

## Maria Jose Rain



### Title

Blue straggler stars in open clusters

### Abstract

Blue straggler stars (BSS) were originally identified in the color-magnitude diagram (CMD) of the globular cluster M3, where they defined an extension of the cluster main sequence, blueward and above the turnoff (TO). Among the variety of objects that populate stellar clusters, BSS are surely between those still presenting many puzzles to astronomers since they are considered crucial probes for the study of the complex interaction between stellar evolution and stellar dynamics. Further, their presence poses a challenge for the standard single-star evolution theory, since stars with masses higher than that of the cluster TO should have evolved into the white dwarf regime long ago and, besides, the major formation scenarios for BSS involve stellar interactions. At present, these exotic stars have been largely identified in different stellar systems, such as globular clusters (GCs), dwarf galaxies, open clusters (OCs), and even in the field populations of the Milky Way. In particular, available catalogs of BSS in OCs are purely based on photometric criteria, namely only the location of a given star in the CMD dictates its BS nature. Nevertheless, systematic investigations of the properties of galactic OCs are hampered by the inhomogeneity of the data available by the date of the catalogs were published, and consequently, the BSS reported in this catalog are mostly of uncertain membership. Thus, while useful, these compilations are not reliable enough to allow the derivation of statistical properties of BSS. The principal aim of this thesis was to create a catalog of BSs in OCs based on the astrometric solutions of Gaia DR2 and not only on photometric criteria. In addition, we have searched also for possible yellow stragglers stars (YSS) i.e possible evolved BSS. Finally, we have complement Gaia DR2 data with multi-epoch spectroscopic data from FLAMES, which allowed us to have a closer look at the BS population in four OCs with very different properties: age, metallicity, mass, and location in the MW disk.

# María José Rain

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*Resumé/CV*

## PERSONAL INFORMATION

**Full Name** María José Rain Sepúlveda  
**Nationality** Chilean  
**Office** Vicolo dell'osservatorio 3, room 03 009, I-35122 Padova-Italy  
**Phone** +39-3498162501  
**Email** mariajoserain@gmail.com  
**Current Status** PhD student

## EDUCATION

- 2015 **Bachelor in Astronomy**, *Graduate in Astronomy*.  
University of Concepción (UdeC), Chile  
No thesis
- 2017 **Degree in Astronomy**, *Astronomer*.  
University of Concepción, Chile  
No thesis
- 2018 **Master in Science**, *Mention astrophysics*, *summa cum laude*.  
University of Concepción, Chile  
Advisor: Sandro Villanova  
Thesis: "Chemical Evolution of the metal-poor Globular Cluster NGC 6809"
- Today **Phd in Astrophysics**.  
Universita degli studi di Padova (UNIPD), Italy  
Advisor: Giovanni Carraro  
Thesis: "Blue Straggler stars in open clusters"

## MAIN RESEARCH TOPICS

My scientific interests are focus on spectroscopic studies of stellar populations, stellar clusters, chemo-dynamical evolution of the Milky Way and its subcomponents, binaries, blue and yellow stragglers.

*Padova – Italy*

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1/4

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## FELLOWSHIPS AND TRAINING

- 2011-2017 **Fellowship for Bachelor studies**, Ministry of Education, Chile. Grant per year.
- 2015 **National conference Support**, Astronomy department, University of Concepción, Chile, Grant conference.
- 2017 **International conference Support**, Physics department, University of Concepción, Chile.
- 2017 **International Conference Support**, Fifth Annual GMT Community Science Meeting, New York, EE.UU.
- 2018 **Fellowship for master studies**, *FONDECYT regular 1170518 project*, Fondo Nacional de Desarrollo Científico y Tecnológico, Chile.
- 2018-2021 **Fellowship for PhD studies**, ANID, Agencia Nacional de Desarrollo Científico y Tecnológico, Chile, Ranked 2 out of 683 applicants.
- 2020 **Visiting graduate research student**, Astronomical Observatory of Córdoba, Argentina. Supervisor: Javier Ahumada.

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## PUBLICATION LIST

- Paper '**Chemical patterns in the metal-poor globular cluster NGC 4372**', *Valenzuela-Calderon, C., Rain, M.J., Villanova, S., Muñoz, C., 2019, ApJ, submitted.*
- Paper '**Chemical Evolution of the metal-poor Globular Cluster NGC 6809**', *Rain, M. J et al., 2019, MNRAS, Accepted.*
- Paper '**A study of the blue straggler population of the old open cluster Collinder 261**', *Rain, M. J et al., 2020, AJ, Accepted.*
- Paper '**The blue straggler population of Trumpler 5, Trumpler 20, NGC 2477**', *Rain, M. J et al., 2020, AJ, Accepted.*
- Paper '**A new, Gaia-based catalog of blue straggler stars in open clusters**', *Rain, M. J et al., 2020, A&A, Submitted.*

