

Rueda Hernández Jorge Armando

Position:

Faculty Professor at ICRANet

Member of ICRANet Faculty

IRAP PhD Faculty

Period covered: 2011-Present



Coordinator of the CAPES-ICRANet Program at ICRANet

CAPES-ICRANet Program Visiting Professor in Brazil

Period covered: 2013-2016

I Scientific Work

1) Nuclear and Atomic Astrophysics.

Within this subject of research I study the properties and processes occurring in compact stars in which nuclear and atomic physics have to be necessarily applied. I focus on the properties of nuclear matter under extreme conditions of density and pressure found in these objects. The equation of state of matter in compact stars is studied in detail taking into account all the interactions between the constituents within a full relativistic framework.

2) White Dwarfs Physics and Astrophysics.

I analyze the structure of white dwarfs within a self-consistent description of the equation of state of the interior together with the solution of the hydrostatic equilibrium equations in general relativity. Both not-magnetized and magnetized white dwarfs are studied. I am also interested in the astrophysics of white dwarfs both isolated and in binaries systems. Magnetized white dwarfs, soft gamma repeaters, anomalous X-ray pulsars, white dwarf pulsars, cataclysmic variables, binary white dwarf mergers, and type Ia supernovae are studied. The role of a realistic white dwarf interior structure is particularly emphasized.

3) Neutron Stars Physics and Astrophysics.

I am interested in computing the properties of the interior structure of neutron stars using realistic models of the nuclear matter equation of state within the general relativistic equations of equilibrium. Strong, weak, electromagnetic and gravitational interactions have to be jointly taken into due account within a self-consistent fully relativistic framework. Both unmagnetized and magnetized neutron stars are considered. From the astrophysical viewpoint, I study systems harboring neutron stars such as isolated and binary pulsars, low and intermediate X-ray binaries, inspiraling and merging double neutron stars. Most extreme cataclysmic events involving neutron stars and their role in the explanation of extraordinarily energetic astrophysical events such as gamma-ray bursts are analyzed in detail.

4) Radiation Mechanisms of White Dwarfs and Neutron Stars.

I study the possible emission mechanisms of white dwarfs and neutron stars. I consider both electromagnetic and gravitational radiation at work in astrophysical systems such as compact star

magnetospheres, in-spiraling and merging relativistic double neutron stars, neutron star-white dwarfs, and neutron star-black hole binaries.

5) Exact Solutions of the Einstein and Einstein-Maxwell Equations in Astrophysics.

I am also interested in studying the ability of analytic exact solutions of the Einstein and Einstein-Maxwell equations to describe the exterior spacetime of compact stars such as white dwarfs and neutron stars. The problem of matching between interior and exterior spacetimes is addressed in detail. The effect of the quadrupole moment on the properties of the spacetime is also investigated. Particular attention is given to the application of exact solutions in astrophysics, e.g. the dynamics of particles around compact stars and its relevance in astrophysical systems such as X-ray binaries.

6) Critical Fields and Non-linear Electrodynamics Effects in Astrophysics.

I study the conditions under which ultrastrong electromagnetic fields can develop in astrophysical systems such as neutron stars and in the process of gravitational collapse to a black hole. The effects of non-linear electrodynamics minimally coupled to gravity are investigated. New analytic and numeric solutions to the Einstein-Maxwell equations representing black holes or the exterior field of a compact star are obtained and analyzed. The consequences on extreme astrophysical systems, for instance gamma-ray bursts, are studied.

7) Distribution of Dark Matter in Galaxies and Cosmological Implications

I study the possible distribution of equilibrium of dark matter particles in galaxies. Particular attention is given to the distribution of fermion candidates. I analyze the possible mass as well as self-interactions that such fermions could have in order to be in agreement with the current astrophysical and cosmological observational constraints. The dark matter distribution in dwarf spheroidal, elliptic, spiral, and big spiral galaxies is considered. I am at the same time interested in the consequences that the inferred dark matter properties and distribution have in cosmology.

