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F-term uplifting via consistent D-terms

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The issue of fine-tuning necessary to achieve satisfactory degree of hierarchy between moduli masses, the gravitino mass and the scale of the cosmological constant has been revisited in the context of supergravities with consistent D-terms. We have studied (extended) racetrack models where supersymmetry breaking and moduli stabilisation cannot be separated from each other. We show that even in such cases the realistic hierarchy can be achieved on the expense of a single fine-tuning. The presence of two condensates changes the role of the constant term in the superpotential, W_0, and solutions with small vacuum energy and large gravitino mass can be found even for very small values of W_0. Models where D-terms are allowed to vanish at finite vevs of moduli fields - denoted cancellable' D-terms - and the ones where D-terms may vanish only at infinite vevs of some moduli - denotednon-cancellable' - differ markedly in their properties. It turns out that the tuning with respect to the Planck scale required in the case of cancellable D-terms is much weaker than in the case of non-cancellable ones. We have shown that, against intuition, a vanishing D-term can trigger F-term uplifting of the vacuum energy due to the stringent constraint it imposes on vacuum expectation values of charged fields. Finally we note that our models only rely on two dimensionful parameters: M_P and W_0.

Author: Dr EYTON-WILLIAMS, Oliver (Institute of Theoretical Physics, University of Warsaw, 00-681 Warsaw, Poland)

Co-authors: Dr MATYSZKIEWICZ, Radek (Institut fur Theoretische Physik, TU Dresden, Germany); Dr LALAK, Zygmunt (Institute of Theoretical Physics, University of Warsaw, 00-681 Warsaw, Poland)

Presenter: Dr EYTON-WILLIAMS, Oliver (Institute of Theoretical Physics, University of Warsaw, 00-681 Warsaw, Poland)

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