Two Views of Higgs Theory and Naturalness

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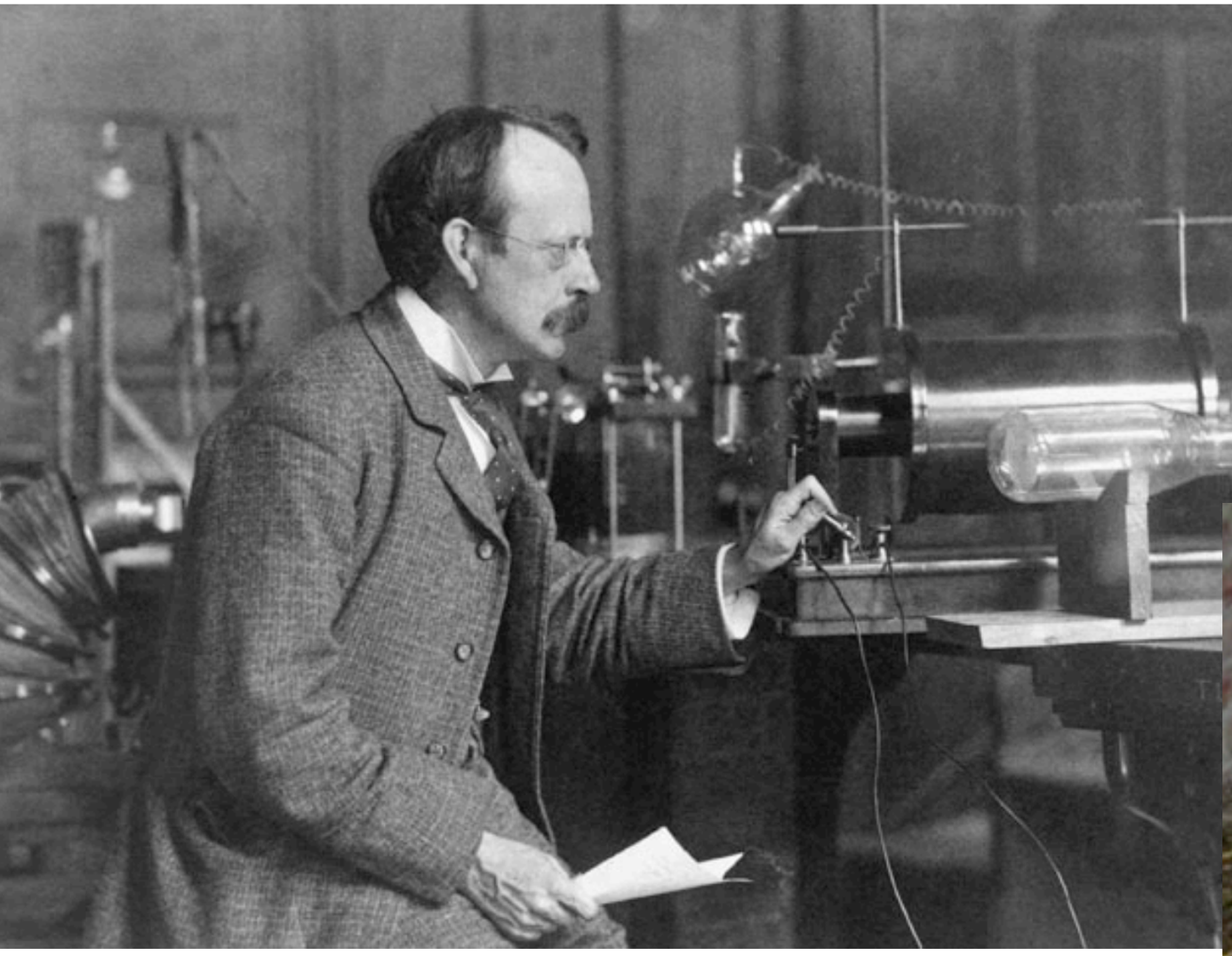
“Now [we] stand at a crossroads: prove [supersymmetry] right in the next year or confront an epochal paradigm shift.”

