

Electron Proton Colliders

EF10 Lol Summary

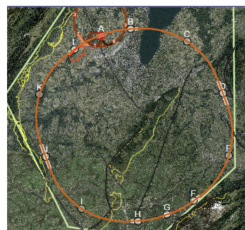
Oliver Fischer

for the LHeC study group



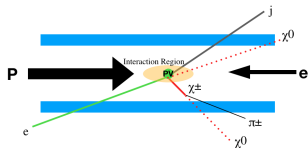
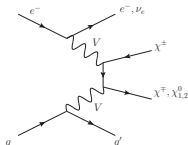
23.09.20

The Large Hadron electron Collider



- ▶ Official CERN project, <http://lhec.web.cern.ch/>
- ▶ CDR [1206.2913], very recent update [2007.14491]
- ▶ Part of the **F**uture **C**ircular **C**ollider: FCC-he (hadron electron)
- ▶ Working groups: PDF, Higgs, Top, Electroweak, **BSM**, ...
- ▶ Motivation:
 - High-resolution microscope: test **QCD** at smallest distances.
 - **PDF**: improve precision of LHC results.
 - Important **Higgs** measurements.
 - Affordable: ~ 1.4 BCHF.

Higgsinos and Dark Photons



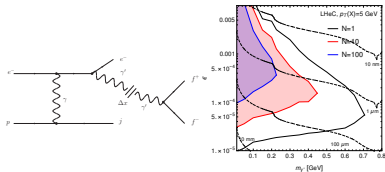
[arXiv:1712.07135]

Long lived Higgsinos:

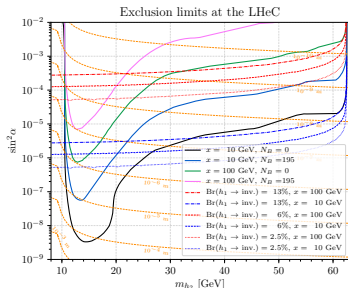
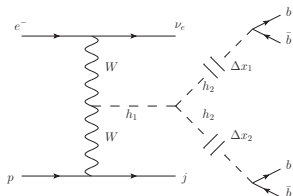
- ▶ Production via vector boson fusion
- ▶ Compressed spectra $\Rightarrow c\tau \sim \mu\text{m}$.
- ▶ Beam remnant jet \Rightarrow primary vertex with $\mathcal{O}(10) \mu\text{m}$ precision
- ▶ Signal: single soft displaced pion.
- ▶ \sim hadronic noise, but can be detected!

Dark Photon

- ▶ LLP for $m_{\gamma'} \sim \text{GeV}$
- ▶ Displaced decays into f^+f^-
- ▶ Backward hemisphere: low background.



Exotic Higgs decays - New!



[2008.09614]

Scalar potential:

$$V(H, S) = -\mu_1^2 H^\dagger H - \mu_2^2 S^\dagger S + \lambda_1 (H^\dagger H)^2 + \lambda_2 (S^\dagger S)^2 + \lambda_3 (H^\dagger H)(S^\dagger S).$$

Tool chain:

MG5 (lifetime activated) + PYTHIA6 (patched) + Delphes
(Displacement module) + 12 background processes

Summary

- ▶ Electron-proton are well motivated (PDF, Higgs, ...)

Europe's affordable track to precision Higgs measurements and the full exploitation of the LHC

- ▶ A lot of **complementary** to other colliders.
- ▶ A variety of **opportunities** for BSM searches:
 - VBF produced particles with compressed spectra;
 - Long lived particles;
 - Signal that looks like hadronic noise;
 - Anything that connects to electron or light quark flavors.
- ▶ Plenty of room for **new** ideas!