

Alejandro Cruz Osorio

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<https://itp.uni-frankfurt.de/osorio/index.html> • [@ACruz_Osorio](https://twitter.com/ACruz_Osorio)
Nationality: Mexican Date of birth: April 17 of 1984

Research Interests

Relativistic Astrophysics : Extragalactic Relativistic Jets – Shadows – Multiwavelength Emission – Accretion onto Compact Objects – General Relativistic Magnetohydrodynamics. General Relativity: Gravitational waves – Neutron and Quark Stars. Nonthermal Particle Acceleration.

Experience

Postdoctoral Fellow in Relativistic Astrophysics

2019–now

Institut für Theoretische Physik, Goethe Universität Frankfurt, Germany

MENTOR: Luciano Rezzolla

- General Relativistic Radiation (shadow) calculations;
 - Construction of a library of SgrA shadow using nonthermal models in the EHT collaboration.
 - Modelling M87 jet launching using non-thermal emission model.
 - Shadow comparison between Kerr black hole and black hole with a Dilatonic field.
- General Relativistic Magnetohydrodynamics simulation;
 - 3D and 2D GRMHD simulations of magnetized disks around black holes.
 - Relativistic common envelopes on black holes and neutron stars.
- Mentoring graduate students
- Member of the collaboration Event Horizon Telescope (Nov.2019–now).
- Member of the collaboration "Black Hole Cam" (Ago.2019 now).

Postdoctoral Fellow in Numerical Relativity

2017–2019

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

MENTOR: José A. Font Roda.

- Numerical relativity simulations of tilted disks with Einstein Toolkit;
 - Numerical solution of Einstein equation in BSSN formulation.
 - Numerical solution of relativistic Hydrodynamics in Valencia formulation.
 - Simulations of tilted torus around Kerr black hole in Mare-Nostrum cluster.
- Accretion of magnetized disks around compact objects;
 - Construction of equilibrium solution of magnetized torus around; Kerr black hole, Hairy black hole and black holes in modified theory of gravity.
 - Simulations of non-linear evolution of magnetized torus around Kerr black hole.

Postdoctoral Fellow in Relativistic Astrophysics

2016–2017

Institut Für Theoretische Physik, Goethe Universität Frankfurt, Germany

MENTOR: Luciano Rezzolla

- Developer of the new exa-scale numerical relativity code: ExaHype;
 - Numerical solution of Einstein equation in CZ4 formulation.
 - Numerical solution of relativistic magnetohydrodynamics in Valencia formulation.
 - Implementation of the MPI and openMP parallelization.

Postdoctoral Fellow in Astronomy

2015–2016

Instituto de Astronomía, Universidad Nacional Autónoma de México (UNAM), México
MENTOR: F. Sánchez

- Relativistic hydrodynamics simulations of wind accretion in presence of clumps around black holes.

Full time interim professor

Aug.2014–Feb.2015

Dep. of Computational Systems, Instituto Tecnológico Superior de los Ríos, México

Education

Ph.D. in Physics

2010-2014

Institute of Physics and Mathematics, UMSNH, México

Supervisor: F. S. Guzmán

Numerical implementation of the relativistic magnetohydrodynamics

M.Sc. in Physics

2008-2010

Institute of Physics and Mathematics, UMSNH, México

Supervisor: F. S. Guzmán

Numerical solution of the wave equation in Minkowski and Schwarzschild space-times in a domain containing the future infinite null

B.Sc in Physics-Mathematics

2002-2008

Faculty of Physical-Mathematical Sciences, UMSNH, México

Supervisor: F. S. Guzmán

Tracking null radial geodesics of spherically symmetric space-times.

Languages

Nahuatl: Native

Spanish: Native

English: Full professional proficiency

German: Basic

Awards and Recognitions

EHT Early Career Award 2022: For the outstanding contribution of Theoretical Modeling of Sagittarius A*. The Event Horizon Telescope collaboration. Dec. 2022

Wissenschaftspreis der Frankfurter Physik 2022 (Science Award of Frankfurt Physics 2022): Department of Physics Goethe University Frankfurt and Walter Greiner Gesellschaft zur Förderung der physikalischen Grundlagenforschung, Frankfurt, Germany. Jul. 2022

2016–2022 SNI I: National Researchers System Recognition by the National Council of Science and Technology (CONACYT ¹), México.

- Third period: January 2023 –
- Second period: January 2019 – December 2022.
- First period: January 2016 – December 2018.

Research Grants

2022–2025 Marie Curie Horizon Europe Staff Exchange action 2022 (NewFunFiCO): Fundamental Fields and Compact Objects: new opportunities, funding 276 000 Euros, **co-PI of Germany branch.**

2021–now JETSET-ERC Fellowship: Institut Für Theoretische Physik, Goethe Universität.

