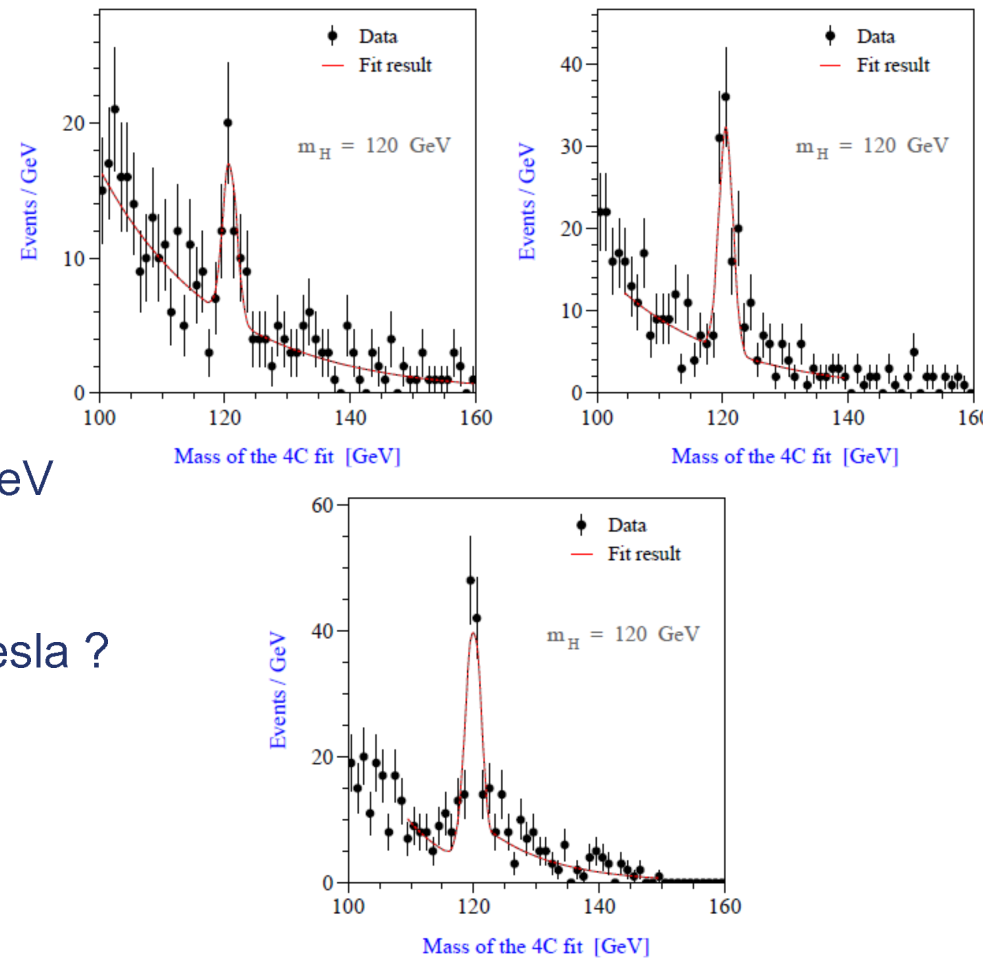


FIGURE 1. The dijet invariant mass from the ZH → $\ell^+\ell^- q\bar{q}$ final state after a 4C kinematic fit for $\sqrt{s}$ = 215 (top left), 222 (top right) and 240 GeV (bottom).

