

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/79821> holds various files of this Leiden University dissertation.

Author: Zari, E.M.

Title: Surveying young stars with Gaia: Orion and the Solar neighbourhood

Issue Date: 2019-10-22

List of publications

First author

Searching for runaway stars in Gaia DR2

E. Zari, T. Marchetti, A. G. A. Brown, and P.T. de Zeeuw, A&A, in prep.

Structure, kinematics, and ages of the young stellar populations in the Orion region

E. Zari, A. G. A. Brown, and P.T. de Zeeuw, 2019, A&A, in press, arXiv:1906.07002

3D mapping of young stars in the solar neighbourhood with Gaia DR2

E. Zari, H. Hashemi, A. G. A. Brown, K. Jardine, and P.T. de Zeeuw, 2018 A&A, 620, 172

Mapping young stellar populations toward Orion with Gaia DR1

E. Zari, A.G.A. Brown, J. de Bruijne, , C.F. Manara, and P.T. de Zeeuw, 2017, A&A, 608, 148

Herschel-Planck dust optical depth and column density maps. II. Perseus

E. Zari, M. Lombardi, J. Alves, C.J. Lada, and H. Bouy, 2016, A&A, 587, 106

Contributing author

3D shape of Orion A from Gaia DR2

J. E. Grossschedl, J. Alves, S. Meingast, C. Ackerl,
J. Ascenso, et al. (incl. **E. Zari**), A&A, 619, 106

The Gaia-ESO Survey: a kinematical and dynamical study of four young open clusters

L. Bravi, **E. Zari**, G.G. Sacco, S. Randich, R. D. Jeffries, et al., 2018, A&A, 615, 37

A Gaia study of the Hyades open cluster

S. Reino, J. de Bruijne, **E. Zari**, F. d'Antona, P. Ventura, 2018, MNRAS, 477, 319

The Gaia-ESO Survey: open clusters in Gaia-DR1 . A way forward to stellar age calibration

S. Randich, E. Tognelli, R. Jackson, R. D. Jeffries, S. Degl'Innocenti, at al. (incl. **E. Zari**), 2018, A&A, 612, 99

Curriculum Vitae

I was born in Milano, Italy, on 9 February 1989. Like other kids, I first wanted to become an astronaut, then a paleontologist. At some point towards the end of middle school I was set to become a journalist, so I decided to focus my high school studies on humanities, and I enrolled the Liceo Classico G. Berchet in Milano. After having successfully learned to translate Latin and ancient Greek texts, in 2008 I found myself attending Physics at Università Statale di Milano, where I completed both my Bachelor's and Master's degree.

My first project related to Astrophysics was my Bachelor's thesis, which I completed in 2012 under the supervision of Prof. dr. Marco Lombardi. In the thesis, I analysed the data of the *Herschel* satellite, and obtained dust maps of the Pipe Nebula. I continued to work with Marco when, one year later, I started my Master's thesis. The project was based on the analysis of the *Herschel* and *WISE* data in the Perseus molecular cloud. The goal was to study the local Schmidt law, that is the relation between gas density and star formation rate within single molecular clouds. A significant fraction of the thesis was carried out at the University of Vienna, under the supervision of Prof. dr. J. Alves.

After my graduation, I started to look for a PhD in Italy. In October 2014, I won a position in Milano, although not in Astrophysics. I thus decided to resign and I started working as a supplementary physics and maths teacher at the Istituto Orsoline di Saronno. At the same time, I applied for PhD positions in Germany and the Netherlands. As a result, in April 2015 I landed in Schipol with a 32 kg suitcase, and took the first of many trains to Leiden. Under the guidance of Dr. Anthony Brown and Prof. dr. P.T. de Zeeuw, I used the first *Gaia* data releases to study the star formation history of the Orion region, the three dimensional structure of the solar neighbourhood, and the kinematic properties of young, early-type stars, looking for runaway star candidates. I presented my work in conferences in Europe and in the US. In 2016 I also attended the 11th Heidelberg IMPRS Summer School on astrostatistics and data mining. Besides my research work, during my years at the Sterrewacht I served as a teaching assistant for the course "Project management for scientists", taught by Prof. dr. C. Keller, and organised the master's student colloquia with Dr. J. Hodge. I also had the opportunity to organise the PhD talks in 2017 as well as the Borrel in 2017/2018.

