Title: Advanced School in General Relativity: Relativistic Astrophysics and Modern Cosmology

Organizers: George E. A. Matsas (IFT/Unesp) and Daniel A. T. Vanzella (IFSC/USP)

Date: July/16 (Monday) to July/27 (Friday) (2012)

LECTURERS

1st WEEK July/15 (Sunday) to July/20 (Friday) (2012):

Lecturers for the 1st week:

- Jolien Creighton, University of Wisconsin at Milwaukee
- Raul Abramo, Universidade de São Paulo

2nd WEEK July/22 (Sunday) to July/27 (Friday) (2012):

Lecturers for the 2nd week:

- John Friedman, University of Wisconsin at Milwaukee
- Robert Caldwell, Dartmouth College

Student Selection Committee:

Elcio Abdalla (IF/USP),
Carlos Lousto (CCRG/Rochester Institute of Technology)
Alberto Saa (IMECC/Unicamp)
Daniel Sudarsky (ICN/UNAM)
Relativistic Astrophysics

1st WEEK July/16 (Monday) to July/20 (Friday) (2012):

- Jolien Creighton, University of Wisconsin at Milwaukee
- 5 lectures of about 1h20min

**Program:**
1. Lie derivatives and Killing vectors.
2. The Newtonian hydrostatic equilibrium equation, the corresponding TOV equation and its solution for uniform density and polytrope models.
3. The field equation for linearized gravity in a Lorenz gauge.

2nd WEEK July/23 (Monday) to July/27 (Friday) (2012):

- John Friedman, University of Wisconsin at Milwaukee
- 5 lectures of about 1h20min

**Program:**
1. General Relativistic Perfect Fluids.
   1a. Definition of Perfect Fluid: Local Isotropy.
   1b. The Einstein-Euler System.
   1c. Barotropic Flows: Enthalpy, the Bernoulli Equation, Injection Energy, and Conservation of Circulation
2. Relativistic Stars.
   2a. Spherical Stars.
   2b. Rotating Relativistic Stars.
   2d. Turning Point Criterion.
   3a. Bumps on Rotating Neutron Stars.
   3b. Waves From Dynamical Instability of a Rapidly Rotating, Collapsing Core.
4. Compact Binaries
Modern Cosmology

1st WEEK July/15 (Sunday) to July/20 (Friday) (2012):

- **Raul Abramo, Universidade de São Paulo**
- **5 lectures of about 1h20min**

Program:
1. Review of GR
2. Einstein's equations
3. Geodesics
4. Kinematics and dynamics of Friedman-Lemaitre models
5. Cosmological time and distances
6. Cosmography (Hubble diagram, acceleration/deceleration, supernovas etc.)
7. Thermodynamics

2nd WEEK July/22 (Sunday) to July/27 (Friday) (2012):

- **Robert Caldwell, Dartmouth College**
- **5 lectures of about 1h20min**

Program:
1. Perturbing the Robertson-Walker metric
2. Inflationary perturbations
3. Transfer of perturbations from the primordial universe to the present
4. Models of Dark Matter, Dark Energy
5. Mass power spectrum, clustering
6. CMB temperature, polarization
7. Weak Lensing of large scale structure, cmb
8. Review of present and future observations (Abramo/Caldwell)