Contribution ID: **99** Type: **not specified**

# Effects of Goldstone bosons on gamma-ray bursts

*Tuesday, 12 July 2016 14:05 (20 minutes)*

Gamma-ray bursts (GRBs) are the most energetic explosion events in the universe.
An amount of gravitational energy of the order of the rest-mass energy of the Sun is released from a small region within a short time.
This should lead to the formation of a fireball of temperature in the MeV range, consisting of electrons/positrons, photons, and a small fraction of baryons.
We exploit the potential of GRB fireballs for being a laboratory for testing particle physics beyond the Standard Model, where we find that Weinberg's Higgs portal model serves as a good candidate for this purpose.
Due to the resonance effects, the Goldstone bosons can be rapidly produced by electron-positron annihilation process in the initial fireballs of the gamma-ray bursts.
On the other hand, the mean free path of the Goldstone bosons is larger than the size of the GRB initial fireballs, so they are not coupled to the GRB's relativistic flow and can lead to significant energy loss.
Using generic values for the GRB initial fireball energy, temperature, radius, expansion rate, and baryon number density, we find that the GRB bounds on the parameters of Weinberg's Higgs portal model are indeed competitive to current laboratory constraints.

## Summary

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**Session Classification:** Parallel III

**Track Classification:** Dark Matter, Dark Energy, Astroparticle