Running Scenarios & Physics Updates

J. List, June 25 2014

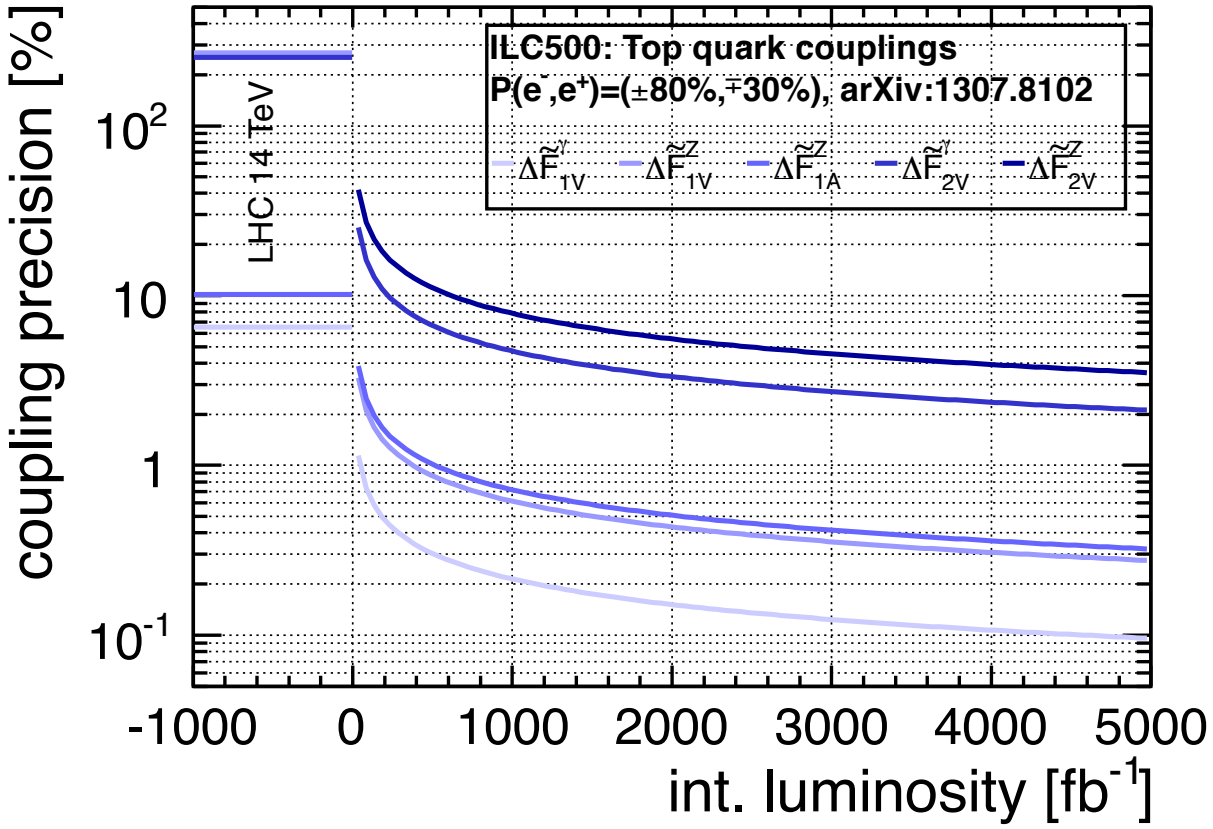
Outline

- Input from physics topics other than Higgs:
  - Top physics
  - TGCs
  - Dark Matter
- Running scenarios > 20 years

Electroweak Couplings of the Top Quark

- Key area for indirect searches for new physics (Higgs compositeness, extra-dimensions, ….)
- Requires ECM > ~400 GeV
- Near threshold, A_FB etc dominated by QCD (remnant of 1S, 1P etc t tbar bound state etc)
- Electron polarisation absolutely required for disentangling coupling to Z and photon
- Current studies assume
  - 250fb-1 with P(e-,e+)=(+80%,-30%) and
  - 250fb-1 with P(e-,e+)=(-80%,+30%)
- More data with right-handed electrons beneficial (eg 75% / 25% split of data set instead of 50%/50%)

Luminosity Scaling (500 GeV)



horizontal axis to be translated to real time according to running scenarios….

