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Small Higgs Mass from Metastability

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We explore the connection between the Higgs hierarchy problem and the metastability of the electroweak vacuum. Previous work has shown that metastability bounds the magnitude of the Higgs mass squared parameter in the $m_H^2 < 0$ case, realized in our universe. We argue for the first time that metastability also bounds the Higgs mass in the counterfactual $m_H^2 > 0$ case; that is, metastability windows m_H^2 . In the Standard Model, these bounds are orders of magnitude larger than the Higgs mass, but new physics can lower these scales. As an illustration, we consider vacuum stability in the presence of additional TeV scale fermions with Yukawa couplings to the Higgs and a dimension-6 term required to prevent complete instability of the vacuum. We find that the requirement of metastability imposes stringent bounds on the values of m_H^2 and the parameters characterizing the new physics.

Mini Symposia (Invited Talks Only)

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