

PERSONAL INFORMATION

Gioia Rau

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JOB EXPERIENCE

November 2017 – Present Research Associate Scientist

CRESST II at CUA & NASA/Goddard Space Flight Center
8800 Greenbelt Rd 20771 Greenbelt (USA)

Currently my research at NASA/GSFC focuses on studying cool, evolved stars in the Galaxy. I analyse their structure combining high-resolution spectroscopic data from the Hubble Space Telescope/STIS and GHRS instruments (see **Rau et al. 2018**, Carpenter et al. 2018), with high-angular resolution interferometric data from CHARA instrument and from the Very Large Telescope Interferometer (VLTI) (**Rau et al. 2019**, see also observing runs below). The **novelty** of these studies resides in the observational and modelling approach. Indeed my work, combining high-angular resolution interferometric observations with high-resolution spectroscopic ones, aims at unraveling the role of the, until now ignored, chromospheric layer, in of cool, evolved stars, and of the upper atmosphere in general.

April 2017 – June 2017 Visiting scientist

European Southern Observatory (ESO)
Karl-Schwarzschild-Strasse 2, 85748 Garching bei München (Germany)

Visiting position during my short postdoc at the University of Vienna (see below). At ESO I worked with Dr. Markus Wittkowski on resolving the atmospheric structure of the Oxygen-rich Mira star R Peg. I reduced the **new Science Verification GRAVITY data** of R Peg. We determined its molecular extension by resolving its atmospheric layers (Wittkowski, **Rau et al. 2018**), and we model its atmosphere by comparison with dynamic model atmospheres. This study represents the **first characterization** of the phase lags between Mira angular sizes in continuum and molecular bands and the lightcurve.

Business or sector European institution

January 2016 – July 2017 Postdoc

University of Vienna (Austria)

Postdoc at the University of Vienna, Institute of Astrophysics, during which I spent 3 months in spring 2017 at ESO HQ (Garching) as a visiting scientist (see above). A side projects I have been working on include extending the comparison between dynamic model atmospheres and spectro-photometric and interferometric observations, to a grid of dynamic models without the assumption of small particle limit (see also Rau et al., PhD thesis), which will help to shed a new light on the process of mass loss in C-rich stars. This might be of special relevance for the semi-regular variable stars, which have been proved by Rau et al. (2017) to have a more compact structure than Mira stars.

EDUCATION AND TRAINING

Oct 2012–Oct 2016

PhD With honors

Thesis Title: “Atmospheres of evolved C-rich stars - from observations to models, and back”.

University of Vienna, Institute for Astrophysics.

Supervisors: Ao. Prof. Dr. F. Kerschbaum & Dr. J. Hron

My PhD research focused on the study of carbon-rich Asymptotic Giant Branch (AGB) stars. I investigated their intriguing atmosphere and the processes happening in there, such as: pulsation, mass loss and stellar winds, and, in the outer envelope, the formation of molecules and dust. Indeed AGB stars are one of the most important contributors to the enrichment of the interstellar medium, via their mass loss, with heavy elements produced in their core, and with the dust produced in their envelope. I developed a joint use, **for the first time in a consistent way** of spectro-photometric and interferometric measurements of AGB stars in synergy, and compared them to the predictions of different kinds of modelling approaches (radiative transfer code such as Mode of Dusty, hydrostatic model atmospheres such as COMARCS models, and self-consistent state-of-the-art dynamic model atmospheres such as DARWIN models), and geometric model fitting tools such as GEMFIND. My first paper as first author focused on one test-star: the carbon-rich Mira RU Vir (**Rau et al., 2015**). In my second paper as first author I applied the same methodology to a set of C-rich stars for comparison (**Rau et al., 2017**). I was also involved in several collaborative publications. **I have been the PI of observations** made at ESO/VLTI, and co-I of several other observing runs (see below). I have established several international collaborations (Italy, Belgium, Sweden, Germany, USA).

Nov 2011 – Sep 2012

Post-Master

Università di Roma La Sapienza

Planck satellite data reduction code development. 2011-2012; Advisor: Dr. A. Melchiorri. I developed numerical codes in preparation of the forthcoming data analysis of the Planck satellite mission.