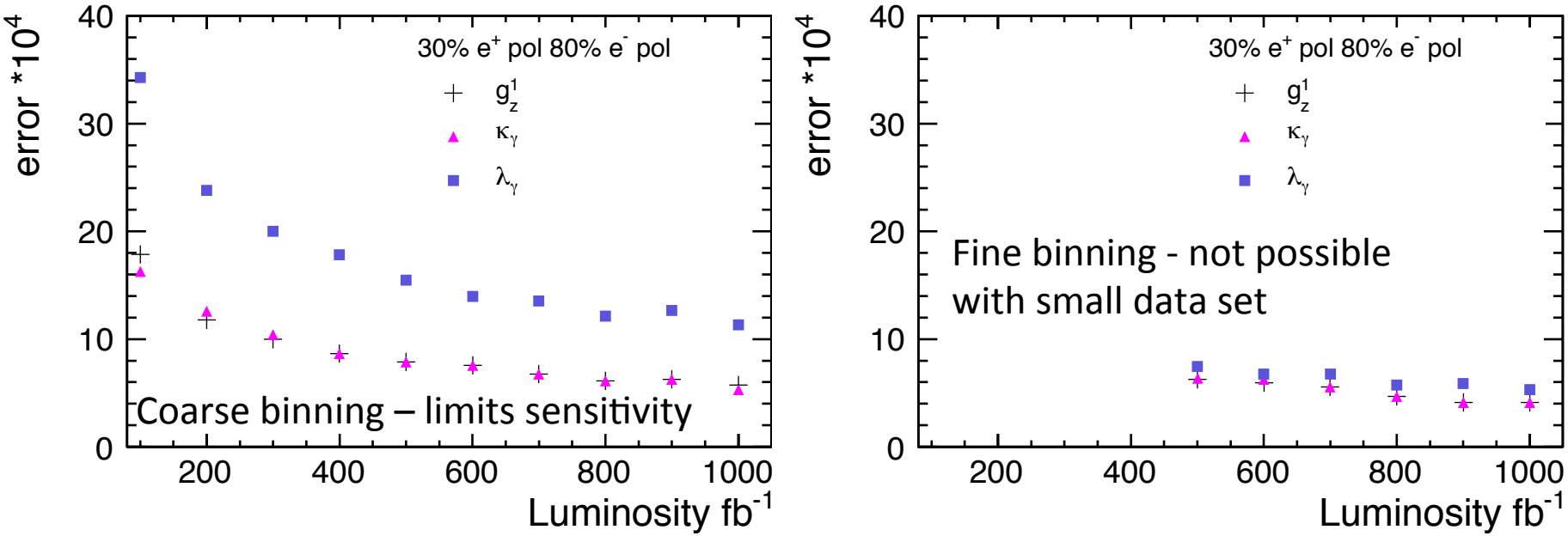
Plan discussed with Roman

- For a few BSM scenarios
  - Translate coupling precision into scale of New Physics
  - O(several TeV) more easy to understand than coupling precision itself
  - Roman will discuss this with Francois Richard

