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Jesús M. Rueda-Becerril

PhD

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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.

In my present position as a postdoctoral researcher at Purdue University, I am developing numerical tools to performe simulations of high energy processes in relativistic jet scenarios such as blazars and γ-ray bursts, in collaboration with Prof. Dimitrios Giannios and the members of his research group.

Interests

High energy astrophysics	Active galactic nuclei — Tidal disruption events — Gamma-ray bursts — Neutron stars: pulsars, magnetars — Fast radio bursts — Accretion — Cosmic rays — Particles acceleration — Relativistic jets: formation, composition — Gravitational waves
Numerical Astrophysics	Radiative transfer equation — Plasma modeling: PIC simulations, Fokker-Planck equation — Magnetohydrodynamics — Numerical Relativity — Mergers
Computer Sciences	Scientific code development — High Performance Computing — Machine Learning — Data Analysis

Professional Experience

Oct. 2018 – **Postdoctoral Fellow**, *Department of Physics and Astronomy, Purdue University*, West Lafayette, IN, USA.

Mentor: Prof. Dimitrios Giannios

- Creator and developer of the code `Paramo`: a numerical code which solves the Fokker-Planck and radiative transfer equations. https://doi.org/10.5281/zenodo.3551922
- External Compton spectrum and evolution in the context of γ-ray burst afterglows [**?**]
- Connection between the baryon loading and the so-called *blazar sequence* (publication in prep.).
- Turbulence as acceleration process in blazars (publication in prep.)
- Research grant obtained from the *NASA Fermi Cycle-12 Guest Investigator Program.*
- Accretion around isolated black holes (publication in prep.)

Jan. – Oct. 2018 **Postdoctoral Fellow**, *Instituto de Física y Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo*, Morelia, Mexico.
MENTOR: Prof. Francisco S. Guzmán
- Training graduate students on numerical tools, e.g., HDF5. https://github.com/altjerue/howto_HDF5
- Mentoring graduate students.
- Treatment of large number of output images from the numerical code `GRTRANS` for Machine Learning analysis.
- Developed the visualization tool `SAPytho` for spectral evolution. https://github.com/altjerue/SAPyto

Oct. 2011 – Jul. 2017 **Graduate research assistant**, *Universitat de València*, Burjassot, Spain.
SUPERVISORS: Prof. Miguel A. Aloy & 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
- Applied the *internal-shocks* model in the context of blazar flares to identify the signature of the magnetization in their SEDs. Our results were contrasted with data from the *Fermi* LAT Second AGN Catalog database [**?**].
- Developed numerical technique to calculate (cyclo-)synchrotron emission from non-, trans-, and ultra-relativistic charged particles. Calculations applied to the *internal-shocks* model of blazar flares [**?**].

Aug. 2009 – Sep. 2011 **Graduate research assistant**, *Universidad Michoacana de San Nicolás de Hidalgo*, Morelia, Mexico.
SUPERVISOR: Prof. José A. Cervera
- Developed a SPH code to evolve a hydrodynamical system with TOV field equations as initial conditions.

Sep. 2008 – May 2009 **Graduate research assistant**, *Universidad Autónoma del Estado de México*, Toluca, Mexico.
SUPERVISOR: Prof. Francisco S. Guzmán
- Developed a numerical solver for null geodesic equation for analytical and numerical metrics [**?**]

Education

2011 – 2017 **Ph.D. in Numerical Astrophysics**, *Departament d'Astronomia i Astrofísica, Universitat de València*, Valencia, Spain.
SUPERVISORS: Prof. Miguel Ángel Aloy Torás and Dr. Petar Mimica
Distinction: *Cum Laude*

2009 – 2011 **M.Sc. in Physics**, *Instituto de Física y Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo*, Morelia, Mexico.

2004 – 2009 **B.Sc. in Physics**, *Facultad de Ciencias, Universidad Autónoma del Estado de México*, Toluca, Mexico.

Technical Skills

PROGRAMMING LANGUAGES	Fortran, Python, Shell Scripting, C/C++, Julia, R
SCIENTIFIC CODES	`SPEV` (Mimica et al. 2009), `GRTRANS` (Dexter 2016), `BHAC` (Porth et al. 2017)
SCIENTIFIC CODE DEVELOPMENT	`SPEV`, `PARAMO`
HIGH PERFORMANCE COMPUTING	OpenMP, MPI, and OpenACC. Developing, compiling, debugging, and running scientific codes on high performance computing systems.
VISUALIZATION	Matplotlib, gnuplot, grace, Visit, Paraview
TOOLS	HDF5, Make, gdb, lldb, Linux/Unix, Windows, MacOS, Mathematica, RStudio, Jupyter, git, mercurial, GitHub, GitLab, Bitbucket, LaTeX, Markdown, MS Office, iWork
DEVELOPER	HTML, Jekyll

Publications

Articles

[4] Zhang, H., Christie, I., Petropoulou, M., **Rueda-Becerril, J. M.** & Giannios, D. "Inverse Compton Signatures of Gamma-Ray Burst Afterglows," MNRAS, staa1583, (2020), arXiv:1910.14049.

[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," MNRAS **468**, 1169–1182, (2017), arXiv:1612.06383.

[2] **Rueda-Becerril, J. M.**, Mimica, P. & Aloy, M. A. "The influence of the magnetic field on the spectral properties of blazars," MNRAS **438**, 1856–1869 (2014), arXiv:1310.5441.

[1] Guzmán, F. S. & **Rueda-Becerril, J. M.** "Spherical boson stars as black hole mimickers," Phys. Rev. D **80**, 084023 (2009), arXiv:1009.1250.