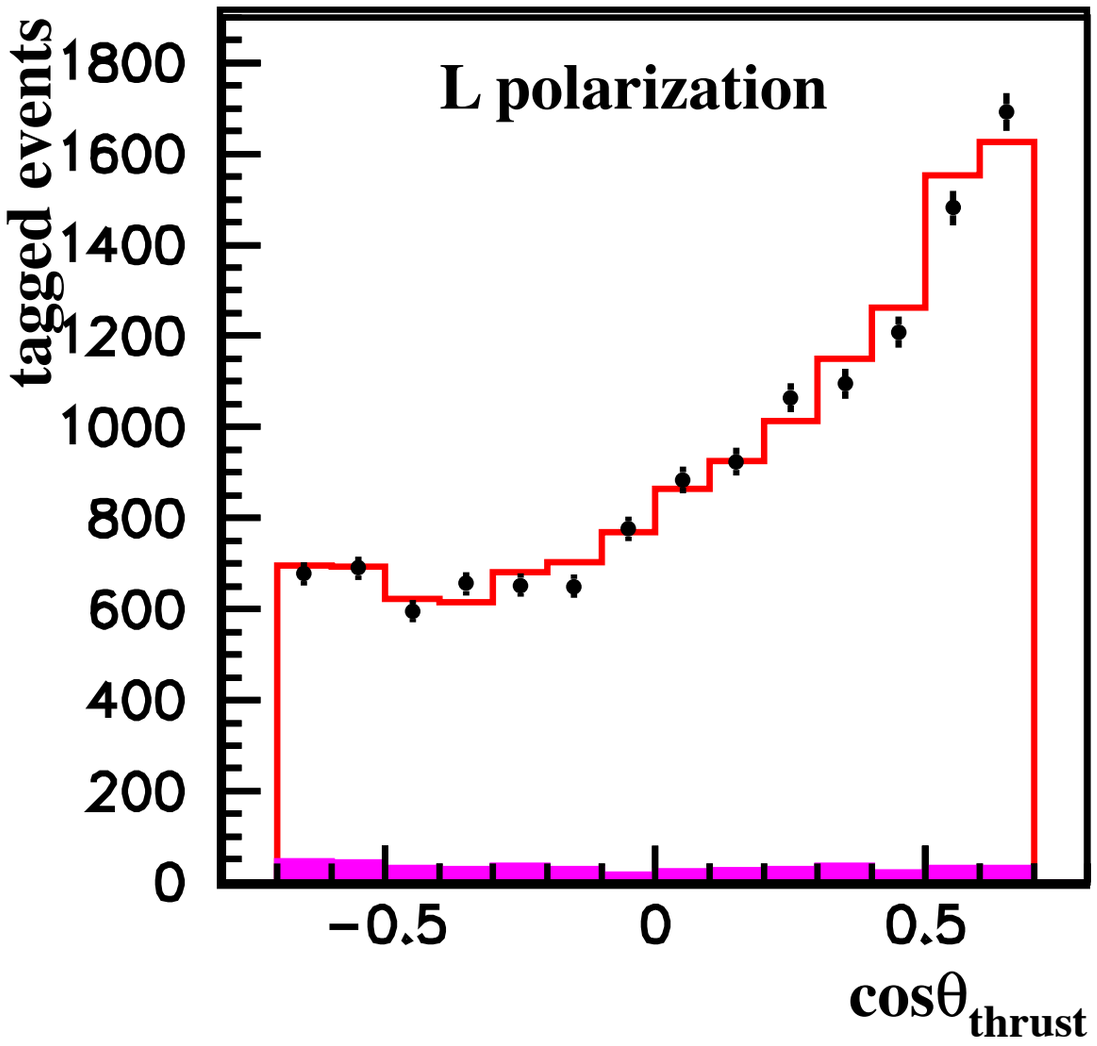
-- J. Lykken and M. Spiropulu

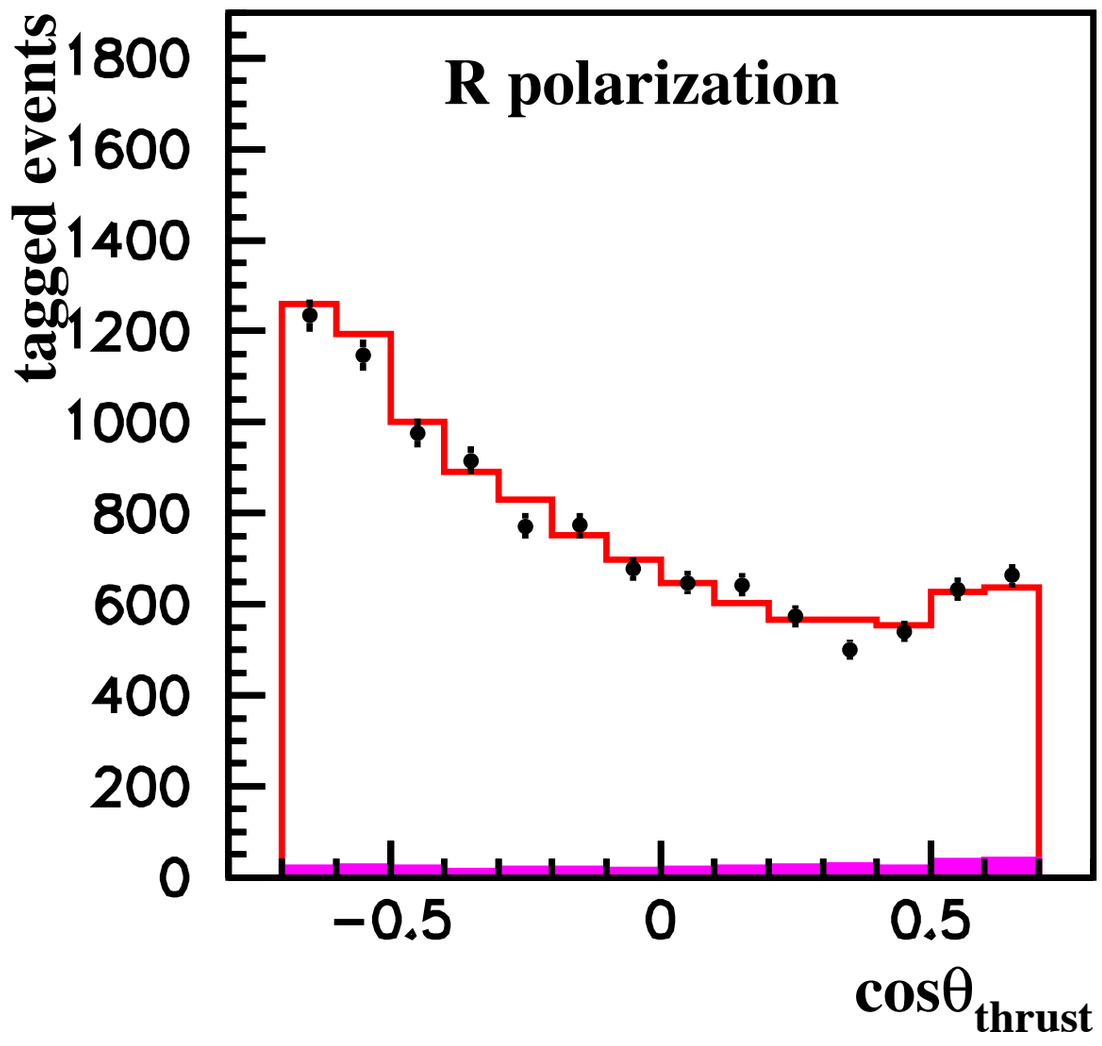


