Proposal for Phys 432

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September 18, 2000

I propose to study the phenomenon of black hole formation following the gravitational collapse of a spherically symmetric SU(2) Yang-Mills field. It has been found that there are two types of thresholds for black hole formation in this model, called Type I and Type II behaviour. For both types the threshold behaviour is described by critical solutions to the Einstein-Yang-Mills equations which are found by fine-tuning the initial data. These solutions are unstable, so if the solution is perturbed slightly, leads either to complete dispersal or to black hole formation. In the Type I region the black hole forms with finite mass and in the Type II region a black hole with infinitesimal mass is formed.

This system will be modeled using Rapid Numerical Prototyping Language (RNPL), a language specifically meant for solving differential systems, developed by Robert Marsa. RNPL will be used to create a model of the system. Then I will attempt to find a family of initial data which produces the critical solutions.

I will be mainly concentrating on the critical solutions in the Type I region but will study the Type II region if there is time.

This project is based in part on an assignment given out in Dr. Matthew Choptuik's course "Relativity Theory II"[1].

[1] Please see `http://laplace.physics.ubc.ca/People/matt/Teaching/98Spring/Phy387N/HW/hw3_0.ps` for the assignment outline.