

# WIMPs in mono-photon channel

## Short description.

The search is for pair-produced WIMPs, where the presence of the interaction is detected by the observation of an ISR photon and nothing else. At ILC (but not LHC) this kind of interaction can be described in a almost model-independent way with EFT. Apart from the obvious  $e^+e^- \rightarrow e^+e^- + \gamma$  irreducible background, also  $e^+e^- \rightarrow e^+e^- + \gamma + \gamma$  (down the beam-pipe) + ISR are the backgrounds. No dedicated signal simulation is needed; one can simply reweight the  $e^+e^- \rightarrow e^+e^- + \gamma$  spectrum (as a function of  $\theta$  and  $E_\gamma$ ) to be that of any signal

This benchmark in particular can probe two features:

- Photon detection and measurement.
- Hermeticity, in particular the performance of the very forward calorimeters.

## Main observables.

The main (and only) direct observables for the signal is the momentum of the ISR photon, The physics observable is the exclusion/discovery WIMPs in the mediator-mass/coupling plane for different lorentz-structures of the interaction.

## Optimisation deliverables.

- Gamma detection efficiency at all angles, in all relevant calorimeters.
- Rejection power of the very forward calorimeters against other activity than the ISR.

## IDR plots & note.

Supporting note (overleaf) : <https://www.overleaf.com/project/5d82feb891023a0001fbbca4>

pdf :



Photon reconstruction : The number of reconstructed photons per generated photon as a function of the signal photon energy.



NrecNgenE\_photon\_IDR.pdf



NrecNgenE\_photon\_IDR.C

Photon reconstruction : The number of reconstructed photons per generated photon as a function of  $\cos_{\theta}$  (left : plot only pfos identified as photon, right: plot all pfos passes cut criteria except for pid).



NrecNgenCosThe...photon\_IDR.pdf



NrecNgenCosThe...a\_photon\_IDR.C



NrecNgenCosThe...allpfo\_IDR.pdf



NrecNgenCosTheta\_allpfo\_IDR.C

Extra: Same as above but plot only  $|\cos_{\theta}| < 0.7$  and  $|\cos_{\theta}| > 0.9$  cases (outside of the drop at  $\cos_{\theta} = 0.8$ ). This indicates the drop at  $\cos_{\theta} = 0.8$  give no effect on Nrec/Ngen vs E.



NrecNgenE\_phot...cosTheta08.pdf



NrecNgenE\_phot...o\_cosTheta08.C

Bcal vetoing (Comparing IDR-L and IDR-S)



bcalveto\_vvNg\_comp.pdf



bcalveto\_vvNg\_comp.C



bcalveto\_vv1g\_comp.pdf



bcalveto\_vv1g\_comp.C



bcalveto\_eeNg\_comp.pdf



bcalveto\_eeNg\_comp.C

Sensitivity : 95% confidence level exclusion limits for different effective operators with a realistic sharing of the polarization at  $4ab^{-1}$  of H20 scenario;  $(-,-,+,+)= (10\%,40\%,40\%,10\%) \sqrt{s}=500\text{--}GeV$ .

Update: Now  $E_{max} < 220GeV$ , which was introduced to avoid Z-return events, has been removed. (But still  $E_{max} < 250$  is set due to a technical issue in a macro.)

1) x-axis range 1-250 GeV



sensitivity\_H20\_IDR.pdf



sensitivity\_H20\_IDR.C

2) x-axis range 1eV - 1TeV (log scale)



sensitivity\_H20\_IDR\_logx.pdf



sensitivity\_H20\_IDR\_logx.C

## People.

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**Reviewer(s):** [Filip Zarnecki](#), [Moritz Habermehl](#)

## References.

Previous analyses by Christoph Bartels & al. : 'Characterising WIMPs at a future e+e Linear Collider', [arxiv:1206.6639](#). Finishing study by Moritz Habermehl & al. : 'WIMP searches at the International Linear Collider' PoS ICHEP2016 (2016) 155, [arxiv:1702.05377](#)

Moritz Habermehl : "Dark Matter at the International Linear Collider", [https://inspirehep.net/record/1717582/files/Moritz\\_Habermehl\\_PhD.pdf](https://inspirehep.net/record/1717582/files/Moritz_Habermehl_PhD.pdf)

## Code

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

