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Young suns and infant planets: probing the origins of solar systems

Bohn, A.J.

Citation

Bohn, A. J. (2021, September 22). *Young suns and infant planets: probing the origins of solar systems*. Retrieved from <https://hdl.handle.net/1887/3213465>

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Note: To cite this publication please use the final published version (if applicable).

List of publications

Refereed publications

26. Sutcliffe, B. J., **Bohn, A. J.**, Birkby, J. L., Kenworthy, M. A., Morzinski, K. M., Doelman, D. S., Males, J. R., Snik, F., Close, L. M., Hinz, P. M., & Charbonneau, D. (2021) *High-contrast observations of brown dwarf companion HR 2562 B with the vector Apodizing Phase Plate coronagraph*, MNRAS (in press)
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24. Zhang, Y., Snellen, I. A. G., **Bohn, A. J.**, Mollière, P., Ginski, C., Hoeijmakers, H. J., Kenworthy, M. A., Mamajek, E. E., Meshkat, T., Reggiani, M., & Snik, F. (2021), *The ^{13}CO -rich atmosphere of a young accreting super-Jupiter*, Nature (in press)
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22. Doelman, D. S., Snik, F., Por, E. H., Bos, S. P., Otten, G. P. P. L., Kenworthy, M., Haffert, S. Y., Wilby, M., **Bohn, A. J.**, Sutcliffe, B. J., Miller, K., Ouellet, M., de Boer, J., Keller, C. U., Escuti, M. J., Shi, S., Warriner, N. Z., Hornburg, K., Birkby, J. L., Males, J., Morzinski, K. M., Close, L. M., Codona, J., Long, J., Schatz, L., Lumbres, J., Rodack, A., Van Gorkom, K., Hedglen, A., Guyon, O., Lozi, J., Groff, T., Chilcote, J., Jovanovic, N., Thibault, S., de Jonge, C., Allain, G., Vallée, C., Patel, D., Côté, O., Marois, C., Hinz, P.,

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Submitted publications

1. **Bohn, A. J.**, Ginski, C., Kenworthy, M. A., Mamajek, E. E., Meshkat, T., Pecaut, M. J., Reggiani, M., Brown, A. G. A., Cugno, G., Henning, T., Launhardt, R., Quirrenbach, A., Rickman, E. L. & Ségransan, D. (2021), *Unveiling wide-orbit companions to K-type stars in Sco-Cen with Gaia EDR3*, A&A (under review)

Conference proceedings

2. Girard, J. H., Haffert, S. Y., Bae, J., Zeidler, P., de Boer, J., **Bohn, A.**, van Holstein, R. G., Brinchmann, J., Snellen, I., Bacon, R., & Keller, C. (2020), *Planet formation with all flavors of adaptive optics: VLT/MUSE's laser tomography adaptive optics to directly image young accreting exoplanets*, Proc. SPIE, 11448, 1144808
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L., Rodriguez-Coira, G., Rousset, G., Shangguan, J., Shimizu, T., Stadler, J., Straub, O., Straubmeier, C., Sturm, E., Stolker, T., van Dishoeck, E. F., Vigan, A., Vincent, F., von Fellenberg, S. D., Ward-Duong, K., Widmann, F., Wieprecht, E., Wiezorrek, E., & Woillez, J. (2020), *The ExoGRAVITY project: using single mode interferometry to characterize exoplanets*, Proc. SPIE, 11446, 114460O

Curriculum vitae

 was born on August 3, 1993, to Ursula Bohn and Florian Gunzer in the lovely city of Würzburg, located in Lower Franconia, Bavaria. Before I celebrated my first birthday, our family moved to the United States of America, where we lived in Shrewsbury, Massachusetts, in the greater Boston metropolitan region. As my parents were working in academia, we relocated again in 1996. This time we went back to Germany; my parents started working in Hannover, Lower Saxony. This is where I spent most of my childhood.

I can also remember several visits at our grandparents' places in Würzburg. This is probably where I had my first astronomical experiences at the age of approximately six: we used my grandfathers old refracting telescope to observe the moon and to see the rings of Saturn. I was fascinated by what was out there, beyond our Earth. Accordingly, I had to get a poster of our Solar System for my own room.

In 1999 I entered primary school and realized that my interests were quite diverse. I was intrigued by the history of humanity, but first and foremost I enjoyed solving math problems and loved to uncover the laws of physics. Besides attending school, I learned to play the piano, and in my free time I either played soccer, tennis, or I took rowing classes on the local lake.

