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Two-dimensional Bose gases near resonance: Competing two and three body interactions MOHAMMAD S. MASHAYEKHI, JEAN-SEBASTIEN BERNIER, DMITRY BORZOV, University of British Columbia, JUN-LIANG SONG, Institute for Quantum Optics and Quantum Information, Austrian Academy of Sciences, FEI ZHOU, University of British Columbia — We report in this Letter the results of our investigation of 2D Bose gases beyond the dilute limit emphasizing the role played by three-body scattering events. We demonstrate that a competition between three-body attractive interactions and two-body repulsive forces results in the chemical potential of 2D Bose gases to exhibit a maximum at a critical scattering length beyond which these quantum gases possess a negative compressibility. For larger scattering lengths, the increasingly prominent role played by three-body attractive interactions leads to an onset instability at a second critical value. The three-body effects studied here are universal, fully characterized by the effective 2D scattering length a_{2D} (or the size of the 2D bound states) and are, in comparison to the 3D case, independent of three-body ultraviolet physics. We find, within our approach, the ratios of the contribution to the chemical potential due to three-body interactions to the one due to two-body to be 0.27 near the maximum of the chemical potential and 0.73 in the vicinity of the onset instability.

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