2019–2021 Black Hole Cam-EHT Fellowship: Institut Für Theoretische Physik, Goethe Universität.

2017–2019 CONACYT Postdoc abroad Fellowship: at Universitat de València.

2016–2017 ExaHyPE-Horizon 2020 EU Fellowship: Institut Für Theoretische Physik, Goethe Universität.

2015–2017 DGAPA postdoc Fellowship: at Institute of Astronomy, UNAM

CONACYT: Consejo Nacional de Ciencia y Tecnología

2008–2010 Fellowship for Ph.D. studies: at the Institute of Physics and Mathematics, UMSNH ², granted by the Mexican Council of Science CONACyT.

2010–2014 Fellowship for M.Sc studies: at the Institute of Physics and Mathematics, UMSNH, granted by the Mexican Council of Science CONACyT.

Grants of computational time allocation

PI of the project **Large-scale numerical-relativity simulations of tilted black hole-torus system**, project-ID: FI-2019-2-0043, **3 Millions CPU-hours**, Estimated cost: 2959 euros, Cluster: Barcelona Supercomputing center-MareNostrum 4.

Microphysical aspects of binary neutron star mergers (BNSMIC), HAWK cluster, High-Performance Computing Center Stuttgart, Stuttgart, Germany. **100 Millions CPU-hours**. PI Luciano Rezzolla.

Publications

- [1] **Cruz-Osorio**, A., Gonzalez-Juarez, A., Guzman, F. S., & Lora-Clavijo, F. D. Numerical solution of the wave equation on particular space-times using CMC slices and scri-fixing conformal compactification. *Rev. Mex. Fis.*, **56**:456–468, pages 456–468. 2010
- [2] **Cruz-Osorio**, A., Lora-Clavijo, F. D., & Guzmán, F. S., Jul. 2010, in *American Institute of Physics Conference Series*, Vol. 1256, *Gravitational Physics: Testing Gravity from Submillimeter to Cosmic*, ed. H. A. Morales-Tecotl, L. A. Urena-Lopez, R. Linares-Romero, & H. H. Garcia-Compean, pages 311–317
- [3] Lora-Clavijo, F. D., **Cruz-Osorio**, A., & Guzmán, F. S. Evolution of a massless test scalar field on boson star space-times. *Phys. Rev. D*, **82(2)**:023005, page 023005. Jul. 2010
- [4] **Cruz-Osorio**, A., Guzmán, F. S., & Lora-Clavijo, F. D. Scalar field dark matter: behavior around black holes. *Journal of Cosmology and Astroparticle Physics*, **2011(6)**:029, page 029. Jun. 2011
- [5] **Cruz-Osorio**, A., Lora-Clavijo, F. D., & Guzmán, F. S. Is the flip-flop behaviour of accretion shock cones on to black holes an effect of coordinates? *Mon. Not. R. Astron. Soc.*, **426(1)**:732–738, pages 732–738. Oct. 2012
- [6] **Cruz-Osorio**, A., Lora-Clavijo, F. D., & Guzmán, F. S., Jul. 2013, in *American Institute of Physics Conference Series*, Vol. 1548, *IX Mexican School on Gravitation and Mathematical Physics: Cosmology for the XXIst Century: Gravitation and Mathematical Physics Division of the Mexican Physical Society DGM-SMF*, ed. L. A. Uren-López, R. Becerril-Bárceñas, & R. Linares-Romero, pages 323–327
- [7] Lora-Clavijo, F. D., Guzmán, F. S., & **Cruz-Osorio**, A. PBH mass growth through radial accretion during the radiation dominated era. *Journal of Cosmology and Astroparticle Physics*, **2013(12)**:015, page 015. Dec. 2013
- [8] Lora-Clavijo, F. D., **Cruz-Osorio**, A., & Guzmán, F. S. CAFE: A New Relativistic MHD Code. *Astrophys. J., Supp.*, **218(2)**:24, page 24. Jun. 2015
- [9] Lora-Clavijo, F. D., **Cruz-Osorio**, A., & Moreno Méndez, E. Relativistic Bondi-Hoyle-Lyttleton Accretion onto a Rotating Black Hole: Density Gradients. *Astrophys. J., Supp.*, **219(2)**:30, page 30. Aug. 2015
- [10] González-Avilés, J. J., **Cruz-Osorio**, A., Lora-Clavijo, F. D., & Guzmán, F. S. Newtonian CAFE: a new ideal MHD code to study the solar atmosphere. *Mon. Not. R. Astron. Soc.*, **454(2)**:1871–1885, pages 1871–1885. Dec. 2015

