Maxime Parra

Personal Information

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Education

Oct 2021 - Sep 2024 — PhD Student

Observation and modeling of ionized flows in Low-Mass X-ray Binaries
Supervisors: Pierre-Olivier Petrucci (France) & Stefano Bianchi (Italy)
Institut de Planétologie et d'Astrophysique de Grenoble - Università Roma Tre

Systematic study of X-ray wind signatures in existing archival XMM-EPIC and *Chandra*-HETG data of Black Hole Low-Mass X-ray Binaries (BHLMXBs)

- Line detection and fitting through blind search and incremental component detection, line significance assessment via Monte-Carlo simulations
- Correlation of line properties with continuum and source parameters
- Inventory of absorption signatures in known candidates, comparison with other samples and wavelengths

Computation of spectral signatures of magnetic wind solutions from the JED-SAD framework

- Study of the behavior and parameter space of 3D self-similar solutions
- Computation of the thermal equilibrium of magnetic disks in different opacity regimes
- Simulations of the spectral signatures of the solutions using the radiative transfer code XSTAR
- Comparison with data of wind-emitting BHLMXBs

Long-term study of the wind evolution in 4U1630-47 with Chandra, NICER, NuSTAR, Suzaku, XMM as well as Swift-BAT and INTEGRAL

- global and outburst specific analysis of the evolution of the absorption line signatures over 20 years and 9 outbursts
- comparisons with theoretical behavior of the absorption line parameters to disentangle wind evolution from SED response
- Correlation of the line properties with high-energy data for a more precise hard/soft state line dichotomy
- Large scale comparison with stability curves to refine and compare this with expected behaviors

Study of the X-ray polarization properties of Black Hole Binaries

- Assessment of the evolution of the wind in NICER spectra of 4U 1630-47 in the soft state during IXPE observations
- Broad band fitting of Cygnus X-1 using NICER, NuSTAR and INTEGRAL data simultaneous to IXPE observations for spectro-polarimetric studies
- Inspection of the polarimetric signatures of the JED-SAD framework with different magnetic field configurations with the Monte-Carlo GRMHD radiative transfer code Monk
- Comparison with the polarization properties of Cygnus X-1 in the X-rays

Sep 2019 - June 2021 — Masters degree in astrophysics

Astrophysics, Space Sciences and Planetology
University Paul Sabatier, Toulouse, France
Syllabus (in French)
Weighted average : 16.4/20 | rank : 2/18

Work experience

Jan 2021 - July 2021	Masters internship *Ultra/Hyper Luminous X-ray Sources: laboratories to study Super-Eddington accretion or discover a new class of Black Holes* Supervisor: Olivier Godet Institut de Recherche en Astrophysique et Planétologie (IRAP), Toulouse, France Search and multi-wavelength analysis of new ULX and HLX candidates in the newest version of the Swift-XRT catalog
Feb 2020 - May 2020	Masters research project *The first simultaneous detection of cosmic fusion in gamma rays and gravitational waves* Supervisor: Jean-Luc Atteia Institut de Recherche en Astrophysique et Planétologie (IRAP), Toulouse, France Study of the physical implications of the detection and estimation of the rate of simultaneous detections of this class of event with current instruments
Feb 2016 - July 2016	Bachelor research internship *An empirical determination of X-ray anisotropy of Quasar emissions* Supervisor: Mike Brotherton University of Wyoming, USA Filtering and analysis of quasar spectra in the visible band, comparison with X-ray data Observations of planetary transits at the Wyoming Infrared Observatory (secondary project)
Apr 2015 - June 2015	Laboratory Research Project *X-ray study of the Intermediate Mass Black Hole ESO 243-49 HLX-1* Supervisor: Natalie Webb Institut de Recherche en Astrophysique et Planétologie (IRAP), Toulouse, France Filtering and spectral analysis of soft X-ray data from the XMM-*Newton* telescope