Michael

Joe

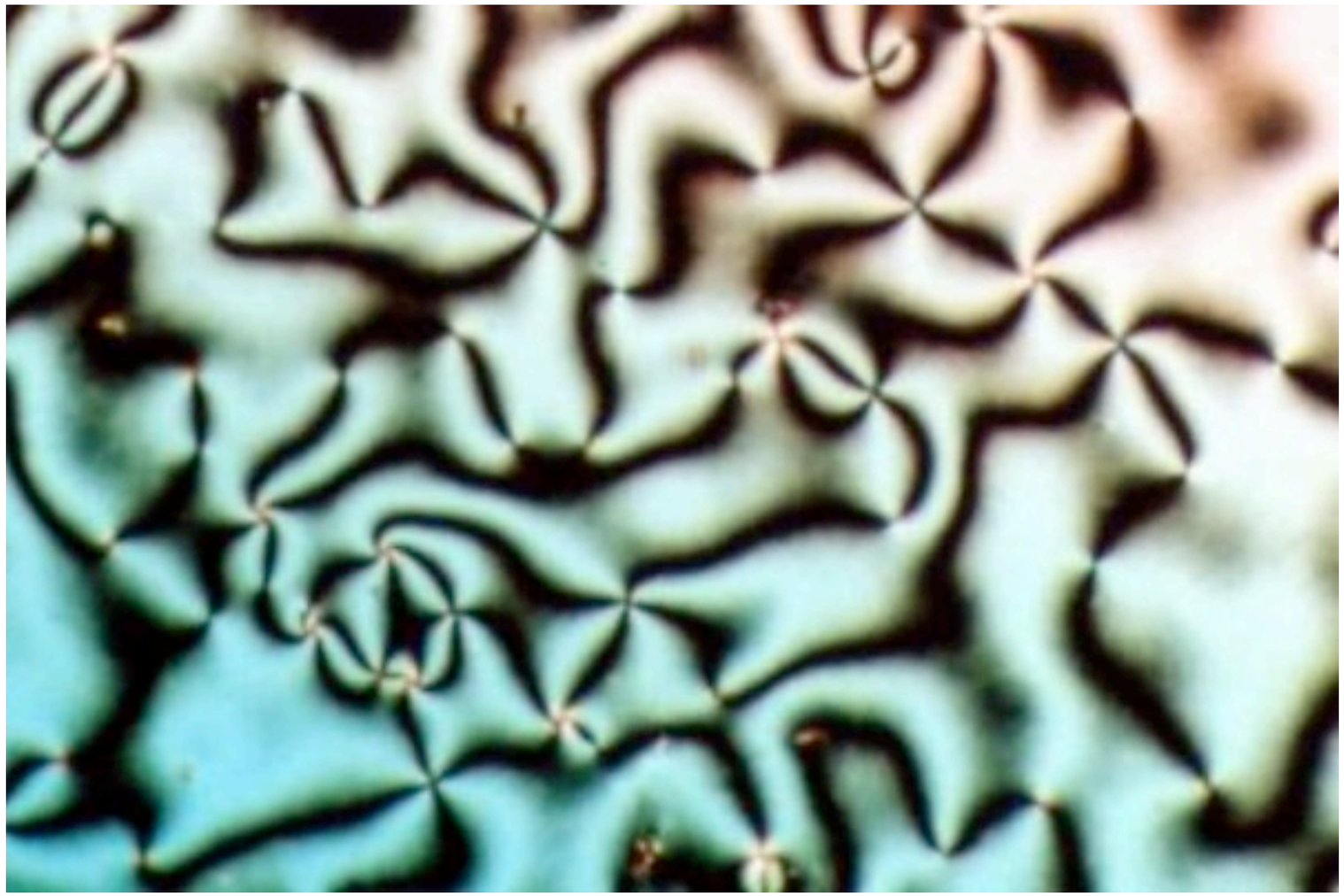
Spontaneous Symmetry Breaking is needed in