Higgs threshold

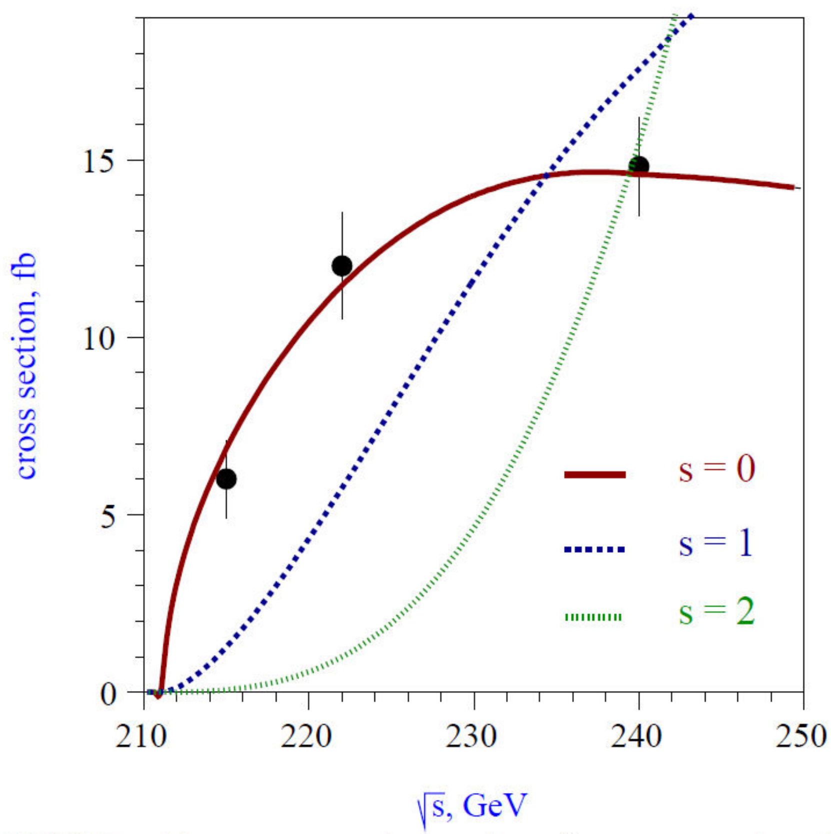


FIGURE 2. The cross sections determined at $\sqrt{s}$ = 215, 222 and 240 GeV (do
predictions for s=0 (full line), s=1 (dashed line) and s=2 (dotted line).

- ✓ $\Delta\sigma/\sigma$ ~ 9.2 % (240 GeV) for 20fb^{-1} (read from the paper)
  ➔ with 250 fb^{-1} , $\Delta\sigma/\sigma$ ~ 2.6 % consistent with ILD LOI (2.5%)

- ✓ Model discrimination based on values are read from the paper.

	20 fb^{-1}			10	5
E(GeV)	215	222	both	both	both
S=1	5.3σ	4.0σ	6.6σ	4.7σ	3.3σ
S=2	6.4σ	7.2σ	9.6σ	6.8σ	4.8σ

Assuming enough data at 230~240 GeV additional 5 fb^{-1} each at 215 and 222 GeV would be OK to rule out S=1 and 2 case

Scenario by P.D.Grannis

Snowmass '05

- Study of Snowmass SM2 point (~ SPS1a point)

$$(m_0 = 100 \text{ GeV}, \ m_{1/2} = 250 \text{ GeV}, \ \tan\beta = 10, \ A_0 = 0, \text{ and sign}\mu = +).$$