- should do something similar for TGCs

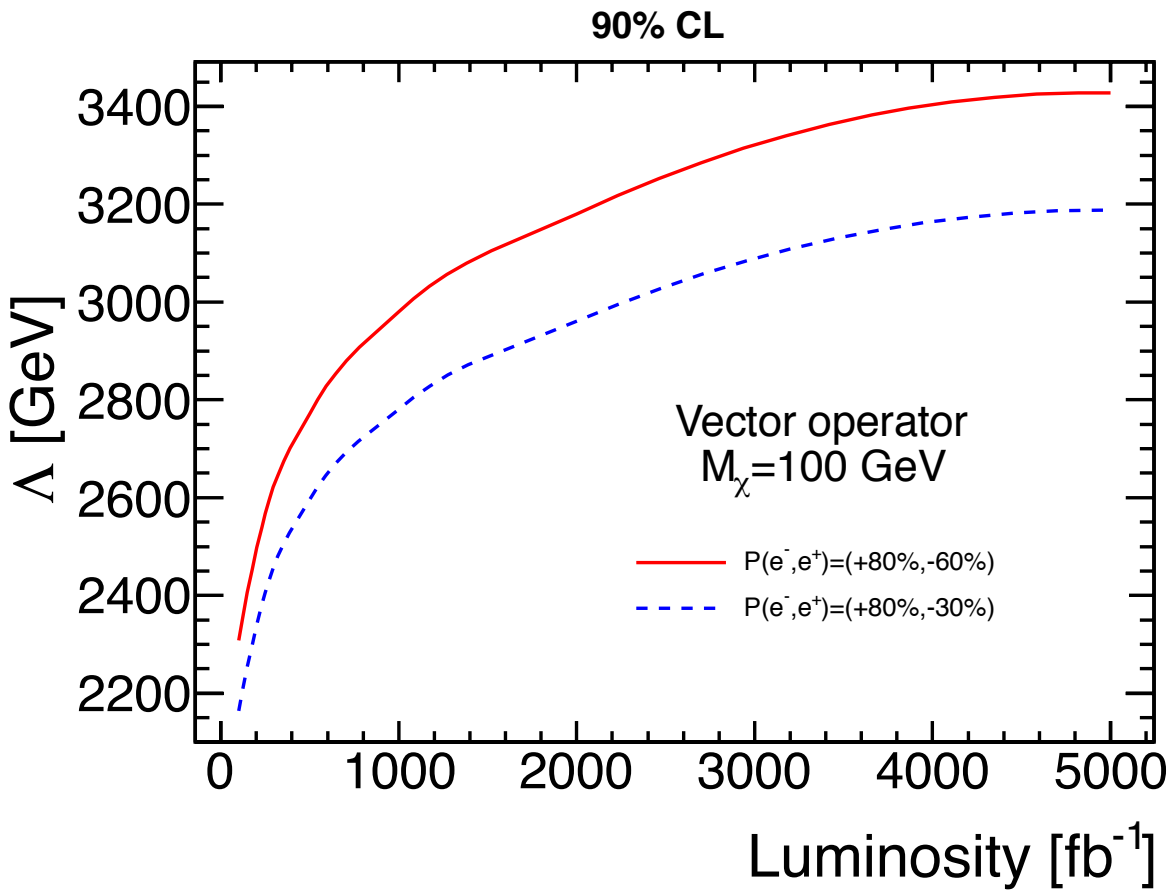
Charged Triple Gauge Couplings

500 GeV I.Marchesini



- Equal sharing of luminosity between +-/-+/++/--
  => 10..20% like-sign lumi enough?
- Estimate of sensitivity at 250 GeV, 350 GeV?

Dark Matter



– LHC 300/3000 fb-1: ~1.6 TeV

– Important example where systematics matter!

Running Scenarios

- Started to collect a table of data sets assumed in various analyses
  -> cf separate spreadsheet
- Not yet complete, but still taking the maximum for each helicity configuration is impressive…
- After slight equalisation and application of common sense, the result seems crazy at the first glance:

Cumulative Dataset Sizes

- At the end of the day:

ECM	Int. Lumi [fb-1]	Physics driver
250 GeV	2000	ZH
350 GeV	200	M_t
500 GeV	5000	ZHH / DM / TGC
1 TeV	8000	Higgs / DM / TGC
90 GeV	100	A_LR
160 GeV	500 (!)	M_W to 2 MeV

Lumi / year at full speed
(ignorant particle physicist version)

ECM	Lumi / year [fb-1]		
	baseline	10 Hz Phys	LumiUp
250 GeV	125	250	500
500 GeV	250		500
1 TeV	500		1000
90 GeV	45 ???	10 Hz f. e+ production	???
160 GeV	80 ???		???

Years at peak lumi

(still ignorant particle physicist version)

ECM	baseline		10 Hz Phys		LumiUp	
	lumi	years	lumi	years	lumi	years
250 GeV	100	1	900	4	1000	2
350 GeV	200	1	-	-	-	-
500 GeV	1000	4	take part of 500 GeV lumi with 1 TeV machine?		4000	8
1 TeV	2000	4	-	-	6000	6

- 20 years of peak lumi operation (excl. ramp-up!) before 1 TeV upgrade, 90 GeV, 160 GeV
- We can now play with different break-down into stages, and include ramp-up

Polarisation split

- "Simulataneous" collection of data with all 4 helicity configurations is essential to minimize systematic uncertainties, eg from
  - Time-dependent detector efficiencies, calibration, aligment etc
  - Luminosity, beam energy and polarisation measurements
- Thus: fast helicity reversal with frequency chosen to obtain a preset "mix" of helicity configurations (sign(P(e-)), sign (P(e+))):

ECM	-+ [%]	+- [%]	++ [%]	-- [%]	Phys. driver
250 GeV	67.5	22.5	5	5	ZH
350 GeV	67.5	22.5	5	5	M_t
500 GeV	40	40	10	10	ZHH / DM / TGC
1 TeV	40	40	10	10	H / DM / TGC
90 GeV	40	40	10	10	A_LR
160 GeV	67.5	22.5	5	5	M_W