II Conferences and educational activities

II a Conferences and Other External Scientific Work

Organizer of the “First Sandoval Vallarta Caribbean Meeting”, Mexico City, Mexico, November 30-December 3, 2015. <www.icranet.org/1sv/>

Organizer of the First Julio Garavito Armero Meeting on Relativistic Astrophysics”, Bucaramanga and Bogotá, Colombia, 23-27 November, 2015. <www.icranet.org/1jg/>

II b Work With Students

Below in the section II c, I list the PhD theses which I have supervised and the ones currently under supervision. They are all distributed in the seven topics listed above in the section I. I also include the scientific production which has been the result of these PhD researches.

II c Diploma thesis supervision

In the following list of PhD theses developed under my supervision, I have also included the topics, from the list of section I, in which the PhD students have performed or are performing their research.

- PhD thesis of Jose Fernando Rodriguez Ruiz 2014-2017, Sapienza University of Rome, Italy. Topics: 1-4. Fellowship: IRAP-PhD

Scientific Production:

L. Becerra, E. Garcia-Berro, J. F. Rodriguez, J. A. Rueda, “Observables of young, massive, magnetized white dwarfs produced by white dwarf mergers”, in preparation.

- PhD thesis of Laura Becerra Bayona 2013-2016, Sapienza University of Rome, Italy. Topics: 1-4. Fellowship: IRAP-PhD

Scientific Production:

L. Becerra, F. Cipolletta, C. L. Fryer, J. A. Rueda, and R. Ruffini, “Angular Momentum Role in the Hypercritical Accretion of Binary-driven Hypernovae”, *ApJ*, vol. 812, p. 100, Oct. 2015.

- PhD thesis of Luis Gabriel Gómez 2013-2016, Sapienza University of Rome, Italy and University of Nice Sophia-Antipolis, Nice, France. Topics: 7. Fellowship: Erasmus Mundus IRAP-PhD

Scientific Production:

L. Gabriel-Gomez and J. A. Rueda, “The Role of the Dark Matter Distribution in the Structure Formation”, *Proc. Second César Lattes Meeting*, in press.

- PhD thesis of Fernanda Gomes Oliveira 2012-2015, Sapienza University of Rome, Italy and University of Nice Sophia-Antipolis, Nice, France. Topics: 2-4. Fellowship: Erasmus Mundus IRAP-PhD

Scientific Production:

C. L. Fryer, F. G. Oliveira, J. A. Rueda, and R. Ruffini, “On the Neutron Star-Black Hole Binaries Produced by Binary-driven-hypernovae”, *Phys. Rev. Lett.*, in press.

R. Ruffini, M. Muccino, M. Kovacevic, F. G. Oliveira, J. A. Rueda, C. L. Bianco, M. Enderli, A. V. Penacchioni, G. B. Pisani, Y. Wang, and E. Zaninoni, “GRB 140619B: a short GRB from a binary neutron star merger leading to black hole formation”, *ApJ*, vol. 808, p. 190, Aug. 2015.

F. G. Oliveira, J. A. Rueda, and R. Ruffini, “X, Gamma-Rays, and Gravitational Waves Emission in a Short Gamma-Ray Burst” *Astrophysics and Space Science Proceedings*, vol. 40, p. 43, 2015.

F. G. Oliveira, J. A. Rueda, and R. Ruffini, “Gravitational Waves versus X-Ray and Gamma-Ray Emission in a Short Gamma-Ray Burst”, *ApJ*, vol. 787, p. 150, June 2014.

- PhD thesis of Diego Leonardo Cáceres Uribe 2011-2014, Sapienza University of Rome, Italy. Topics: 2 and 4. Fellowship: IRAP-PhD

Scientific Production:

Jaziel G. Coelho, R. C. R. de Lima, D. L. Cáceres, M. Malheiro, J. A. Rueda, R. Ruffini “On the Rotation-power Nature of SGRs and AXPs”, ApJ, submitted.

J. G. Coelho, R. M. Marinho, M. Malheiro, R. Negreiros, D. L. Cáceres, J. A. Rueda, and R. Ruffini, “Dynamical Instability of White Dwarfs and Breaking of Spherical Symmetry Under the Presence of Extreme Magnetic Fields”, ApJ, vol. 794, p. 86, Oct. 2014.

D. L. Cáceres, J. A. Rueda, and R. Ruffini, “On the stability of ultra-magnetized white dwarfs”, Journal of Korean Physical Society, vol. 65, pp. 846{849, Sept. 2014.

