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Non-Abelian order in s-wave superconductors: Phases and quantum transitions[1] SUMANTA TEWARI, Physics & Astronomy, Clemson University, Clemson, SC, TUDOR STANESCU, Department of Physics, West Virginia University, Morgantown, WV, JAY SAU, Condensed Matter Theory Center, Dept. of Physics, University of Maryland, College Park, MD, PARAG GHOSH, Dept. of Physics and Astronomy, George Mason University, Fairfax, VA, SANKAR DAS SARMA, Condensed Matter Theory Center, Dept. of Physics, University of Maryland, College Park, MD — Non-Abelian topological superconductivity has been predicted to occur in s-wave superconductors with a sizable spin-orbit (SO) coupling. As is now well known, such a system can be used for topological quantum computation. When an external Zeeman splitting crosses a critical value, the system passes from a regular, non-topological, superconducting phase to a topological one. On the other hand, in the absence of SO coupling this critical value corresponds to the Zeeman splitting above which the system loses its s-wave superconductivity. We are thus led to the paradoxical conclusion that the topological superconducting phase appears in a parameter regime at which the system actually is non- superconducting in the absence of SO coupling. In this work we resolve this paradox.

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