the Standard Model.



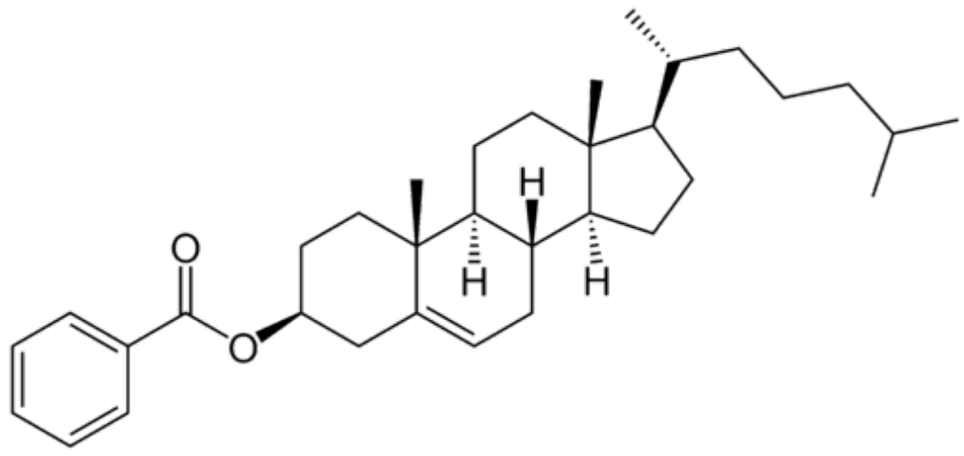


Can we ask, why does the symmetry break?

