Physics & Astronomy Colloquium - Spring 2019

Tuesday, March 26th at 3:30 pm in SC 234

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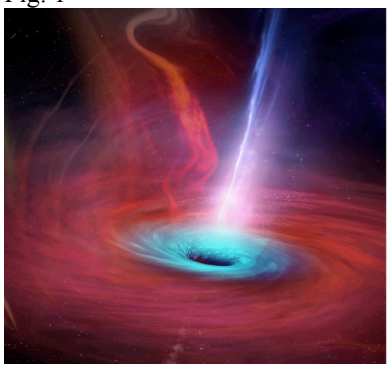
From Special to General Relativity with Unruh and Hawking: Light from atoms falling into a black hole

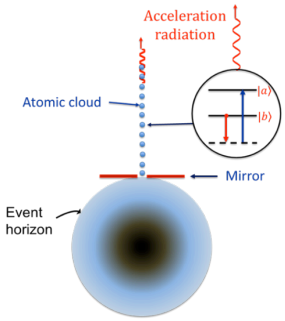
General relativity as originally developed by Einstein is based on the union of geometry and gravity. Half a century later the union of general relativity and thermodynamics was found to yield surprising results such as Bekenstein-Hawking black hole entropy and Hawking radiation. In their seminal works, Hawking, Unruh and others showed how quantum effects in curved space yield a blend of thermodynamics, quantum field theory and gravity which continues to intrigue and stimulate. It has been shown [1] that virtual processes in which atoms jump to an excited state while emitting a photon is an alternative way to view Unruh acceleration radiation. The present work [2] is an extension of that logic by considering what happens when atoms fall into a black hole (BH) as shown in Fig. 1. This problem also shows a new way to arrive at Einstein's equivalence principle. Connection with the "temperature as an imaginary time" paradigm of many-body theory is also illustrated by this problem. In general, the quantum optics – black hole physics interface is a rich field.

[1] M.O. Scully, V.V. Kocharovsky, A. Belyanin, E. Fry, F. Capasso, Phys. Rev. Lett. **91**, 243004 (2003).

[2] M.O. Scully, S. Fulling, D. Lee, D. Page, W. Schleich, A.A. Svidzinsky, PNAS **115**, 8131 (2018).

Fig. 1





Refreshments at 3:00 pm in SC 103