EXscalar - New exotic scalars:

Decay independent search

Teresa Núñez - DESY

- Previous study: Search for extra scalars produced in association with a Z boson at the ILC

- Status and Plans

EXscalar – focus topic working meeting , 29-05-24

Search for extra scalars produced in assotiation to a Z boson at the ILC

$$e^+e^- \rightarrow Z' \rightarrow ZS^0 \rightarrow \mu^+\mu^- S^0$$
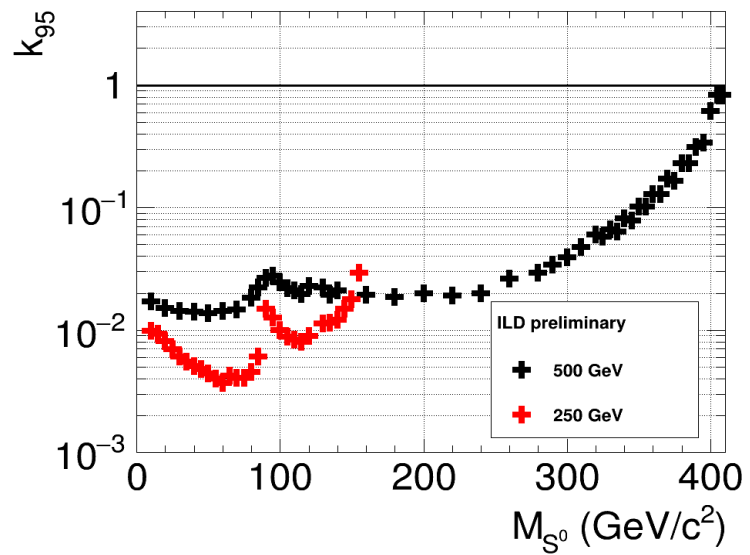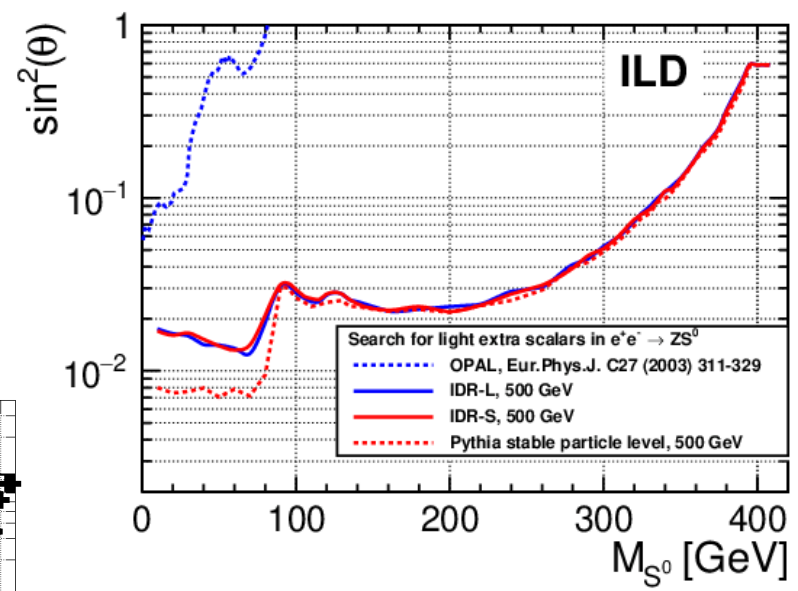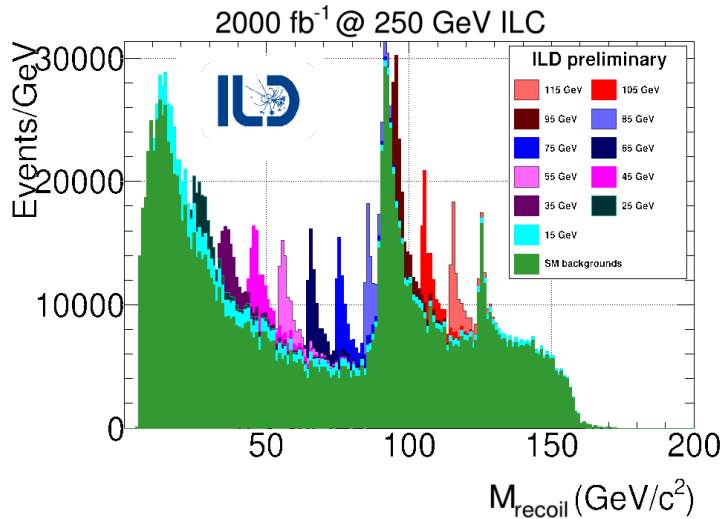
arxiv:1902.06118

arxiv:2005.06265

- Studies using the full detector simulation and reconstruction procedures of the ILD at the ILC ($\sqrt{s}$ = 250/500 GeV)
- Searches done for any mass and independent of the S^0 decay mode: based on the recoil of the scalar against the Z

Important detector performance aspects are:

- di-muon identification and momentum reconstruction
- ISR identification and energy reconstrucion

