

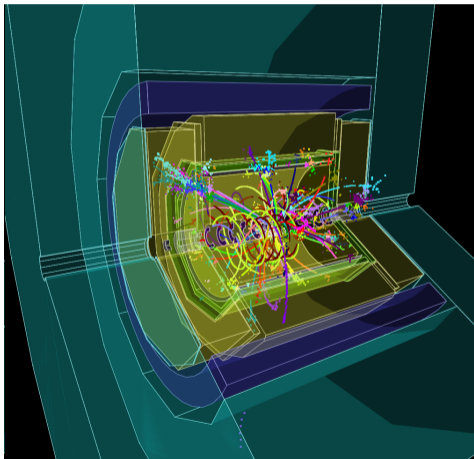
A detailed visualization of a particle detector, likely the International Linear Collider (ILC) detector. The image shows a central beam pipe with a series of detector layers, including calorimeters and tracking chambers. Numerous tracks of particles are shown as glowing lines originating from the interaction point and extending outwards. The background is dark with some ambient light effects, suggesting a high-tech, futuristic environment.

ILD report

LLPs - Long Lived Particles

Aleksander Filip Żarnecki
Faculty of Physics, University of Warsaw

ECFA Focus topic round table
April 29, 2024



The International Large Detector (ILD) is a detector concept for both **Linear and Circular** e^+e^- Colliders. **Dedicated CC design version implemented, full simulation studies ongoing...**

It is based on particle flow for overall event reconstruction, with central tracking based on the large volume Time Projecting Chamber (TPC).

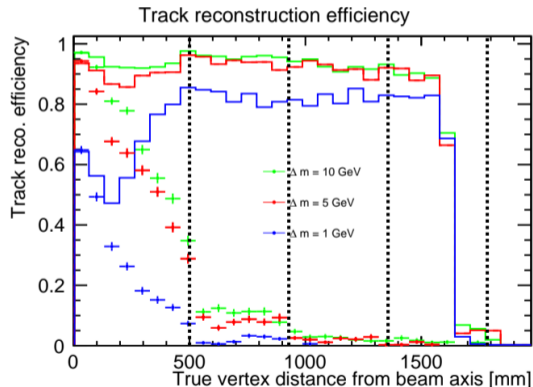
Large volume, with isotropic sensitivity, for displaced track reconstruction...

Ongoing full simulation study see presentation by Jan Klamka

- Track reconstruction settings modified for better LLP acceptance
- Dedicated displaced vertex finding procedure implemented
- Background from overlay events included
- General limits on LLP production extracted
- Performance compared for TPC with pad readout and all-silicon tracking design \Rightarrow

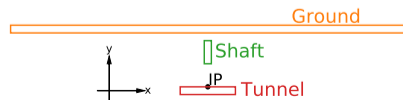
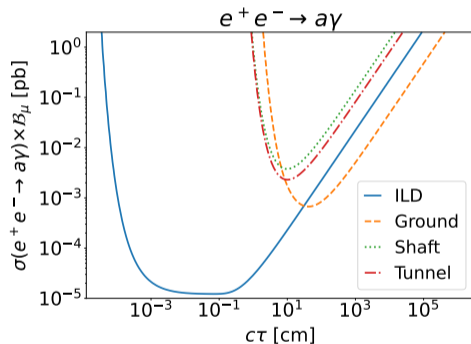
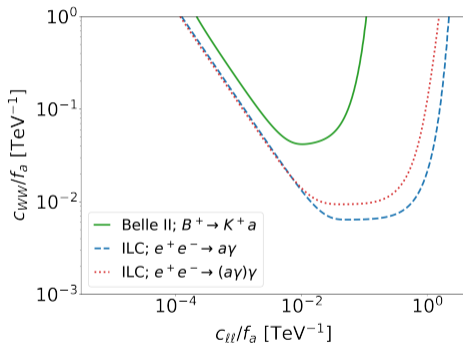
Still to be studied:

- Limits for specific BSM models
- Performance of TPC with pixel readout

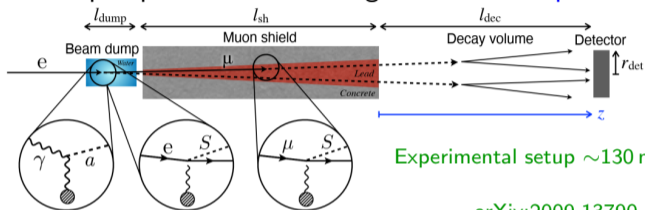


Earlier studies LLPs discovery potential for sub-GeV ALPs

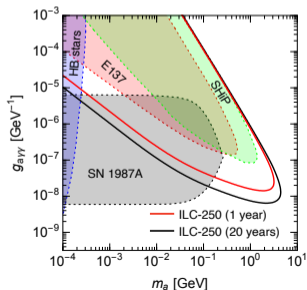
arXiv:2202.11714



Concept of main beam dump experiments searching for axion-like particles or new scalars:



arXiv:2009.13790, see also arXiv:2105.13768



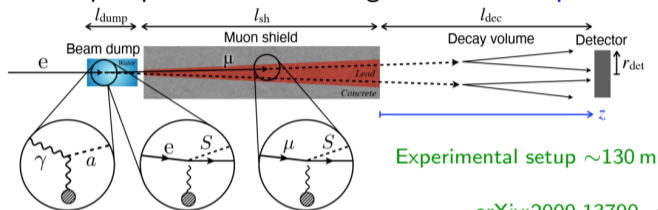
Axion-like particle model

looking for $a \rightarrow \gamma\gamma$

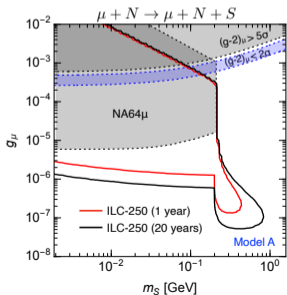
$$\mathcal{L} \ni -\frac{1}{4} g_{a\gamma\gamma} a F_{\mu\nu} \tilde{F}^{\mu\nu} + \frac{1}{2} (\partial_\mu a)^2 - \frac{1}{2} m_a^2 a^2$$

An order of magnitude better sensitivity than other experiments

Concept of main beam dump experiments searching for **axion-like particles** or **new scalars**:



arXiv:2009.13790, see also arXiv:2105.13768



Light scalar coupled to **charged leptons**

$$\mathcal{L} \ni \frac{1}{2}(\partial_\mu S)^2 - \frac{1}{2}m_S^2 S^2 - \sum_{l=e,\mu,\tau} g_l S \bar{l} l$$

Sensitivity down to very small couplings

Model A: $g_l \propto m_l$