UMSNH: Universidad Michoacana de San Nicolás de Hidalgo

- [11] **Cruz-Osorio**, A., & Lora-Clavijo, F. D. Non-axisymmetric relativistic wind accretion with velocity gradients on to a rotating black hole. *Mon. Not. R. Astron. Soc.*, **460(3)**:3193–3201, pages 3193–3201. Aug. 2016
- [12] **Cruz-Osorio**, A., Sánchez-Salcedo, F. J., & Lora-Clavijo, F. D. Relativistic Bondi-Hoyle-Lyttleton accretion in the presence of small rigid bodies around a black hole. *Mon. Not. R. Astron. Soc.*, **471(3)**:3127–3134, pages 3127–3134. Nov. 2017
- [13] Becerra-Vergara, E. A., Mojica, S., Lora-Clavijo, F. D., & **Cruz-Osorio**, A. Anisotropic quark stars with an interacting quark equation of state. *Phys. Rev. D*, **100(10)**:103006, page 103006. Nov. 2019
- [14] Arroyo-Chávez, G., **Cruz-Osorio**, A., Lora-Clavijo, F. D., Campuzano Vargas, C., & García Mora, L. A. Neutron and quark stars: constraining the parameters for simple EoS using the GW170817. *Astrophys Space Sci.*, **365(2)**:43, page 43. Feb. 2020
- [15] **Cruz-Osorio**, A., Gimeno-Soler, S., & Font, J. A. Non-linear evolutions of magnetized thick discs around black holes: dependence on the initial data. *Mon. Not. R. Astron. Soc.*, **492(4)**:5730–5742, pages 5730–5742. Mar. 2020
- [16] **Cruz-Osorio**, A., & Rezzolla, L. Common-envelope Dynamics of a Stellar-mass Black Hole: General Relativistic Simulations. *Astrophys. J.*, **894(2)**:147, page 147. May 2020
- [17] Event Horizon Telescope Collaboration, Akiyama, K., Algaba, J. C., et al. First M87 Event Horizon Telescope Results. VII. Polarization of the Ring. *Astrophys. J. Lett.*, **910(1)**:L12, page L12. Mar. 2021
- [18] Event Horizon Telescope Collaboration, Akiyama, K., Algaba, J. C., et al. First M87 Event Horizon Telescope Results. VIII. Magnetic Field Structure near The Event Horizon. *Astrophys. J. Lett.*, **910(1)**:L13, page L13. Mar. 2021
- [19] Goddi, C., Martí-Vidal, I., Messias, H., et al. Polarimetric Properties of Event Horizon Telescope Targets from ALMA. *Astrophys. J. Lett.*, **910(1)**:L14, page L14. Mar. 2021
- [20] EHT MWL Science Working Group, Algaba, J. C., Anczarski, J., et al. Broadband Multi-wavelength Properties of M87 during the 2017 Event Horizon Telescope Campaign. *Astrophys. J. Lett.*, **911(1)**:L11, page L11. Apr. 2021
- [21] Narayan, R., Palumbo, D. C. M., Johnson, M. D., et al. The Polarized Image of a Synchrotron-emitting Ring of Gas Orbiting a Black Hole. *Astrophys. J.*, **912(1)**:35, page 35. May 2021
- [22] Kocherlakota, P., Rezzolla, L., Falcke, H., et al. Constraints on black-hole charges with the 2017 EHT observations of M87*. *Phys. Rev. D*, **103(10)**:104047, page 104047. May 2021
- [23] **Cruz-Osorio**, A., Gimeno-Soler, S., Font, J. A., De Laurentis, M., & Mendoza, S. Magnetized discs and photon rings around yukawa-like black holes. *Phys. Rev. D*, **103(12)**:124009, page 124009. Jun. 2021
- [24] **Cruz-Osorio**, A., Lora-Clavijo, F. D., & Herdeiro, C. GW190521 formation scenarios via relativistic accretion. *Journal of Cosmology and Astroparticle Physics*, **2021(07)**:032, page 032. Jul. 2021
- [25] Janssen, M., Falcke, H., Kadler, M., et al. Event Horizon Telescope observations of the jet launching and collimation in Centaurus A. *Nature Astronomy*, **5**:1017–1028, pages 1017–1028. Jul. 2021
- [26] **Cruz-Osorio**, A., Fromm, C. M., Mizuno, Y., et al. State-of-the-art energetic and morphological modelling of the launching site of the M87 jet. *Nature Astronomy*, **6**:103–108, pages 103–108. Jan. 2022
- [27] Satapathy, K., Psaltis, D., Özel, F., et al. The Variability of the Black Hole Image in M87 at the Dynamical Timescale. *Astrophys. J.*, **925(1)**:13, page 13. Jan. 2022