LOI sps1a' : m_0=70 GeV, $m_{1/2}$=250GeV, $\tan\beta$=10, A_0=-300, signμ=+

		M	Final state	(BR(%))			
124GeV	$\tilde{e}_R$	143	$\tilde{\chi}_1^0 e$ (100)				
	$\tilde{e}_L$	202	$\tilde{\chi}_1^0 e$ (45)	$\tilde{\chi}_1^\pm \nu_e$ (34)	$\tilde{\chi}_2^0 e$ (20)		
124	$\tilde{\mu}_R$	143	$\tilde{\chi}_1^0 \mu$ (100)				
	$\tilde{\mu}_L$	202	$\tilde{\chi}_1^0 \mu$ (45)	$\tilde{\chi}_1^\pm \nu_\mu$ (34)	$\tilde{\chi}_2^0 \mu$ (20)		
109.2	$\tilde{\tau}_1$	135	$\tilde{\chi}_1^0 \tau$ (100)				
	$\tilde{\tau}_2$	206	$\tilde{\chi}_1^0 \tau$ (49)	$\tilde{\chi}_1^- \nu_\tau$ (32)	$\tilde{\chi}_2^0 \tau$ (19)		
	$\tilde{\nu}_e$	186	$\tilde{\chi}_1^0 \nu_e$ (85)	$\tilde{\chi}_1^\pm e^\mp$ (11)	$\tilde{\chi}_2^0 \nu_e$ (4)		
	$\tilde{\nu}_\mu$	186	$\tilde{\chi}_1^0 \nu_\mu$ (85)	$\tilde{\chi}_1^\pm \mu^\mp$ (11)	$\tilde{\chi}_2^0 \nu_\mu$ (4)		
	$\tilde{\nu}_\tau$	185	$\tilde{\chi}_1^0 \nu_\tau$ (86)	$\tilde{\chi}_1^\pm \tau^\mp$ (10)	$\tilde{\chi}_2^0 \nu_\tau$ (4)		
96.1	$\tilde{\chi}_1^0$	96	stable				
185	$\tilde{\chi}_2^0$	175	$\tilde{\tau}_1 \tau$ (83)	$\tilde{e}_R e$ (8)	$\tilde{\mu}_R \mu$ (8)		
	$\tilde{\chi}_3^0$	343	$\tilde{\chi}_1^\pm W^\mp$ (59)	$\tilde{\chi}_2^0 Z$ (21)	$\tilde{\chi}_1^0 Z$ (12)	$\tilde{\chi}_1^0 h$ (2)	
	$\tilde{\chi}_4^0$	364	$\tilde{\chi}_1^\pm W^\mp$ (52)	$\tilde{\nu}\nu$ (17)	$\tilde{\tau}_2 \tau$ (3)	$\tilde{\chi}_{1,2} Z$ (4)	$\tilde{\ell}_R \ell$ (6)
185	$\tilde{\chi}_1^\pm$	175	$\tilde{\tau}_1 \tau$ (97)	$\tilde{\chi}_1^0 q\bar{q}$ (2)	$\tilde{\chi}_1^0 \ell\nu$ (1.2)		
	$\tilde{\chi}_2^\pm$	364	$\tilde{\chi}_2^0 W$ (29)	$\tilde{\chi}_1^\pm Z$ (24)	$\tilde{\ell}\nu_\ell$ (18)	$\tilde{\chi}_1^\pm h$ (15)	$\tilde{\nu}_\ell \ell$ (8)

Chargino/Neutralino study for LOI used the point5 parameter (not sps1a)

Assumed run scenario

Table 1: Run allocations for the SPS1 Minimal Sugra parameters.

Beams	Energy	Pol.	$\int \mathcal{L}dt$	$[\int \mathcal{L}dt]_{\text{equiv}}$	Comments
e^+e^-	500	L/R	335	335	Sit at top energy for sparticle masses
e^+e^-	M_Z	L/R	10	45	Calibrate with Z's
e^+e^-	270	L/R	100	185	Scan $\widetilde{\chi}_1{}^0\ \widetilde{\chi}_2{}^0$ threshold (L pol.) Scan $\widetilde{\tau}_1\ \widetilde{\tau}_1$ threshold (R pol.)
e^+e^-	285	R	50	85	Scan $\widetilde{\mu}_R{}^+\ \widetilde{\mu}_R{}^-$ threshold
e^+e^-	350	L/R	40	60	Scan $t\bar{t}$ threshold Scan $\tilde{e}_R\ \tilde{e}_L$ threshold (L & R pol.) Scan $\widetilde{\chi}_1{}^+\ \widetilde{\chi}_1{}^-$ threshold (L pol.)
e^+e^-	410	L	60	75	Scan $\widetilde{\tau}_2\ \widetilde{\tau}_2$ threshold Scan $\widetilde{\mu}_L{}^+\ \widetilde{\mu}_L{}^-$ threshold
e^+e^-	580	L/R	90	120	Sit above $\widetilde{\chi}_1{}^\pm\ \widetilde{\chi}_2{}^\mp$ threshold for $\widetilde{\chi}_2{}^\pm$ mass
e^-e^-	285	RR	10	95	Scan with e^-e^- collisions for $\tilde{e}_R$ mass