Most important limitation comes from the ISR identification

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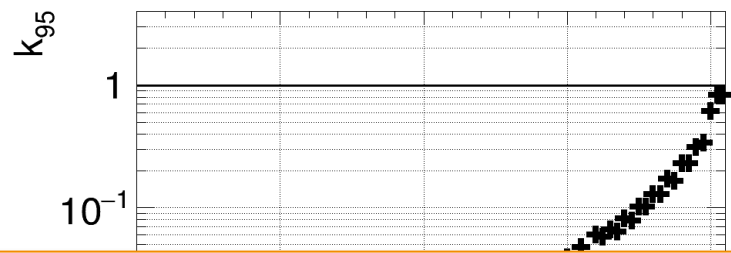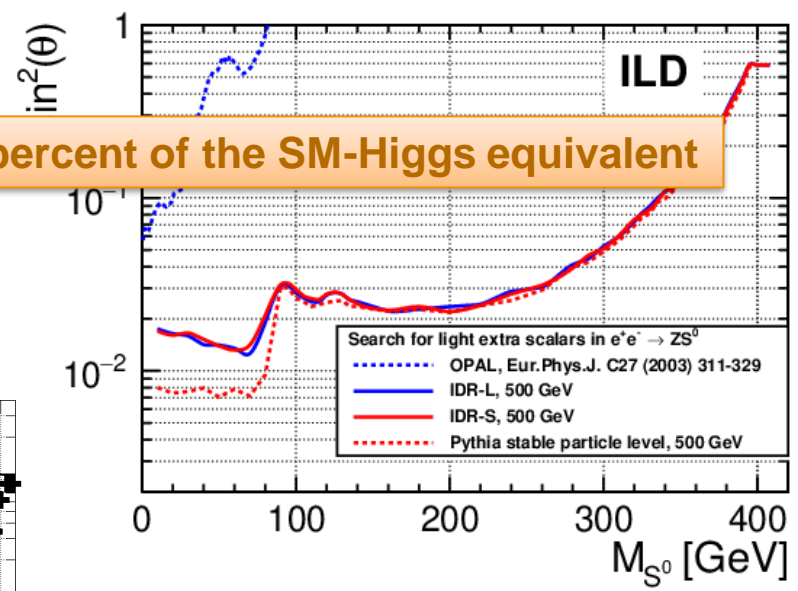| GEMEINSCHAFT

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Expected sensitivities at 95% CL for the cross section scale factor with respect to the SM Higgs,$\sin^2(\theta)$, for scalars masses between 10 and 410 GeV

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Search for extra scalars produced in assotiation to a Z boson at the ILC

2000 fb^{-1} @ 250 GeV ILC

ILD preliminary

115 GeV	105 GeV
95 GeV	85 GeV
75 GeV	65 GeV
55 GeV	45 GeV
35 GeV	25 GeV
15 GeV	
SM backgrounds	

ILC can exclude couplings down to a few percent of the SM-Higgs equivalent

Search for light extra scalars in $e^+e^- \to ZS^0$
- OPAL, Eur.Phys.J. C27 (2003) 311-329
- IDR-L, 500 GeV
- IDR-S, 500 GeV
- Pythia stable particle level, 500 GeV

Expected sensitivities at 95% CL for the cross section

Limits two orders of magnitude more sensitive than the ones from LEP
Covering substantial new phase space

+ 500 GeV
+ 250 GeV

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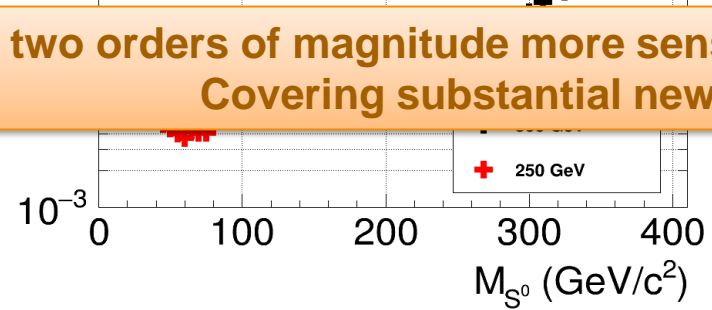
Status and Plans

General plans:

- Try to optimize previous studies done at DESY:
  - use/produce signal samples with last whizard version
  - check if it is possible to optimize ISR analysis, crucial point in sensitivity
- Add new Z decay modes for recoil analysis (e+/e-, hadronic ?)

Status:

- Code from previous studies, full simulation, is taken and run
- Performance studies being performed: comparing "private" Marlin processors to standard ones (mainly focused on ISR finding)

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Status and Plans

Next steps:

- Start with 250 GeV samples, based on latest production and adding signal samples.
- For signal samples at least generate & sgv Z→ μμ/ee/qq. If needed, Z→ μμ prioritize for full simulation/reconstruction.
- For 500 GeV, there are signal and SM samples with right beam-spectrum but old Whizard and ILCSoft. Not possible to get SM samples with the latest Whizard and ILCSoft on any useful time-scale.

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