Skills

Data reduction and analysis of astrophysics data

X-ray	Data reduction: NICER, NuSTAR, Swift-XRT+BAT (Heasoft), XMM (SAS), Chandra (CIAO) Spectral analysis softwares: Proficient Xspec and Pyxspec user Simulation of Chandra data (Marx) Automated source detection, imagery, timing analysis and mid/high-resolution spectroscopy Proficient in line detection and characterization
Optical	Data reduction: HST (Drizzlepac), MUSE (mpdaf) Data analysis: Photometry (photutils), 3D spectroscopy (CAMEL) Automated source detection, imagery ISM diagnostics from line data, BPT Comparisons with photo-ionisation and shock-ionisation model libraries (MAPPINGS V)

Programming languages:	Python, Bash, basics of: C, Fortran, Pearl, Matlab, TCL, TeX macros
Operating systems :	Linux, Windows
Languages:	French (mother tongue), English (C1), Italian (B2)

Publications

Datta et al. 2024	Impact of the disk magnetization on MHD disk wind signatures A&A 687, 2, https://doi.org/10.1051/0004-6361/202349129 (10/11 co-authors)
Gianolli et al. 2024	Supermassive Black Hole Winds in X-rays – SUBWAYS. III. A population study on Ultra-Fast Outflows A&A 687, 235, https://doi.org/10.1051/0004-6361/202348908 (8/47 co-authors)
Steiner et al. 2024	An IXPE-led X-Ray Spectropolarimetric Campaign on the Soft State of Cygnus X-1: X-Ray Polarimetric Evidence for Strong Gravitational Lensing ApjL 969, L30, https://doi.org/10.3847/2041-8213/ad58e4 (10/142 co-authors)
Ingram et al. 2024	Tracking the X-Ray Polarization of the Black Hole Transient Swift J1727.8–1613 during a State Transition ApJ 968, 76, https://doi.org/10.3847/1538-4357/ad3faf (35/123 co-authors)
Marra et al. 2024	IXPE observation confirms a high spin in the accreting black hole 4U 1957+115 A&A 684, 95, https://doi.org/10.1051/0004-6361/202348277 (33/116 co-authors
Ratheesh et al. 2024	The high polarisation of the X-rays from the Black Hole X-ray Binary 4U 1630–47 challenges standard thin accretion disc scenario ApJ 964,77, https://iopscience.iop.org/article/10.3847/1538-4357/ad226e (24/114 co-authors)
Parra et al. 2024	The current state of disk wind observations in BHLMXBs through X-ray absorption lines in the iron band A&A 681, 49, https://doi.org/10.1051/0004-6361/202346920
Veledina et al. 2023	Discovery of X-ray Polarization from the Black Hole Transient Swift J1727.8-1613 ApjL 958, L16, https://iopscience.iop.org/article/10.3847/2041-8213/ad0781 (36/116 co-authors)
Chakravorty et al. 2022	Absorption lines from magnetically driven winds in X-ray binaries – II. High resolution observational signatures expected from future X-ray observatories MNRAS 518, https://academic.oup.com/mnras/article/518/1/1335/6786287 (16/16 co-authors)
Gúrpide et al. 2022	MUSE spectroscopy of the ULX NGC 1313 X-1: A shock-ionised bubble, an X-ray photoionised nebula, and two supernova remnants A&A 666, 100, https://doi.org/10.1051/0004-6361/202142229 (2/5 co-authors)