In early 2019 I accepted a post-doc position in Heidelberg, to work with Hans-Walter Rix on the preparation and exploitation of the SDSS-V survey of young stars.

Acknowledgements

In these many years towards the end of my education, I met many people who supported, inspired, and motivated me. I am grateful to all of them.

I would like to start by thanking my family: without them, none of this would have been possible. Grazie per avermi fatto scoprire l'astronomia, e in generale le scienze, fin da bambina: ricordo ancora la prima conferenza al Planetario di Milano, il primo libro di Astronomia letto al mare, il film Apollo 13, e come non menzionarle, tutte le puntate di Super Quark, con Piero e Alberto Angela, Paco Lanciano, e Danilo Mainardi. Grazie per tutti i vostri sacrifici, che mi hanno permesso di seguire sempre i miei desideri. Grazie per aver accettato tutte le mie scelte, anche quando non le capivate, e per avermi incoraggiata e spronata anche a distanza.

My research career in Astronomy started in Milano and Vienna, where I was supervised by Marco Lombardi and João Alves. Marco and João, thank you for teaching me what research is about, for motivating me, and for being always available for me. In my university years I shared memorable moments with some special friends: Alessia, Amedeo, Benedetta, Carlo, Charlotte, Chiara, Chiara, Claudia, Enrico, Ettore, Federico, Francesca, Guglielmo, Luca, Marco, Maria Giulia, Michela, Valeria: grazie per i pranzi, le pause, i laboratori, le ore di studio in biblioteca, le corse, le vacanze e i viaggi! Gulielmo, abbiamo condiviso non solo gli anni universitari, ma anche quelli di dottorato: grazie per le passeggiate ad Amsterdam, per le intense sere di scrittura della tesi, e per le tante risate insieme. Thanks also to my friends in Vienna, in particular Stefan and Josefa. I fondly remember the time I spent in Vienna. Thank you for welcoming me as part of the group since the very first day!

I feel very privileged to have spent the last years as a PhD student in Leiden. Living in such a welcoming country, working in a vibrant department, and meeting so many people from all over the world, truly opened my mind. I would like to first thank the computer and secretarial staff, for keeping everything running smoothly. Thank you in particular to Leonardo Lenoci, who helped me installing the software required for creating some of the figures of Chapter 4. I am grateful to Xander Tielens, for the support in the final part of my PhD and for his encouraging words. I would also like to thank Tim de Zeeuw for the discussions and advice on different topics, and for having introduced me to the Spaghetti Western genre. I will never be able to fully express my gratitude to Anthony Brown for giving me the opportunity to embark on my PhD. Anthony, I feel very lucky for having experienced your balanced guidance, your care, and your expertise throughout my entire PhD.

Thank you to all the participants of the Leiden-ESTEC *Gaia* group meetings, and in particular: Timo Prusti, Jos de Bruijne, Daniel Michalik, and Alice Zocchi. You have always made the meeting active and insightful with your comments. I would also like to thank Carlo Manara, for his support in the first steps of my PhD, and for giving me the opportunity to join him in an observing trip to Paranal. Thanks to Arthur Bosman, Merel van 't Hoff, Sierk van Terwisga, Lukasz Tychoniec, and all

the participants to the Star Formation coffees, for sharing with me their expertise on disc chemistry, jets, and proto-stars, and in particular to Daniel Harsono, for the many interesting conversations. Special thanks also to my office-mates, Alvaro Hacar, Nadia Murillo, and Giovanni Rosotti. Alvaro, it has been a pleasure to share an office with you in Leiden (and Vienna as well!). Thank you for the scientific and non-scientific discussions, and for the infinite amount of cookies you provided me during the long winter afternoons. Thanks also to all the participants and the organisers of the *Gaia* sprints, which have always been an incredibly useful learning experience. I would like to thank in particular Sven Buder, Christina Eilers, Keith Hawkins, Eloisa Poggio, and Sara Rezaei for the many fun discussions.