- PhD thesis of Jonas Pedro Pereira's PhD 2011-2014, Sapienza University of Rome, Italy and University of Nice Sophia-Antipolis, Nice, France. Topics: 3 and 6. Fellowship: Erasmus Mundus IRAP-PhD

Scientific Production:

J. P. Pereira and J. A. Rueda, “Energy decomposition within Einstein-Born-Infeld black holes”, Phys. Rev. D, vol. 91, p. 064048, Mar. 2015.

J. P. Pereira and J. A. Rueda, “Radial Stability in Stratified Stars”, ApJ, vol. 801, p. 19, Mar. 2015.

J. P. Pereira, J. G. Coelho, and J. A. Rueda, “Stability of thin-shell interfaces inside compact stars”, Phys. Rev. D, vol. 90, p. 123011, Dec. 2014.

J. P. Pereira, H. J. Mosquera Cuesta, J. A. Rueda, and R. Ruffini, “On the black hole mass decomposition in nonlinear electrodynamics”, Physics Letters B, vol. 734, pp. 396{402, June 2014.

- PhD thesis of Carlos Raul Arguelles 2011-2014, Sapienza University of Rome, Italy. Topics: 7. Fellowship: IRAP-PhD

Scientific Production:

C. R. Arguelles, J. A. Rueda, and R. Ruffini, “Theoretical evidence of 50 keV fermionic dark matter from Milky Way observables”, Phys. Rev. Lett., submitted.

C. R. Arguelles, N. E. Mavromatos, J. A. Rueda, and R. Ruffini, “The role of self-interacting right-handed neutrinos in galactic structure”, JCAP, submitted.

R. Ruffini, C. R. Arguelles, and J. A. Rueda, “On the core-halo distribution of dark matter in galaxies”, MNRAS, vol. 451, pp. 622-628, July 2015.

R. Ruffini, C. R. Arguelles, B. M. O. Fraga, A. Geralico, H. Quevedo, J. A. Rueda, and I. Siutsou, “Black Holes in Gamma Ray Bursts and Galactic Nuclei”, International Journal of Modern Physics D, vol. 22, p. 60008, Sept. 2013.

- PhD thesis of Sheyse Martins de Carvalho 2010-2013, Sapienza University of Rome, Italy and University of Nice Sophia-Antipolis, Nice, France. Topics: 1-3. Fellowship: Erasmus Mundus IRAP-PhD

Scientific Production:

S. M. de Carvalho, J. A. Rueda, and R. Ruffini, “On the Relativistic Feynman-Metropolis Equation of State at Finite Temperatures”, Proc. Thirteenth Marcel Grossmann Meeting, pp. 2481-2483, Jan. 2015.

S. M. de Carvalho, R. Negreiros, J. A. Rueda, and R. Ruffini, “Thermal evolution of neutron stars with global and local neutrality”, Phys. Rev. C, vol. 90, p. 055804, Nov. 2014.

S. M. de Carvalho, J. A. Rueda, and R. Ruffini, “On the cooling of globally-neutral neutron stars”, Journal of Korean Physical Society, vol. 65, pp. 861-864, Sept. 2014.

S. M. de Carvalho, M. Rotondo, J. A. Rueda, and R. Ruffini, “Relativistic Feynman-Metropolis-Teller treatment at finite temperatures”, Phys. Rev. C, vol. 89, p. 015801, Jan. 2014.

S. M. de Carvalho, J. A. Rueda, M. Rotondo, C. Argüelles, and R. Ruffini, “The Relativistic Feynman Metropolis Teller Theory at Zero and Finite Temperatures”, International Journal of Modern Physics Conference Series, vol. 23, pp. 244-247, Jan. 2013.

- PhD thesis of Riccardo Belvedere 2008-2013, Sapienza University of Rome, Italy. Topics: 1, 3-4. Fellowship: IRAP-PhD

Scientific Production:

R. Belvedere, J. A. Rueda, and R. Ruffini, “On the Magnetic Field of Pulsars with Realistic Neutron Star Configurations”, ApJ, vol. 799, p. 23, Jan. 2015.