In 2002, I started taking Latin classes in school. To me this did not feel like learning an actual language; translating ancient texts was more like a puzzle that needed to be solved. As the translation relies on a set of pre-defined rules and symbols, I felt that Latin class was quite similar to math courses. But not only the translation of these ancient manuscript was a lot of fun, also the content directly fed my enthusiasm for history classes: it was fascinating to obtain first-hand insights into Caesar's thoughts during the Gallic War, to learn how to prepare a good speech directly from Cicero, or to discuss moral issues with the Stoic philosopher Seneca the Younger. As this class perfectly combined both these interests of mine, it was not a big surprise to my parents that I also wanted to learn ancient Greek, as soon as this class was offered in school. In the years to come, the books of Virgil, Ovid, and Pliny the Younger were thus supplemented by the works of Aristotle, Plutarch, and Homer. For the sole reason that it was not allowed to graduate with both Latin and ancient Greek as major subjects, I decided to enroll in physics, maths, and Greek for my high-school diploma. These classes were complemented by Latin and history classes as minor subjects.

Due to this broad range of interests, I was uncertain what to do next after my final high-school exams in 2011. By choosing just one possibility, I would exclude so many interesting topics. For that reason I did not start my University studies right away, but participated in a new project that was initiated by the Hannover Medical School (MHH). As a research assistant at the Institute of Cartography and Geoinformatics of Leibniz University Hannover, I obtained hands-on experience with scientific research. I further acquired my first programming skills with Java, which I used to contribute to a project on autonomous real-time analysis of surveillance camera data. Besides these intriguing insights, I had the opportunity to sit in

on various University lectures. Due to these experiences I had made up my mind after one year of scientific research: I decided to study physics, which felt to me as the purest of natural sciences.

For this endeavor I moved to Zurich, Switzerland, where I began my physics studies at ETH Zürich (Swiss Federal Institute of Technology) in 2012. I enjoyed the theoretical approach in the first years: several math classes were mandatory, as this knowledge was crucial to properly describe physical processes. As I did a major in general physics, I did not learn a lot about astronomy during the first two years of my Bachelor. But the introduction class to astrophysics that I took in 2014 directly caught my interest, and I signed up for a field trip as part of the practical coursework. During this trip we stayed on top of the Diavolezza, a mountain in the Swiss Alps with an altitude of almost 3'000 m. At night we went outside to perform simple astronomical observations; during the day we analyzed the data and wrote our report. As I have lived most of my life in big cities, I never had seen such a clear night sky before. The combination with the moonlit panorama of the Eastern Alps was mesmerizing, and intensified my interest in astronomical research.

When I started my Master of Physics in 2015, I therefore signed up for several astronomy courses. I enjoyed a semester project on the detection of exoplanet transits with the University's student telescope and worked on my Master's Thesis entitled "High-contrast imaging of extra-solar planets around the nearest stars". Especially the positive influence of my supervisors Sascha Quanz and Hans Martin Schmid, convinced me to pursue a PhD in astronomy after my undergraduate studies. In August 2017 I started my position at Leiden Observatory, the Netherlands, to continue my work on the direct detection of extra-solar planets under the supervision of Matthew Kenworthy, Frans Snik, and Christoph Keller. The main scientific results that we obtained during this four-year PhD program are collected in this doctoral thesis.

Software



SEVERAL (open-source) software packages were used to create the content of this thesis. The layout and typesetting of the text was performed with $\text{\LaTeX}$ and the cover was designed with Adobe Photoshop and Adobe InDesign. We further used the SIMBAD database, operated at CDS, Strasbourg, France (Wenger et al. 2000). This work has used data from the European Space Agency (ESA) mission Gaia, processed by the Gaia Data Processing and Analysis Consortium (DPAC). Funding for the DPAC has been provided by national institutions, in particular the institutions participating in the Gaia Multilateral Agreement. This thesis makes use of VOSA, developed under the Spanish Virtual Observatory project supported by the Spanish MINECO through grant AyA2017-84089. To achieve the scientific results presented in this thesis we made use of the *Python* programming language,⁷ especially the *SciPy* (Virtanen et al. 2020), *NumPy* (Oliphant 2006), *Matplotlib* (Hunter 2007), *emcee* (Foreman-Mackey et al. 2013), *scikit-image* (Van der Walt et al. 2014), *scikit-learn* (Pedregosa et al. 2012), *photutils* (Bradley et al. 2016), and *astropy* (Astropy Collaboration et al. 2013, 2018) packages.