- [28] Fromm, C. M., **Cruz-Osorio**, A., Mizuno, Y., et al. Impact of non-thermal particles on the spectral and structural properties of M87. *Astronomy and Astrophysics*, 660:A107, page A107. Apr. 2022
- [29] Event Horizon Telescope Collaboration, Akiyama, K., Algaba, J. C., Alberdi, A., & Alef, W. First Sagittarius A* Event Horizon Telescope Results. I. The Shadow of the Supermassive Black Hole in the Center of the Milky Way. *Astrophys. J. Lett.*, **930(2)**:L12, page L12. May 2022
- [30] Event Horizon Telescope Collaboration, Akiyama, K., Algaba, J. C., Alberdi, A., & Alef, W. First Sagittarius A* Event Horizon Telescope Results. II. EHT and Multiwavelength Observations, Data Processing, and Calibration. *Astrophys. J. Lett.*, **930(2)**:L13, page L13. May 2022
- [31] Event Horizon Telescope Collaboration, Akiyama, K., Algaba, J. C., Alberdi, A., & Alef, W. First Sagittarius A* Event Horizon Telescope Results. III. Imaging of the Galactic Center Supermassive Black Hole. *Astrophys. J. Lett.*, **930(2)**:L14, page L14. May 2022
- [32] Event Horizon Telescope Collaboration, Akiyama, K., Algaba, J. C., Alberdi, A., & Alef, W. First Sagittarius A* Event Horizon Telescope Results. IV. Variability, Morphology, and Black Hole Mass. *Astrophys. J. Lett.*, **930(2)**:L15, page L15. May 2022
- [33] Event Horizon Telescope Collaboration, Akiyama, K., Algaba, J. C., Alberdi, A., & Alef, W. First Sagittarius A* Event Horizon Telescope Results. V. Testing Astrophysical Models of the Galactic Center Black Hole. *Astrophys. J. Lett.*, **930(2)**:L16, page L16. May 2022
- [34] Event Horizon Telescope Collaboration, Akiyama, K., Algaba, J. C., Alberdi, A., & Alef, W. First Sagittarius A* Event Horizon Telescope Results. VI. Testing the Black Hole Metric. *Astrophys. J. Lett.*, **930(2)**:L17, page L17. May 2022
- [35] Farah, J., & Event Horizon Telescope Collaboration. Selective Dynamical Imaging of Interferometric Data. *Astrophys. J. Lett.*, **930(2)**:L18, page L18. May 2022
- [36] Wielgus, M., & Event Horizon Telescope Collaboration. Millimeter Light Curves of Sagittarius A* Observed during the 2017 Event Horizon Telescope Campaign. *Astrophys. J. Lett.*, **930(2)**:L19, page L19. May 2022
- [37] Georgiev, B., & Event Horizon Telescope Collaboration. A Universal Power-law Prescription for Variability from Synthetic Images of Black Hole Accretion Flows. *Astrophys. J. Lett.*, **930(2)**:L20, page L20. May 2022
- [38] Broderick, A., & Event Horizon Telescope Collaboration. Characterizing and Mitigating Intraday Variability: Reconstructing Source Structure in Accreting Black Holes with mm-VLBI. *Astrophys. J. Lett.*, **930(2)**:L21, page L21. May 2022
- [39] Röder, J., **Cruz-Osorio**, A., Fromm, C. M., et al., Jan. 2022, in *European VLBI Network Mini-Symposium and Users' Meeting 2021*, page 24
- [40] Issaoun, S., Wielgus, M., & Event Horizon Telescope Collaboration. Resolving the inner parsec of the blazar J1924–2914 with the Event Horizon Telescope. *Astrophys. J.*, **934(2)**:21, page 21. Jul. 2022
- [41] Broderick, A., Pesce, D., Gold, R., et al. The Photon Ring in M87*. *Astrophys. J.*, **935(1)**:61, page 61. Aug. 2022
- [42] Meringolo, C., **Cruz-Osorio**, A., Rezzolla, L., & Servidio, S. Microphysical Plasma Relations from Special-relativistic Turbulence. *Astrophys. J.*, **944(2)**:122, page 122. Feb. 2023
- [43] Jorstad, S., Wielgus, M., Lico, R., et al. The Event Horizon Telescope Image of the Quasar NRAO 530. *Astrophys. J.*, **943(2)**:170, page 170. Feb. 2023

- [44] Röder, J., **Cruz-Osorio**, A., Fromm, C. M., et al. Probing the spacetime and accretion model for the Galactic Center: Comparison of Kerr and dilaton black hole shadows. *Astronomy and Astrophysics*, 671:A143, page A143. Mar. 2023
- [45] **Cruz-Osorio**, A., Rezzolla, L., Lora-Clavijo, F. D., et al. Bondi-Hoyle-Lyttleton accretion onto a rotating black hole with ultralight scalar hair. *arXiv e-prints*, page arXiv:2301.06564, page arXiv:2301.06564. Jan. 2023

Teaching and Mentoring

Graduated students.....