Feb 2011–May 2011

“Borsa per la Tesi all'estero” (Fellowship to develop my Master Thesis) at CalTech & JPL

I won, on the basis of the average of my grades, one of the 4 fellowships of the entire Faculty of Natural Science of Università La Sapienza, with which I developed my Master Thesis research at California Institute of Technology (CalTech), & NASA/JPL

My Master thesis focused on the analysis of the secondary anisotropies in the Cosmic Microwave Background (CMB). I presented the innovative analysis conducted at NASA/JPL of the secondary anisotropies in the CMB and foregrounds, particularly taking into account the contributions of the Sunyaev-Zel'dovich-effect and DSFG (Dusting Star Forming Galaxies). For this purpose I developed a numerical analysis and implemented numerical codes (IDL), in order to verify the good agreement between the calculated values of the cosmological parameters and those of the Standard Cosmological Model. MCMC were used to obtain samples of cosmological parameters in the phase space. My work included the dataset of the *WMAP* team, *ACT*, and *ACBAR* instruments.

Nov 2009–Oct 2011

Laurea Magistrale in Astrofisica Cum Laude

Università degli Studi di Roma La Sapienza, Facoltà di Fisica

- Title: *Secondary anisotropies in the Cosmic Microwave Background*
- Supervisors: Dr. Graça Rocha (CalTech), Dr. Alessandro Melchiorri (La Sapienza)
- Description: An analysis of the secondary anisotropies of the Cosmic Background Radiation, their influence on the cosmological parameters, and their correlations (see point above).
- Marks: 110/110 **cum Laude**

Oct 2006–Oct 2009

Laurea Triennale in Astronomia ed Astrofisica

Universita' degli Studi di Roma La Sapienza, Facolta' di Fisica

A compact overview of the physical origin of the Dark Energy and a description of the correlation between dark energy and the age of the Universe.

Sept 2001–Jun 2006 **High School Diploma**

Liceo Classico Statale Plauto

GRANTS, AWARDS, & FELLOWSHIPS

- Grants**
- 2017 PI of Schrodinger Fellowship, Austrian Science Fund (FWF) - Cool stars winds and chromospheres - Grant Amount: 164,000 €.
 - 2017 PI of PSL Fellowship (**Declined**), Paris/Meudon - Grant Amount: 55,000 €.
 - 2017 PI of Nasa Postdoctoral Fellowship, NASA/Goddard - Grant Amount: ~300,000 \$.

- Awards**
- 2018 Selected work (Wittkowski, Rau et al. 2018, see below) for the NASA/GSFC “Science Nuggets”: my work was selected by the NASA/GSFC Science Division in the month of August, to present it to Center management (the Center Director and his Executive Council) to highlight the great research being done in the Division.
 - 2016 Winner of the award “Abschlussstipendium der Universität Wien”: 1 over 12 awards, among the *whole* University of Vienna, for finishing PhD students - 6,000 €.
 - 2011 Winner of the award “Borsa di studio per tesi all'estero”: 1 over 4 awards, among the *whole* Facolta' di Scienze Naturali of the Universita' degli Studi di Roma La Sapienza, for developing my Master Thesis abroad - 3,000 €.

