Contribution ID: **388** Type: **Poster (Student, In Competition) / Affiche (Étudiant(e), inscrit à la compétition)**

Energy of vortices in an Abelian Higgs model (in 2+1 dimensions) with sixth-order potential

Wednesday, 18 June 2014 19:00 (2 minutes)

I will consider a generalization of the Abelian Higgs model in 2+1 dimensions. The model describes a scalar field interacting with a U(1) gauge field and gives rise to vortex solutions carrying magnetic flux. In 3+1 dimensions, the vortex becomes a one-dimensional topological defect which appears in condensed matter physics as a vortex line in type-II superconductors. For a strong magnetic flux (large winding number), the vortex presents a thin-wall profile, which gives rise to certain simplifications in the analysis.
I will present how the energy of the static configuration depends on the parameters of the model and in particular on the winding number of the vortex. For the usual choice of potential (quartic), variation of one parameter leads to a type-I and type-II vortex, as the energy dependence on the winding number show that vortices attract or repel each other respectively.
The potential chosen here is a sixth-order polynomial such that the core of the vortex is the true vacuum (absolute minimum) while the field at infinity goes to the false (local minimum of the potential) vacuum. Their decay rate into an instable classical configuration with growing radius had already been estimated by a semi-classical approximation to show their impact on the stability of the false vacuum. The classical existence of vortex solutions will be shown numerically, and a scan of the parameters of the model reveals an interesting energetic behavior.

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Session Classification: DTP Poster Session, with beer (2) / Session d'affiches DPT, avec bière (2)

Track Classification: Theoretical Physics / Physique théorique (DTP-DPT)