- Jan Röder (M.Sc. in Astrophysics) with Summa cum laude** **14.04.2020**
Institut für Theoretische Physik, Goethe Universität Frankfurt, Germany *co-supervisor: Luciano Rezzolla*
Comparison of Kerr and dilaton black hole shadows: Impact of non-thermal emission
- Luis García (B.Sc. in Physic)[14]** **12.03.2019**
Faculty of Physics, UNAM, México
Quark star using MIT bag model
- Griselda Arroyo Chávez (B.Sc. in Physic) with "Mención Honorífica" [14]** **26.01.2018**
Faculty of Physics, Universidad Veracruzana, México *co-supervisor: C. Campuzano*
Observational and numerical comparability of neutron stars models using a polytropic EoS

Teaching.....

- 2022 Hydrodynamics and Magnetohydrodynamics, M. Sc. in Physics program, summer semester, Institute of Theoretical Physics, Goethe-Universität Frankfurt, Germany. [Notes here](#)
- 2016 Relativity, Science Faculty (Physic), UNAM, México.
- 2015 Electrodynamics, M. Sc. in Astrophysics program, Institute of Astronomy-UNAM, México.
- 2015 Hydrodynamics in general relativity, M. Sc. in Astrophysics program, Institute of Astronomy-UNAM, México.
- 2014 General Physics, Department of Computer Systems Engineering, Instituto Tecnológico Superior de los Ríos, Tabasco, México.
- 2014 Fluid mechanics, Environmental Engineering, Instituto Tecnológico Superior de los Ríos, Tabasco, México.
- 2014 Transport phenomena, Environmental Engineering, Instituto Tecnológico Superior de los Ríos, Tabasco, México.
- 2014 Graduation Seminar. Master in Nutritional, Universidad de Morelia, Michoacán, México.
- 2014 Statistics II. Masters in Nutritional, Universidad de Morelia, Michoacán, México.
- 10-13 Mathematics I, Faculty of Biology, Universidad Michoacana de San Nicolás de Hidalgo, Michoacán, México.
- 10-13 Physics, Faculty of Biology, Universidad Michoacana de San Nicolás de Hidalgo, Michoacán, México.
- 2010 Thermodynamics, Faculty of Electrical Engineering, Universidad Michoacana de San Nicolás de Hidalgo, Michoacán, México.

Tutoring.....

- 2022 General Relativity, Winter semester, Professor of the course: Dr. Luciano Rezzolla, Goethe-Universität Frankfurt, Germany.
- 2021 Proseminar on Astrophysics, summer semester, Professor of the course: Dr. Laura Sagunski and Dr. Jürgen Schaffner Bielich, Goethe-Universität Frankfurt, Germany.
- 2021 Einführung in die Programmierung für Physiker (Introduction to programming for physicists), winter semester, Professor of the course: Dr. Eberhard Engel, Goethe-Universität Frankfurt, Germany.

Talks

Invited talks – Conferences.....

- Interpretando la imagen de la sombra de Sagitario A* utilizando relatividad general**
Plenary Talk, LXV Congreso Nacional de Física, Zacatecas, México. Oct 4 2022

Shadow of the supermassive black hole in M87

*Review Talk, Growing Black Holes: Accretion & Mergers In memory of Sergio Colafrancesco
Kathmandu, Nepal, May 15-20, 2022*

GW190521 formation scenarios via relativistic accretion

Engineering Week, Faculty of Higher Studies "Aragón" -UNAM, Mexico City, México. October 28th 2021.

Invited talks – Seminars.....

Acceleration of non-thermal particles from turbulent plasmas

Coloquio del Instituto de Ciencias Físicas, UNAM, Cuernavaca, Morelos, Mexico. Jan 27, 2023.

Interpretando la imagen de la sombra de Sagitario A* utilizando relatividad general

Seminario del Dep. de Física, Universidad Autónoma Metropolitana Iztapalapa, México. Oct 7 del 2022

Interpretación teórica de la sombra del agujero negro supermasivo Sagitario A*

Coloquio del Instituto de Astronomía, UNAM, Mexico. Oct 6, 2022.

SgrA*: Our own black hole at the heart of the Milky Way

*Seminario del Instituto de Física y Matemáticas/Facultad de Ciencias Físico-Matemáticas de la UMSNH
Morelia, Michoacán, México. May 27 2022*

Jets relativistas:

*Mecanismo de generación, aceleración de partículas y emisión electromagnética en multi-frecuencias
Coloquio del Instituto de Astronomía, UNAM, Mexico. May 11, 2022.*

Electromagnetic emission from relativistic jets:

*Modeling the launching and high energy emission using GRMHD simulations
Seminar, Instituto Avanzado de Cosmología, Mexico. April 1, 2022.*

Multiwavelength emission of M87 jet from GRMHD simulations

Seminario "Dr. Jesús Reyes Corona", Instituto de Física—UAP, Mexico. February 4th 2022.

Understanding multi-wavelength emission of M87 jet using general relativistic MHD simulations

AstroLunch, The Netherlands Institute for Radio Astronomy, Netherlands. January 26th 2022.