- Travel Grants**
- 2018 Travel grant IAU 2018 - 500 €.
 - 2016 Travel grant award sponsored by the Austrian Astronomical Society (OeGAA) to attend the conference “Blowing in the wind” - 350 €.
 - 2016 Travel grant award sponsored by University of Vienna under the program “Dissemination”, to attend the conference “Blowing in the wind” - 600 €.
 - 2016 Travel grant award sponsored by the Italian Ministry of Foreign Affairs and International Cooperation (MAECI) to attend the conference “Blowing in the wind”. - 1,700 €.
 - 2016 Travel grant award sponsored by Observatoire de Paris & CNRS, to attend the conference “Blowing in the wind” - 1,000 €.
 - 2016 Travel grant award sponsored by the European Astronomical Society (EAS), to attend EWASS 2016 - 800 €.
 - 2015 Travel grant award sponsored by the Austrian Astronomical Society (OeGAA) to attend the conference IAU-GA - 350 €.
 - 2015 Travel grant award from the Italian Ministry of Foreign Affairs and International Cooperation (MAECI) to attend the conference IAU-GA - 1,700 €.
 - 2015 Travel grant award sponsored by ESO (European Southern Observatory) to attend the ESO STEPS conference - 800 €.
 - 2015 Travel grant award sponsored by the competitive contest from the University of Vienna under the program “Dissemination”, to attend the conference EWASS 2015 - 300 €.
 - 2012 Winner of the grant to develop my PhD thesis at the University of Vienna.
 - 2010 One of the 10 winners of MITO award contest, among the whole department of Physics of the University of Rome La Sapienza (see Academic Experiences).
 - 2005 Local winner (Rome Sud) of the High-School Mathematics and Physics Italian Olympiads.

ACADEMIC EXPERIENCES & DUTIES

Editor – 2019-ongoing Editorial board member of the AGB Newsletter

Referee – 2019 MNRAS journal
– 2018 MNRAS journal
– 2018 A&A journal
– 2016 “Information Bulletin on Variable Stars”

Panel review – 2019 HST
– 2019 TESS
– 2018 CHANDRA
– 2018 K2
– 2018 ESO/DPR
– 2018 NASA/SMD

Organizer – 2019 Summer interns working group
– 2018-ongoing Leading and proposing the two-monthly High-Angular Resolution Interferometry (“HARI”) meeting at NASA/GSFC
– 2018 LOC at the symposium “Environments of Terrestrial Planets Under the Young Sun: Seeds of Biomolecules” at NASA/GSFC
– 2015 Chair of the IAU 2015 Focus Meeting 7 conclusive session
– 2012-2014 Leading and proposing the weekly “Dust meeting” at the Institute of Astrophysics in Vienna

Visiting positions – 2018 Visiting scientist ESO HQ (Garching) 1 week
– 2017 Visiting scientist ESO HQ (Garching) 3 months
– 2011 Visiting student at CalTech University & NASA JPL 4 months

Summer schools – 2013 VLT Summer School - High angular resolution for stellar astrophysics September 2013 (Barcelonnette, France).
– 2010 Educational Excursion at Testa Grigia Observatory, MITO Telescope, for an observational campaign headed by Prof. Marco de Petris to test the atmospheric spectrometer CASPER2, in the context of studying the SZ effect (Breuil-Cervinia, Italy).
– 2010 Cosmology Summer School: The CMB at High Angular Resolution 5-10 July 2010 (IESC, Cargèse, Corsica, France).
– 2010 Visit at the LNGS, with Prof. Di Domenico

TALKS & POSTERS

Invited conference talks – Jan 2020 **Invited** conference talk, AAS 2020 special session: “Imaging Stars A Century of Advances in High Angular Resolution Astronomy”
– Mar 2018 **Invited** talk at the conference “Imaging of stellar surfaces”
– Nov 2018 **Invited** talk at the CRESST II retreat, Baltimore

- Invited seminar talks**
- Apr 2019 **Invited** seminar talk at the University of Vienna
 - Feb 2019 **Invited** seminar talk at The Catholic University of America)
 - Dec 2018 **Invited** seminar talk at INAF/OAR (Observatory of Rome)
 - Dec 2018 **Invited** seminar talk at ESO HQ in Garching
 - Dec 2018 **Invited** seminar talk at the Harvard-Smithsonian center for Astrophysics
 - Nov 2018 **Invited** seminar talk Macquarie University
 - Nov 2018 **Invited** seminar talk at the University of Melbourne
 - Sept 2018 **Invited** seminar talk at Nice observatory (OCA)
 - Aug 2018 **Invited** seminar talk at the NASA/Goddard SED director series
 - May 2016 **Invited** seminar talk at the Budapest Astronomical Observatory (Host: Prof. Maria Lugaro)
 - Apr 2016 **Invited** seminar talk at the University of Padova, for the *Starkey* meeting (Host: Prof. Paola Marigo)