nematic liquid crystal



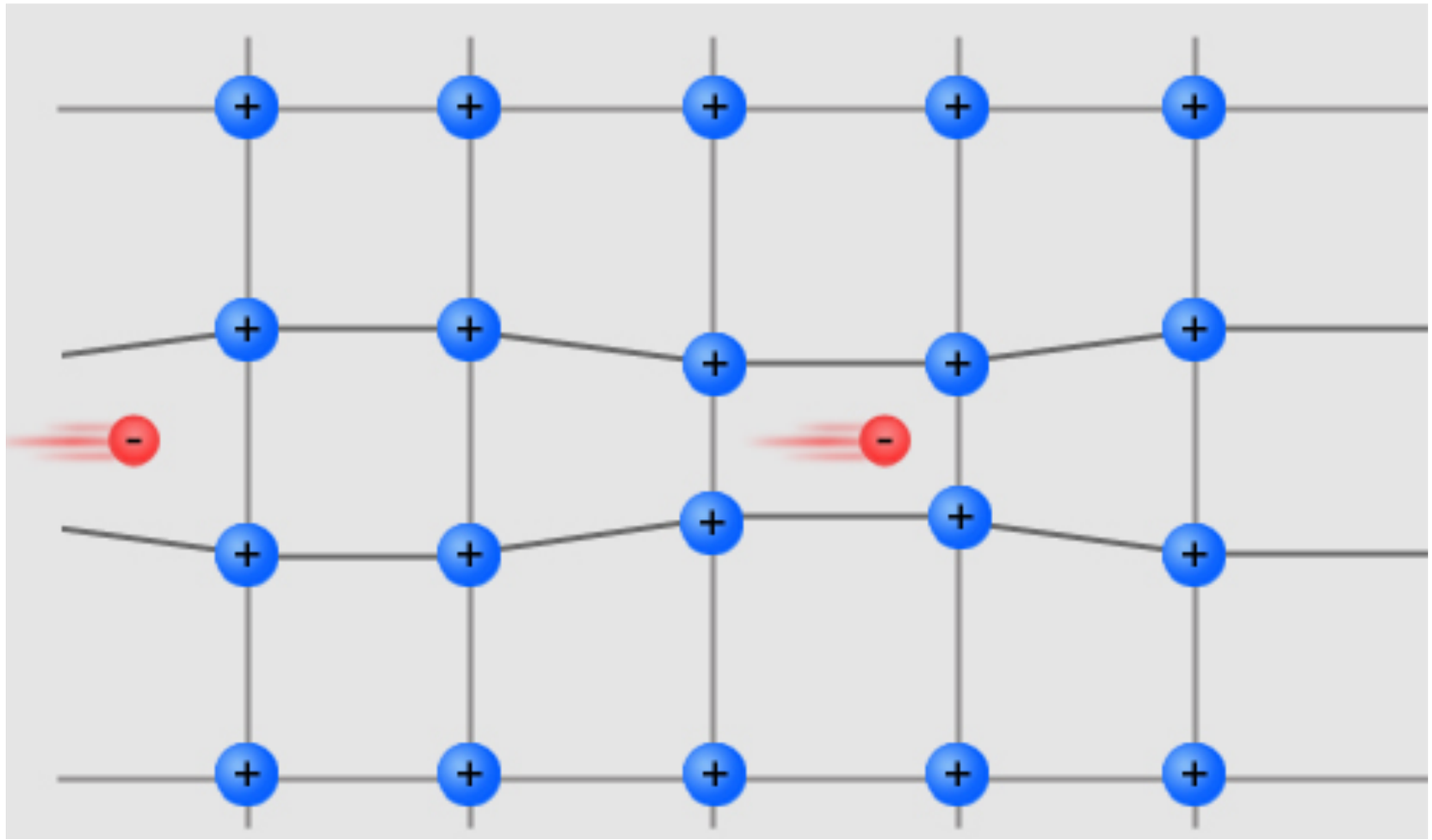
cholesterol benzoate



superconductivity

The mechanism of Cooper pairing explains

why electrons pair; why $T_c \ll T_F$

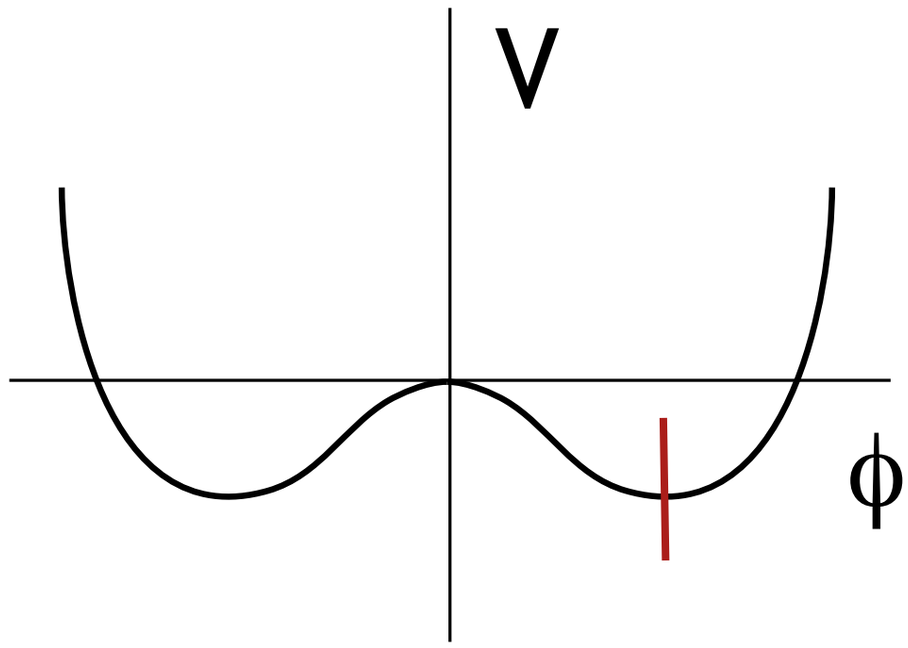


Landau-Ginzburg phenomenology of supersymmetry

$$V(\phi) = \mu^2|\varphi|^2 + \lambda|\varphi|^4$$

"mechanism of superconductivity":

