First results from Higgs recoil analysis for HALFH

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[1]DESY, Hamburg

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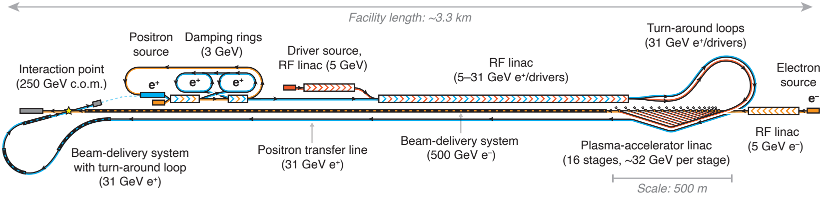
CLUSTER OF EXCELLENCE
QUANTUM UNIVERSE

Hybrid Asymmetric Linear Higgs Factory (HALHF)



- So we have
  - $\mathrm{E(e^-)} = 500$ GeV, $\mathrm{E(e^+)} = 31$ GeV $\Rightarrow E_{cm} = 2\sqrt{500 \cdot 31} = 249$ GeV.
- Look at
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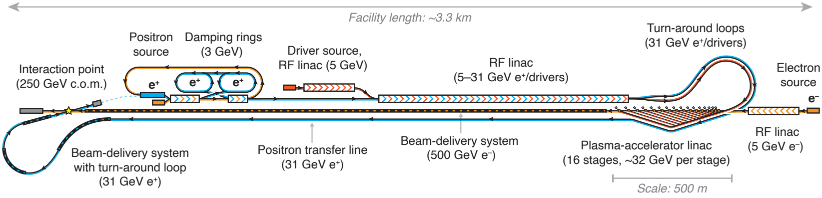

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Higgs recoil at HALHF

First look at the experimental implications of the HALHF.
Generate with Whizard. Settings:

- E(e^-) = 500 GeV, E(e^+) = 31 GeV
  $\Rightarrow E_{cm} = 2\sqrt{500 \cdot 31} = 249$ GeV.
- No beam-spectrum (not yet available), no crossing angle, no polarisation.
- But ISR - the worst spoiler of the recoil mass - is included.
- Simulate ILD with SGV.
- Red-dash: HALHF, black-solid: same conditions, but E(e^-) = E(e^+) = 124.5
  - $\cos\theta$ of the muons ...
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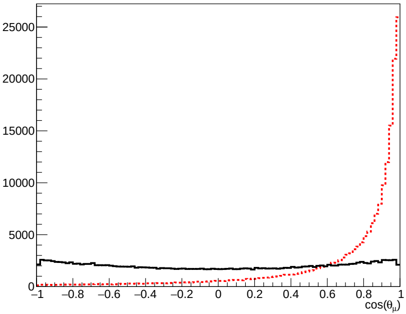

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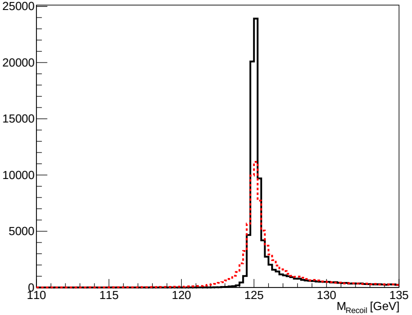

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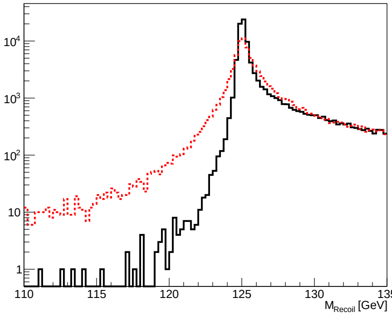

Higgs recoil at HALHF

First look at the experimental implications of the HALHF.
Generate with W

- E(e$^-$) = 50
  $\Rightarrow E_{cm} = 2$
- No beam-s
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- Simulate IL
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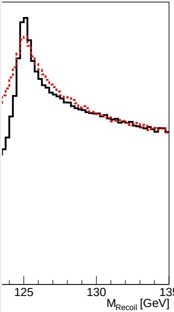
Preliminary uptake

- The problem is not acceptance: almost all μ:s are seen.
- Rather, it is that they are largely seen in the much weaker forward tracking.
- This can't be ameliorated with less material or better point-resolution: the problem is the lever-arm!
- So, either the forward region needs to be made longer, or the B-field must be modified ...



