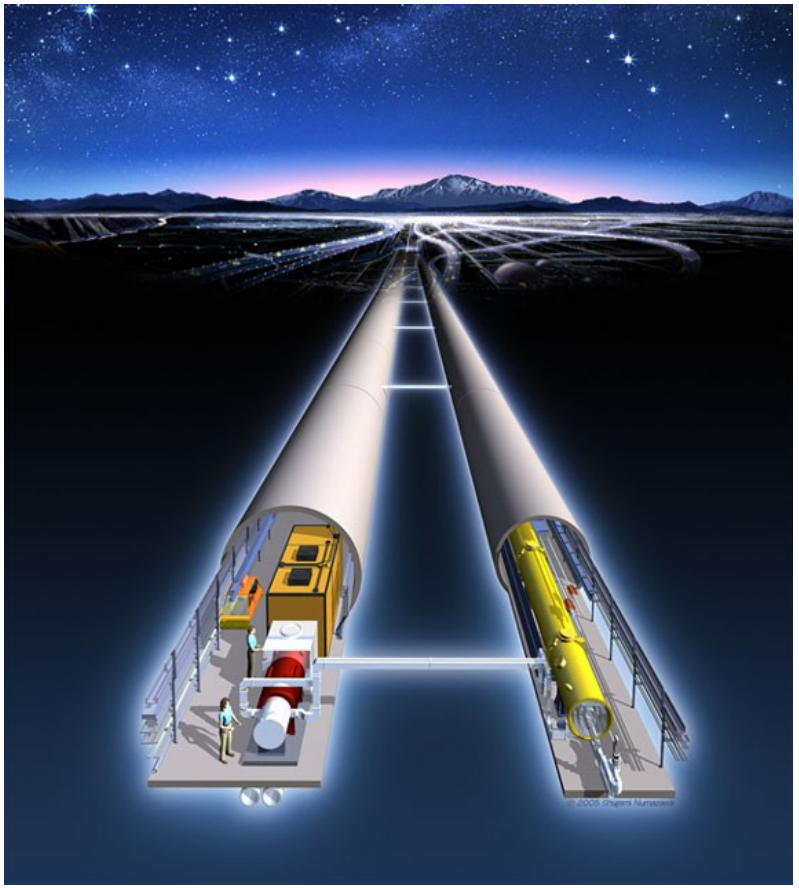
Top/QCD Session at LCWS16

An incomplete summary



Roman Pöschl

ILD Software and Analysis Meeting 14/12/16

Disclaimer

- Given the short preparation time I will focus on experimental talks (talks given by experimenters) and topics relevant for ILD

- Purpose is to not only show the glitter and glory but point out open issues

(Higgs/EW) Top/QCD - Overview

So, what's new at LCWS16?

For overview/introduction, see R. Pöschl, N. Craig

Higgs/EW session

Higgs Couplings	Chen (CMS), Ph. Roloff, N. Craig, M. Pandurovic
CP properties	Chen (ATLAS), D. Jeans, T. Ogawa, M. Kikuchi
Self-coupling	C. Duerig, T. Barklow
Higgs and BSM	S. Kanemura, Ph. Bechtle, Y. Kato, K. Sakurai, H. Yokoya

Prospect studies from ILD, SiD, CLIC and new calculations/insights from theory...
Comparison/complementarity with other projects: ATLAS, CMS, FCCee, FCChh

Top/QCD session

Top EW Couplings	M.V., R. Pöschl, Y. Sato, M. Peskin
Top mass	Kim (CMS), A. Penin, A. Maier, J. Fuster, P. Marquard
Higgs and top (ttH)	K. Yorita (ATLAS), J. Reuter, M. Mangano (FCChh)
Reco. & QCD	R. Ström, S. Kluth

