Florida Atlantic University

Department of Physics

Statement of the professional goals and an assessment of progress for the Annual Progress Report for Petr Tsatsin.

Thesis Title: “Compact-object binary mergers.”

Thesis Advisor: Dr. P. Marronetti.

Compact-object binary systems are one of the most promising source of gravitational radiation; if they are composed by two neutrons stars, they may be also engines of short Gamma-ray Bursts. It was found recently that binary black hole mergers can produce very high velocity 'kicks' that may result in the newly formed black hole to escape the host galaxy. Phenomena like these have great impact in galaxy and large-structure formation. Neutron stars are also the most dense objects in the universe, carrying information about the state of matter at supra-nuclear densities.

Evolution of the compact binary systems is governed by Einstein's Field Equations which have to be solved using numerical methods with the aid of supercomputers. The main goal of my research is to study compact binary mergers using most recent numerical approaches designed for these particular problems.

Especially, I will mostly work with binary neutron stars. The simulation of the neutron star mergers involves GR and Hydrodynamics but also nuclear reactions and neutrino transport. I'm currently working in the development of Genasis, a numerical code that incorporates a full general relativistic treatment of MHD, neutrino transport, state-of-art nuclear networks and EOS. This work is done in collaboration with ORNL. The code is on early development stage. So, my task is the implementation and testing of the BSSN formalism, as well as the auxiliary tools(such as those needed for gravitational wave extraction).

I have dedicated this past academic year to taking the required classes in order to prepare for qualification exams which I successfully passed. I've been studying mathematical and computational background related to my thesis topic. During the Spring 2010 I've started working with GENASIS code.

April 28, 2010.