

# Letter of Interest: Search for new scalars at FCC-ee

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ABSTRACT: The FCC-ee provides a rich dataset at center-of-mass collision energies between 90 and 365 GeV. This data can be used to search for new scalars with couplings to the Z boson. We explore the Z boson recoil mass spectrum in search for beyond the standard model signature.

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The FCC-ee, a lepton collider with center-of-mass collision energies between 90 and 365 GeV, is proposed to address key open questions of modern physics. The precision instrument is designed for the in-depth exploration of nature at the smallest scales, optimised to study the Z, W, Higgs and top particles with high precision, with samples of  $5 \times 10^{12}$  Z bosons,  $10^8$  W pairs,  $10^6$  Higgs bosons and  $10^6$  top quark pairs. FCC-ee offers unprecedented sensitivity to new physics, either via the production of new particles or in form of deviations from the standard model (SM). The clean experimental conditions at lepton colliders allow for precision measurements of the known particles with the highest precision and for exploring the unknown [1, 2].

As a proposed Higgs factory, the cornerstone of the FCC-ee physics program is the exploration of the Higgs boson at center-of-mass energies of 240 to 365 GeV. A direct and model-independent measurement of its coupling to the Z boson through the study of the Z boson recoil mass spectrum in  $e^+e^- \rightarrow Z + X$  events at  $\sqrt{s} = 240$  GeV. This measurement is unique to lepton colliders [3].

The recoil mass analysis strategy can be deployed to search for non-SM Higgs boson decays such as Higgs boson to invisible decays or more exotic signatures. The mass spectrum recoiling the Z boson can also be explored in search for new scalars with coupling to the Z boson. This search has been performed at LEP by the OPAL collaboration at center-of-mass energies of 90 GeV and up to 209 GeV [4].

With this project, we study the sensitivity to detect additional scalars by probing at center-of-mass energies of 90 to 365 GeV. Leading backgrounds are 2- and 4-fermion processes.

## References

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- [4] A. et al., *Decay-mode independent searches for new scalar bosons with the opal detector at lep*, *Eur. Phys. J. C* **27** (2003) 311–329, [[0206022](#)].