LC can determine α_s at large scale with a precision that matters

LCWS16: Top, Higgs, EW, QCD 7 marcel.vos@ific.uv.es

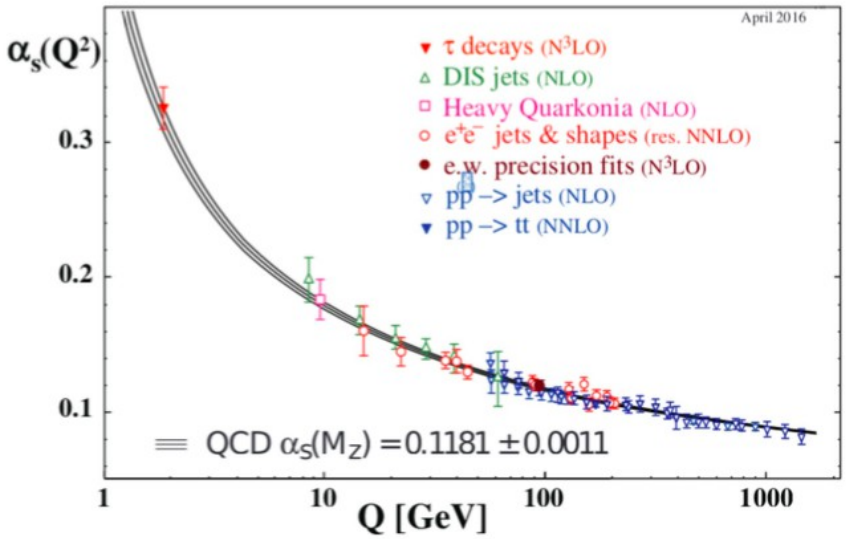
M. Vos

Score only 15:11 for Higgs/EW ;-)

alpha_s

- $\alpha_s(m_z)$ at below 1% from e^+e^- ?
  - Result from Lattice QCD already there
    - If you believe all of it
  - Best option is EW precision fit → GigaZ
  - Needs confirmation from other methods
    - Semi-incl. FFs, jets+event shapes
- Control / understand non-pert effects
  - Need GigaZ and ISR program
    - Optimize for very low angle ISR γ detection
  - Jets and event shapes at highest energies
    - At 500 GeV had. effects down by factor 5 → error O(0.001), need matching exp. error → control WW bkg

World average: $\alpha_s(m_z) = 0.1181 \pm 0.0011$



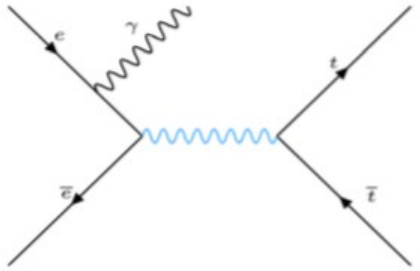
Remark RP: Topic completely uncovered in experimental studies

S. Kluth

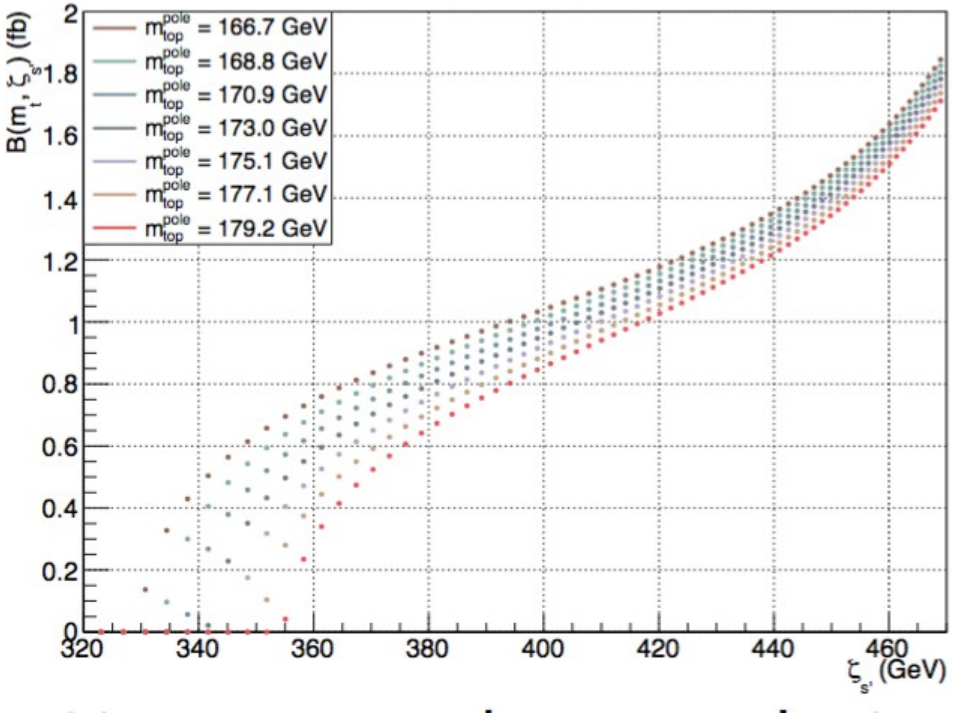
Top mass and ISR

- The idea is to measure the top-quark mass (m_t) measuring the differential cross section of the process $e^-e^+ \rightarrow ttbar\ \gamma_{ISR}$

