

# Tansu Daylan

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Born 31 October 1989, Age 30, Turkish Citizen

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## Education

- 2018, Ph.D. in Physics, Harvard University, Cambridge, MA, US
- 2015, M.A. in Physics, Harvard University, Cambridge, MA, US
- 2013, B.S. in Physics (double major), Middle East Technical University (METU), Ankara, Turkey
- 2012, B.S. in Electrical and Electronics Engineering, METU, Ankara, Turkey
- 2008, High school diploma, Robert College, Istanbul, Turkey

## Positions

- 2018-2021, Postdoctoral Kavli Fellow, MIT, Cambridge, MA, US
- 2013-2018, Research/Teaching Fellow, Harvard, Cambridge, MA, US
- 2011-2013, Teaching Assistant, METU, Ankara, Turkey

## Research Statement

I have had the exciting opportunity to make significant contributions in a broad range of research fields, i.e., exoplanets, cosmology, astro-particle physics, and astro-statistics.

Record of my research output: [NASA ADS](#), [Google Scholar](#), and [ORCID](#)

**Authored 41 research publications (5 first-author, 18 core-author, 18 contributing author), (33 published, 8 submitted)**

**Number of citations: 970, h-index: 13** (retrieved from NASA ADS)

PhD Thesis: A Transdimensional Perspective on Dark Matter (2018), advisor: Douglas P. Finkbeiner

## Selected Research Achievements

- Led the discovery of four small exoplanets transiting a bright, Sun-like star, HD 108236 (Daylan+2020),
- Significantly contributed to the discovery or characterization of more than 40 exoplanets (e.g., Daylan+2019),
- Co-developed a widely-used inference framework to model stars and exoplanets (Günther&Daylan2020),
- Led the group vetting of the NASA TESS mission, which has delivered more than 2100 exoplanet candidates,
- Built a method to probe the small-scale structure of dark matter using gravitational strong lensing to test the Lambda Cold Dark Matter model (Daylan+2018),
- Constructed a novel statistical method to perform transdimensional inference (Daylan+2017),
- Revealed a potential connection between the anomalous gamma-ray emission from the inner Milky Way and Weakly Interacting Massive Particle self-annihilation (Daylan+2016, 530 citations).

## Awards, Honors and Achievements

- Selected into the the NASA FDL research team (2020)
- MIT Kavli Fellowship (2018)
- MIT Translational Fellowship (2018)
- AAS Chambliss Honorable Mention (2015)
- WorldQuant Fellowship (2014)
- Harvard Purcell Fellowship (2013)
- Selected among the young researchers to attend the Lindau Nobel Laureates Meeting (2012)
- Featured by the Scientific American in the “30 under 30” list (2012)
- Ranked 10<sup>th</sup> among 1.5 million participants (i.e., 99.999th percentile) in the National University Entrance Exam (2008)
- Turkish Republic Prime Ministry Great Achievement Scholarship (2008-2012)
- Turkish Education Foundation Superior Success Scholarship (2008-2012)
- Highest GPA in the class (EEE, twice, 2008 and 2009)
- Winner of Bilkent University Undergraduate Physics Research Competition (2013)
- Honorable Mention Award for EEE graduation project of autonomous construction robot design (2012)

## Professional activities

- President of the MIT Postdoctoral Association (2020-2021)
- Human Affairs Chair of the MIT Postdoctoral Association (2019-2020)
- TESS Science Office exoplanet vetting lead (since 2018)
- NOIRLab Telescope Allocation Committee member 2019B, 2020A
- Reviewer for the Hubble Space Telescope proposals
- Referee for the Astrophysical Journal
- Reviewer for NASA Frontier Development Lab 2018
- Exoplanet Atmospheres Session Chair, AAS235 (January 2020)
- Editorial board member for the Turkish Journal of Physics (since 2019)
- Reviewer for the Future Investigators in NASA Earth and Space Science and Technology 2020
- Local organizing committee member for the TESS Science Conference I (July-August 2019)
- Organizing committee member for the workshop "Gravitational Waves: New Challenges and Opportunities" (July 2019)
- Organizer of the MIT Exoplanet Journal Club (since 2018)
- Member of the science council for the East Anatolian Observatory (since 2019)
- Research mentor for the Harvard-MIT Science Research Mentoring Program (2019-2020)
- Mentor, MIT Mentor Advocate Partnership (2018-2019)
- Observing experience with the 4-meter Blanco Telescope for the DECam Plane Survey, 2016B-0279, CTIO, Chile.
- Extensive data analysis (machine learning and Bayesian inference) experience with astrophysical datasets collected by space and ground-based missions such as Fermi-LAT, Chandra, HST, SDSS, DECam, TESS, Kepler, and AMS-02.