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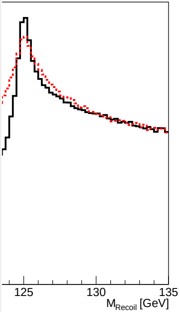

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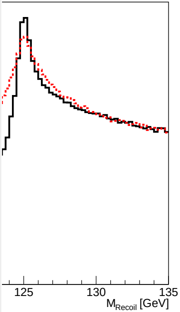

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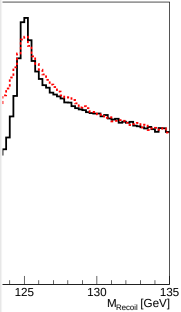
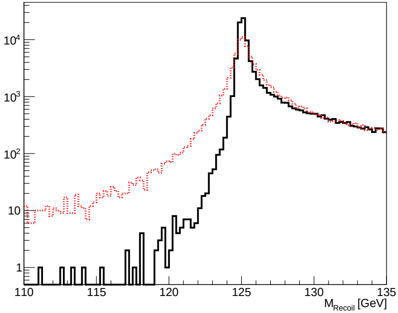


Higgs recoil at HALHF: modified ILD

Modify detector length (Easy to do with SGV)

- ILD at ILC and ILD at HALHF
- and ILD made twice longer in the forward at HALHF
- and ILD made twice longer in the forward, but reduce TPC radius from 1.8 m to 1.55 m ⇒ about the same size (Solenoid volume, area of detectors).
- Long-ILD would give a recoil-mass peak about 80% lower ⇒ very roughly S/B 20% worse ⇒ ∼ 60% more integrated luminosity needed.



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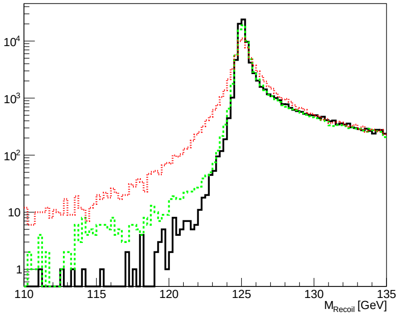

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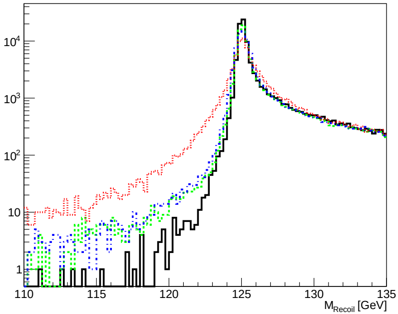

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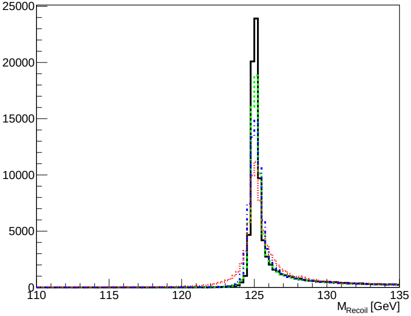

Muon pairs at HALHF

What about fermion pairs, and things like A_{FB} ?

- Generate $e^+e^- \rightarrow \mu^+\mu^-$, and look at Pseudorapidity of μ^+(dashed) and μ^- (solid), separately. Black is ILD@ILC, Red is longer, R-reduced ILD at HALHF.
- In the lab-frame ...
- ... or the CM frame.
- $\Rightarrow$ The symmetry is broken - loss in the forward, but gain in the backward - Maybe that partly compensates ? Also slightly wider ...

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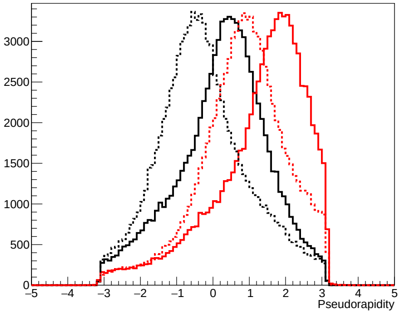

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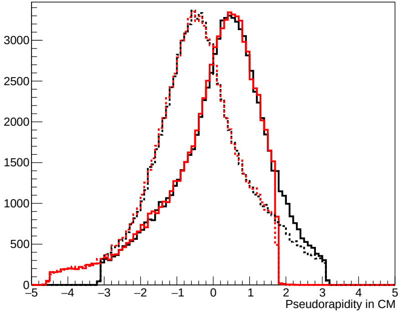

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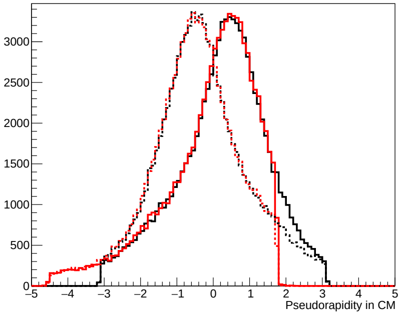

Outlook - No conclusions ...

More work needed:

- Beam-spectrum ?
- Pairs-background - is it better/worse/similar to ILC ?
  - ... and adapt lowest angle detectors to this
- Luminosity measurement: How to do that when bhabha's are not back-to-back ?
- Modify B-field in the forward (toroidal, di-pole, ...). And what would that do the pairs ...
- More physics implications: Flavour tag, searches, ...
  - Need tools development for asymmetric beams and detectors (both Whizard and SGV...)

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