R. Belvedere, J. A. Rueda, and R. Ruffini, “Static and rotating neutron stars fulfilling all fundamental interactions”, Journal of Korean Physical Society, vol. 65, pp. 897-902, Sept. 2014.

R. Belvedere, K. Boshkayev, J. A. Rueda, and R. Ruffini, “Uniformly rotating neutron stars in the global and local charge neutrality cases”, Nuclear Physics A, vol. 921, pp. 33-59, Jan. 2014.

R. Belvedere, J. A. Rueda, and R. Ruffini, “Neutron Star Cores in the General Relativistic Thomas-Fermi Treatment”, International Journal of Modern Physics Conference Series, vol. 23, pp. 185-192, Jan. 2013.

R. Belvedere, D. Pugliese, J. A. Rueda, R. Ruffini, and S.-S. Xue, “Neutron star equilibrium configurations within a fully relativistic theory with strong, weak, electromagnetic, and gravitational interactions”, Nuclear Physics A, vol. 883, pp. 1-24, June 2012.

R. Belvedere, J. Rueda, and R. Ruffini, “Mass, Radius and Moment of Inertia of Neutron Stars”, Proc. X-ray Astrophysics up to 511 keV, p. 7, Sept. 2011.

R. Belvedere, J. A. Rueda, R. Ruffini, and S.-S. Xue, “The influence of the core on the structure of the outer crust of neutron stars”, Proc. 25th Texas Symposium on Relativistic Astrophysics, p. 270, 2010.

**- PhD thesis of Kuantay Boshkayev 2009-2012, Sapienza University of Rome, Italy. Topics: 2-5.
Fellowship: IRAP-PhD**

K. Boshkayev, J. Rueda, and M. Muccino, “Extracting multipole moments of neutron stars from quasi-periodic oscillations in low mass X-ray binaries”, *Astronomy Reports*, vol. 59, pp. 441-446, June 2015.

K. Boshkayev, J. A. Rueda, R. Ruffini, and I. Siutsou, “General Relativistic and Newtonian White Dwarfs”, *Proc. Thirteenth Marcel Grossmann Meeting*, pp. 2468-2474, Jan. 2015.

K. Boshkayev, J. A. Rueda, and R. Ruffini, “SGRs and AXPs as Massive Fast Rotating Highly Magnetized White Dwarfs: the case of SGR 0418+5729”, *Proc. Thirteenth Marcel Grossmann Meeting*, pp. 2295-2300, Jan. 2015.

K. Boshkayev, D. Bini, J. Rueda, A. Geralico, M. Muccino, and I. Siutsou, “What can we extract from quasiperiodic oscillations?”, *Gravitation and Cosmology*, vol. 20, pp. 233-239, Oct. 2014.

K. Boshkayev, J. A. Rueda, R. Ruffini, and I. Siutsou, “General relativistic white dwarfs and their astrophysical implications”, *Journal of Korean Physical Society*, vol. 65, pp. 855-860, Sept. 2014.

R. Belvedere, K. Boshkayev, J. A. Rueda, and R. Ruffini, “Uniformly rotating neutron stars in the global and local charge neutrality cases”, *Nuclear Physics A*, vol. 921, pp. 33-59, Jan. 2014.

J. A. Rueda, K. Boshkayev, L. Izzo, R. Ruffini, P. Loren-Aguilar, B. Kulebi, G. Aznar-Siguán, and E. Garcia-Berro, “A White Dwarf Merger as Progenitor of the Anomalous X-Ray Pulsar 4U 0142+61?”, *ApJL*, vol. 772, p. L24, Aug. 2013.

K. Boshkayev, L. Izzo, J. A. Rueda, and R. Ruffini, “SGR 0418+5729, Swift J1822.3-1606, and 1E 2259+586 as massive, fast-rotating, highly magnetized white dwarfs”, *A&A*, vol. 555, p. A151, July 2013.

K. Boshkayev, J. Rueda, and R. Ruffini, “On the Maximum Mass and Minimum Rotation Period of Relativistic Uniformly Rotating White Dwarfs”, *International Journal of Modern Physics Conference Series*, vol. 23, pp. 193-197, Jan. 2013.

K. Boshkayev, J. A. Rueda, R. Ruffini, and I. Siutsou, “On General Relativistic Uniformly Rotating White Dwarfs”, *ApJ*, vol. 762, p. 117, Jan. 2013.