$$\mu^2 < 0$$



explain SSB within the Standard Model ?

strong interactions of the top quark?

$$\alpha_t = \frac{\lambda_t^2}{4\pi} = 0.08 \qquad \text{c.f.} \qquad \alpha_s = \frac{g_s^2}{4\pi} = 0.12$$

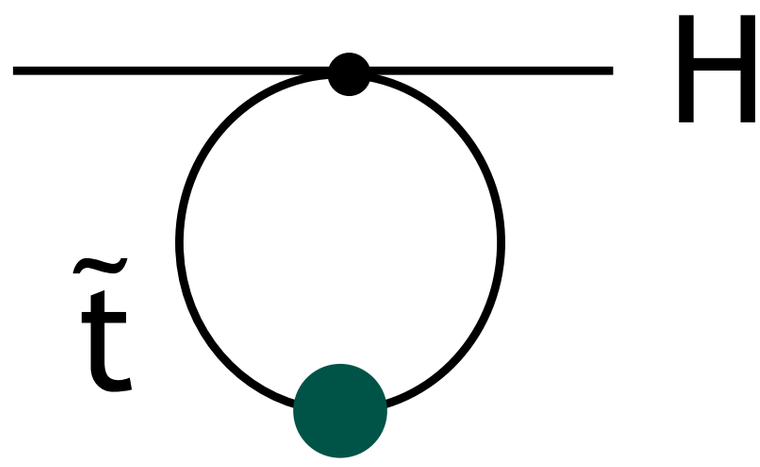
dimensional transmutation ?

$$\mu^2 = \mu^2_{\rm bare} + \frac{\lambda}{8\pi^2}\Lambda^2 - \frac{3y_t^2}{8\pi^2}\Lambda^2 + \cdots$$