- Contributions**
- Aug 2018 Contributed poster at EWASS 2018
 - Aug 2018 Contributed poster at the IAU-GA Symposium “Why Galaxies Care About AGB Stars”
 - Mar 2018 Contributed talk at the conference “Imaging of stellar surfaces”
 - Jul 2017 Contributed talk at the conference “Physics of evolved stars”
 - Jun 2017 Contributed talk at the conference “EWASS 2017”
 - Aug 2016 Contributed talk at the conference “Blowing in the Wind” (Quy Nhon, Vietnam)
 - Jul 2016 Contributed talk at EWASS 2016
 - Aug 2015 Contributed talk at the IAU XXIX General assembly Focus Meeting 7
 - Jun 2015 Contributed talk at EWASS 2015
 - Jul 2015 Poster contribution at ESO STEPS, ESO/Garching
 - Jul 2014 2 Poster contribution at “Why Galaxies Care About AGB Stars III” Vienna, Austria
 - Jan 2014 Poster contribution at “VLTI community days” Grenoble, France
 - Sep 2013 Poster contribution at VLTI summer school, Barcelonette, France
 - Jul 2012 Participation Marcel at the Grossmann 13th conference, Stockholm, Sweden

OBSERVING RUNS

- 2019 **PI** of the observing runs at ESO/VLTI with the MATISSE instrument (ID: 0104.D-0279) - 12.5 h
- 2019 Co-I of the accepted Cycle 7 ALMA proposal 2019.1.00796.S
- 2019 Co-I of the accepted ALMA DDT proposal 2018.A.00026.S
- 2018 Co-I of the observing run at VLTI/GRAVITY (ID: 0102.D-0197) - 24h
- 2018 Co-I of the observing run at VLTI/SPHERE and VLTI/GRAVITY (ID: 0102.D-0240) - 20h
- 2017 Co-I of the observing run at VLTI/GRAVITY (ID: 0101.D-0616) - 31h
- 2014 **PI** of the observing runs at ESO/VLTI with the MIDI instrument (ID: 093.D-0708) - 6 h
- 2014 Co-I of the observing run at ESO/VLTI with the MIDI instrument (ID: 092.D-0152) - 9 h
- 2013 Co-I of the observing run at ESO/VLTI with the MIDI instrument (ID: 092.D-0665)- 7.5 h

TEACHING

- 2019 Fall Astronomy course at The Catholic University of America, Guest lecturer of Prof. Duilia de Mello
- 2015 Assistant for the Astronomy class exercises, University of Vienna

