

Jesús M. Rueda-Becerril

PhD

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Nationality: Mexican

Last Updated: September 14, 2020

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 at the Universitat de València I developed high programming skills in several languages such as Python, R, Fortran, C/C++, Shell and version control systems like Git. 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) in the *internal shocks* model.

I am currently a postdoctoral fellow at the Department of Physics and Astronomy at Purdue University, I am developing numerical tools to perform simulations of high energy processes in relativistic jet scenarios such as blazars and γ -ray bursts, in collaboration with my mentor Prof. Dimitrios Giannios, and the members of his research group.

Interests

High-energy astrophysics — Transients — Relativistic jets — Numerical astrophysics

Professional Experience

Postdoctoral Fellow

October 2018 – present

Department of Physics and Astronomy, Purdue University, USA

MENTOR: Prof. Dimitrios Giannios

- Creator and developer of the code Paramo
 - Numerical Fokker-Planck equation solver
 - Numerical non-thermal radiation processes: synchrotron and inverse Compton
 - Numerical Klein-Nishina radiative cooling
- Mentoring graduate students
- 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* [5].
- Turbulence as acceleration process in blazars using Paramo (work in progress)
- Simulations of accretion around galactic isolated black holes using HARM (work in progress)
- Radiative cooling in relativistic outflows using Paramo (work in progress)

Postdoctoral Fellow

January – September 2018

Instituto de Física y Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo, Mexico

MENTOR: Prof. Francisco S. Guzmán

- Trained graduate students on computational tools, e.g., HDF5. https://github.com/altjerue/howto_HDF5
- Mentored graduate students.
- Developed a Python script to treat 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/SAPytho>

Graduate research assistant

October 2011 – July 2017

Departament d'Astronomia i Astrofísica, Universitat de València, Spain

SUPERVISORS: Prof. Miguel A. Aloy & Dr. Petar Mimica

- Applied the *internal-shocks* model to blazar flares
- Identified spectral signatures of magnetization.
- Contrasted simulations with data from the *Fermi*-LAT Second AGN Catalog database [2].
- Developed numerical technique to calculate (cyclo-)synchrotron emission
- Calculated (cyclo-)synchrotron emission from non-, trans-, and ultra-relativistic charged particles [3].

Graduate research assistant

August 2009 – September 2011

Instituto de Física y Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo, Mexico

SUPERVISOR: Prof. José A. Cervera

- Developer of a SPH code to evolve a hydrodynamical system with TOV initial conditions.

Undergraduate research assistant

September 2008 – May 2009

Facultad de Ciencias, Universidad Autónoma del Estado de México, Mexico

SUPERVISOR: Prof. Francisco S. Guzmán

- Developer of numerical null geodesic equation solver for analytical and numerical metrics [1]
- Priced with the *Lic. Juan Josafat Pichardo Cruz* award.

Education

Ph.D. in Physics

Oct. 2011 – Jul. 2017

Universitat de València, Spain

Excellent *cum laude*.

SUPERVISORS: Prof. Miguel A. Aloy & Dr. Petar Mimica.

Numerical treatment of radiation processes in the internal shocks of magnetized relativistic outflows

M.Sc. in Physics

Aug. 2009 – Sep. 2011

Universidad Michoacana de San Nicolás de Hidalgo, Mexico

SUPERVISOR: Prof. José A. Cervera

Study of TOV stars with the SPH method

B.Sc. in Physics

Aug. 2004 – Dec. 2008

Universidad Autónoma del Estado de México, Mexico

SUPERVISOR: Prof. Francisco S. Guzmán

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. *Baryon loading of blazar jets independent of accretion rate, not so their luminosity*, (2020), submitted for review to MNRAS [arXiv:2009.02273](https://arxiv.org/abs/2009.02273).
- [4] Zhang, H., Christie, I., Petropoulou, M., Rueda-Becerril, J. M. & Giannios, D. *Inverse Compton Signatures of Gamma-Ray Burst Afterglows*, [MNRAS](https://arxiv.org/abs/1910.14049) **496**, 974–986, (2020), [arXiv:1910.14049](https://arxiv.org/abs/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](https://arxiv.org/abs/1612.06383) **468**, 1169–1182, (2017), [arXiv:1612.06383](https://arxiv.org/abs/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](https://arxiv.org/abs/1310.5441) **438**, 1856–1869 (2014), [arXiv:1310.5441](https://arxiv.org/abs/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*, (2020)
4. Rueda-Becerril, J. M., Harrison, A. O. & Giannios, D. *The blazar sequence revised*, (2020)
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, PI: Giannios, D., Co-I: Rueda-Becerril, J. M.

2019

Grants and Fellowships

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

Jan. – Sep. 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.

Sep. 2014 – Aug. 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 Grisolia* awarded by the Council of Education, Research, Culture and Sport of the Valencian Community, 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

Marcos Moshinsky Award: for *Best Poster* presented at the IWARA 2020 Video Conference, Mexico City, 6 – 12 September 2020.

Lic. Juan Josafat Pichardo Cruz Award: for finishing and defending a thesis within a year after completing the undergraduate credits, granted by the Universidad Autónoma del Estado de México, 2009.

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

Meetings and conferences

Contributed Talks.....

