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Postdoctoral Research Associate
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Profile

Doctor in Astrophysics with high expertise in programming, data analysis and problem solving. I am creative, innovative, analyst and hard worker.

During my PhD studies I developed high programming skills in several languages such as Python, R, Fortran 95, C, Shell and version control tools like Git using platforms such as GitHub and Bitbucket. I worked on developing sophisticated numerical tools which were implemented to simulate blazar flares (prompt high energy radiation from relativistic jets of active galactic nuclei). This has shown my fast learning skill of new programming languages and develop efficient codes to solve the problem posed.

I am coauthor of three articles in peer reviewed scientific journals and author of a doctoral thesis, qualified as innovative, in which several numerical and programming issues were overcome, reason why it received the distinction of excellent. In addition, I have good English skills which makes me capable of discussing and interact fluently in both Spanish and English.

I want to apply my mathematical knowledge, programming skills and data analysis experience to machine learning, data mining, decision making and modelling.

Interests

High energy astrophysics

- Cosmic rays
- Particles acceleration processes
- Active galactic nuclei
  - Relativistic jet: formation, composition, magnetization
  - Blazars
  - Radio galaxies
  - Quasars
  - TDEs
- Microquasars.
- Gamma-ray bursts.
- Pulsars
- X-ray binaries

Numerical Astrophysics	○ Numerical solutions to the radiation transport equation with astrophysical applications. ○ Numerical simulations of particle acceleration processes. ○ Numerical hydrodynamics and magnetohydrodynamics. ○ Performance, stability, convergence and accuracy of numerical codes.
Computer Sciences	○ Decision-making optimization ○ Machine learning (supervised and unsupervised) ○ Neuronal networks ○ Text mining ○ Network analysis

Employment

2017–Present **Posdoctoral Research Associate**, *Instituto de Física y Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo*, Morelia, Mexico.

Education

2011–2017 **PhD in Physics**, *Universitat de València*, Valencia, Spain, **Grade:** Distinction *Cum Laude*.
Supervisors: Prof. Miguel Ángel Aloy Torás and Dr. Petar Mimica
Thesis: *Numerical treatment of radiation processes in the internal shocks of magnetized relativistic outflows*. Access: `http://roderic.uv.es/handle/10550/60003`

2009–2011 **MSc in Physics**, *Instituto de Física y Matemáticas*, 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 (fixed and free format), OpenMP, Python (2, 3), R, RStudio, Shell, Makefile, HDF5, Git, Mathematica, LaTeX, Atom (text editor), Emacs, gnuplot, grace, GitHub
Intermediate	C, C++, Julia, Elisp, MPI, SageMath, yEd, OpenOffice, Microsoft Office (Word, Excel, PowerPoint), iWork (Pages, Numbers, Keynote), DOT, TikZ/PGF, GeoGebra
Basic	HTML, Jekyll, Matlab, Maple, Java, Swift, Perl, SQL, Java

Experience

2017–Present **Postdoctoral Research Associate**, *Instituto de Física y Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo*, Morelia, Mexico.

2011–2017 **Graduate research assistant**, *Universitat de València*, Burjassot, Spain.

- Automatized the launching of simulations, treatment of data and generation of plots for an extensive parameter space study of the internal shocks code developed by Petar Mimica and Miguel A. Aloy in order to find traces left in the spectra due to the magnetization of the shocked shells of plasma.
- Extracted and interpreted from the simulations of the main characteristics of blazars SEDs, e.g. Compton dominance, syncrotron and Compton peaks, spectral index using `Python` and `Shell`.
- Extracted, cleaned and processed data from the *Fermi* LAT Second AGN Catalog database for the comparison with our simulations.
- We confronted a challenge when we intended to include further microphysical phenomena in the simulations. To overcome this
  - Implemented a routine for a more general distribution of particles (thermal-nonthermal) to be treated in the original code.
  - Calculated tables with the Magnetobremsstrahlung emission of charged particles of arbitrary velocity and the emissivity for isotropic distributions of electrons using a code that I developed from scratch.
- Contributed to the writing of and coauthored two manuscript for publication in a peer-reviewed journal.
- Developed high expertise with `Python`, `R`, `RStudio`, `Fortran 95`, `Shell`, `git`, `GitHub`, `Bitbucket`.

2010–2011 **Graduate research assistant**, *Instituto de Física y Matemáticas*, Morelia, Mexico.

- A problem posed for master thesis was the simulation of a TOV star using smoothed-particle hydrodynamics (SPH) numerical method. For this I developed a newtonian and relativistic SPH codes in `Fortran 95`.
- The evolution of the system was carried out using Predictor-Corrector routine which I also wrote in `Fortran 95`.
- For the initial conditions I used the numerical solution of the TOV field equations, using a fourth order Runge-Kutta solver also written in `Fortran 95`.
- For the analysis and plotting I used and mastered `gnuplot`.

2008–2009 **Graduate research assistant**, *Universidad Autónoma del Estado de México*, Toluca, Mexico.

- Predict the trajectory of light around black holes and similar objects such as Boson stars was the problem posed for the bachelor degree thesis. To solve such problem I wrote the geodesic equation for a spherically symmetric and static space-time and solved them using a RK4 routine, written in `Fortran 95`. I characterized such routine studying its convergence and stability for both an analytic and numeric metrics.
- I interpreted light trajectories due to curved space-times and characterized such trajectories for gravitational lenses.
- Contributing to the writing of and coauthored a manuscript for publication in a peer-reviewed journal.

2007–2008 **Undergraduate research assistant**, *Universidad Autónoma del Estado de México*, Toluca, Mexico.

Internship service project, supervised by 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**, *Universidad Autónoma del Estado de México*, 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.

Publications

Articles

3. **Rueda-Becerril, J. M.**, Mimica, P. & Aloy, M. A. 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 (2017). 10.1093/mnras/stx476.

2. **Rueda-Becerril, J. M.**, Mimica, P. & Aloy, M. A. The influence of the magnetic field on the spectral properties of blazars. *Mon. Not. R. Astron. Soc.* **438**, 1856–1869 (2014). 10.1093/mnras/stt2335.

1. Guzmán, F. S. & **Rueda-Becerril, J. M.** Spherical boson stars as black hole mimickers. *Phys. Rev. D* **80**, 084023 (2009). 10.1103/PhysRevD.80.084023.

Proceedings

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

2. **Rueda-Becerril, J. M.**, Mimica, P., Aloy, M. A. & Aloy, C. Numerical study of

broadband spectra caused by internal shocks in magnetized relativistic jets of blazars. In *The Innermost Regions of Relativistic Jets and Their Magnetic Fields*, vol. 61 of *European Physical Journal Web of Conferences*, 02007 (2013). 10.1051/epjconf/20136102007.

1. Mimica, P., Aloy, M. A., **Rueda-Becerril, J. M.**, Tabik, S. & Aloy, C. Numerical simulations of dynamics and emission from relativistic astrophysical jets. In *24th IUPAP Conference on Computational Physics*, vol. 454 of *Journal of Physics: Conference Series*, 012001 (2013). 10.1088/1742-6596/454/1/012001.

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 UAEMex, 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.

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.

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

Outreach

2009 **Rueda-Becerril, J. M.**, *¿Decía Einstein la verdad? (Was Einstein saying the truth?)*, oral presentation at the weekly colloquium of Physics students: *Café Ciencias*, Toluca, Mexico, 11 March.

Other activities

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

Languages

Spanish	Mother tongue	
English	Proficient	*TOEFL certified.*
Catalan	Basic	
French	Basic	
German	Basic	