Jesús Misráyim Rueda-Becerril

PhD candidate

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Jesus Rueda-Becerril
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Education

2011– **PhD in Physics**, *Universitat de València*, Valencia, Spain.
Supervisors: Prof. Miguel Ángel Aloy Torás and Dr. Petar Mimica
Thesis: *Radiation Transport in Relativistic Magnetized Fluids — Applications to Relativistic Outflows*

2009–2011 **MSc in Physics**, *Instituto de Física y Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo*, Morelia, Michoacan, Mexico.
Supervisor: Prof. José Antonio González Cervera
Thesis: *Study of TOV stars with the SPH method*

2004–2009 **BSc in Physics**, *Universidad Autónoma del Estado de México*, Toluca, State of Mexico, Mexico.
Supervisor: Prof. Francisco S. Guzmán Murillo
Thesis: *Numerical solution of null geodesics for the generation of gravitational lenses in spherically symmetric space-times*

Computer skills

Proficient Unix (Linux, macOS), FORTRAN (77, 90, 95, 2003), Python, Shell, Mathematica, LaTeX, gnuplot, grace, OpenMP, GeoGebra, Emacs, HDF5, Makefile, Git

Intermediate C, C++, R, Julia, Elisp, MPI, SageMath, yEd, OpenOffice, Microsoft Office, iWork, DOT, TikZ/PGF

Basic HTML, Matlab, Maple, Java, Swift, Perl

Publications

Articles

3. J. M. Rueda-Becerril, P. Mimica, and M. A. Aloy. On the influence of a hybrid thermal-non-thermal distribution in the internal shocks model for blazars. *Mon. Not. R. Astron. Soc.*, 468:1169–1182, June 2017.

2. J. M. Rueda-Becerril, P. Mimica, and M. A. Aloy. The influence of the magnetic field on the spectral properties of blazars. *Mon. Not. R. Astron. Soc.*, 438:1856–1869, February 2014.

1. F. S. Guzmán and J. M. Rueda-Becerril. Spherical boson stars as black hole mimickers. *Phys. Rev. D*, 80(8):084023, October 2009.

Proceedings

3. J. Rueda-Becerril, P. Mimica, and M. A. Aloy. Numerical simulations of the internal shock model in magnetized relativistic jets of blazars. In *Proceedings of Swift: 10 Years of Discovery (SWIFT 10)*, page 159, Rome, Italy, December 2014.

2. J. M. Rueda-Becerril, P. Mimica, M. A. Aloy, and C. Aloy. Numerical study of broad-band spectra caused by internal shocks in magnetized relativistic jets of blazars. In *The Innermost Regions of Relativistic Jets and Their Magnetic Fields*, volume 61 of *European Physical Journal Web of Conferences*, page 02007, June 2013.

1. P. Mimica, M. A. Aloy, J. M. Rueda-Becerril, S. Tabik, and C. Aloy. Numerical simulations of dynamics and emission from relativistic astrophysical jets. In *24th IUPAP Conference on Computational Physics*, volume 454 of *Journal of Physics: Conference Series*, page 012001, August 2013.

Interests

High energy physics around black holes

- Theory and observation of high energy radiation in different scenarios where black holes are involved.
  - Radiation transport.
  - Radiation source and source region.
  - Particles acceleration processes.
- Active galactic nuclei.
  - Blazars.
    - Acceleration processes in the emission region.
    - Location of the emission region.
    - The spectral effects due to different constituents of the material in the emission region.
  - Radio galaxies.
  - Quasars.
- Tidal disruption events.
- Microquasars.
- Gamma-ray bursts.

Numerical Astrophysics

- Numerical solutions to the radiation transport equation with astrophysical applications.
- Numerical treatment of the microphysics involved in the emission of high energy radiation.
- Numerical hydrodynamics and magnetohydrodynamics
- Performance, stability, convergence and accuracy of numerical codes.

Research experience

2011– **Graduate research assistant**, *DAA, UV*, Burjassot, Spain.

PhD studies

- Parameter study using the code developed by Petar Mimica and Miguel A. Aloy for the internal shocks (IS) model.
  - Development of software capable of automatizing the launch of simulations of ISs
  - Development of software capable of automatizing the generation of plots from the IS code.
  - Interpretation of lightcurves (LCs) and spectral energy distributions (SEDs)
  - Identification and interpretation of the main physical parameters in the shocks.
  - Identification of the physical parameters in the model which led to observational data.
- Processing and analysis of data from Fermi 2LAC catalogue.
- Identification and interpretation of the main characteristics of blazars SEDs (Compton dominance, syncrotron and Compton peaks, spectral index).
- Calculation of the spectral index from SED data, specifically in the 0.1–10 GeV band.
- Parabolic fitting of SEDs.
- Injection of a hybrid thermal-nonthermal distribution of particles in the IS model.
- Calculation of Magnetobremsstrahlung tables of charged particles of arbitrary velocity.
- Calculation of the emissivity for isotropic distributions of particles using Magnetobremsstrahlung tables.
- Implementation of Magnetobremsstrahlung and hybrid distributions to the ISs code.
- Contribution to the writing of two manuscript for publication in a peer-reviewed journal.