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## CONFERENCES, WORKSHOPS AND SCHOOLS

- December 9-10, 2020 **XVI meeting of the Chilean Astronomical Society I**, *Sociedad Chilena de Astronomia, SOCHIAS*, Online Workshop.
- December 8-12, 2020 **IAUS 367: Education and Heritage in the era of Big Data in Astronomy**, *International Astronomical Union, IAU*, Virtual conference.
- November 16, 2020 **ERC Sex and Gender dimension in frontier research**, *European research council*, Online Workshop.
- Oct 31, Nov 6-8, 2020 **Spectroscopy Workshop 2020**, *American Association of Variable Stars observers, AAVSO*, Online Workshop.
- October 21-22, 2020 **20th Anniversary of Science Exploration with UVES**, *European Organisation for Astronomical Research in the Southern Hemisphere, ESO*, Online Workshop.
- September 7-8, 2020 **Microworkshop of PhD students cycles XXXIII, XXXIV, XXXV, annual reports**, *Universita degli studio di Padova, Padova, Italy*, Online Workshop.  
Contribution: Talk 'Blue straggler stars in open clusters'

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2/4

- September 9-10, 2019 **Microworkshop of PhD students cycles XXXII, XXXIII, XXXIV, annual reports**, *Universita degli studio di Padova*, Padova, Italy.  
Contribution: Talk 'Blue straggler stars in open clusters'
- October 16, 2017 **Microworkshop on using TOPCAT, STILTS, and ADQL on Astronomical databases**, *The Pontifical Catholic University of Chile (PUC)*, Santiago, Chile.
- September 17-20, 2017 **Fifth Annual GMT Community Science Meeting: Chemical Evolution of the Universe**, *Tarrytown House Estate & Conference Center*, Tarrytown, NY, United States.  
Contribution: Poster - 'Chemical Evolution of the metal poor Globular Cluster NGC 6809'
- July 22-29, 2017 **SDSS-IV Collaboration Meeting Santiago 2017**, *The Pontifical Catholic University of Chile (PUC)*, Santiago, Chile.
- May 22-26, 2017 **Third Winter School of the Valongo Observatory**, *Federal University of Rio de Janeiro (OV-UFRJ)*, Rio de Janeiro, Brazil.  
Contribution: Poster - 'Chemical Evolution of the Metal Poor Globular Cluster M55'
- March 2-3, 2017 **Stellar populations in stellar clusters and dwarf galaxies: new astronomical and astrophysical challenges**, *European Southern Observatory (ESO)*, Santiago, Chile.  
Contribution: Poster - 'Spectroscopic study of the Globular Cluster M55'
- April 13-17, 2015 **ESO Workshop: Satellites and Streams in Santiago**, *European Southern Observatory (ESO)*, Santiago, Chile.  
Contribution: Poster - 'Looking for the Parents of the Orphan Stream'

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## PROJECTS, PROPOSALS AND TELESCOPE TIME AWARDED

- Project **'Tracing the formation of the Milky Way and Nearby Dwarf Galaxies using Globular Clusters'**, *Villanova et al.*, FONDECYT Regular Proyecto 1170518, Project accepted.
- Proposal **'On the origin of atypical Mg-poor Milky Way Field Stars with Globular Cluster Second-generation-like Chemical Patterns'**, *Fernández-Trincado et al.*, Time Awarded .
- Department Project **'Internal dynamics of Galactic star clusters in the Gaia era: binaries, blue stragglers, and their effect in estimating dynamical masses '**, *Carraro et al.*, id: 27153, Project accepted.

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## OBSERVATIONAL EXPERIENCE

- November 23-24, 2014 **0.9m SMARTS, Cerro Tololo Inter-American Observatory (CTIO)**, Cerro Tololo, IV Región, Chile.

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## OUTREACH ACTIVITIES

- 2014-2018 **Astronomical Outreach Team (E.D.A)**, *Department of Astronomy, University of Concepcion*, Role: Coordinator.
- 2016 **ChileVa Scientific Camp**, *Explora CONICYT*, Role: Advisor.

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3/4

- 2017-2018 **UdeC Telescope team**, *Department of Astronomy, University of Concepcion*, Role: Telescope instructor.
- 2017 **Astronomic School Congress**, *Department of Astronomy, University of Concepcion*, Role: Project Advisor.
- 2018 **Astronomical School for teachers**, *Department of Astronomy, University of Concepcion*, Role: Instructor.

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## Languages

**Spanish(Mothertongue), English, Italian, Mapudungun**

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## References

**Dr. Giovanni Carraro**, *giovanni.carraro@unipd.it*.

Universita degli studio di Padova, Italy

**Dr. Javier Ahumada**, *javier@oac.unc.edu.ar*.

Observatorio Astronómico, Universidad Nacional de Córdoba, Argentina

**Dr. Sandro Villanova**, *svillanova@astro-udec.cl*.

Universidad de Concepción, Chile