Simulations of accretion processes onto boson stars.

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Solutions of the Einstein's equations when coupled with a complex scalar field, compact Boson Stars (BS), if existent, would present no hard surface nor event horizon. Therefore, they provide a compelling scenario for astrophysical phenomena such as accretion flows, for which simulations play a crucial role in gaining a deeper understanding due to its rather rich complexities. The study of accretion processes can, for instance, reveal the presence of instabilities on analytical models, hint the origins of viscous momentum transport and predict the spectrum of emission of astrophysical sources. Indeed, through simulations, accretion onto BS have been shown to have different features from those onto black holes, for its peculiar effective gravitational potential gives rise to interesting structures regarding accretion dynamics [1,2,3]. Although intriguing, the BS in these previously reported simulations were mainly limited to ultra compact solutions that qualify them as black hole mimickers. Thus, we revisit the problem in our project, with a broader approach regarding the parameters of the BS (e.g. core density and and rotational quantum integer *k*). As preliminary tests we investigate the disruption of clouds near mini BS with various masses, simulating the evolution of ideal magnetohydrodynamics on a 2D grid. Furthermore we aim to do the same with rotating BS and implement different initial conditions to investigate the formation of discs and the final configurations of the plasma in the vicinity of such compact objects. The simulations are being accomplished using the Black Hole Accretion Code (BHAC) [4]. Although our project is in a preliminary stage we are looking forward to discuss our early results.

References

[1] Z. Meliani, P. Grandclément, F. Casse, F. H. Vincent, O. Straub and F. Dauvergne, Class. Quant. Grav. **33,** 155010 (2016)

[2] Z. Meliani, F. Casse, P. Grandclément., E. Gourgoulhon and F. Dauvergne, Class. Quant. Grav. **34,** 225003 (2017)

[3] H. Olivares, Z. Younsi, M. F. Christian, M. De Laurentis, O. Porth, M. Yosuke, H. Falcke, M. Kramer and L. Rezzolla, ePrint, arXiv: 1809.08682 [gr-qc] (2018)

[4] O. Porth, H. Olivares, Y. Mizuno, Z. Younsi, L. Rezzolla, M. Moscibrodzka, H. Falcke and M. Kramer, ePrint, arXiv: 1611.09720 [gr-qc] (2016)