2010–2011 **Graduate research assistant**, *IFM, UMSNH*, Morelia, Mexico.

Master thesis project

- Writing of a Newtonian smoothed-particle hydrodynamics (SPH) code.
- Implementation of a Predictor-Corrector method for the time evolution of the hydrodynamic equations.
- Implementation of a Newton-Rapson method for the recovery of the hydrodynamic primitive variables.
- Solving of the Sod shock tube.
- Solving of an isothermal collapse.
- Writing of a relativistic SPH code.
- Solving of the relativistic Sod shock tube.
- Writing of the TOV field equations.
- Solution of the TOV equations with an RK4 code to generate the initial conditions of the SPH code.

2008–2009 **Graduate research assistant**, *Faculty of Sciences, UAEMéx*, Toluca, Mexico.

Bachelor thesis project

- Writing of the geodesic equation for a spherically symmetric and static space-time.
- Writing of a fourth order Runge-Kutta solver (RK4)
- Testing of the RK4 with ordinary differential equations with well known analytic solution
- Characterization of the RK4 code
  - Convergence
  - Stability
- Application of RK4 to the geodesics equation in a Schwarzschild space-time
- Implementation of a first order interpolation routine for the Christoffel symbols from a numerical metric.
- Implementation of the code to the
- Application of RK4 to the geodesics equation in a Boson stars (numerical) solution of Einstein's field equations.
- Characterization of gravitational lenses around:
  - Black holes,
  - Boson stars.
- Interpretation of light trajectories due to curved space-times.
- Contributing to the writing of a manuscript for publication in a peer-reviewed journal.

2007–2008 **Undergraduate research assistant**, *Faculty of Sciences, UAEMéx*, Toluca, Mexico.
Internship service project
Supervisor: Prof. Jorge Orozco Velasco.
- Writing the elliptic equations in finite differences form
- Characterization of the typical kinds of boundary conditions:
  - Dirichlet
  - Neumann
- Writing of a code which solves the two-dimensional Laplace equation in Cartesian coordinates with Dirichlet and Neumann boundary conditions.

25 Jun–24 Aug 2007 **Undergraduate research assistant**, *Mexican Academia of Science*, Morelia, Mexico.
National program for temporary stays at national research centers for undergraduate science students.
Supervisor: Prof. Francisco S. Guzmán Murillo.
- Numerical solution of the wave equation with finite differences.
- Numerical solution of Burgers' equation with finite differences.
- Numerical solution of the general relativistic one-dimensional wave equation in the 3+1 formalism with finite differences.

2005–2008 **Undergraduate researcher assistant**, *Faculty of Sciences, UAEMéx*, Toluca, Mexico.
Volunteer work in a faculty research project
Supervisor: Prof. Porfirio D. Rosendo-Francisco
- Exposure of graphite samples to microwaves
  - Ultrasonic cleaning of graphite samples.
  - Systematic exposure graphite samples to microwaves (2.45 GHz).
  - Observation of the superficial effects using a metallographic microscope.
  - Characterization of the structures observed.
- Exposure of graphite samples to elecric arcs
  - Ultrasonic cleaning of graphite samples.
  - Characterization of a Tesla coil.
    - Input current.
    - Output flux of electrons.
  - Controlled handling of a Tesla coil.
  - Systematic exposure of the surface of graphite samples to a perpendicular and tangential electric arc.
  - Observation of surface effects with a metallographic microscope.
  - Characterization of the zones around the contact region.
  - Characterization of the temperature around the contact region.
  - Characterization of the structures which appeared after the exposure.
  - Analysis of X-rays spectra of the samples.
  - Identification of induced families of lattice planes.

Meetings and conferences

Oral presentations

2014 **Rueda-Becerril, J.M.**; Mimica, P.; Aloy, M.A., *Numerical simulations of the internal shock model in magnetized relativistic jets of blazars*, IVICFA's Fridays: Computation in Physics, Paterna, Spain, 17 October.

