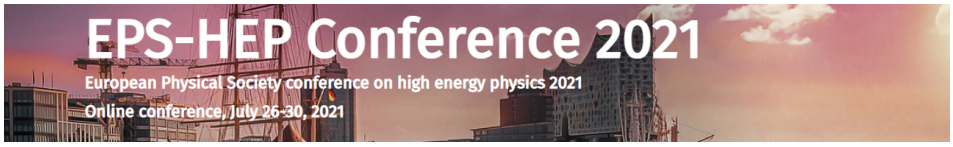

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Non-singular vortices with positive mass in 2+1-dimensional Einstein gravity with AdS_3 and Minkowski background

Wednesday 28 July 2021 17:05 (20 minutes)

We find numerically static vortex solutions where the scalar and gauge fields have a non-singular profile under Einstein gravity in an AdS_3 background. Vortices with different winding numbers n, VEV v and cosmological constant Λ are obtained. These vortices have positive mass and are not BTZ black holes as they have no event horizon. The mass is determined in two ways: by subtracting the numerical values of two separate asymptotic metrics and via an integral that is purely over the matter fields. The mass of the vortex increases as the cosmological constant becomes more negative and this coincides with the core of the vortex becoming smaller (compressed). We then consider the vortex with gravity in asymptotically flat spacetime for different values of the coupling $\alpha = 1/(16\pi G)$. At the origin, the spacetime has its highest curvature and there is no singularity. It transitions to an asymptotic conical spacetime with angular deficit that increases significantly as α decreases. For comparison, we also consider the vortex without gravity in flat spacetime. For this case, one cannot obtain the mass by the first method (subtracting two metrics) but remarkably, via a limiting procedure, one can obtain an integral mass formula. In the absence of gauge fields, there is a well-known logarithmic divergence in the energy of the vortex. With gravity, we present this divergence in a new light. We show that the metric acquires a logarithmic term which is the $2+1$ dimensional realization of the Newtonian gravitational potential when General Relativity is supplemented with a scalar field.

First author

Ariel Edery

Email

aedery@ubishops.ca

Collaboration / Activity

Bishop's University

Primary author: EDERY, Ariel (Bishop's University)

Presenter: EDERY, Ariel (Bishop's University)

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