Jesús M. Rueda-Becerril | PhD

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Nationality: Mexican

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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

Postdoctoral Fellow
Department of Physics and Astronomy *Oct. 2018 – Present*
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.
- External Compton spectrum and evolution in the context of γ-ray burst afterglows [4]
- Connection between the baryon loading and the so-called *blazar sequence* (publication in prep.).
- Research grant obtained from the *NASA Fermi Cycle-12 Guest Investigator Program*.
- Turbulence as acceleration process in blazars (work in progress)
- Accretion around isolated black holes (work in progress)

Postdoctoral Fellow
Instituto de Física y Matemáticas *Jan. – Oct. 2018*
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

Graduate research assistant
Departament d'Astronomia i Astrofísica *Oct. 2011 – Jul. 2017*

Universitat de València, Burjassot, Spain
Supervisors: Prof. Miguel A. Aloy & Dr. Petar Mimica
- 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 [2].
- 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 [3].

Graduate research assistant
Instituto de Física y Matemáticas *Aug. 2009 – Sep. 2011*
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.

Undergraduate research assistant
Facultad de Ciencias *Sep. 2008 – May 2009*
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 [1]

Education

Ph.D. in Physics (Numerical Astrophysics)
Universitat de València, Spain *Oct. 2011 – Jul. 2017*
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

M.Sc. in Physics
Universidad Michoacana de San Nicolás de Hidalgo, Mexico *Aug. 2009 – Sep. 2011*
Supervisor: Prof. José A. Cervera
Thesis: *Study of TOV stars with the SPH method*

B.Sc. in Physics
Universidad Autónoma del Estado de México, Mexico *Aug. 2004 – Dec. 2008*
Supervisor: Prof. Francisco S. Guzmán
Thesis: *Numerical solution of null geodesics for the generation of gravitational lenses produced by spherically-symmetric and static spacetimes*

Publications

Articles

[5] **Rueda-Becerril, J. M.**, Harrison, A. O. & Giannios, D.

[4] Zhang, H., Christie, I., Petropoulou, M., **Rueda-Becerril, J. M.** & Giannios, D. *Inverse Compton Signatures of Gamma-Ray Burst Afterglows*, MNRAS **496**, 974–986, (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

5. **Rueda-Becerril, J. M.** *A numerical approach for radiative cooling in relativistic outflows*,

4. **Rueda-Becerril, J. M.**, Harrison, A. O. & Giannios, D. *The blazar sequence revised*,

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.

Research Grants

NASA Fermi Cycle-12 Guest Investigator Program **Grant #121077**
A simple model to understand the blazar sequence *2019*
PI: Giannios, D., Co-I: **Rueda-Becerril, J. M.**

Grants and Fellowships

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

2018: **Fellowship** 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, Spain.

Sep. 2009 – Aug. 2011: **Fellowship** for MSc studies at the Institute of Physics and Mathematics, Universidad Michoacana de San Nicolás de Hidalgo, granted by the Mexican Council of Science and Technology (CONACyT).

Jun. – Aug. 2007: **Fellowship** for a temporary stay (3 months) in a national research center under the *XVII summer of scientific investigation program* awarded by the Mexican Academia of Science.

Awards

2009: **Award** *Lic. Juan Josafat Pichardo Cruz*, granted by the Autonomous University of the State of Mexico, for finishing and defending a thesis within a year after completing the undergraduate credits.

