

# Low mass extra Higgses in $e^+e^- Zh$

## Short description.

We study the sensitivity of ILD to detect low mass, higgs-like states. This is done with the recoil-technique, ie. we only search for and measure the Z (\*) decays into two muons, and search for peaks in the the recoil-mass spectrum. The actual decay-mode of the Higgs-like object is not important. Many BSM models predict such states, and once the decay-modes and/or the coupling to the Z is significantly different (lower) than the SM-higgs, such a state might well have escaped detection at LEP (and LHC).

This benchmark in particular can probe three features:

- Muon detection, in particular isolated ones.
- Muon identification.
- Detecting, identifying and measuring ISR photons.

## Main observables.

The main direct observables for the signal are the momentum and identity of decay-products of the Z, Depending on the mass of the Higgs-like object, the Z might be on-shell or off-shell. Different patterns of "return to the Z" ISR will also emerge depending on the Higgs-like object's mass. The physics observable is the exclusion/discovery range for such states as a function of their mass, and the strength of the coupling to the Z wrt that of the SM higgs - Z coupling.

## Optimisation deliverables.

- Isolated muon detection and identification
- ISR finding and reconstruction

## IDR plots.

reconstructed Z boson mass

2 fermion channel



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$M_{\{S\}}=20$  GeV



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ISR Photon tagging efficiency



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Recoil mass distribution

The exclusion limits plots



exclusion\_limit.pdf



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## IDR note.

[Search\\_Scalars\\_at\\_the\\_ILC.pdf](#)

[Search\\_Scalars\\_at\\_the\\_ILC.pdf](#) (new version, Nov 18, 2019)

## People

Main investigator: [Yan Wang](#) , assisted by [Jenny List](#) and [Mikael Berggren](#), reviewed by [Kiyotomo Kawagoe](#) and [Junping Tian](#).

## Code

The GitHub repository is [ILDbench\\_extraH](#) in the ILDAAnaSoft project.

## References.

- Yan Wang, "Search Extra Scalars at the ILC" proceedings [[LCWS17](#), [LCWS18](#), [ICHEP2018](#) ]

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Backup plots, mainly for different scalar masses.

reconstructed Z boson mass

$M_{\{S\}}=100$  GeV

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$M_{\{S\}}=200$  GeV

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$M_{\{S\}}=300$  GeV

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