The blazar sequence revised

9th International Workshop on Astronomy and Relativistic Astrophysics, Video Conference, 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

9th International Workshop on Astronomy and Relativistic Astrophysics, Video Conference, September 6–12, 2020

Marcos Moshinsky Award for Best Poster. <https://www.youtube.com/watch?v=OTJiKg7kOPI>

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

Teaching & Mentoring Experience

Zachary Davis

Graduate student, Department of Physics and Astronomy, Purdue University

Mentoring

2018 – Present

Amanda O. Harrison [5]

Graduate student, Department of Physics and Astronomy, Purdue University

Mentoring

2018 – 2020

Hao Zhang [4]

Graduate student, Department of Physics and Astronomy, Purdue University

Mentoring

2018 – 2019

Graduate Thermodynamics course

Dr. James P. Edwards, IFM, Universidad Michoacana de San Nicolás de Hidalgo

Class Substitution

2018

Technical Skills

Programming Languages: Fortran, Python, Shell Scripting, C/C++

Scientific Code Experience: SPEV (Mimica et al. 2009), GRTRANS (Dexter 2016), HARM (McKinney et al. 2012)

Scientific Code Development: SPEV [2, 3], PARAMO [5]

High Performance Computing: OpenMP, MPI, OpenACC

Tools: HDF5, version-control systems, Jupyter, gnuplot, Paraview

Outreach

Los más rápidos y los más furiosos (*The Fastest and the Most Furious*)

Community of Undergraduate Physics Students, Juárez Autonomous University of Tabasco
Tabasco, Mexico

Online Talk

September 4, 2020

Una simulación de la física y la astrofísica (<i>A Simulation of Physics and Astrophysics</i>) <i>Community of Undergraduate Physics Students, Juárez Autonomous University of Tabasco</i> Tabasco, Mexico	Online Talk August 14, 2020
ANITA y la teoría de los universos paralelos (<i>ANITA and the theory of parallel universes</i>) <i>Científicos Mexicanos en el Extranjero</i> , mexiciencia.github.io/post/anita	Blog post May 29, 2020
¿Qué es el modelo SIR? (<i>What is the SIR model?</i>) <i>Científicos Mexicanos en el Extranjero</i> , mexiciencia.github.io/post/modelo-sir	Blog post May 25, 2020
Evolución del brote epidémico de COVID-19 (<i>Evolution of the COVID-19 epidemic outbreak?</i>) <i>Científicos Mexicanos en el Extranjero</i> , mexiciencia.github.io/post/covid19 Collaborator with the data analysis/modeling	Blog post April 5, 2020
Annual Department of Physics and Astronomy Poster Event <i>Department of Physics and Astronomy, Purdue University</i> West Lafayette, IN, USA	Posters (3) presentation November 13, 2019
Post-Doc Panel Q&A: What happens when we complete our PhDs? <i>Department of Physics and Astronomy, Purdue University</i> West Lafayette, IN, USA	Panelist April 10, 2019
Annual Department of Physics and Astronomy Poster Event <i>Department of Physics and Astronomy, Purdue University</i> West Lafayette, IN, USA	Poster presentation November 14, 2018
¿Decía Einstein la verdad? (<i>Was Einstein saying the truth?</i>) <i>Facultad de Ciencias, Universidad Autónoma del Estado de México</i> Toluca, Mexico	Talk March 11, 2009

Professional development

Writing Winning Grants <i>Dr. Lauren Broyles, Purdue University, West Lafayette, IN, USA, November 7, 2019</i>	<i>Lecture</i>
XSEDE HPC Workshop: Summer Boot Camp <i>John Urbanic, Purdue University, West Lafayette, IN, USA, June 3 – 6, 2019</i>	<i>Workshop</i>
Data Analysis and Machine Learning with Python <i>Dr. Alejandro Torres, Universitat de València, Burjassot, Spain, February 7 – 16, 2017</i>	<i>Workshop</i>
Numerical relativity simulations of BBH coalescence using the Einstein Toolkit <i>Dr. Vassilios Mewes, Universitat de València, Burjassot, Spain, July 6 – 7, 2016</i> No. of hours: 8	<i>Workshop</i>
The Universe in the light of PLANCK and BICEP2 <i>Prof. Nick Mavromatos, Universitat de València, Burjassot, Spain, May 23 – 16, 2014</i> No. of credits: 2	<i>Lecture series</i>
Dark Matter <i>Prof. Alejandro Ibarra, Universitat de València, Burjassot, Spain, September 23 – 27, 2013</i> No. of credits: 2	<i>Lecture series</i>
International Cargèse School on Cosmic Accelerators <i>Institut d'Études Scientifiques de Cargèse, Cargèse, France, April 23 – May 8, 2013</i>	<i>Summer school</i>
Introduction to C++ Programming <i>Dr. Jacek Generowicz, Universitat de València, Burjassot, Spain, April 9 – 12, 2012</i> No. of credits: 6	<i>Workshop</i>
Numerical Relativistic Astrophysics <i>Prof. Luciano Rezzolla, Universitat de València, Burjassot, Spain, March 27 – April 4, 2012</i> No. of hours: 9	<i>Lecture series</i>

Fortran for Scientific Computing

HLRS, University of Stuttgart, Stuttgart, Germany, Mar. 5 – 9, 2012

No. of hours: 33

Workshop

Synergetic Activities

X Scientific Meeting of the Spanish Astronomical Society

Valencia, Spain

Organizing contributor, 14–16 December, 2012

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

Dr. Maxim Barkov

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