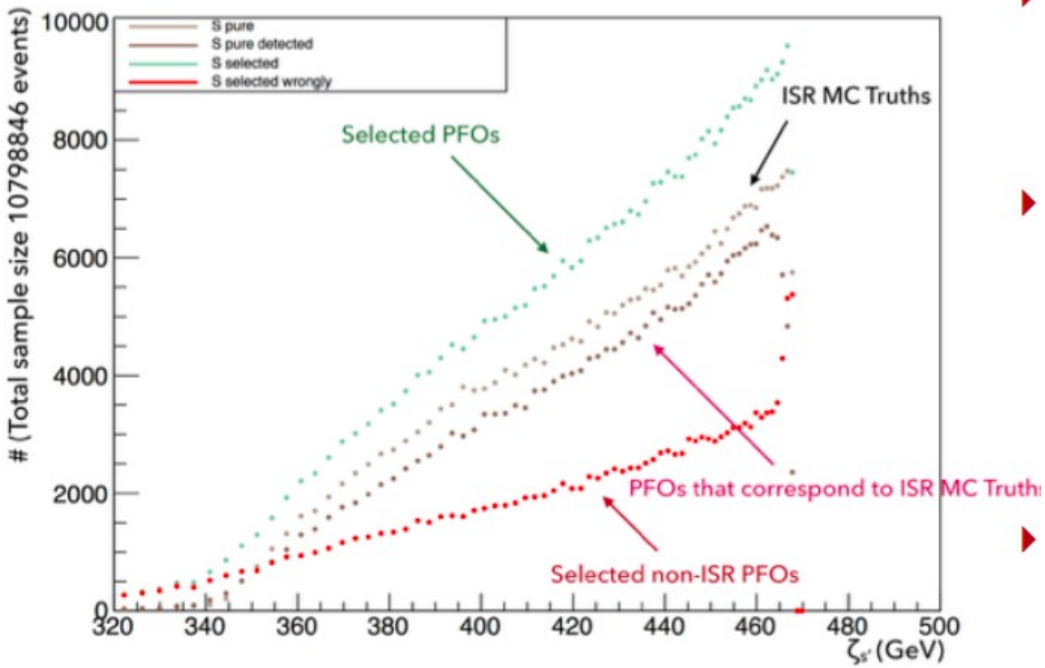
...in the continuum



Cross section Theory



Detector simulation

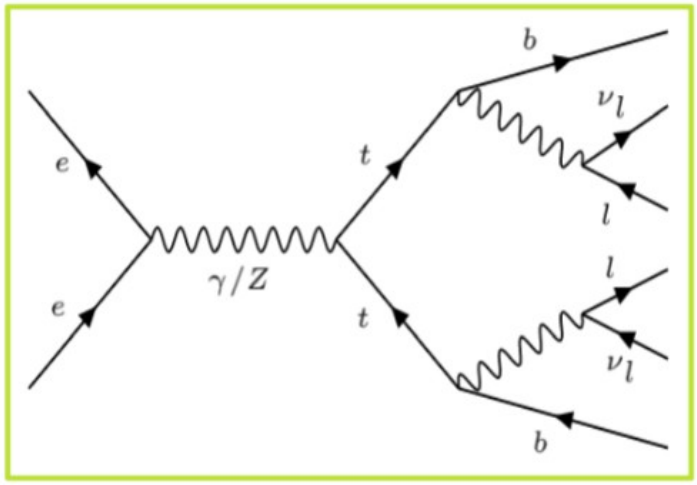


Understanding nature of PFO Objects

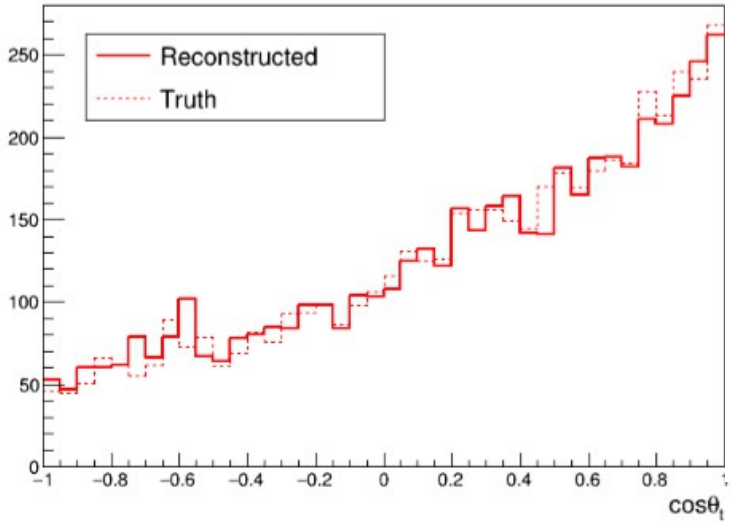
Goal (ISR and ISR): 100 MeV accuracy on top mass

P. Gomiz

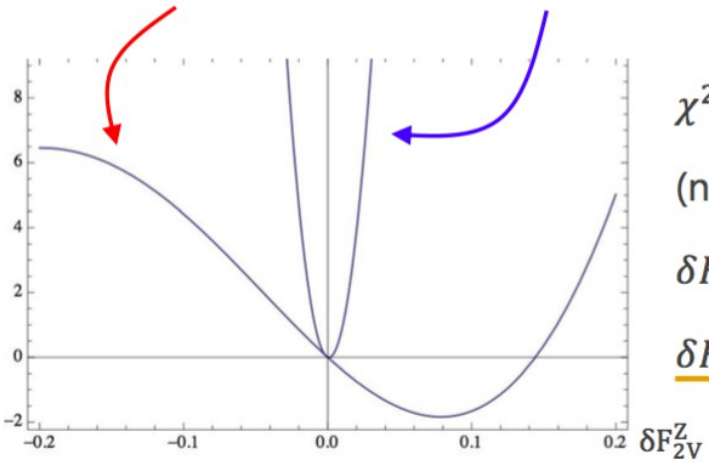
Top form factors with ME Method



- So far signal only
- Hadronisation and detector effects taken into account
- Kinematic reconstruction of 8 unknowns using (at least) 8 constraints
- Optimal solution by comparing Eb(meas.) with Eb(rec)
- Minimize $(\chi^2_{\text{tot.}})' = \chi^2_{\text{tot.}} + \chi^2_{\text{direction}}$
  to determine $(\theta_t, \phi_t, m_t, m_{\bar{t}}, m_{W^+}, m_{W^-}, \theta_b, \phi_b, \theta_{\bar{b}}, \phi_{\bar{b}})$



Excellent polar angle reconst.
and other helicity angles
but MC truth for seed of fit



Using all helicity angles superior
To using just polar angle in
FF determination

Δ_{F1}	-0.0067 ± 0.0082
Δ_{F2}	0.035 ± 0.017
Δ_{F3}	-0.056 ± 0.012
Δ_{F4}	0.035 ± 0.018
Δ_{F5}	-0.022 ± 0.026
Δ_{F6}	0.042 ± 0.045
Δ_{F7}	-0.0081 ± 0.015
Δ_{F8}	0.010 ± 0.032
Δ_{F9}	0.013 ± 0.024
Δ_{F10}	-0.010 ± 0.022

