Rosquist Kjell

Period covered: 2008-2009

I Scientific Activities

Ongoing projects

1. Spatial curvature in cosmology
   Spatial curvature is a key factor in cosmological theory. We are investigating properties of spatial curvature, such as estimating its size directly from the mass distribution in the universe and we are also analyzing theoretically how the spatial curvature depends on the observer.
   Collaborators: L. Samuelsson, Umeå University, Sweden and H. Quevedo, ICRANet

2. Inhomogeneous cosmology
   The matter in the present universe occurs in discrete lumps such as stars and galaxies. However, current models of the universe treat the matter as a homogeneous fluid. The purpose of this project is to attempt to quantify how the discrete nature of the matter influences the evolution of the universe. One ingredient in this quest is to determine the size of the spatial curvature as outlined in the previous project.
   Collaborator: L. Samuelsson, Umeå University, Sweden

3. Microphysical gravitomagnetic effects
   In Einstein gravity, the source of the gravitational field has an additional part, namely the spin (or angular momentum) which is responsible for the gravitomagnetic field in analogy with the magnetic field in electromagnetism. In this project we work with the Einstein-Maxwell field equations which are responsible for the interaction between the gravitational and electromagnetic fields. We use solutions of the field equations to examine how the gravitomagnetic field induces modifications of the Coulomb electromagnetic field at the Compton scale. The results are amenable to experimental verification.
   Collaborators: L. Samuelsson, Umeå University, Sweden, M. von Strauss, Stockholm University, Sweden
   Consultant: R. Ruffini, ICRANet

4. Black holes as accelerators
   When particles collide near black holes, they can in principle attain extremely high center-of-mass energies. We are estimating the practical limits on the energy of particles escaping from such collisions near black holes.
   Collaborator: M. von Strauss, University of Stockholm, Sweden

5. Dynamics on a curved background.

    a. Influence of the expansion of the universe on local systems
    A local system such as the solar system, e.g., is in principle influenced by the cosmological spacetime curvature. In this project we are investigating the long term effects on local systems caused by the expansion of the universe.
    Collaborator: G. Pucacco, ICRANet and University of Rome

    b. Influence on local systems when crossing stationary horizons
    In a non-stationary spacetime, local energy conservation is broken due to the non-existence of a local time translation symmetry. We are investigating the loss of energy conservation for a system falling into a black hole which is necessarily non-stationary inside the horizon.
    Collaborator: G. Pucacco, ICRANet and University of Rome
    Consultant: V. Belinski, ICRANet

6. Separability of relativistic systems
    The Hamiltonian of a relativistic mechanical system includes a timelike part in the kinetic energy in addition to the momenta present in standard classical mechanics. Consequently, the Hamiltonian has an indefinite signature as opposed to the positive definite signature of systems in standard classical mechanics. Relativistic systems have two new types of separability structures in addition to the Hamilton-Jacobi type separability for non-relativistic systems. To obtain a better of understanding of relativistic systems, we are investigating and classifying the new separability types.
    Collaborator: G. Pucacco, ICRANet and University of Rome

II Conferences and educational activities

Conferences and Other External Scientific Work

Lectures and talks at the University of Rome and at conferences:

Bego Scientific Recontres, Nice, February 2006

Eleventh Marcel Grossmann Meeting on General Relativity (MG11), Berlin, July 2006

Italy-Korea meeting, Pescara, June 2007

18th International Conference on General Relativity and Gravitation **(**GR18), Sydney, July 2007

12th Marcel Grossmann conference on general relativity, Paris 2009 (2 talks)

First Galileo-Xu Guang-qi meeting 2009

11th Italian-Korean meeting 2009

Invited talks 2009

Albert Einstein Institute, Potsdam, Germany

ICRA/CBPF, Rio de Janeiro, Brazil

Erasmus Mundus Ph D program

Work with upcoming Erasmus Mundus Joint Doctorate Ph D program starting 2010 with several European and extra-European universities including Stockholm University.

Work With Students

Mikael von Strauss, graduate student
– Project on interacting fields using the theory of general relativity

Diploma thesis supervision

Tomas Bylund
– Carter's constant

Other Teaching Duties

Courses taught in the academic year 2008-2009:

Relativistic quantum mechanics (advanced undergraduate level)

Waves and Quantum Mechanics (undergraduate level)

Work With Postdocs

Lars Samuelsson at the Nordita Institute, Stockholm.
– Work on Carter's constant and other aspects of relativistic astrophysics

III Service activities

Within ICRANet

Adviser at various scientific committees

Member of Ph D committee for G. Yegorian thesis, Rome University, 2008

Outside ICRANet

External examiner of licentiate thesis 2006 of Thomas Bäckdahl, Linköping University, Sweden.

Member of Ph D committee 2008 for Thomas Bäckdahl, Linköping University, Sweden

V Other

Collaboration with R. Ruffini, V. Belinski and others on aspects of general relativity, in particular field energy and interactions including both gravity and electromagnetic fields.

2009 List of Publications

K. Rosquist, T. Bylund and L. Samuelsson, Carter's constant revealed, Int. J. Mod. Phys. D 18 (2009) 429, (E-print, arXiv:0710.4260).

K. Rosquist, A unifying coordinate family for the Kerr-Newman metric, Gen. Rel. Grav. 41 (2009) 2619.

K. Rosquist, Some Consequences of Gravitationally Induced Electromagnetic Effects in Microphysics, J. Kor. Phys. Soc. (2009) (in press).

G. Pucacco and K. Rosquist, Non-standard separability on the Minkowski plane, J. Nonlinear Math. Phys. 2009 (in press)