Modeling Radiation Emission of M87 Jet with GRMHD Simulations

Dep. of Gravitation and Field theory seminar, Institute of Nuclear Physics-UNAM, México. Sep. 30th 2021.

General relativistic simulations of the common-envelope evolution

Physics Department Seminar, Universidad de la Sapienza Roma, Roma, Italy. March 17th, 2021.

Electromagnetic emissions from relativistic jets and magnetized disks

*Multidisciplinary seminar, Facultad de ciencias,
Universidad Autónoma del Estado de México, Toluca, México. November 26th 2020*

Relativistic Fluid Accretion Around a Black Hole

*AstroCoffee seminar, Institute for Theoretical Physics, Goethe University,
Frankfurt, Germany. May 9th 2017*

Fix Mesh Refinement in Cartesian coordinates

Institute of Astronomy-UNAM, Mexico City, México. June 14th 2016.

"Newton (Siglo XVII)–Diplomado en Astrofísica"

Institute of Astronomy-UNAM, Mexico City, México. May 12th 2016.

"Relativistic Bondi-Hoyle accretion onto rotating black holes using CAFE code

*Seminar of National Institute of Astrophysics, Optics and Electronics(INAOE)
Tonantzintla, Puebla, México. March 4th 2016.*

Primordial black holes as seeds of supermassive black holes

Seminar of the Faculty of Physics, Universidad Veracruzana, Veracruz, México. February 4th 2016.

Relativistic accretion of supersonic winds around rotating black holes

Seminar group DATA, Institute of Astronomy-UNAM, Mexico City, México. January 19th 2016.

Contributed Talks.....

Multi-wavelength emission of M87 jet using self-consistent electron-to-proton temperature

Workshop on Kinetic Models of Relativistic Plasmas, Trinity College, Dublin, Ireland, Feb. 27 – March.2, 2023.

Non-thermal emission at event horizon and jet launching scales

New Generation Event Horizon Telescope Meeting 2022. June 22-25 2022.

Modeling the limb brightening of M87 jet: Effects of electron temperature and magnetic energy

Event Horizon Telescope Meeting 2022. June 19-22 2022.

Modeling MWL emission with GRMHD and GRRT simulations

Event Horizon Telescope Meeting 2021. December 6-10 2021.

Non-thermal emission in SANE and MAD GRMHD simulations

Event Horizon Telescope SgrA Theory Symposium 2020. September 4th 2020.*

Non-linear evolution of magnetized-torus-BH: Comparison between magnetic field approaches

689. WE-Heraeus-Seminar on Accretion in strong gravity, Bad Honnef, Germany. February 4-8 2019.

Evolution of a Magnetized Thick disk around a highly rotating black hole

The European Einstein Toolkit meeting 2018, Lisbon, Portugal. September 13th 2018.

Consistent construction of a magnetised accretion disc around a highly rotating black hole

Spanish-Portuguese Relativity Meeting 2018, Palencia, Spain. September 4th 2018.

Special and General relativistic magnetohydrodynamics in ExaHyPE

ExaHyPE council Meeting, Garching, Germany. April 3th 2017.

CAFE a new relativistic MHD code

28th Texas Symposium on Relativistic Astrophysics, Geneva, Switzerland. December 2015.

Relativistic Bondi-Hoyle Accretion onto a Rotating Black Hole: Density Gradients

X Mexican School on Gravitation and Mathematical Physics, Playa del Carmen, México. December 2014.

Morelia, a new special relativistic MHD code

X workshop of the DGFM, Hidalgo, México. December 2013.

Morelia, a new special relativistic MHD code

XXV National Congress of Astronomy, Mexico city, México. November 2013.

Flip-flop instability of the shock cone in Bondi-Hoyle accretion

IX Mexican School on Gravitation and Mathematical Physics, Guadalajara, México. December 2012.

Flip-flop instability in the wind accretion around a rotating black hole

LV National Congress of Physics, Morelia, México. October 2012.

Bondi-Hoyle accretion onto Schwarzschild and Kerr black holes

XXIV National Congress of Astronomy, Guadalajara, México. September 2011.

Solution of a scalar field on a background of Schwarzschild containing the null infinity future

LIII Congress of Physics, Veracruz, México. October 2010.

Numerical solution of the wave equation on space-times with scri-fixing conformal compactifications

VIII Mexican School on Gravitation and Mathematical Physics of the DGFM-SMF, Playa del Carmen, México. December 10th 2009

Poster Sessions.....

Gravitational Waves From Long-Time Evolution Of Tilted Thick Disc Around A Rotating Black Hole

22nd International Conference on General Relativity and Gravitation-13th Edoardo Amaldi Conference on Gravitational Waves, València, Spain. July 7th-12th 2019.