## Awarded Grants and Telescope Time

- Leveraging The Synergy Between TESS And Speculoos: Hunting For Exoplanets Around The Nearest Late M Dwarfs, 2020, as co-I, PI: Günther, TESS Guest Investigator Program, Cycle 3, ID G03279.
- Disintegrating Rocky Bodies Transiting White Dwarfs: The Key To Understanding Exoplanet Compositions, 2020, as co-I, PI: Vanderburg, TESS Guest Investigator Program, Cycle 3, ID G03207.
- A Systematic Study Of TESS Orbital Phase Curves, 2020, as co-I, PI: Shporer, TESS Guest Investigator Program, Cycle 3, ID G03232.
- Disintegrating Rocky Bodies Transiting White Dwarfs: The Key To Understanding Exoplanet Compositions, 2019, as co-I, PI: Vanderburg, TESS Guest Investigator Program, Cycle 2, ID G022077.
- Atmospheric characterization of two temperate mini-Neptunes formed in the same protoplanetary nebula, 2019, as co-I, PI: Mikal-Evans, HST Proposal, Cycle 27, ID 15814.

## Authored Software

- **Probabilistic Cataloger (PCAT)**, Daylan et al. 2017, Daylan et al. 2018, a transdimensional, hierarchical, and Bayesian framework to sample from the posterior probability distribution of a metamodel, i.e., union of models with different dimensionality, given some data,  
<https://github.com/tdaylan/pcat>
- **Allesfitter**, Günther & Daylan, 2019, widely used software to model exoplanets and stars in time-series data,  
<https://www.allesfitter.com>
- **Lion**, Portillo et al., 2017, a fast probabilistic cataloger for astronomical images

