Title:	Exploring Superradiance and Quasinormal Modes of a Black Hole through Scalar Fields
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Abstract:	Black holes are a class of solutions to the Einstein's field equations that describes the curvature of spacetime caused by a very dense mass distribution. These are formed by the collapse of a massive star. The mass distribution of the black hole is concentrated at its singularity, that is a spacetime point of infinite density. It results in event horizon of a black hole and many of its properties. One of the important properties of a rotating or Kerr black hole is Ergoregion. It is the region between outer event horizon and surface of infinite redshift of the black hole. Roger Penrose in 1960s proposed the Penrose process which talks about a method of extracting energy from a rotating black hole. He considered the case of particles. Later, this idea was combined with the idea of Superradiance. Superradiance in a physical system talks about amplification of radiation. It was extended to the case of a rotating black hole by William H. Press in 1972. These superradiant modes can be thought of as the modes of the black holes perturba- tions. Quasinormal modes are another class of perturbation modes. These describes an outgoing wave at spatial infinity. Radiation from the black holes and many other systems are dominated by these quasinormal modes. So there is an obvious interest in finding the quasinormal modes. In this project we talk about black holes and its properties including the Penrose process. Then we talked about the superradiance and the frequency range for a scalar field that can undergo superradiance. We looked at what we can infer from this about the scalar field and the possibility of detecting these fields. We then studied the perturbations in black holes and the quasinormal modes. One of the ways of finding these modes the Prüfer method. We tried to replicate the frequencies obtained from this method and compared it with the results of WKB and Phase-amplitude method.
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