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Beyond parafermions: Defects and zero-modes in non-Abelian phases NETANEL LINDNER, Technion - Israel Institute of Technology, EREZ BERG, ADY STERN, Weizmann Institute of Science — Non-Abelian topological phases of matter can be utilized to encode and manipulate quantum information in a non-local manner, such that it is protected from imperfections in the implemented protocols and from interactions with the environment. The condition that the non-Abelian statistics of the anyons supports a computationally universal set of gates sets a very stringent requirement which is not met by many topological phases. We consider the possibility to enrich the possible topological operations supported by a non-Abelian topological phase by introducing defects into the system. We show that such defects bind zero modes which form a unique algebra that goes beyond the algebra of parafermions which describes defects in Abelian phases. For the case of a bi-layer containing Ising anyons, we show that by coupling zero modes one can obtain a set of topological operations that implements a universal set of gates.

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