K. Boshkayev, J. Rueda, and R. Ruffini, “On the Maximum Mass of General Relativistic Uniformly Rotating White Dwarfs”, *International Journal of Modern Physics E*, vol. 20, pp. 136-140, 2011.

II d Other Teaching Duties

In addition to the supervision of PhD theses, I teach in the IRAP PhD Program and in the Doctoral Schools organized within it. The topics of teaching are the ones in section I.

II e International Scientific Collaborations

In Brazil: with Prof. Sergio B. Duarte from CBPF at Rio de Janeiro, Prof. R. Negreiros from UFF at Niterói, Prof. Débora P. Menezes from UFSC at Florianópolis Profs. S. O. Kepler and C. A. Z. Vasconcellos from UFRGS at Porto Alegre, Profs. R. Marinho Jr and M. Malheiro from ITA at São José dos Campos, Prof. Luis J. Rangel-Lemos from UFT at Palma.

In Colombia: with Profs. Luis Nuñez and Guillermo González from UIS at Bucaramanga, Prof. Leonardo A. Pachón from UdeA at Medellín, Prof. César A. Valenzuela from Univalle at Cali.

In Kazakhstan: with Prof. Kuantay Boshkayev from Al-Farabi Kazakh National University at Almaty.

In Mexico: with Prof. Hernando Quevedo from UNAM at México D. F.

In Spain: with Prof. Enrique García-Berro from UPC at Barcelona.

In USA: with Prof. Chris L. Fryer from LANL at New Mexico, Prof. G. Mathews from UND at South Bend.

II e. Work With Postdocs

-Riccardo Belvedere (CAPES-ICRANet Program Fellow at ICRANet - Rio de Janeiro and Universidade Federal Fluminense). Scientific collaboration in the topics 1 and 3.

Scientific Production:

R. Belvedere, J. A. Rueda, and R. Ruffini, “On the Magnetic Field of Pulsars with Realistic Neutron Star Configurations”, *ApJ*, vol. 799, p. 23, Jan. 2015.

R. Belvedere, K. Boshkayev, J. A. Rueda, and R. Ruffini, “Uniformly rotating neutron stars in the global and local charge neutrality cases”, *Nuclear Physics A*, vol. 921, pp. 33-59, Jan. 2014.

- Rafael Camargo Rodrigues de Lima (CAPES-ICRANet Program Fellow at ICRANet - Pescara). Scientific collaboration in the topics 1 and 3.

Scientific Production:

Jaziel G. Coelho, R. C. R. de Lima, D. L. Caceres, M. Malheiro, J. A. Rueda, R. Ruffini “On the Rotation-power Nature of SGRs and AXPs”, *ApJ*, submitted.

- Sheyse Martins de Carvalho (CAPES-ICRANet Program Fellow at ICRANet – Rio de Janeiro and Universidade Federal Fluminense). Scientific collaboration in the topics 1-3.

Scientific Production:

S. M. de Carvalho, R. Negreiros, J. A. Rueda, and R. Ruffini, “Thermal evolution of neutron stars with global and local neutrality”, *Phys. Rev. C*, vol. 90, p. 055804, Nov. 2014.

- Jaziel Goulart Coelho (CAPES-ICRANet Program Fellow at ICRANet and Sapienza University of Rome). Scientific collaboration in the topics 1-3.

Scientific Production:

Jaziel G. Coelho, R. C. R. de Lima, D. L. Caceres, M. Malheiro, J. A. Rueda, R. Ruffini “On the Rotation-power Nature of SGRs and AXPs”, *ApJ*, submitted.

J. G. Coelho, R. M. Marinho, M. Malheiro, R. Negreiros, D. L. Caceres, J. A. Rueda, and R. Ruffini, “Dynamical Instability of White Dwarfs and Breaking of Spherical Symmetry Under the Presence of Extreme Magnetic Fields”, *ApJ*, vol. 794, p. 86, Oct. 2014.

J. P. Pereira, J. G. Coelho, and J. A. Rueda, “Stability of thin-shell interfaces inside compact stars”, *Phys. Rev. D*, vol. 90, p. 123011, Dec. 2014.