

# Jesús M. Rueda-Becerril

PhD

525 Northwestern Avenue  
West Lafayette  
IN 47907, USA

✉ [jruedabe@purdue.edu](mailto:jruedabe@purdue.edu)

🌐 [altjerue.github.io](https://altjerue.github.io)

in [jeruebe](#)

🐦 [jerue103](#)

🐙 [altjerue](#)

Nationality: Mexican

## Interests

---

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

## Professional Experience

---

### Postdoctoral Fellow

Department of Physics and Astronomy  
Purdue University, West Lafayette, IN, USA

Oct. 2018 – Present

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  $\gamma$ -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 isolated black holes using HARM (work in progress)
- Radiative cooling in relativistic outflows using Paramo (work in progress)

### Postdoctoral Fellow

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

Jan. – Oct. 2018

MENTOR: Prof. Francisco S. Guzmán

- Training graduate students on computational tools, e.g., HDF5. [https://github.com/altjerue/howto\\_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/SAPytho>

### Graduate research assistant

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

Oct. 2011 – Jul. 2017

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 flares [3].

### Graduate research assistant

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

Aug. 2009 – Sep. 2011

SUPERVISOR: Prof. José A. Cervera

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

## Undergraduate research assistant

Facultad de Ciencias

Universidad Autónoma del Estado de México, Toluca, Mexico

SUPERVISOR: Prof. Francisco S. Guzmán

o Developer of numerical null geodesic equation solver for analytical and numerical metrics [1]

Sep. 2008 – May 2009

## 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*

## 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 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

---

**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.

## 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*

<https://www.youtube.com/watch?v=0TJiKg7k0PI>

#### **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*

### **Thermodynamics for graduates**

*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 system, 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*

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

## Professional development

---

<b>Writing Winning Grants</b> Dr. Lauren Broyles, Purdue University, West Lafayette, IN, USA, November 7, 2019	<b>Lecture</b>
<b>XSEDE HPC Workshop: Summer Boot Camp</b> John Urbanic, Purdue University, West Lafayette, IN, USA, June 3 – 6, 2019	<b>Workshop</b>
<b>Data Analysis and Machine Learning with Python</b> Dr. Alejandro Torres, Universitat de València, Burjassot, Spain, February 7 – 16, 2017	<b>Workshop</b>
<b>Numerical relativity simulations of BBH coalescence using the Einstein Toolkit</b> Dr. Vassilios Mewes, Universitat de València, Burjassot, Spain, July 6 – 7, 2016 No. of hours: 8	<b>Workshop</b>
<b>The Universe in the light of PLANCK and BICEP2</b> Prof. Nick Mavromatos, Universitat de València, Burjassot, Spain, May 23 – 16, 2014 No. of credits: 2	<b>Lecture series</b>
<b>Dark Matter</b> Dr. Alejandro Ibarra, Universitat de València, Burjassot, Spain, September 23 – 27, 2013 No. of credits: 2	<b>Lecture series</b>
<b>International Cargèse School on Cosmic Accelerators</b> Institut d'Études Scientifiques de Cargèse, Cargèse, France, April 23 – May 8, 2013	<b>Summer school</b>
<b>Introduction to C++ Programming</b> Dr. Jacek Generowicz, Universitat de València, Burjassot, Spain, April 9 – 12, 2012 No. of credits: 6	<b>Workshop</b>
<b>Numerical Relativistic Astrophysics</b> Prof. Luciano Rezzolla, Universitat de València, Burjassot, Spain, March 27 – April 4, 2012 No. of hours: 9	<b>Lecture series</b>
<b>Fortran for Scientific Computing</b> HLRS, University of Stuttgart, Stuttgart, Germany, Mar. 5 – 9, 2012 No. of hours: 33	<b>Workshop</b>

## 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), [arXiv:2009.02273](#).
- [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*, (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](#).

## References

---

**Dr. Maxim Barkov**

Department of Physics and Astronomy  
Purdue University  
525 Northwestern Avenue  
West Lafayette, IN 47907, USA

✉ [mbarkov@purdue.edu](mailto:mbarkov@purdue.edu)

☎ +1 (765) 494-5194

**Dr. Petar Mimica**

Qindel Group  
Valencia, Spain

✉ [petar.mimica@gmail.com](mailto:petar.mimica@gmail.com)

**Prof. Dimitrios Giannios**

Department of Physics and Astronomy  
Purdue University  
525 Northwestern Avenue  
West Lafayette, IN 47907, USA

✉ [dgiannio@purdue.edu](mailto:dgiannio@purdue.edu)

☎ +1 (765) 494-5194

**Prof. Miguel Ángel Aloy**

Departament d'Astronomia i Astrofísica  
Universitat de València  
Edificio de Investigación  
C/ Dr. Moliner s/n  
46100 Burjassot, Valencia, Spain

✉ [Miguel.A.Aloy@uv.es](mailto:Miguel.A.Aloy@uv.es)

☎ +34 963 543 080