First 10 parameter fit
Looks promising

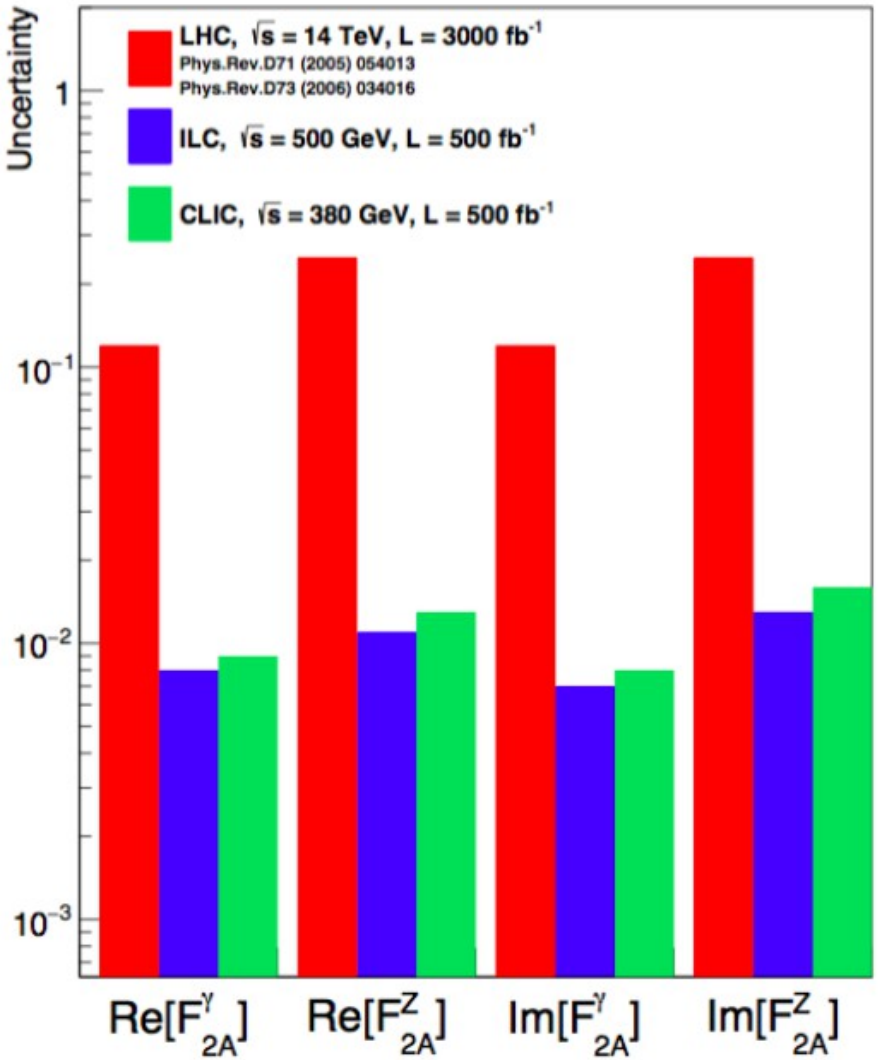
Y. Sato

CPV Top form factors

... based on “optimal” observables proposed by Bernreuther et al.

Well over an order of magnitude better than limits from associated production at the LHC

Precision similar at 380 GeV and 500 GeV



Paper of LC potential in the CPV sector in preparation (IFIC-LAL collaboration)

Quantity	$Re[F^{\gamma}_{2A}]$	$Re[F^{Z}_{2A}]$	$Im[F^{\gamma}_{2A}]$	$Im[F^{Z}_{2A}]$
SM value at tree level	0	0	0	0
LHC	0.12	0.25	0.12	0.25
TESLA TDR	0.007	0.008	0.008	0.010
ILC@500 GeV	0.007	0.011	0.007	0.012
CLIC@380 GeV	0.009	0.013	0.008	0.016

M. Vos

Top couplings meet EFT

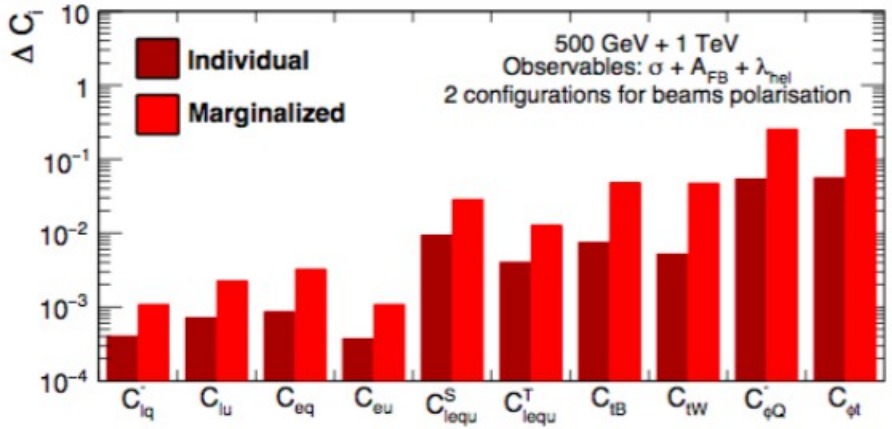
EFT analyses: top EW couplings

EFT $$\mathcal{L}_{eff} = \mathcal{L}_{SM} + \frac{1}{\Lambda^2}\sum_i C_i O_i + \mathcal{O}\left(\Lambda^{-4}\right)$$

Express the impact of "any" BSM physics in terms of a finite number of D6 operators. Use all data to constrain coefficients.

