Contribution ID: **1284** Type: **Oral (Student, In Competition) / Orale (Étudiant(e), inscrit à la compétition)**

Tunneling decay of false vortices: Gravitational effects

Tuesday 14 June 2016 14:30 (15 minutes)

We consider the decay of vortices trapped in a $U(1)$-breaking false vacuum of a Einstein-Hilbert-Higgs theory in $2+1$ dimensions. In the true vacuum, the $U(1)$ symmetry is unbroken. The potential of the model allows the formation of metastable vortex solutions. These vortices contain the true vacuum inside in addition to a unit of magnetic flux and the appropriate topologically nontrivial false vacuum outside. The work presented extends a previous analysis by coupling the vortices to gravity.
We employ numerical methods as well as analytic methods using the so-called thin-wall approximation to verify that static metastable vortices remain when gravity is turned on. In the latter case, knowledge of the metric of space-time inside and outside the core of the vortex allows one to use Israel's junction conditions and to study the dynamics of the vortex's radius. We compute an estimate for the tunneling amplitude of the vortex in the semiclassical approximation. This process of tunneling through expansion of a vortex core is of cosmological importance, as it could be much more rapid than the spontaneous decay of the false vacuum.

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Session Classification: T2-7 Gravity, Astrophysics and Cosmology (DTP) / Gravité, astrophysique et cosmologie (DPT)

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