⁷Python Software Foundation, <https://www.python.org/>

Acknowledgments



BTAINING a PhD degree is long and steady process. Whereas various co-authors made significant scientific contributions to the results that are presented in the main chapters of this thesis, there is also an important number of other people, whose impact helped me to start my studies at Leiden Observatory in the first place, and to make the past four years an unforgettable and light-hearted period of my life. I hope that the following paragraphs do justice to these fellows, and I would like to apologize in advance if I might have forgotten anyone meaningful that I encountered during this journey.

First of all I want to thank Matthew Kenworthy, who was my daily supervisor at Leiden Observatory. Thanks Matt for being always available (even when you were on vacation), for guiding me through the past four years, and for several unforgettable memories outside our regular work environment: e.g., at conferences, on sailing boats, or observatory barbecue events. I will certainly miss all our intriguing discussions and meetings and really hope that we can continue our great collaboration in the future.

I also want to thank Christian Ginski for his co-supervision of my work during the past four years. In the beginning, Christian, you helped me a lot to get started with the data reduction of our YSES program. You taught me how to write decent observing proposals and that every idea – even if it is crazy and unorthodox – is worth submitting. Even though the number of my science and coding questions for you decreased throughout the years, you always took your time to discuss and plan the further outline of our project. I really appreciate all your dedication for teaching and guiding students such as me, and I hope that we will stay in touch for the years to come.

I am also extremely grateful for the support of Frans Snik and Christoph Keller, who acted as my co-supervisor and promotor, respectively. I really learned to appreciate your extremely broad range of interest and experience, often combining astronomical concepts and instruments with more relevant use cases in private industry or social sciences. You always had great suggestions for additional tests and critical remarks regarding results from our study. It is fair to say that I certainly learned a lot from you about instrumentation, teaching, and project management, and I want to thank you for all these new insights.

I would also like to thank all my co-authors whose contributions were vital to publishing the articles that are compiled in this thesis. In addition to the four people mentioned before, these are Christian Adam, Myriam Benisty, Jozua de Boer, Daniel Evans, Eric Mamajek, Carlo Manara, Tiffany Meshkat, Markus Mugrauer, Gabriella Muro-Arena, Mark Pecaut, Maddalena Reggiani, Pierre Maxted, Steven Rieder, John Southworth, Kamen Todorov, Nikolaus Vogt, and Schuyler Wolff. Special thanks goes also to David Doelman, who provided the Dutch summary of this thesis.

Even though the results from our work on misalignments in transitional disks by combining VLTI/GRAVITY and ALMA data did not end up in this thesis, I would also like to express

my deepest sympathies and acknowledgements towards Myriam Benisty and Karine Perraut. Although I was no official student of yours and I did not even attend any of your affiliations, you allocated a lot of your time to introduce me to the wonders of optical interferometry with the VLTI. I really appreciate all the support and help from you during this project; I always enjoyed our extremely interesting discussions on Friday afternoon.

The same goes for our work in progress together with Melvyn Davies and Alexander Mustill. I really enjoyed our discussions on the dynamical evolution of planetary systems and I certainly learned a lot about theoretical work in astrophysics.

I am also happy to have met various additional collaborators either at Leiden University or at international conferences. It was a great experience to either submit proposal ideas or to publish our results in several scientific papers together with Beth Biller, Anthony Brown, Gabriele Cugno, Julien Girard, Christiane Helling, Sascha Hinkley, Jens Hoeijmakers, Markus Janson, Jens Kammerer, Aurora Kesseli, Sylvestre Lacour, Yamila Miguel, Paul Molliere, Sascha Quanz, Ignas Snellen, Andrew Skemer, Tomas Stolker, Arthur Vigan, Kevin Wagner, Jason Wang, Eleonora Zari, and Yapeng Zhang.

But even the most exciting work can become tedious and meaningless if the social environment is not right. Therefore, I would like to thank all the people that helped making Leiden Observatory a place to remember. Thanks to all these fellows that were organizing the interview sessions in early 2017, the social events at the observatory, and the PhD introductory events. Due to all these immense efforts it was nearly impossible not to feel welcome at Leiden Observatory from the very beginning.