Excellent tool (with well-known limitations) to relate BSM sensitivities of different measurements and to "score" the discovery reach of HEP projects.

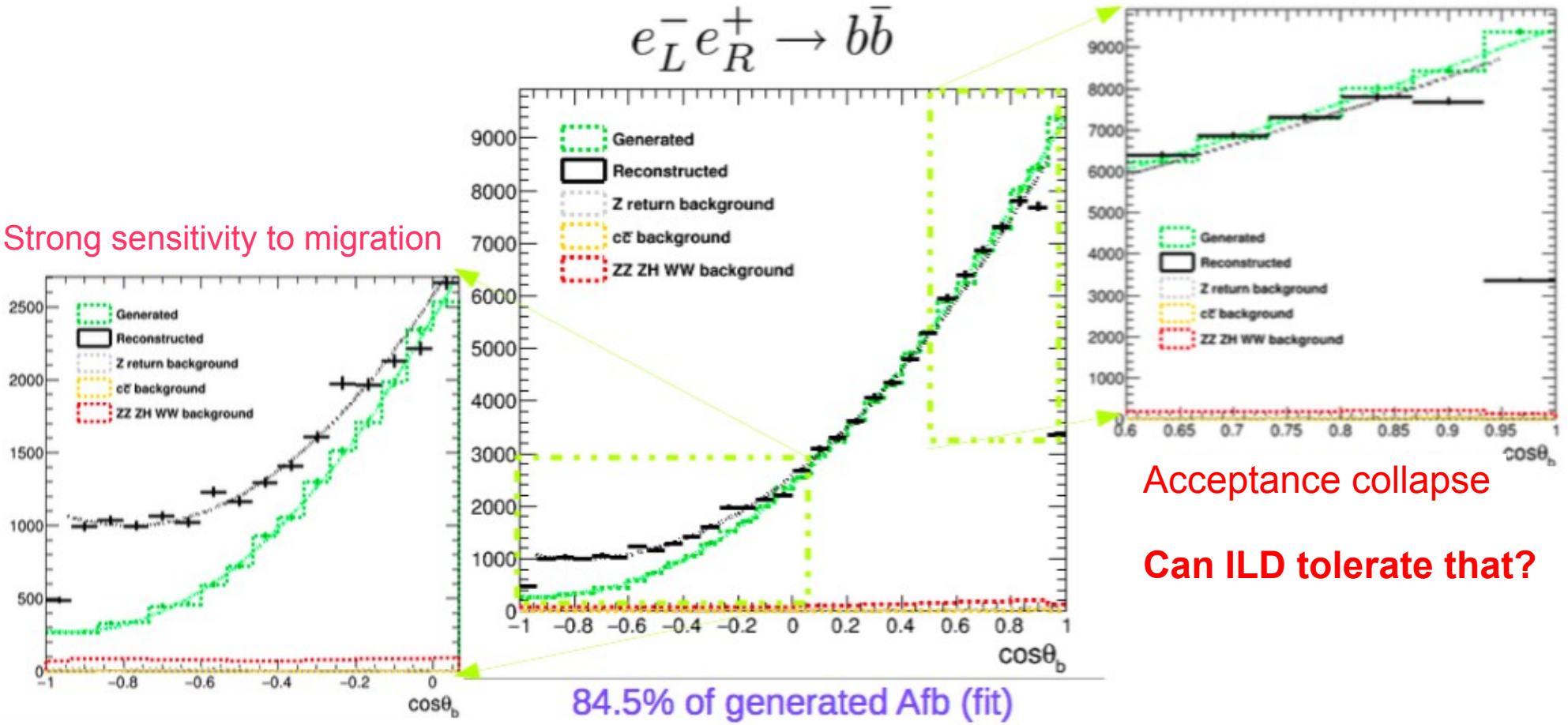
Preliminary



García, Perelló:
Fit top EW D6 operators
Include constraints from:
$e^+e^- \to b\bar{b}$ (R. Pöschl)
operation at $\sqrt{s} > 1$ TeV (R. Ström)

