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Timecrystalline vortices, anyons and the Poincaré index formula

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I start by an update of vortices, as described by the Gross-Pitaevskii (GP) equation, explaining why there is room for new phenomena. First I describe what a time crystal is in Hamiltonian context. Then, I show that minimal energy solutions of GP equation behave like a time crystal. Furthermore, I show that as a consequence vortices of GP equation have anyonic exchange. I conclude with a topological analysis of multi-vortex systems and their Kosterlitz-Thouless transition, using the Poincaré index formula. At the end, I comment on three dimensional extensions such as closed and possibly knotted vortex lines.

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