PUBLICATIONS

- Refereed Journals**
- **Rau et al., 2019, ApJ, in press** “Constraining stellar parameters and atmospheric dynamics of the carbon AGB star V Oph” (<https://arxiv.org/abs/1907.08693>)
 - **Rau et al., 2019, BAAS, 51(3), 241** “Cool, evolved stars: structure and evolution”
 - **Rau et al., 2018, ApJ, 869, 1** “HST/GHRS Observations of Cool, Low-Gravity Stars. VI - Mass-Loss Rates and Wind Parameters for M Giants”
 - **Rau et al., 2017, A&A, 600, 92** “The adventure of carbon stars. Observations and modeling of a set of C-rich AGB stars”
 - **Rau et al., 2015, A&A, 583, A106** “Modelling the atmosphere of the carbon-rich Mira RU Vir”
 - Dharmawardena et al., 2019, MNRAS, in press. “The Nearby Evolved Stars Survey: I. JCMT/SCUBA-2 Sub-millimetre detection of the detached shell of U Antliae”
 - Monnier, **Rau**, et al., 2019, BAAS, 51c, 514M “The Future of Exoplanet Direct Detection”
 - Monnier, **Rau**, et al., 2019, BAAS, 51c, 498M “Imaging the Key Stages of Planet Formation”
 - Airapetian et al., 2019, BAAS, 51c, 564A “Reconstructing Extreme Space Weather From Planet Hosting Stars”
 - Checlair et al., 2019, BAAS, 51c, 328R “A Statistical Comparative Planetology Approach to Maximize the Scientific Return of Future Exoplanet Characterization Efforts”
 - Rackham et al., 2019, BAAS, 51c, 241R “Constraining Stellar Photospheres as an Essential Step for Transmission Spectroscopy of Small Exoplanets”
 - Roettenbacher et al., 2019, BAAS, 51c, 56C “High Angular Resolution Astrophysics: Resolving Stellar Surface Features”
 - Carpenter et al., 2019, BAAS, 51c, 12K “Stars at High Spatial Resolution”
 - Wittkowski, **Rau** et al. 2018, A&A, 613L, 7 **Letter**: “VLT/IRISA measurements of cool evolved stars I. Modeling R Peg”
 - Carpenter et al., 2018, ApJ, 869, 157 “The Advanced Spectral Library (ASTRAL): Reference Spectra for Evolved M-Stars”
 - Brunner et al., 2018 A&A, in press. “ALMA observations of the “fresh” carbon-rich AGB star TX Piscium: The discovery of an elliptical detached shell”
 - Kopparapu et al. 2018, BAAS, 51(3) 012 “Exoplanet Diversity in the Era of Space-based Direct Imaging Missions”, [arXiv1803.03812](https://arxiv.org/abs/1803.03812)
 - Cikota et al., 2017, MNRAS, 471, 2111 “Common continuum polarization properties: a possible link between proto-planetary nebulae and Type Ia Supernova progenitors”
 - Bazso et al., 2017, MNRAS, 466, 1555 “Dynamics and habitability in circumstellar planetary systems of known binary stars”
 - Paladini et al., 2017, A&A, 600, 136 “A joint venture in the infrared: the MIDI+VISIR+Herschel view on the mass loss of evolved stars. I. The inner scales as seen by MIDI”
 - Paladini et al., 2017, Msngr, 168, 28 “To be or not to be Asymmetric? VLT/MIDI and the Mass-loss Geometry of AGB Stars”
- Proceedings**
- Rau 2018, iss, confE, 29R Modeling of Red Giant and AGB Stars Atmospheres: Constraints from VLT and HST Observations
 - Carpenter & Rau 2018, iss, confE, 4C Imaging the Surfaces of Stars from Space
 - Rau et al. 2016 “The dynamic atmospheres of carbon rich giants: constraining models via interferometry”. Conference proceedings of “Cool Stars 19”, id.111
 - Rau et al. 2016 “Modelling A Set Of Carbon-Rich Agb Stars At High-Angular Resolution”. Conference proceedings of “Cool Stars 19”, id.110
 - Rau et al. 2015 “Modelling Carbon-rich AGB stars”. Astronomy in Focus, as presented at the IAU XXIX General Assembly, 2015. Proceedings of the IAU, Volume 29B, 2016, pp. 160-161
 - Rau et al. 2015 “Modelling a set of C-rich AGB stars: the cases of RU Vir and R Lep”. MmSAIt, 87, 260
 - Rau et al. 2014 “Into the modelling of RU Vir”. ASPC, 497, 137
 - Paladini C., et al. 2014 “VLT/MIDI Large Program: AGB Stars at Different Spatial Scales”. ASPC, 497, 97

- In preparation**
- Rau et al. 2019, in prep. “*Flares in K2 field giant stars, and their chromospheric activity*”
 - Morris et al. 2019, in prep. (**Letter**) “*Methanol and water in the central core of η Carinae*”
 - Rau et al. 2020, in prep. “*RADMC3D modeling of spectro-interferometric data of RU Vir and V Oph*”