Presentations at conferences

		20 years of winds in 4U 1630-47
Contributed talk	Sep 2024	Congresso Nazionale Oggetti Compatti XIII Palermo, Italy
Invited talk	July 2024	From the Dolomites to the event horizon: Sledging down the Black Hole potential well (7th edition) Sexten, Italy
		Physically motivated spectro-polarimetry: Applying GR radiative transfer to a self-similar accretion ejection framework
Invited talk	Aug 2023	South Bohemian X-ray polarisation workshop Cesky Krumlov, Czech Republic
		The current state of disk wind observations in BHLMXBs through X-ray absorption lines in the iron band
Contributed talk	Aug 2023	High Resolution X-ray Spectroscopy: A Chandra Workshop Boston, United States
Contributed talk	June 2023	Vasto Accretion Meeting 2023 Vasto, Italy
Contributed talk	June 2023	The X-ray Universe 2023 Athens, Greece
Contributed talk	May 2023	10th MICROQUASAR WORKSHOP Heraklion, Greece
Contributed talk	Sep 2022	Congresso Nazionale Oggetti Compatti XII Palermo, Italy
Invited talk	July 2022	From the Dolomites to the event horizon: Sledging down the Black Hole potential well (6th edition) Sexten, Italy
Poster	June 2022	XMM-Newton 2022 Science Workshop: Black Hole accretion under the X-ray microscope Madrid, Spain
Contributed talk	May 2022	1st Mondragone Frontiers of Astronomy Series Rome, Italy
Contributed talk	Mar 2022	10th FERO meeting Toulouse, France

Grants

2024	JSPS Postdoctoral Fellowship (Standard Program) *Comparing magnetic models and XRISM spectra to understand disk winds in Black Hole X-ray Binaries* duration: 24 months

Awarded observation time

XRISM AO 1	180ks XRISM ESA + JAXA	A high spectral resolution view of the wind evolution in the Spectral Transition of a Black Hole Low-Mass X-ray Binary **PPI** (JAXA PI: Shidatsu M.) - ToO
NuSTAR Cycle 10	60ks NuSTAR	Understanding Disk Winds in previously uncovered states of Black Hole X-ray Binaries co-I (PI: Shidatsu M.) - ToO
XMM AO 23	340ks XMM 200ks NuSTAR 40 ks Swift	Tracking the Wind of a Black Hole Low-Mass X-ray Binary in Spectral Transition **PI** - LP ToO
XMM AO 23	140ks XMM 200ks NuSTAR	Comparing the early rise and decay phases of X-ray binaries outbursts in Spectral Transition co-I (PI: Barnier S.) - ToO
IXPE GO 1	105ks IXPE 10 ks NICER	A novel view of disk winds in transient Black Hole Low-Mass X-ray Binaries with X-ray Spectro-Polarimetry **PI** - ToO
INTEGRAL AO 20	50ks INTEGRAL	Probing the spectro-polarimetric properties of Cygnus X-1 through simultaneous IXPE and INTEGRAL observations **PI** - DDT
XMM AO 22	60ks XMM	High-resolution spectroscopy of an ultrafast outflow in an accreting black hole Co-I (PI: M. Del Santo)

Teaching and Outreach

2022 - Current	Member of the outreach organisation "UniverSCiel" French organisation for outreach in astronomy and astrophysics, with multiple activities at various events and in schools during the year, including the yearly Astro-Jeunes festival Based in Toulouse, France
Aug 2024	**50 ans pour comprendre la croissance des trous noirs** Public outreach talk for the "nouvelles lumières" cycle of the XXXIVth Fleurance Astronomy Festival Fleurance, France
Aug 2024 Aug 2023 Aug 2022	Organizing committee of the XVII-XIXth Astro-Jeunes Festivals Fleurance, France Children edition of the yearly Fleurance Astronomy Festival • One week of astrophysics courses for 120+ children of ages 4 to 18 • Seminars and activities entirely created by PhD students of IRAP (Toulouse, France) and IPAG (Grenoble, France) • Collaboration with french researchers, professors and astronomers • Creation, launch and data analysis of a stratospheric balloon • Supervisor of the "black thread" program (ages 14-18) Valued as 144 hours of outreach for the PhD
Feb - June 2022	Teaching Assistant Université Grenoble Alpes, Grenoble, France Undergraduate Course: Electricity DC-AC 38 hours

Interests and activities

Astrophysics:	Multiple participations to the adult Fleurance Astronomy Festival (as an attendee)
Sports:	climbing (bouldering, sport climbing)
Miscellaneous:	roleplaying (D&D, homebrew), tabletop games