CASL Computational Science Seminar

Title: Black Hole Perturbations

Speaker: Dr Sam Dolan (UCD School of Mathematical Sciences
UCD
CASL)

Date: Tue 22nd May 2007 at 2:00PM

Location: CASL Seminar Room - Belfield Office Park

Abstract: A black hole is to General Relativity what a proton is to classical electromagnetism: an idealised "unit" of field charge. However, unlike electromagnetism, gravitation is intrinsically non-linear, so such "units" cannot be easily combined. The lack of a superposition principle hinders the study of even the simplest dynamical systems (e.g. the two-body problem). In general, exact solutions are hard to find, unless a high degree of symmetry is present.

By contrast, linearised perturbation theory allows one to study "weak" disturbances without resorting to full-blown numerical simulation. Over the years, perturbation theory has been used to study (amongst other things) black hole stability, particle capture, and gravitational radiation from black holes.

In the first half of this talk I review a notable success of the perturbation approach: the prediction of black-hole "resonant frequencies" (called quasi-normal modes). A

range of quick-and-easy methods for their calculation are discussed. In the second half of the talk, I look at less well-known modes called bound-states. If the black hole is rotating, it turns out that bound-state modes may become unstable. This is due to an effect called superradiance by which a black hole transfers rotational energy into a perturbing field. I conclude with a suggestion for a time-domain simulation of this effect.

mailto:stephen.osullivan@ucd.ie