Stellar winds effect in Bondi-Hoyle accretion around Schwarzschild black hole

3rd Karl Schwarzschild Meeting - Gravity and the Gauge/Gravity Correspondence, Frankfurt, Germany. July 24th-28th 2017.

Wind accretion on a Schwarzschild black hole in slab symmetry

LIV National Congress of Physics 2011, Yucatán, México. October 2011

Basic tests of general relativity hydrodynamics codes

VII School of the Gravitation and Mathematical Physics Division of the Mexican Physical Society, Playa del Carmen, México. December 2006.

Lectures at Workshops.....

Numerical methods for the study of relativistic astrophysics

Workshop on Numerical Relativity, Faculty of Physics, University of Veracruz, Xalapa, Veracruz. November 18th-20th 2015.

Introduction to programming in Fortran 90

18 anniversary of the Instituto Tecnológico Superior de los Ríos, Tabasco, México. November 26th & 27th 2014.

The science of science fiction

First Multidisciplinary Academic Week of the Instituto Tecnológico Superior de los Ríos, Tabasco, México. November 17th & 18th 2014.

Outreach.....

Agujeros negros y como encontrarlos sin morir en el intento

Seminario de Estudiantes del Posgrado en Astrofísica., UNAM, Ciudad de México, México. February 22th 2022.

Talk

Siluetas en la oscuridad: El agujero negro en el corazón de la Vía Láctea

Seminario del Club de Ciencias "Johann Carl Friedrich Gauss", Facultad de Ingeniería Universidad Autónoma de Chihuahua. Chihuahua, México. November 10th 2022.

Talk

Telescopio del Horizonte de Eventos - El centro de la Vía Láctea

CONACYT, Mexico. August 2022.

Interview

Physik an der Goethe-Universität: Auszeichnung für herausragende Forschung

(Physics at the Goethe University: Award for outstanding research) Goethe Universität, Frankfurt am Main, Germany. July 08th 2022.

Post

Congratulations to Dr. Cruz-Orsorio, laureate of the 2022 Frankfurt Physics Prize!

Goethe Universität, Frankfurt am Main, Germany. July 08th 2022.

Post

Astronomers reveal first image of the black hole at the heart of our galaxy

Event Horizon Telescope-Mexico, May 12th 2022.

Panelist of EHT Conference(Mexico) – YouTube

Press Conference

Simulando los chorros del agujero negro de M87, Minute 1:55:00

Coffee Break: Señal y Ruido, November 12th 2021, Spain.

Coffee Break (YouTube) Ep341: Gravitondas; Monopolos; Fluidos en Roca Porosa; Agua en Galaxias; Agujeros Negros, Minute 2:08:35

Podcast

Wie Schwarze Löcher ihren Jet zünden

UniReport Nr.6, Goethe Universität, Frankfurt am Main, Germany. December 9th 2021.

Press

Jet from giant galaxy M87: Computer modelling explains black hole observations

Goethe Universität, Frankfurt am Main, Germany. November 04th 2021.

Nature Astronomy Press Release has 119 replicas in 36 countries.

Press Release

Der Astrophysiker Alejandro Cruz Osorio im Porträt

UniReport Nr.5, Goethe Universität, Frankfurt am Main, Germany. October 12th 2017.

Press

The first image of a supermassive hole

"Jornadas de Ciencia y Matemáticas", Center for research and teaching of mathematics, Morelia, México. October 13th 2020.

Talk

A supermassive black hole as the engine of our galaxy

Astronomical Society of Mexico, Mexico city, México. March 30th 2016.

Talk

A supermassive black hole at the center of our galaxy!	Talk
<i>Night of Stars, Institute of Astronomy-UNAM, Mexico city, México. November 28th 2015.</i>	
Talking with Astronomers	Talk
<i>Night of Stars, Institute of Astronomy-UNAM, Mexico city, México. November 28th 2015.</i>	
What is a black hole?	Talk
<i>Feast of Sciences and Humanities, UNAM UNIVERSUM-Museum, Mexico city, México. October 17th 2015.</i>	
LIGHT: our eyes throughout the universe	Talk
<i>22 National Week of Science and Technology, International Year of Light, Instituto Tecnológico Superior Huichapan, Hidalgo, México. October 12th 2015.</i>	
Nota sobre magnetohidrodinámica	Radio
<i>Radio UNAM 96.1 FM, Programa: Primer Movimiento min:1:54, Mexico city, México. June 28th 2016. http://goo.gl/S6YzX7</i>	
UNAM estudia el universo con el uso de códigos numéricos	Press
<i>El Universal, Mexico city, México. June 20th 2016. http://goo.gl/CcGB6x</i>	
Códigos numéricos para la Astrofísica	Press
<i>Agencia informativa CONACYT, Mexico city, México. May 16th 2016.</i>	

Academic Service

Organizing committee.....

