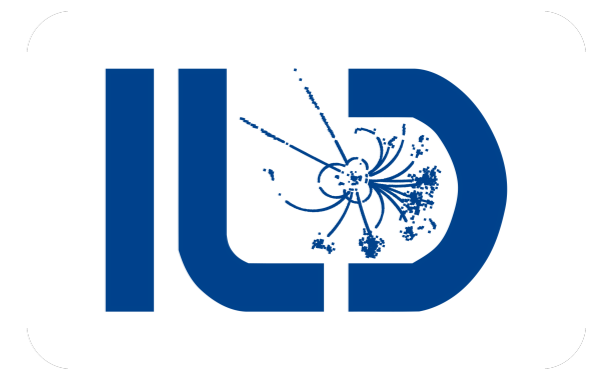# News from the LCC Physics WG: What's the role of **positron polarisation** at 250 GeV?

J. List,
ILD Software & Analysis Meeting
8.11.2017

Reminder

- positron polarisation was never a hard requirement, but considered a beneficial add-on

- the undulator source was not chosen as baseline because of its capability to deliver a polarised beam, but for technical & cost reasons

- for the case the technical and/or cost preference would change, Lyn Evans asked the Physics & Detector community to specify the impact of positron polarisation on the physics program **at 250 GeV**
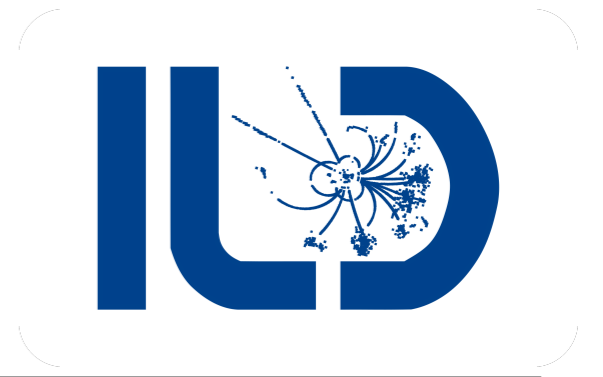
This is not the first time…

$(P(e^-), P(e^+))$	Effects for $P(e^-) \longrightarrow P(e^-)$ and $P(e^+)$	Gain w.r.t. (80%,0%)& Requirement		
		(90%,0)	(80%,60%)	(80%,30%)
Statistics:				
P_{eff}	V,A processes	90%	95%	94%
$\mathcal{L}_{\text{eff}}/\mathcal{L}$	# of interacting particles	–	×1.5	×1.2
$\Delta A_{LR}/A_{LR}$	due to error propagation	0	×3	×2
Standard Model:				
top threshold	Electroweak coupling measurement	0	× 3	× 2
$t\bar{q}$	Limits for FCN top couplings improved		× 1.8	× 1.4
CPV in $t\bar{t}$	Azimuthal CP-odd asymmetries give access to S- and T-currents up to 10 TeV	–	$P^{\text{T}}_{e^-} P^{\text{T}}_{e^+}$	$P^{\text{T}}_{e^-} P^{\text{T}}_{e^+}$ ×0.8
W^+W^-	TGC: error reduction of $\Delta\kappa_\gamma, \Delta\lambda_\gamma, \Delta\kappa_Z, \Delta\lambda_Z$	?	×1.8	?
	Specific TGC $\tilde{h}_+ = \text{Im}(g_1^{\text{R}} + \kappa^{\text{R}})/\sqrt{2}$	–	$P^{\text{T}}_{e^-} P^{\text{T}}_{e^+}$	$P^{\text{T}}_{e^-} P^{\text{T}}_{e^+}$ ×?
CPV in γZ	Anomalous TGC $\gamma\gamma Z, \gamma ZZ$	–	$P^{\text{T}}_{e^-} P^{\text{T}}_{e^+}$	$P^{\text{T}}_{e^-} P^{\text{T}}_{e^+}$ ×?
HZ	Separation: $HZ \leftrightarrow H\bar{\nu}\nu$	?	×4	× 2
	Suppression of $B = W^+\ell^-\nu$	?	×1.7	?
$t\bar{t}H$	Top Yukawa coupling at $\sqrt{s} = 500$ GeV	?	×2.5	×1.6

This is not the first time…

$(P(e^-), P(e^+))$	Effects for $P(e^-) \longrightarrow P(e^-)$ and $P(e^+)$	Gain w.r.t. (80%,0%)& Requirement		
		(90%,0)	(80%,60%)	(80%,30%)
Supersymmetry:				
$\tilde{e}^+ \tilde{e}^-$	Quantum numbers L, R and Yukawa	–	$P_{e^-} P_{e^+}$	$P_{e^-} P_{e^+} \times 0.6$
$\tilde{\mu}\tilde{\mu}$	S/B, $B = WW \rightarrow \Delta m_{\tilde{\mu}_{L,R}}$ in cont.	?	$\times 5\text{-}7$	?
$HA, m_A > 500$ GeV	Access to difficult parameter space	?	$\times 1.6$	?
CPV in $\tilde{\chi}_i^0 \tilde{\chi}_j^0$	Direct CP-odd observables	–	$P_{e^-}^T P_{e^+}^T$	$P_{e^-}^T P_{e^+}^T \times ?$
RPV in $\tilde{\nu}_\tau \rightarrow \ell^+ \ell^-$	Test of spin: S/B, $S/\sqrt{B}$	?	$\times 10$	?
Extra Dimensions:				
$G\gamma$	Enhancement of S/B, $B = \gamma \nu \bar{\nu}$,	?	$\times 3$	?
$e^+ e^- \rightarrow f\bar{f}$	Unique distinction ADD vs. RS	–	$P_{e^-}^T P_{e^+}^T$	$P_{e^-}^T P_{e^+}^T \times 0.5$
New gauge boson Z':				
$e^+ e^- \rightarrow f\bar{f}$	Measurement of Z' couplings	?	$\times 1.5$	?
Contact interactions:				
$e^+ e- \rightarrow e\bar{e}$	Model independent bounds	–	$P_{e^-} P_{e^+}$	$P_{e^-} P_{e^+} \times ?$
Precision measurements of the Standard Model at GigaZ:				
Z-pole	Improvement of $\Delta \sin^2 \theta_W$	?	$\times 10$	$\times 5$ (?)
	Improvement of Higgs bounds	?	$\times 10$	?
	Constraints on CMSSM parameter space	?	$\times 5$	?

"POWER report", G. Moortgat-Pick et al, Phys.Rept. 460 (2008) 131-243

Revisit with respect to

- LHC results

- 250 GeV running

- new ILC studies

- new interpretations (eg EFT approach)

Plan

- Jim Brau requested an additional section for the recent 250-GeV-physics-case document

- time scale: ~ 4 weeks

- Michael Peskin asked JL to organise this and write a first draft

- will call for a phone meeting with all interested people (exp + theo) very soon

=> if YOU would like to give input / take part in discussions etc, please send me an email!