OUTREACH & MEDIA

- Outreach**
- 2019-Ongoing Scientist behind the “Ask a NASA Scientist”
 - 2019-Ongoing Collaboration and review work for “Art of the Cosmos”
 - 2019 Representing NASA scientists at the outreach event at the Italian Embassy in DC, May 11th, 2019
 - 2018 Invited conclusive talk, as NASA expert, for the virtual exchange program, organised by the Bureau of Educational and Cultural Affairs’ Collaboratory, between three schools in Pennsylvania, South Carolina, and Pistoia, Italy, to increase knowledge in the field of exoplanets (see those three pages: [first](#), [second](#), and [third](#)).
 - 2012-2017 Contributing in various outreach activities at the University of Vienna (e.g. “Nachts auf der Sternwarte”.
 - 2014 Collaborating with the association “TEDxVienna” (2014 conference).
 - 2015 **Invited** public talk “*We are all Stardust*” at the University of Vienna.
 - 2011-2012 Scientific guide and teacher in Planetarium and astronomical museum of Rome, and for ATA (Associazione Tuscolana di Astronomia).
 - 2009-2010 Several outreach events at University of Rome La Sapienza.
 - 2010 Work with the portable planetarium in schools and public events in Rome.
 - 2009 Scientific guide of the exhibition “Expo Astri e Particelle” at Palazzo delle Esposizioni, Rome.
 - 2009 Scientific explainer at the Festival of Science: “L’ Universo”, Rome
 - 2009 Scientific explainer for the event “XLuna” (40th anniversary of the moon landing)
 - 2009 Scientific explainer for the Research week - Frascati Scienza
 - 2008-2010 Permanent public outreach laboratory at Planetarium of Rome (& training).
 - 2008 - 2009 Training course at Planetario di Roma.

- Press releases**
- 2018 Press release NASA/GSFC communication account on [Twitter](#) and [Facebook](#) featuring my 2018 first author publication
 - 2017 [Press release of my grant at the University of Vienna](#)

- Media**
- 2019 Interview for a major Italian newspaper “il Giornale”, published on Sat. July 13th 2019
 - 2019 Article on a major Italian newspaper “La Repubblica”
 - 2018-2019 Three video interviews for RaiNews24, featured on the news, in the column (“*Rubrica Societa’ di RaiNews24: Non solo 8 Marzo*”), for Italian talented women, and in the column “Futuro24” ([here from min. 8:29](#)).
 - 2018 Interview for the Australian Triple R radio station ([here from min. 36:00](#))

ADDITIONAL INFORMATION

PERSONAL SKILLS

Mother tongue Italian

Other languages	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C2	C1	C1	C2
German	B1	B1	B2	B2	B1
Spanish	A1	A2	A1	A1	A1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2: Proficient user
Common European Framework of Reference (CEF) level

PROFESSIONAL SKILLS & KEY COMPETENCES

Observations UV high-resolution spectroscopy. Optical/IR and sub-mm interferometry at high angular resolution, spectroscopy, photometry. Observational proposal writing (VLTI/MIDI, ALMA, see below).

Modeling Modeling stellar chromospheres, atmospheres, dust, circumstellar environments. Using stellar evolutionary models. Computing synthetic spectra, synthetic photometry, and interferometric visibilities.

Data handling Dealing with: UV data, IR spectroscopic, photometric and interferometric data. Interferometric data reduction (EWS and MIA routines for VLTI/MIDI, and ESO/REFLEX pipeline for VLTI/GRAVITY).

Communication skills

- Ability to work independently and in team environment.
- Organising and problem-solving skills. Communication & interpersonal skills. Public outreach.
- Team work: I have worked in various types of research teams. I am currently working with a PhD student
- Leadership skills
- Intercultural skills: I am experienced at working in different environments (European and American)

Organisational / managerial skills

- I am currently organizing the meeting series "HARIM" (High-Angular Resolution Interferometric Meeting)
- during my PhD I organised a seminar series called "Dust meeting"
- Time management: always concluded on time the studies and projects in which I was involved.

Computer skills

- Languages: IDL, C, f90, AWK, bash, learning Python
- Text Editing: \LaTeX
- OS: Mac OS X, Linux

Other Junior member of the IAU. Lover of Nature, Space, philosophy. I believe that sport is life: my favorites are volleyball, skiing, and running. I enjoy writing, and always carry with me a book. Occasionally I play guitar and learn piano.

Last update: August 5th, 2019