➔Total 695 fb^{-1} by true luminosity

➔Total 1000 fb^{-1} by equivalent luminosity
(scaled by 1/E)

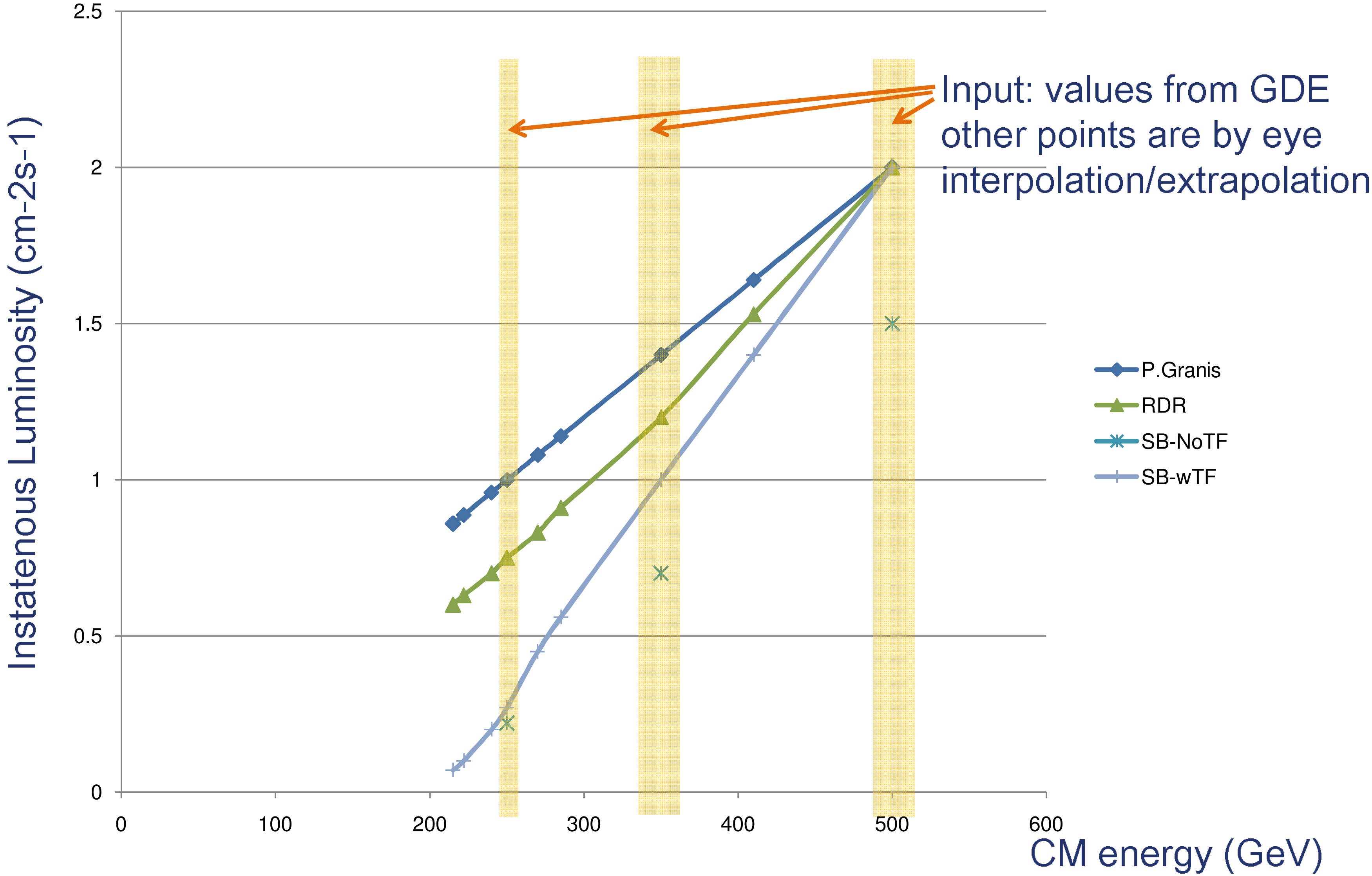
SUSY performance comparison

- Stau1
  - P.Granis:
    - Stau1 endpoint (500 GeV, 335 fb^{-1} ?) : Δm(stau1) ~ 1~2 GeV
      Stau1 scan at 270 GeV, 100fb^{-1}, R pol. : Δm(stau1) ~0.64GeV
  - ILD LOI (500 GeV, 500fb^{-1})
    - Δm(stau1) ~0.1GeV$\oplus$1.3 σ(LSP mass)

- smuonL
  - P.Granis
    - end point (500 GeV, 335 fb-1 ?) : Δm(smuon) ~ 0.7 GeV
      scan (410 GeV, 60 fb-1) : Δm(smuon) ~ 0.7 GeV
  - ILD LOI
    - end point (500 GeV, 500 fb-1) : Δm(smuonL) ~ 0.5 GeV

End point meas. at 500 GeV may be sufficient for mass meas.

Luminosity assumption



Comparison of run scenarios

(Note: new scenario 1&2 are not optimized) (Leff=500 GeV equiv lum.)

		E(GeV)	Pol	Scenario by P.Granis				New Scenario1				New Scenario2			
				Lreal	L eff			Lreal	L eff			Lreal	L eff		
					1/E	RDR	SBwTF		1/E	RDR	SBwTF		1/E	RDR	SBwTF
Top energy	e+e-	500	L/R	335	335	335	335	335	335	335	335	200	200	200	200
Calibration	e+e-	Mz	L/R	10	45	45	45	10	45	45	45	4	18	18	18
Chi10-CHi20 scan, stau scan	e+e-	270	L/R	100	185	241	444	100	185	241	444	0	0	0	0
smu_R scan	e+e-	285	R	50	85	110	179	50	88	110	179	0	0	0	0
tt threshold e_R e_L scan (L& R pol.) chi1+ chi1- scan (L pol.)	e+e-	350	L/R	40	60	67	80	40	57	67	80	40	57	67	80