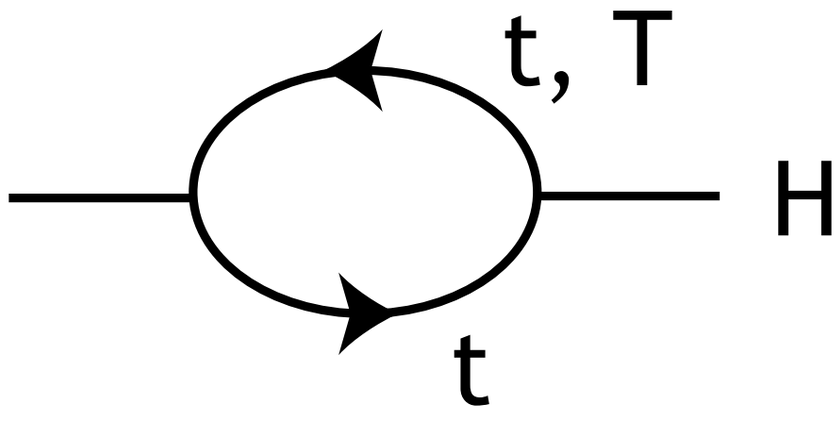
Any explanation of SSB requires new forces between Standard Model particles.

This also necessarily requires new particles:

supersymmetry:



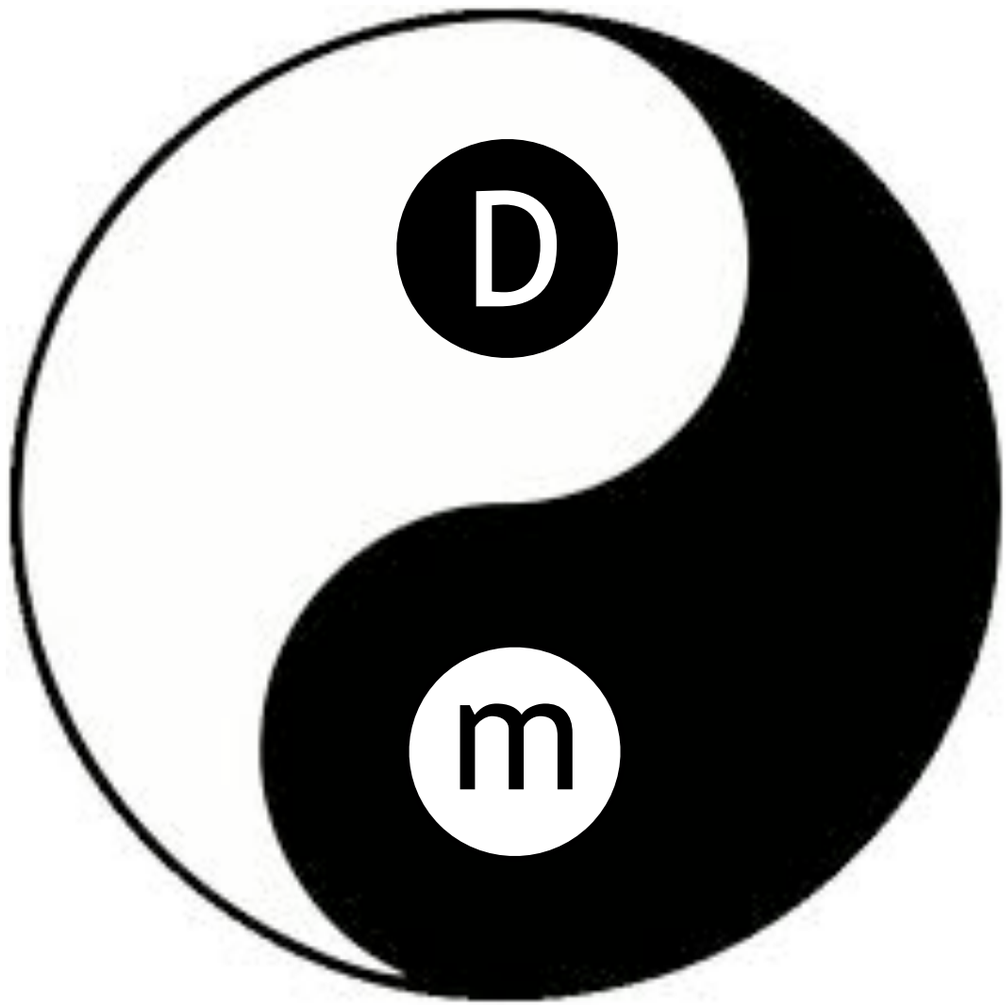
Little Higgs:



Whatever these new particles are, they answer other central questions of physics:

origin and pattern of
quark and lepton masses
CP violation
baryogenesis

maybe also, dark matter.



The LHC, at higher energy and higher luminosity, gives us an excellent opportunity to find these particles.

“Keep the faith, baby !”

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