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Stability and collapse of fermions in a binary dipolar Bose-Fermi 164Dy-161Dy mixture

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Trapped degenerate dipolar Bose and Fermi gases of cylindrical symmetry with the polarization vector along the symmetry axis are only stable for the strength of dipolar interaction below a critical value. In the case of bosons, the stability of such a dipolar Bose-Einstein condensate (BEC) is investigated for different strengths of contact and dipolar interactions using variational approximation and numerical solution of a mean-field model. In the disk shape, with the polarization vector perpendicular to the plane of the disk, the atoms experience an overall dipolar repulsion and this fact should contribute to the stability. However, a complete numerical solution of the dynamics leads to the collapse of a strongly disk-shaped dipolar BEC as well as a Fermi superfluid. A collapse can be induced in a disk-shaped stable binary Bose-Fermi mixture by jumping the interspecies contact interaction from repulsive to attractive by the Feshbach resonance technique. Collapse and fragmentation in the fermions after subsequent explosions are illustrated. The present study is carried out in three-dimensional space using realistic values of dipolar and contact interactions.

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