## Publications

### Papers

1. Vanderburg et al. **A giant planet candidate transiting a white dwarf.** *Nature*, Sep 2020, doi:10.1038/s41586-020-2713-y.
2. Dai et al. **TKS III: A Stellar Obliquity Measurement of TOI-1726 c.** Submitted, Aug 2020, arXiv:2008.12397.
3. Burt et al. **TOI-824 b: A New Planet on the Lower Edge of the Hot Neptune Desert.** *ApJ*, Aug 2020, doi:10.3847/1538-3881/abac0c
4. Günther et al. **Complex Modulation of Rapidly Rotating Young M Dwarfs: Adding Pieces to the Puzzle.** Submitted, Aug 2020, arXiv:2008.11681
5. Kane et al. **Transits of Known Planets Orbiting a Naked-Eye Star.** *AJ* 160(3):129, Jul 2020, doi:10.3847/1538-3881/aba835.
6. Ikwut-Ukwa et al. **The K2&TESS Synergy I: Updated Ephemerides and Parameters for K2-114, K2-167, K2-237, & K2-261.** Submitted, Jul 2020, arXiv:2007.00678.
7. Basturk et al. **A holistic and probabilistic approach to the ground-based and spaceborne data of HAT-P-19 system.** *MNRAS*, 496(4):4174-4190, Jun 2020, doi:10.1093/mnras/staa1758.
8. Daylan et al. **TESS discovery of a super-Earth and three sub-Neptunes hosted by the bright, Sun-like star HD 108236.** Submitted, Apr 2020, arXiv:2004.11314.
9. Günther and Daylan. **Allesfitter: Flexible Star and Exoplanet Inference From Photometry and Radial Velocity.** Submitted, Mar 2020, arXiv:2003.14371.
10. Dalba et al. **The TESS-Keck Survey. I. A Warm Sub-Saturn-mass Planet and a Caution about Stray Light in TESS Cameras.** *AJ*, 159(5):241, May 2020, doi:10.3847/1538-3881/ab84e3.
11. Wong et al. **Systematic Phase Curve Study of Known Transiting Systems from Year 1 of the TESS Mission.** *AJ* 160 155, Mar 2020, doi:10.3847/1538-3881/ababad
12. Badenas-Agusti et al. **HD 191939: Three Sub-Neptunes Transiting a Sun-like Star Only 54 pc Away.** *AJ* 160 113, Feb 2020, doi:10.3847/1538-3881/aba0b5.
13. Addison et al. **TOI-257b (HD 19916b): A Warm sub-Saturn on a Moderately Eccentric Orbit Around an Evolved F-type Star.** Submitted, Jan 2020. arXiv:2001.07345.
14. Gilbert et al. **The First Habitable Zone Earth-sized Planet from TESS. I: Validation of the TOI-700 System.** 160(3):116, Jan 2020. doi:10.3847/1538-3881/aba4b2.
15. Shporer et al. **GJ 1252 b: A 1.2 R<sub>Earth</sub> planet transiting an M3-dwarf at 20.4 pc.** *ApJL*, 890(1):L7, Feb 2020, doi:10.3847/2041-8213/ab7020.
16. Jordan et al. **TOI-677 b: A Warm Jupiter (P=11.2d) on an eccentric orbit transiting a late F-type star.** *AJ*, 159(4):145, Apr 2020, doi:10.3847/1538-3881/ab6f67.
17. Pepper et al. **TESS Reveals HD 118203b to be a Transiting Planet.** *AJ*, 159(6):243, Jun 2020, doi:10.3847/1538-3881/ab84f2.
18. Wong et al. **Exploring the atmospheric dynamics of the extreme ultra-hot Jupiter KELT-9b using TESS photometry.** *AJ*, 160(2):88, Oct 2019, doi:10.3847/1538-3881/aba2cb.
19. Daylan et al. **TESS observations of the WASP-121 b phase curve.** Submitted, Sep 2019, arXiv:1909.03000.
20. Feder et al. **Multiband Probabilistic Cataloging: A Joint Fitting Approach to Point Source Detection and Deblending.** *AJ*, 159(4):163, Apr 2020, doi:10.3847/1538-3881/ab74cf.
21. Dawson et al. **TOI-216b and TOI-216c: Two warm, large exoplanets in or slightly wide of the 2:1 orbital resonance,** *AJ*, 158(2):65, Aug 2019, doi:10.3847/1538-3881/ab24ba.
22. Yu et al. **Identifying Exoplanets with Deep Learning III: Automated Triage and Vetting of TESS Candidates,** *AJ*, 158(1):25, Jul 2019, doi:10.3847/1538-3881/ab21d6.
23. Fausnaugh et al. **Early Time Light Curves of 18 Bright Type Ia Supernovae Observed with TESS.** Submitted, Apr 2019, arXiv:1904.02171.
24. Espinoza et al. **HD 213885b: A transiting 1-day-period super-Earth with an Earth-like composition around a bright ( $V = 7.9$ ) star unveiled by TESS.** *MNRAS*, 491(2):2982-2999, Jan 2020, doi:10.1093/mnras/stz3150.
25. Günther et al. **A Super-Earth and two sub-Neptunes transiting the bright, nearby, and quiet M-dwarf TOI-270.** *Nature Astronomy*, page 420, Jul 2019, doi:10.1038/s41550-019-0845-5.
26. Bouma et al. **WASP-4b Arrived Early for the TESS Mission.** *AJ*, 157(6):217, Jun 2019, doi:10.3847/1538-3881/ab189f.
27. Rodriguez et al. **An Eccentric Massive Jupiter Orbiting a Subgiant on a 9.5-day Period Discovered in the Transiting Exoplanet Survey Satellite Full Frame Images.** *AJ*, 157(5):191, May 2019, doi:10.3847/1538-3881/ab11d9.
28. Quinn et al. **Near-resonance in a system of sub-Neptunes from TESS.** *AJ*, 158(5):177, Nov 2019, doi:10.3847/1538-3881/ab3f2b.
29. Günther et al. **Stellar Flares from the First TESS Data Release: Exploring a New Sample of M-dwarfs.** *AJ*, 159(2):60, Feb 2020, doi:10.3847/1538-3881/ab5d3a.
30. Shporer et al. **TESS Full Orbital Phase Curve of the WASP-18b System.** *AJ*, 157(5):178, May 2019, doi:10.3847/1538-3881/ab0f96.
31. Schlafly et al. **The DECam Plane Survey: Optical Photometry of Two Billion Objects in the Southern Galactic Plane.** *ApJS*, 234(2):39, Feb 2018, doi:10.3847/1538-4365/aaa3e2.

32. Daylan et al. **The Small-scale Structure in Strongly Lensed Systems via Transdimensional Inference.** *ApJ*, 854(2):141, Feb 2018. doi:10.3847/1538-4357/aaaa1e.
33. Portillo et al. **Improved Point-source Detection in Crowded Fields Using Probabilistic Cataloging.** *AJ*, 154(4):132, Oct 2017, doi:10.3847/1538-3881/aa8565.
34. Daylan et al. **Inference of Unresolved Point Sources at High Galactic Latitudes Using Probabilistic Catalogs.** *ApJ*, 839(1):4, Apr 2017, doi:10.3847/1538-4357/aa679e.
35. Daylan et al. **The characterization of the gamma-ray signal from the central Milky Way: A case for annihilating dark matter.** *Physics of the Dark Universe*, 12:1â23, Jun 2016, doi:10.1016/j.dark.2015.12.005.

