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Fractional Vortices in $J = 2$ Condensates[1] DAVID FERGUSON, JAMES SAULS, Northwestern University — We consider the possible ground-states and topologically stable line defects in BCS and BEC condensates with total spin $J = 2$, including spinor BECs, as well BCS condensates with total angular momentum $J = 2$. For cold Fermi gases it may be possible to realize ${}^1D_2$ or ${}^3P_2$ condensates of BCS pairs described by a symmetric and traceless matrix, $A_{\mu\nu}$, for the $2J+1 = 5$ complex amplitudes that transform as a rank 2 tensor under joint spin and orbital rotations. Condensates with $J = 2$ have a rich phase diagram. We discuss the residual symmetry and fundamental group of $J = 2$ condensates exhibiting *complex, bi-axial* order, $A_{\mu\nu} = \Delta\, e^{i\varphi}\left[u_\mu u_\nu + \epsilon v_\mu v_\nu + \epsilon^2 w_\mu w_\nu\right]$, where $\epsilon = e^{i\,2\pi/3}$ and u, v, w are an othogonal triad. This remarkable phase has tetrahedral point symmetry and is described by a non-abelian fundamental group $\pi_1(G/H)$. We classify the topologically stable line defects and show that conventional $U(1)$ phase vortices can dissociate into *fractional* vortices with $2\pi/3$ phase winding combined with tetrahedral rotations, indexed by the conjugacy classes of the non-abelian isotropy subgroup H, and consider associated fermionic bound states.

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David Ferguson
Northrop Grumman - Baltimore

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