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The sign of the D-term in extremely unstable systems

In theoretical and model studies so far the D-term D was always found negative. The first insights from experiment indicate negative D-terms for pion and proton. A proof that $D < 0$ was formulated based on classical stability arguments. It is therefore interesting to ask whether it is possible to encounter a positive D-term, if a physical system is unstable. This question was addressed in the Q-cloud system, an extreme parametric limit in which a stable soliton dissociates, delocalizes, and spreads out over all space forming an infinitely dilute gas of free quanta. But even in this system $D < 0$ was found. In this work we go a step further: we show that the previously studied Q-cloud solution was a ground state which has even more unstable excited states. We study the energy-momentum tensor and other properties of these Q-cloud excitations, and show that their D-terms are nevertheless consistently described, and negative — despite the extreme instability of this system. We present numerical results that support our conclusions. We conjecture that stability is a necessary condition for D to be negative, but not sufficient.

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