Meetings and conferences

Contributed Talks

The blazar sequence revised
IWARA 2020 Video Conference, Mexico City, Mexico, September 6–12, 2020
https://www.youtube.com/watch?v=BAZNWLNT69M

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, 2014

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, 2013

Poster Sessions

A numerical approach for radiative cooling in relativistic outflows
IWARA 2020 Video Conference, Mexico City, Mexico, September 6–12, 2020
https://www.youtube.com/watch?v=0TJiKg7kOPI

Numerical simulations of the internal shock model in magnetized relativistic jets of blazars
Swift: 10 years of Discovery, Rome, Italy, December 2–5, 2014

Numerical study of broadband spectra caused by internal shocks in magnetized relativistic jets
The Innermost Regions of Relativistic Jets and Their Magnetic Fields, Granada, Spain, June 10–14, 2013

Invited Talks

Morphology of the spectra from numerical simulations of the internal shocks model for blazars
Astrophysics Seminar, Purdue University, West Lafayette, IN, USA, February 4, 2019

Numerical simulations of the internal shocks model in magnetized relativistic jets of blazars
DATA group weakly Seminar, Instituto de Astronomía, UNAM, Mexico City, Mexico, June 19, 2018

Numerical treatment of non-thermal radiation in the internal shocks model for blazars
Weekly Seminar, Instituto de Física y Matemáticas, Morelia, Mexico, March 2, 2018

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

Teaching & Mentoring Experience

Hao Zhang [4] — **Mentoring**
Graduate student, Department of Physics and Astronomy, Purdue University — *2018 – 2019*

Amanda O. Harrison [5] — **Mentoring**
Graduate student, Department of Physics and Astronomy, Purdue University — *2018 – 2020*

Zachary Davis — **Mentoring**
Graduate student, Department of Physics and Astronomy, Purdue University — *2018 – Present*

Outreach

Los más rápidos y los más furiosos (*The Fastest and the Most Furious*) — **Online Talk**
Community of Undergraduate Physics Students, Juárez Autonomous University of Tabasco — *September 4, 2020*
Tabasco, Mexico

Una simulación de la física y la astrofísica (*A Simulation of Physics and Astrophysics*) — **Online Talk**
Community of Undergraduate Physics Students, Juárez Autonomous University of Tabasco — *August 14, 2020*
Tabasco, Mexico

Annual Department of Physics and Astronomy Poster Event — **Posters (3) presentation**
Department of Physics and Astronomy, Purdue University — *November 13, 2019*
West Lafayette, IN, USA

Post-Doc Panel Q&A: What happens when we complete our PhDs? — **Panelist**
Department of Physics and Astronomy, Purdue University — *April 10, 2019*
West Lafayette, IN, USA

Annual Department of Physics and Astronomy Poster Event — **Poster presentation**
Department of Physics and Astronomy, Purdue University — *November 14, 2018*
West Lafayette, IN, USA

¿Decía Einstein la verdad? (Was Einstein saying the truth?) — **Talk**
Facultad de Ciencias, Universidad Autónoma del Estado de México — *March 11, 2009*
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` [2, 3], `PARAMO` [5]

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

Professional development

Writing Winning Grants
Dr. Lauren Broyles, Purdue University, West Lafayette, IN, USA, November 7, 2019 — *Lecture*

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

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

Numerical relativity simulations of BBH coalescence using the Einstein Toolkit
Dr. Vassilios Mewes, Universitat de València, Burjassot, Spain, July 6 – 7, 2016 *Workshop*
No. of hours: 8

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

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

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

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

Numerical Relativistic Astrophysics
Prof. Luciano Rezzolla, Universitat de València, Burjassot, Spain, March 27 – April 4, 2012 *Lecture series*
No. of hours: 9

Fortran for Scientific Computing
HLRS, University of Stuttgart, Stuttgart, Germany, Mar. 5 – 9, 2012 *Workshop*
No. of hours: 33

Advanced Summer School
CINVESTAV, Ciudad de México, Mexico, June 2006 *Summer school*

Advanced Summer School
Instituto de Física, Universidad de Guanajuato, León, Mexico, August 2006 *Summer school*

Synergetic Activities

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

Volunteering

Científicos Mexicanos en el Extranjero
Member & Co-Founder *Sep. 2019 – Present*
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: **Representative** of the Physics students community 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

Catalan: professional working proficiency

French: Basic

German: Basic

Portuguese: Basic

References

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Prof. Miguel Ángel Aloy
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