Robustness of zero-modes in parafermion chains[1] ADAM JERMYN,
ROGER MONG, JASON ALICEA, California Institute of Technology — Several
models for 1D topological phases are known to host zero-modes that enable high-
fidelity quantum information storage and manipulation. The Majorana fermion
chain provides a classic example. Here the system supports Majorana zero-modes
that guarantee two-fold degeneracy in the ground state and excited states to within
exponential accuracy. Chains of "parafermions"–which represent generalized Ma-
jorana fermions–also support zero-modes, but, curiously, only under much more
restricted circumstances as shown recently by Fendley. We shed light on this in-
teresting finding by exploring the properties of ground-states and excited states in
parafermion chains using analytic methods as well as DMRG and exact diagonal-
ization of a truncated Hilbert space model. We show that the absence of exact
zero-modes admits a simple physical picture in terms of domain-wall dynamics.

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