#### Proceedings

36. S. Schael et al. **Precision measurements of the electron spectrum and the positron spectrum with AMS**, 33rd International Cosmic Ray Conference, Rio De Janeiro, 2013
37. J. Casaus et al. **Determination of the positron anisotropy with AMS**, 33rd International Cosmic Ray Conference, Rio De Janeiro, 2013
38. V. Choutko et al. **Precision Measurement of the Cosmic Ray Helium Flux with AMS Experiment**, 33rd International Cosmic Ray Conference, Rio De Janeiro, 2013
39. S. Haino et al. **Precision measurement of the proton flux with AMS**, 33rd International Cosmic Ray Conference, Rio De Janeiro, 2013
40. A. Oliva et al. **Precision Measurement of the Cosmic Ray Boron-to-Carbon Ratio with AMS**, 33rd International Cosmic Ray Conference, Rio De Janeiro, 2013
41. B. Bertucci et al. **Precision measurement of the  $e^+ + e^-$  spectrum with AMS**, 33rd International Cosmic Ray Conference, Rio De Janeiro, 2013

## Teaching experience

- Summer 2019, Lecturer, Research summer school "Quantum to Cosmos: Ideas and Applications", Istanbul, Turkey
- Spring 2019, Guest Lecturer for MIT Course 12S680, Artificial Intelligence for TESS Applications, MIT, Cambridge, MA
- Spring 2019, Guest Lecturer for Harvard Course Astro 130, Cosmology, Harvard, Cambridge, MA
- Fall 2016, Teaching Fellow, Graduate Cosmology, Harvard University, Cambridge, MA
- Spring 2015, Teaching Fellow, The Energetic Universe, Harvard University, Cambridge, MA
- Spring 2013, Fall 2012, Spring 2012, Teaching Assistant, Modern Physics, METU, Ankara, Turkey

## Research mentoring experience

- MIT graduate student: Mariona Badenas-Agusti
- Harvard undergraduate student: Richard Feder-Staehle
- Wellesley undergraduate students: Emma Chickles and Lindsey Gordon
- High school research interns: Rohan Subramani, Ashley Davidson, Kartik Pinglé, and Jasmine Wright

## Affiliations

- Junior Member, International Astronomical Union (IAU), since 2020
- American Physical Society, since 2016
- American Astronomical Society, since 2014
- Sigma Xi Society, since 2014
- TESS Atmospheric Characterization Working Group, since 2019
- TESS Follow-up Working Group, since 2019
- TESS Objects of Interest Working Group, since 2018
- Associate member, CERN, 2011-2013
- AMS-02 Collaboration, 2011-2013

## Selected Talks

- *TOI 1233: A quartet of exoplanets discovered by TESS*, TESS Science Meeting 20, (Remote), 11 June 2020
- *Recharacterization of the atmosphere of WASP-121b*, University of Florida, (Remote), 9 April 2020
- *TESS observations of the WASP-121b phase curve*, AAS235, Honolulu, HI, 5 January 2020
- *Hot Jupiters and the TESS phase curve of WASP-121b*, Yale University, 19 November 2019
- *TESS phase curve of WASP-121b*, University of Arizona, 30 October 2019
- *Probing the small-scale structure in strong lenses with PCAT*, MIT, 28 September 2018
- *TESS phase curve of WASP-121b*, BAESM, Cambridge, MA, 5 April 2019
- *Probing the small-scale structure in strong lenses with PCAT*, JPL, Pasadena, CA, 4 March 2019
- *Recharacterization of previously known exoplanets in multi-sector TESS data*, AAS233, Seattle, WA, 6-10 January 2019
- *PSF fitting with the TESS data*, TESS Science Meeting 15, Cambridge, MA, 6 August 2018
- *Probing faint gamma-ray point sources in the inner Milky Way using PCAT*, TeVPA2017, Columbus, OH, 09 August 2017
- *Inner Milky Way Gamma Ray Excess*, Cape Cod Astronomical Society, 5 January 2017
- *Probing the GeV Excess using PCAT*, IDM2016, Sheffield, UK, 18 July 2016
- *Inference of Dim Gamma-Ray Point Sources Using PCAT*, Dark Matter and Gamma Rays 2015, Obergurgl, Austria, 09 December 2015
- *Contribution of Dark Matter annihilations to the low-redshift metagalactic ionization rate*, DPF2015, Ann Arbor, MI, 06 August 2015
- *Can MSPs account for the gamma-ray excess in the inner Milky Way?*, EWASS2015, Tenerife, Spain, 25 June 2015
- *Scrutinizing the Diffuse Gamma-Ray Emission in the Inner Galaxy*, TeVPA2014, Amsterdam, Netherlands, 26 June 2014
- *The Characterization of the Gamma-Ray Signal from the Central Milky Way*, Fermi Summer School, University of Delaware, Lewes, DE, 31 May 2014
- *Anomalous Gamma-Ray Emission from the Inner Galaxy*, Particle Seminar, Harvard University, Boston, MA, 07 May 2014
- *Photon Reconstruction In Calorimetric Mode*, AMS Collaboration Meeting, CERN, Geneva, Switzerland, 14 February 2013

