

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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lepton_pair_inm..._sigma_nh20.pdf

[lepton_pair_inm_nh_20.C](#) [lepton_pair_inm__difference_nh20.C](#) [lepton_pair_inm_sigma_nh20.C](#)

ISR Photon tagging efficiency



ISRphoton_taggi..._efficiency.pdf

[ISRphoton_tagging_efficiency.C](#)

Recoil mass distribution

The exclusion limits plots



[exclusion_limit.pdf](#)



[exclusion_limit...compare_LEP.pdf](#)



[exclusion_limit...mpare_py_de.pdf](#)

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[exclusion_limits_08_03_compare_LEP.C](#)

[exclusion_limits_08_03_compare_py](#)

IDR note.

[Search_Scalars_at_the_ILC.pdf](#)

[Search_Scalars_at_the_ILC.pdf](#)(new version, October 14, 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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