M. Vos

b-quark pair production



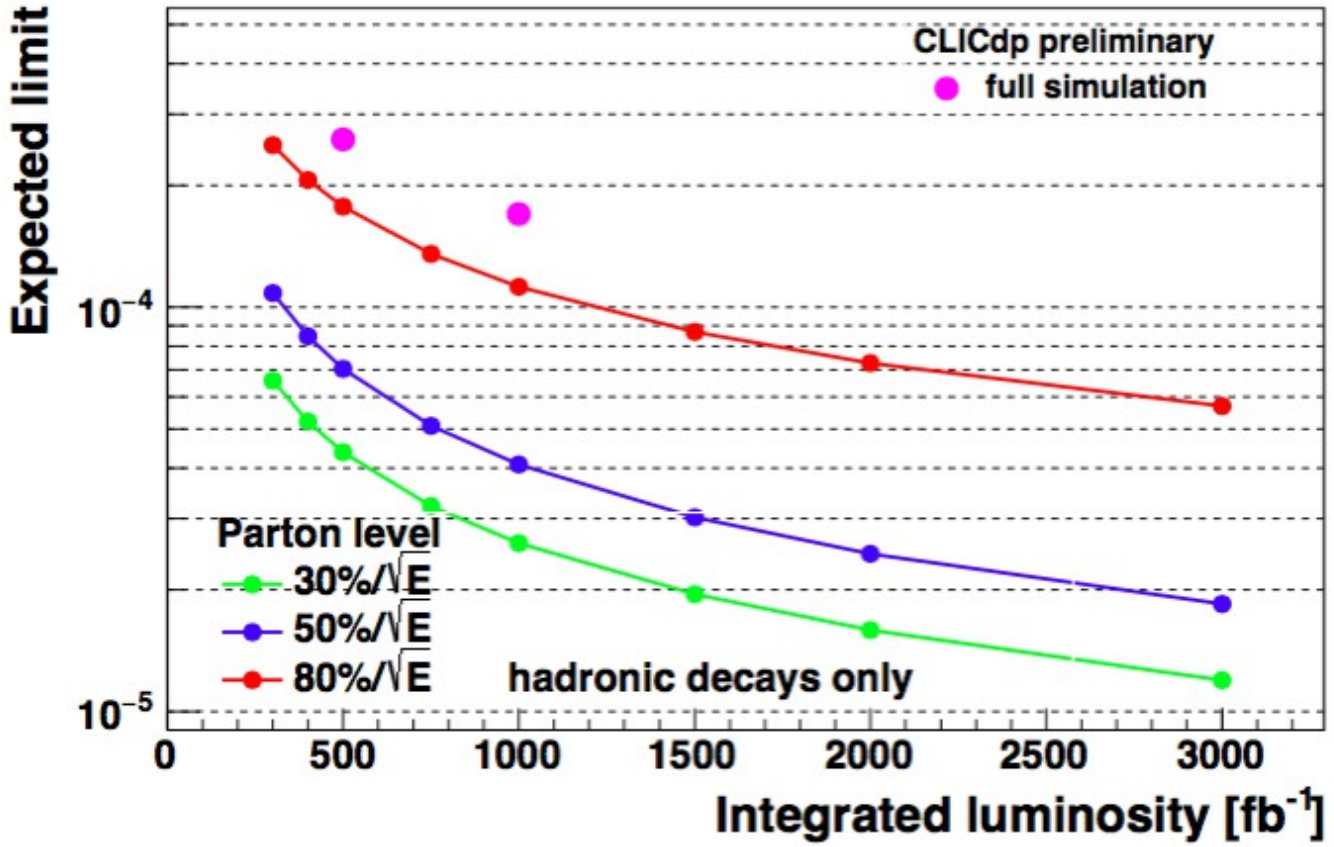
- Migration into backward hemisphere and collapsing acceptance at large polar angles have to be addressed
- Successful Correction procedure for migration effect under development
- Start with x-section determination and interpretation in terms of physics