2014 **Rueda-Becerril, J.M.**; Mimica, P.; Aloy, M.A., *Influence of the magnetic field on the spectral properties of blazars in the internal shocks scenario*, Extreme-Astrophysics in an Ever-Changing Universe: Time-Domain Astronomy in the 21st Century, Ierápetra, Greece, 16–20 June.

2013 **Rueda-Becerril, J.M.**; Mimica, P.; Aloy, M.A., *Numerical study of broadband spectra caused by internal shocks in magnetized relativistic jets*, XXXIV Biennial meeting of the Royal Spanish Society of Physics, Valencia, Spain, 15–19 July.

2009 **Rueda-Becerril, J.M**, *¿Decía Einstein la verdad?*, weekly colloquium of Physics students *Café Ciencias*, Toluca, Mexico, 11 March.

Poster presentations

2014 **Rueda-Becerril, J.M.**; Mimica, P.; Aloy, M.A., *Numerical simulations of the internal shock model in magnetized relativistic jets of blazars*, Swift: 10 years of Discovery, Rome, Italy, 2–5 December.

2013 **Rueda-Becerril, J.M.**; Mimica, P.; Aloy, M.A., *Numerical study of broadband spectra caused by internal shocks in magnetized relativistic jets of blazars*, The Innermost Regions of Relativistic Jets and Their Magnetic Fields, Granada, Spain, 10–14 June.

2007 **Rueda-Becerril, J.M.**; Leyte González, R.; García Santibañez, F.; Rosendo-Francisco, P., *Analysis of the superficial structure of graphite samples submitted to an electric arc*, L National Physics Meeting, Boca del Río, Mexico, 29 October–2 November.

2006 **Rueda-Becerril, J.M.**; Leyte González, R.; García Molina, N.; Rosendo-Francisco, P., *Modifications on the superficial structure of graphite samples*, XLIX National Physics Meeting, San Luis Potosí, Mexico, 16–19 October.

2005 **Rueda-Becerril, J.M.**; Gómez Díaz, A.; Rosendo-Francisco, P., *Studies of microwave effects of graphite samples*, XLVIII National Physics Meeting, Guadalajara, Mexico, 17–21 October.

Attendance only

2016 CoCoNuT Meeting 2016, Burjassot, Spain, 14–16 December

2008 LI National Physics Meeting, Zacatecas, Mexico, 20–24 October

Organization

2012 Contribution to the organization of the X Scientific Meeting of the Spanish Astronomical Society, Valencia, Spain, 14–16 December

Professional development

7–16 Feb 2017 **Data Analysis and Machine Learning with Python**, *UV*, Burjassot, Spain.
No. of hours: 8

23–16 May 2014 **The Universe in the light of PLANCK and BICEP2**, *UV*, Burjassot, Spain.
No. of credits: 2

23–27 Sep 2013 **Dark Matter**, *UV*, Burjassot, Spain.
No. of credits: 2

23 Apr–8 May 2013 **International Cagèse School on Cosmic Accelerators**, *Institut d'Études Scientifques de Cargèse*, Cargèse, France.

9–12 Apr 2012 **Introduction to C++ Programming**, *UV*, Burjassot, Spain.
No. of credits: 6

27 Mar–4 Apr 2012 **Numerical Relativistic Astrophysics**, *UV*, Burjassot, Spain.
No. of hours: 9

5–9 March 2012 **Fortran for Scientific Computing**, *High Performance Computing Center Sttutgart*, Stuttgart, Germany.
No. of hours: 33

Jun 2006 **Advanced Summer School**, *CINVESTAV*, Ciudad de México, Mexico.

Aug 2006 **Advanced Summer School**, *Instituto de Física of the Universidad de Guanajuato*, León, Mexico.

Awards and Scholarships

2014–2016 **Fellowship** from the Mexican Federal Government to study abroad awarded by the National Council of Science and Technology (CONACyT).

2011–2014 **Fellowship** "Santiago Grisolía" awarded by the Council of Education, Research, Culture and Sport of the Valencian Comunity.

2009–2011 **Fellowship** for academic training for MSc studies granted by the Mexican Council of Science and Technology (CONACyT).

2009 **Award** "Lic. Juan Josafat Pichardo Cruz", granted by the UAEMéx, for finishing the BSc thesis and graduating within a year after completing the undergraduate credits.

25 Jun–24 Aug 2007 **Fellowship** for a temporary stay in a national research center under the XVII summer of scientific investigation program awarded by the Mexican Academia of Science.

Other activities

Aug 2007–May 2009 Physics students representative at the Governing Council of the Faculty of Sciences of the UAEMéx

Languages

Spanish	Mother tongue
English	Proficient
Catalan	Basic
French	Basic
German	Basic