

A GENERALIZED-LAGUERRE-HERMITE PSEUDOSPECTRAL METHOD FOR COMPUTING SYMMETRIC AND CENTRAL VORTEX STATES IN BOSE-EINSTEIN CONDENSATES

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ABSTRACT. A generalized-Laguerre-Hermite pseudospectral method is proposed for computing symmetric and central vortex states in Bose-Einstein condensates (BECs) in three dimensions with cylindrical symmetry. The new method is based on the properly scaled generalized-Laguerre & Hermite functions and a normalized gradient flow. It enjoys three important advantages: (i) it reduces a three dimensional (3D) problem with cylindrical symmetry into an effective two-dimensional (2D) problem; (ii) it solves the problem in the whole space instead of in a truncated artificial computational domain; and (iii) it is spectrally accurate. Extensive numerical results for computing symmetric and central vortex states in BECs are presented for one-dimensional (1D) BEC, 2D BEC with radial symmetry and 3D BEC with cylindrical symmetry.

Key words and phrases. Generalized-Laguerre-Hermite functions, Bose-Einstein condensate, central vortex state, symmetric state, normalized gradient flow.

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