- **Chair of the AstroCoffee seminar**, Institut fur Theoretische Physik, Johann Wolfgang Goethe Universität Frankfurt, Oct.2020 – Sep.2022
- **EHT Sgr A* Theory Busy Days (2020-Q4)**, Event Horizon Telescope Collaboration, Nov 30th – Dec 4th 2021.
- **First Student Meeting 2014**, Instituto Tecnológico Superior de los Ríos, November 20th 2015, Tabasco, México.
- **Basic Electronics Conference-Workshop**, Faculty of Science Physics and Mathematics-UMSNH, April 28th & 29th 2006, Morelia, México.
- **1º Regional Meeting of Optic**, September 19th-23th 2005 , Morelia, México.

Journal Reviewer.....

- Astrophysical Journal
- American Journal of Physics ³
- Revista Mexicana de Física
- MDPI-Universe ⁴
- Referee at DiRAC-cluster England: Astronomy, Particle Physics and Nuclear Physics

Synod & Examiner.....

- Synod committee of **Bachelor thesis** defence of the student German David Prada Méndez, Thesis: Análisis del espectro de emisión proveniente de un toro magnetizado alrededor de singularidades desnudas con deformación cuadrupolar (17.February.2023), Faculty of Physics, Universidad Industrial de Santander, Colombia.
- Synod committee of **Bachelor thesis** defence of the student Jennyfer Camila Acevedo Muñoz , Thesis: Análisis numérico de la interacción del sistema agujero negro – campo escalar en un espacio-tiempo dinámico (17.February.2023), Faculty of Physics, Universidad Industrial de Santander, Colombia.
- Synod committee of **Master thesis** defence of the student Juan Manuel Velásquez Cadavid, Thesis: Simulation of the intensity map in magnetically polarized accretion disks around Kerr black holes (13.October.2022), Master of Applied Mathematics, Faculty of Physics, Universidad Industrial de Santander,

American Journal of Physics 87, 330 (2019). <https://doi.org/10.1119/1.5096895>
 Universe 2021, 7(2), 22; <https://doi.org/10.3390/universe7020022>

- Colombia.
- Synod committee of **Bachelor project** defence of the student German David Prada Méndez, Thesis: Análisis del espectro de emisión proveniente de un toro magnetizado alrededor de singularidades desnudas con deformación cuadrupolar (22.August.2022), Faculty of Physics, Universidad Industrial de Santander, Colombia.
 - Examiner of **PhD project** of the student Gustavo Magallanes Guijón, December 3, 2021, project:Statistical and computational methods in inference binary black holes PhD on Astrophysics program of the Institute of Astronomy, UNAM, México.
 - Examiner committee of **Bachelor thesis** defence of the student Cédric Jockel, Thesis: Modelling of plasma accretion onto black hole mimickers (20.October.2021), Institut für Theoretische Physik, Johann Wolfgang Goethe -Universität Frankfurt am Main, Germany.
 - Examiner of postdoctoral program **2021 Estancias Posdoctorales por México**, CONACYT, México, 2021.
 - Synod committee of **Bachelor thesis** defence of the student Jose Miguel Amado Dugarte, Thesis: Numerical study of relativistic magnetohydrodynamic laminar currents in a magnetically polarized fluid (21.July.2021), Faculty of Physics, Universidad Industrial de Santander, Colombia.
 - Examiner committee of **Master thesis** defence of the student Jan Röder, Thesis: Comparison of Kerr and dilaton black hole shadows: Impact of non-thermal emission (13.April.2021), Institut für Theoretische Physik, Johann Wolfgang Goethe -Universität Frankfurt am Main, Germany.
 - Synod committee of **Master project** defence of the student Juan Manuel Velásquez Cadavid, Thesis: Simulation of the intensity map in magnetically polarized accretion disks around Kerr black holes (04.December.2020), Master of Applied Mathematics, Faculty of Physics, Universidad Industrial de Santander, Colombia.
 - Synod committee of **PhD project** of the student Alejandro Aguayo Ortiz (2018 –2021), PhD on Astrophysics program of the Institute of Astronomy, UNAM, México.
 - Synod committee of **Master thesis** defence of the student Manuel Eduardo de la Cruz Hernández, Thesis: Modelling of work surfaces in 1D astrophysical jets at the relativistic strong shock limit (31.June.2019), Institute of Astronomy, UNAM, México.
 - Synod committee of **Master thesis** defence of the student Alejandro Aguayo Ortiz, Thesis: A direct Primitive Variable Recovery Scheme for hyperbolic conservative equations (27.Jul.2018), Institute of Astronomy, UNAM, México.

Computer skills

Languages: Fortran, Python, C/C++

Code Development: CAFE, BHAC, BHOSS

High Performance: OpenMP, MPI, AMR, FMR

Codes: Einstein Toolkit, ehtim

References

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