tau2-tau2 threshold mu_L+mu_L- scan	e+e-	410	L	60	75	78	86	60	73	78	86	0	0	0	0
chi_1 chi_2 threhould for chi_2 mass	e+e-	580	L/R	90	120	120	120	0	0	0	0	0	0	0	0
scan e-e- for e_R	e-e-	285	RR	10	95	95	95	0	0	0	0	0	0	0	0
Higgs	e+e-	215		0	0	0	0	5	47	17	143	4	9	13	114
		222		0	0	0	0	5	11	16	100	4	9	13	80
		240		0	0	0	0	100	208	286	1000	66	138	189	660
Total				695	1000	1091	1384	705	1049	1194	2412	318	431	499	1152

■: same as P.Granis (slide 5.)

- ✓■ About 40% increase of effective int. luminosity, if SB2009 is adapted to P.Granis's scenario
- ✓■ If low energy Higgs running is included, SB2009 wTF requires about 2 times more eff. lum. than RDR
- ✓■ If we require the total equivalent integrated luminosity of 500 fb^{-1}, luminosity at each energy points are much smaller than a half of luminosity used in LOI studies.

Summary

- Effective integrate luminosity of 500 fb^{-1} in total is not enough.
  - Actual integrated luminosity in real run can be optimized later based on discoveries in future. What integrate luminosity shall we assume for DBD study ?

- SUSY SPS1a'
  - If true, we would like to have as many luminosity as possible at each energy points
  - If not true, still we would like to scan at thresholds of Higgs and Top.

  ➔ Luminosity ~ close to 1/E is desirable

- Estimation of "Maximum luminosity we need at each energy points for several physics scenario" would be interesting to study