Contribution ID: **46** Type: **not specified**

Very light dilaton and naturally light Higgs boson

Friday, February 1, 2019 1:30 PM (40 minutes)

We study very light dilaton, arising from a scale-invariant ultraviolet theory of the Higgs sector in the standard model of particle physics. Imposing the scale symmetry below the ultraviolet scale of the Higgs sector, we alleviate the fine-tuning problem associated with the Higgs mass. When the electroweak symmetry is spontaneously broken radiatively à la Coleman-Weinberg, the dilaton develops a vacuum expectation value away from the origin to give an extra contribution to the Higgs potential so that the Higgs mass becomes naturally around the electroweak scale. The ultraviolet scale of the Higgs sector can be therefore much higher than the electroweak scale, as the dilaton drives the Higgs mass to the electroweak scale. We also show that the light dilaton in this scenario is a good candidate for dark matter of mass mD~1 eV–10 keV, if the ultraviolet scale is about 10–100 TeV. Finally we propose a dilaton-assisted composite Higgs model to realize our scenario. In addition to the light dilaton the model predicts a heavy U(1) axial vector boson and two massive, oppositely charged, pseudo Nambu-Goldstone bosons, which might be accessible at LHC.

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