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Inverse problem of analog systems to ultra compact objects: from scattering properties to perturbation potentials

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In this talk, we present a method to study the properties of ultra-compact, horizonless objects starting from their scattering properties in terms of an inverse problem. The method is based on a combined inversion of Gamow's formula and the Bohr-Sommerfeld rule. Since the direct measurements of transmission and reflection coefficients of astrophysical compact objects are not available from existing gravitational wave measurements, we show that the method is well suited for laboratory based experiments of analogue gravity systems. To demonstrate its capabilities, we apply it to an analogue model of ultra compact horizonless objects which consists of an imperfect draining vortex in a bathtub. Our method cannot only reconstruct the surface reflectivity and compactness, but also yields a good approximation of the effective perturbation potential encoding the dynamical properties of the system. We conclude that this approach is complementary to methods based on the source's quasi-normal mode spectrum and discuss possible extensions.

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