## Selected Poster Presentations

- *TESS phase curve of WASP-121b*, TESS Science Conference I, Cambridge, MA, 29 July - 2 August 2019
- *Recharacterization of previously known exoplanets in multi-sector TESS data*, Kepler Science Conference V, Glendale, CA, 4-8 March 2019
- *Scrutinizing the unresolved x-ray background in the CDFS field via transdimensional sampling*, the 16<sup>th</sup> AAS HEAD Meeting, Sun Valley, ID, 20-24 August 2017
- *Inference of Dim Gamma-Ray Point Sources Using Probabilistic Catalogues*, the 227<sup>th</sup> AAS Meeting, Kissimmee, FL, 07 January 2016
- *Inference of Dim Gamma-Ray Point Sources Using Probabilistic Catalogues*, 6<sup>th</sup> Fermi Symposium, Arlington, VA, 08 November 2015

- *Contribution of GeV Scale Dark Matter Annihilations to the Cosmic Ultraviolet Background*, the 225<sup>th</sup> AAS Meeting, Seattle, WA, 06 January 2015
- *GeV excess electrons upscattering the CMB: a possible resolution to the "Photon Underproduction Crisis"*, 5<sup>th</sup> Fermi Symposium, Nagoya, Japan, 20 October 2014
- *The Characterization of the Gamma-Ray Signal from the Central Milky Way*, Sackler Conference, Cambridge, MA, 19 May 2014

## Selected Science Outreach

- Lecturer, The Project Science Voyagers, (2016-2018, addressed ~30,000 high school students)
- Lecturer, Turkish Ministry of Education e-conference, (2018, addressed ~9,000 high school students)
- Lecturer, Astronomy in Schools (addressed ~1500 high school students)
- Mentor, First Lego League
- Over 10 invited appearances on science outreach podcasts and interviews
- Over 100 science outreach talks to universities and high schools
- Author, *Science & Utopia* and *Tree of Evolution*
- Contributor, *Cambridge Explores the Universe*, CfA, Cambridge, April 2016
- Contributor, *Ask a Scientist*, Cambridge Science Festival, Cambridge, April 2016
- Contributor, *Sky & Space Day*, Cambridge Science Festival, Cambridge, April 2015
- Lecturer, *Beacon Hill Seminars*, Cambridge, MA, (2014-2016)
- Lecturer, *Science In The News Public Science Lectures*, Cambridge, MA, (2014-2016)
- Author, *Harvard Science In The News*, 2014
- Lecturer, "There is a Scientist In My Classroom" Project, Cambridge, MA, 2013
- Organizer, *Mobile CERN exhibition*, METU, Ankara, Turkey, 2012

## Coding

- Unix-like operating systems, Python, IDL, C++, MATLAB, Mathematica
- TensorFlow, Numpy, Numba, PyCUDA
- Relational databases, SQL
- Jekyll, HTML5, JavaScript, CSS

## Selected Workshops, Schools and Conferences Attended

- January 2020, *Inclusive Teaching Workshop*, Cambridge, MA
- 27 May - 06 June 2014, *Fermi Summer School 2014*, Lewes, DE
- 28 May - 01 June 2013, *Recent Developments in High Energy Physics and LHC*, METU NCC, Cyprus
- 01 - 06 July 2012, *Lindau Nobel Laureates Meeting*, Lindau, Germany
- June - August 2011, *Summer school on particle physics*, CERN, Geneva, Switzerland
- June 2010, *Summer school on nonrelativistic quantum mechanics*, Bilkent University, Ankara, Turkey
- June - July 2007, *Summer Research Program*, Koç University, Istanbul, Turkey

## Personal interests

- Lifelong aviator, holding a Private Pilot License since 2012
- Amateur radio operator, holding a ham radio license
- Partner dances: Tango and Bachata