During these years in Leiden, Amsterdam, and Padova, I shared lunches, coffee breaks, borrels, dinners, and drinks with many people who always provided topics for interesting and stimulating conversations: Alberto, Alice, Allison, Andrej, Andrew, Anna, Anna Grazia, Ann-Sofie, Aurelien, Christian, Chris, Clement, Emanuele, Eva, Francisca, Giada, Heather, Hiddo, Igone, Javi, Jorrit, Josh, Kirsty, Leah, Luis Henry, Luke, Macla, Mattia, Marcelo, Matus, Mike, Nico, Niels, Omar, Pedro, Salvatore, Stella, Vincenzo, Ylva... and many others. Thanks everyone! Special thanks to the PhD students, past and present, who volunteered to bring us the Friday borrels. David, Mason, Allison, Christian, Ann-Sofie, Chris, Nico, Pedro, Santiago, Kim, Maria Cristina, Francisca, Yours Truly, Kirsty, Hiddo, Stijn, Fraser, Anna, Mantas, Martijn, Sanjana: thank you for helping everyone relax every Friday!

With a small group of colleagues I have a special bond. During these four years and half, they made my life special, and certainly their support and our friendship contributed to the positive outcome of this PhD. Dilovan and Fraser, thank you for being the extra office-mates of my final year: the chats and coffee breaks with you have helped me to unwind during some of the toughest times of my PhD. Gabriella, grazie per i fantastici wine and cheese e per le incredibili performances canore! Santiago, I admire your relaxed attitude in all the things you do. I am glad that we have organised the *Gaia* meetings together! Valeriya, your achievements are inspirational to me, both as a scientist and as a pastry chef. Thank you for all your delicious cakes! Kim, your motivation and your passion for science are really amazing! Grazie per le corse, i borrel, e le ricette condivise! Jit and Christos, the times I have spent with you have always been fun. Thanks for all the playing and singing together, and for sharing with me all the ups and downs of the PhD life. Francesco, sei tra i protagonisti e artefici di alcuni dei miei migliori ricordi a Leiden. Grazie per le serate pre-elettorali, i film di Fantozzi, le canzoni di Battiato e gli inni partigiani. Marco e Gabi, l'ultimo anno ad Amsterdam è stato fantastico anche grazie a voi. Grazie per i brunch, per le cene del sabato sera, e per tutti i momenti trascorsi insieme. Gabi, grazie per tutto quello che abbiamo condiviso in questi quattro anni, specialmente nel periodo delle applications. Le lunghe discussioni sul futuro mi hanno sempre aiutata a fare chiarezza sui miei prossimi passi. Mieke, you are one of the first people I met here at the sterrewacht, and I am so glad we kept our friendship through the years. You are a woman of action, always busy in your many activities, but you have always found time to help me. You are one of the reasons I have felt so welcome in this country! Aayush, I am thankful for all our discussion about life and work. I deeply cherish the many memories of our times together (they are so many I can not decide which one to mention), but most importantly, thank you for trying to teach me the difference between "hair" and "air".

Maria Cristina, grazie per essere stata la complice perfetta di tutte le attività artistiche e atletiche che abbiamo fatto insieme: senza di te gli ultimi tre anni sarebbero stati decisamente noiosi! Tommaso, abbiamo condiviso romantici tramonti da Coebelweg 77, conferenze, momenti di panico prima delle data releases (e anche dopo), concerti e viaggi. Grazie per gli incoraggiamenti e i consigli, per le lunghissime discussioni scientifiche e ancora di più per quelle non scientifiche.

I have shared a large part of my life with three special friends. Ester, Irene e Nina, grazie per essere state le compagne (vicine o lontane) di tutte le mie avventure. Mi avete reso forte e serena dopo i fallimenti, e avete condiviso con me tutti i miei successi. Siete sempre presenti quando ho bisogno di voi, e, anche se ci vediamo raramente, vi sento sempre vicine e pronte ad aiutarmi. Un grazie speciale a Irene, per aver letto e corretto il riepilogo della tesi in italiano.

Infine, Lorenzo, la tua presenza e il tuo sostegno sono stati fondamentali durante gli anni universitari e di dottorato. Grazie per i momenti divertenti e per quelli noiosi, per i viaggi e per le serate sul divano, per le ore spese cantando e per quelle lavorando. Nuove sfide ci attendono, ma nessuna mi spaventa quando siamo insieme.