Proceedings

3. **Rueda-Becerril, J. M.**, Mimica, P. & Aloy, M. A. "Numerical simulations of the internal shock model in magnetized relativistic jets of blazars," PoS(SWIFT 10) **233**, 159 (2014), arXiv:1502.07882.

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," EPJ Web Conf. **61**, 02007 (2013), arXiv:1309.4612.

1. Mimica, P., Aloy, M. A., **Rueda-Becerril, J. M.**, Tabik, S. & Aloy, C. "Numerical simulations of dynamics and emission from relativistic astrophysical jets," J. Phys.: Conf. Ser **42**, 012001 (2013), arXiv:1211.1794.

Teaching & Mentoring Experience

2018 – 2019 **Mentoring**, *Hao Zhang*, Department of Physics and Astronomy, Purdue University.

2018 – **Mentoring**, *Amanda O. Harrison*, Department of Physics and Astronomy, Purdue University.

2018 – **Mentoring**, *Zachary Davis*, Department of Physics and Astronomy, Purdue University.

Meetings and conferences

Talks

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, Ierápetra, Greece, June 16–20.

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, July 15–19.

Poster Sessions

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, December 2–5.

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, June 10–14.

Invited Talks and Seminars

Feb. 4, 2019 **Seminar**, *Morphology of the spectra from numerical simulations of the internal shocks model for blazars*, Purdue University, West Lafayette, IN.

Jun. 19, 2018 **Seminar**, *Numerical simulations of the internal shocks model in magnetized relativistic jets of blazars*, Weekly colloquium of the DATA group of the Institute of Astronomy, UNAM, Mexico City, Mexico.

Mar. 2, 2018 **Seminar**, *Numerical treatment of nonthermal radiation in the internal shocks model for blazars*, Weekly coloquium of the Institute of Physics and Mathematics, UMSNH, Morelia, Mexico..

Oct. 17, 2014 **Seminar**, *Numerical simulations of the internal shock model in magnetized relativistic jets of blazars*, IVICFA's Fridays: Computation in Physics, Paterna, Spain.

Professional development

Nov. 7, 2019 **Writing Winning Grants**, *Dr. Lauren Broyles*, Purdue University, West Lafayette, IN..

Jun. 3 – 6, 2019 **XSEDE HPC Workshop: Summer Boot Camp**, *John Urbanic*, Purdue University, West Lafayette, IN..

Feb. 7 – 16, 2017 **Data Analysis and Machine Learning with Python**, *Dr. Alejandro Torres*, Universitat de València, Burjassot, Spain..

Jul. 6 – 7 **Numerical relativity simulations of BBH coalescence using the Einstein Toolkit**, *Dr. Vassilios Mewes*, Universitat de València.
Burjassot, Spain. No. of hours: 8

May 23 – 16, 2014 **The Universe in the light of PLANCK and BICEP2**, *Prof. Nick Mavromatos*, Universitat de València.
Burjassot, Spain. No. of credits: 2

Sep. 23 – 27, 2013 **Dark Matter**, *Dr. Alejandro Ibarra*, Universitat de València.
Burjassot, Spain. No. of credits: 2

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

Apr. 9 – 12, 2012 **Introduction to C++ Programming**, *Dr. Jacek Generowicz*, Universitat de València.
Burjassot, Spain. No. of credits: 6

Mar. 27 – Apr. 4, 2012 **Numerical Relativistic Astrophysics**, *Prof. Luciano Rezzolla*, Universitat de València.
Burjassot, Spain. No. of hours: 9

Mar. 5 – 9, 2012 **Fortran for Scientific Computing**, *HLRS, University of Stuttgart*, Uwe Küster & Ralf Schneider.
Stuttgart, Germany. No. of hours: 33

Research Grants

2019 PI: Giannios, D.; Co-I: **Rueda-Becerril, J. M.**, *NASA Fermi Cycle-12 Guest Investigator Program*, A simple model to understand the blazar sequence.

Awards and Grants

2018 – 2020 **Fellowship** from the Mexican Federal Government for a postdoctoral stay abroad awarded by the National Council of Science and Technology (CONACyT).

2018 **Grant** from the Mexican Federal Government under the *Program for the Professional Development of Higher Education Institutions*, awarded by the Secretariat of Public Education.

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

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

Sep. 2009 – Aug. 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.

Outreach

2019 **Presentation of three posters**, *Annual Department of Physics & Astronomy Poster Event*, Purdue University.
November 13, West Lafayette, IN

2019 **Round table**, *Post-Doc Panel Q&A: What happens when we complete our PhDs?*, Purdue University.
April 10, West Lafayette, IN

2018 **Presentation of a poster**, *Annual Department of Physics & Astronomy Poster Event*, Purdue University.
November 14, West Lafayette, IN

Synergetic Activities

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

Volunteering

Sep. 2019 – **Member & Co-Founder**, *Científicos Mexicanos en el Extranjero.*
We are a group of Mexican scientists collaborating with mexican research centers. We're committed with society, intending to narrow down the gap between science and the common knowledge.
Homepage: https://mexiciencia.github.io

Other activities

Aug 2007– May 2009 Physics students representative at the Governing Council of the Faculty of Sciences of the Universidad Autónoma del Estado de México

Languages

Spanish	native proficiency	
English	full professional proficiency	*TOEFL certified.*
Catalan	professional working proficiency	
French	Basic	
German	Basic	
Portuguese	Basic	

References

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