Fractional Vortices in $J = 2$ Condensates\textsuperscript{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, $A_{\mu\nu} = \Delta e^{i\varphi} [u_{\mu}u_{\nu} + \epsilon v_{\mu}v_{\nu} + \epsilon^2 w_{\mu}w_{\nu}]$, where $\epsilon = e^{i 2\pi/3}$ and $u, v, w$ are an orthogonal 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.

\textsuperscript{1}Supported by NSF Grant DMR-1106315.

David Ferguson
Northrop Grumman - Baltimore

Date submitted: 15 Nov 2013

Electronic form version 1.4