Year-1 CalVision: Princeton

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Based on this initial study:

Marco T. Lucchini, Lorenzo Pezzotti, Giacomo Polesello, Christopher G. Tully
"**Particle Flow with a Hybrid Segmented Crystal and Fiber Dual-Readout Calorimeter,**"
https://arxiv.org/abs/2202.01474

Funded for 50% grad student support in FY23

1) Implement hybrid DR geometry in a full detector framework
    a) to expand the number of groups benchmarking hybrid DR
    b) to provide a code base to test hybrid DR particle flow approaches
    c) to introduce additional benchmarks for calorimeter performance
2) Participate in test beams for crystal DR
    a) contribute where possible to test beam data-taking

Redoing figure 9 of this paper with a hybrid DR with PFA is the most important first step:
https://arxiv.org/pdf/1308.6176.pdf

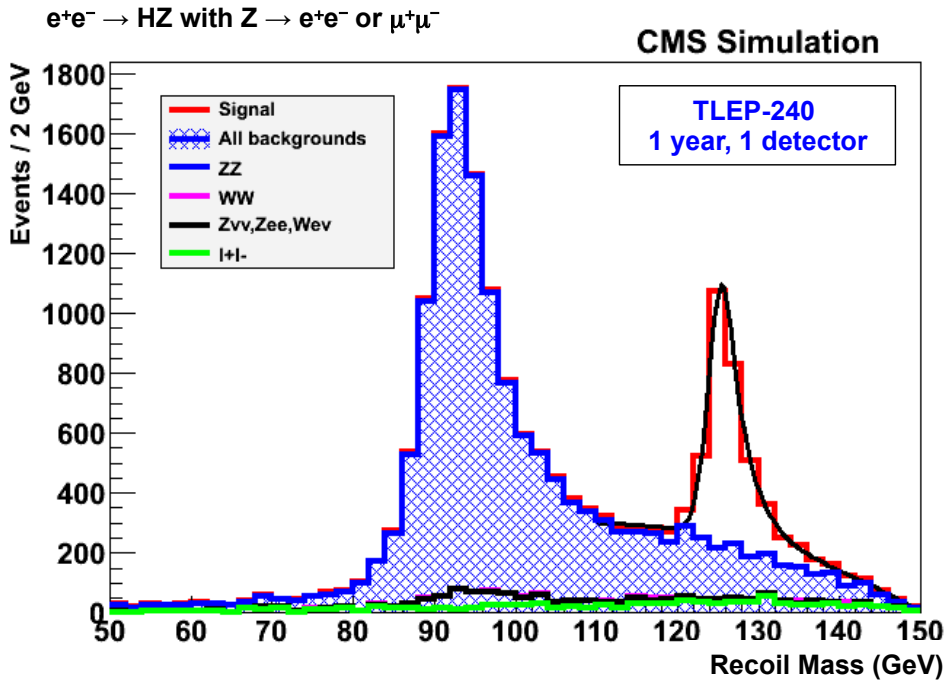

Fig. 9: Distribution of the mass recoiling against the lepton pair in the $e^+e^- \to HZ$ channel, in the $Z \to \ell^+\ell^-$ final state ($\ell = e, \mu$), taken from Ref. [35], for an integrated luminosity equivalent to one year of data taking with one TLEP detector (assumed to be the CMS detector). The number of Higgs boson events (the red histogram) obtained from a fit of this distribution is proportional to the inclusive HZ cross section, σ_{HZ}.

That number of 0.4% is used by this theory paper to quote 28% precision on the indirect measurement of the trilinear coupling of the Higgs to itself:
https://arxiv.org/pdf/1312.3322.pdf

This figure predicts a ~ 3-sigma sensitivity to the indirect measurement of the Higgs trilinear coupling – similar to the LEP delta_rho measurement used to constrain the Higgs sector to be made from doublets

I estimate this blue region could be reduced with a better calorimeter and the measurement improved from 0.4% → 0.2% or better.

This would provide 5-10 sigma sensitivity.

A much more complex benchmark involving mixing H and Z decays from PFA from Hydrid DR.