These social activities helped a lot to meet a large group of friends at the observatory. Special thanks goes to my office mates (David Doelman, Maaïke van Kooten, and Vikram Radhakrishnan), the rest of the instrumentation group (Steven Bos, Olivier Burggraaff, Dirk van Dam, Floor Derkink Patrick Dorval, Fedde Fagginger Auer, Sebastiaan Haffert, Rob van Holstein, Elina Kleisioti Dora Klindžić, Rico Landman, Willeke Mulder, Mireille Ouellet, Emiel Por, Thijs Stockmans, and Michael Wilby), my Dutch-class teammates (Yannick Bahe, Leonard Burtscher, Gabriela Calistro Rivera, Patricia Liebing, Paul Mollière, Matus Rybak) and our great teacher Mandy de Waal, and a huge group of coffee, lunch, and borrel-buddies (Kirsty Butler, Stijn Debackere, Leindert Boogaard, Ben Sutcliffe, Leon Trapman, Hiddo Algera, Andrew Barr, Arthur Bosman, Eva Bøgelund, Michal Bulak, Turgay Caglar, Dario Campisi, Omar Contigiani, Andrej Dvornik, Kimberly Emig, Fraser Evans, Marta Frias Castillo, Aniek Gloudemans, Anna de Graaff, Pooneh Nazari, Dilovan Serindag, Jeroen Terwisscha van Scheltinga, and Mantas Zilinskas) that I share several unforgettable memories with. I want to thank all of you for the exciting lunch and coffee breaks, discussions during borrels, several funny evenings and nights in Leiden, great conference trips, and astonishing performances when singing Karaoke in Japan.

In addition I was very grateful that I was allowed to supervise the semester projects of several brilliant bachelor and master students myself. Vaishali Chandramohan, Sven Kiefer, Pengyu Liu, Matthijs Mars, Bas van Veen, and Christopher Seay, it was a pleasure working together with all of you. It was great to see your progress with exciting projects that were closely related my own research. To see your Master's thesis even published in a peer-reviewed scientific paper, Sven, made me very proud as your supervisor.

Zu guter Letzt möchte ich natürlich noch meiner Familie danken, deren Unterstützung es mir erst ermöglicht hat, mein Studium der Physik abzuschließen und mich dadurch für eine Promotion zu qualifizieren. Besonderer Dank geht an meine Eltern Ursula Bohn und Florian Gunzer, die mich seit jeher unterstützen und hinter mir stehen. Mit meinem Bruder Tilman Bohn konnte ich mich jederzeit super von der Arbeit ablenken, sei es durch tiefgründige Diskussionen über die neusten Entwicklungen aus der Welt des Sports oder gemeinsame Spieleabende.

Ebenfalls bin ich meinen Großeltern dankbar für all ihr Interesse, das sie stets an meiner Arbeit gezeigt haben. Insbesondere die ersten Beobachtungen durch ein Teleskop auf dem Balkon von Elisabeth und Hermann Bohn, die wohl bereits damals meine Begeisterung für

die Astronomie geweckt haben, werde ich nie vergessen. Auch wenn ihr beide das letzte Kapitel meiner Promotion nicht miterleben werdet, so werdet ihr mir immer in Erinnerung bleiben, wenn ich in den Himmel schaue. Ebenso habt ihr, Jutta und Ulrich Gunzer, maßgeblich zu meiner Faszination für alte Sprachen und und antike Kulturen beigetragen. Zwar ist dieses Schriftstück nun keine medizinische Abhandlung voller lateinischer und altgriechischer Fachwörter geworden, doch auch über das Leben außerhalb der Erde wurde sich im alten Griechenland schon der Kopf zerbrochen. In diesem Sinne leistet diese Arbeit eventuell einen kleiner Beitrag dazu, Antworten auf die Fragen antiker Philosophen wie Aristoteles und Lucretius zu finden.⁸

Außerdem möchte ich mich bei meiner Lebenspartnerin Christina Gantner bedanken, die die gesamte Zeit über an meiner Seite gestanden hat. Danke, dass du mich immer bedingungslos unterstützt und an mich glaubst, dass wir in den letzten Jahren unzählige Dinge gemeinsam erleben konnten, dass die teils größere räumliche Distanz zwischen uns nie ein Problem dargestellt hat und dass ich nun seit mehr als einem Jahr deinen Schreibtisch zum Arbeiten benutzen darf.

⁸Dazu empfehle ich euch insbesondere Kapitel 1.1.