S. Bilokin, F. Richard, R. Pöschl

Top and FCNC

Expected limits on $BR(t \to ch) \times BR(h \to b\bar{b})$

Comparison with parton level results, different jet energy resolutions



- Room for improvement
- Higher energies may help

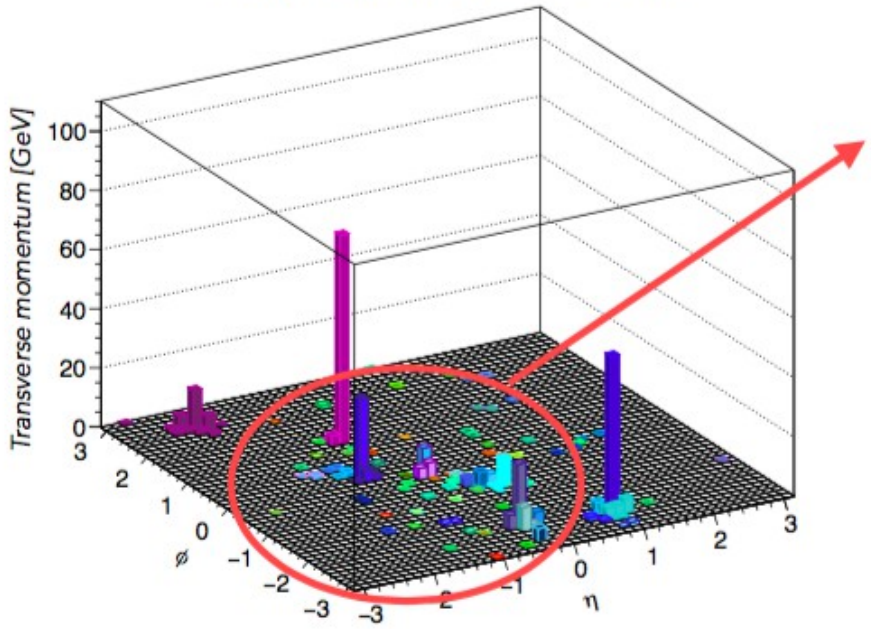
A.F. Zarnecki, N. v.d. Kolk

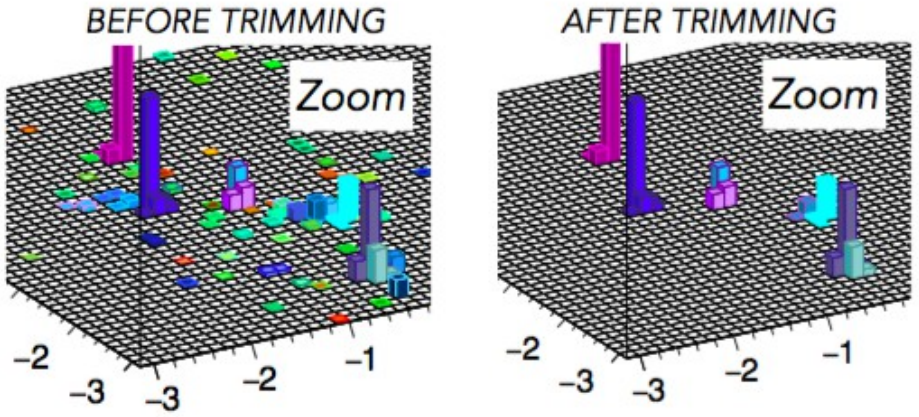
Algorithms: Boosted Top at 3 TeV

Jet Trimming

Synergy with LHC

Full phi-eta space
fully-hadronic ttbar event





- Trimming of the jets is an alternative/complementary way to reduce the impact from the beamstrahlung background
- Pre-clustering into so-called microjets
- Inclusive pre-clustering of PFO objects into microjets
- Algorithm used: ee generalised kt
- Optimisation of:
  - Microjet energy threshold E_{th}
  - Jet radius R_{micro}

Conclusions

- Highly interesting top/QCD programme

- Apologises to Theory and LHC Friends

- New analyses are in the making but need careful (experimental) scrutinising

- Who takes on alpha_s in ILD?

- Looking for exciting results in 2017

- Come to the top workshop Top@LC2017 7-9 June 2017 at CERN