

# Tansu Daylan

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Born 31 October 1989, Age 31, 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, 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 50 research publications (5 lead author, 6 co-lead author, 16 contributing author, 23 collaborating author), (39 published, 11 submitted or accepted)**

**Number of citations: 1180, h-index: 15** (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+2021),
- 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).

## 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 2020A, 2020B
- Reviewer for the HST proposals, NASA Frontier Development Lab, and the Future Investigators in NASA Earth and Space Science and Technology 2020
- Referee for the AAS journals AJ, ApJ, and ApJS
- Session Chair in AAS235 and AAS237
- Editorial board member for the Turkish Journal of Physics (since 2019)
- 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 DECam on the 4m Blanco Telescope at CTIO and PFS on the 6.5m Clay (Magellan II) Telescope at LCO.
- 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, TESS, Kepler, and AMS-02.

## Awarded telescope resources as PI

- 2-minute cadence targets. **Searching For Compact Objects With Stellar Companions Using TESS**, TESS Guest Investigator Program, Cycle 3, ID G03254.
- 1.5 nights. **Revealing the dynamical history of an exceptional multiplanetary system with small transiting planets and a bright host**, Magellan Clay/PFS, 2021A.

## Awarded grant funding

- **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/daylan/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

## Teaching experience

- Fall 2020, Guest Lecturer, Selected Topics in Graduate Physics, 8.398, MIT, Cambridge, MA, US
- Summer 2019, Lecturer, "Quantum to Cosmos: Ideas and Applications", Research summer school, Istanbul, Turkey
- Spring 2019, Guest Lecturer, Artificial Intelligence for TESS Applications, 12.S680, MIT, Cambridge, MA, US
- Spring 2019, Guest Lecturer, Undergraduate Cosmology, Astro 130, Harvard University, Cambridge, MA, US
- Fall 2016, Teaching Fellow, Graduate Cosmology, Physics 212, Harvard University, Cambridge, MA, US
- Spring 2015, Teaching Fellow, The Energetic Universe, SPU 19, Harvard University, Cambridge, MA, US
- Spring 2013, Fall 2012, Spring 2012, Teaching Assistant, Modern Physics, PHYS207, METU, Ankara, Turkey

## Publications

### Peer-reviewed papers (in review or published)

#### Lead author

1. Daylan et al. **TESS discovery of a super-Earth and three sub-Neptunes hosted by the bright, Sun-like star HD 108236.** *AJ*, 161:85, Feb 2021, doi:10.3847/1538-3881/abd73e.
2. Daylan et al. **TESS observations of the WASP-121 b phase curve.** *AJ*, 161:131, Feb 2021, doi:10.3847/1538-3881/abd8d2.
3. Daylan et al. **The Small-scale Structure in Strongly Lensed Systems via Transdimensional Inference.** *ApJ*, 854:141, Feb 2018, doi:10.3847/1538-4357/aaaa1e.
4. Daylan et al. **Inference of Unresolved Point Sources at High Galactic Latitudes Using Probabilistic Catalogs.** *ApJ*, 839:4, Apr 2017, doi:10.3847/1538-4357/aa679e.
5. 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.

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#### Co-lead author

6. Günther and Daylan. **Allesfitter: Flexible Star and Exoplanet Inference From Photometry and Radial Velocity.** *ApJS*, Accepted, Mar 2020, arXiv:2003.14371.
7. Johnson, Sundaresan, Daylan, et al. **RotNet: Fast and Scalable Estimation of Stellar Rotation Periods Using Convolutional Neural Networks.** *NeurIPS 2020*, Dec 2020.
8. Wong, Shporer, Daylan, 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
9. Badenas-Agusti, Günther, Daylan, 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.
10. Feder, Portillo, Daylan, et al. **Multiband Probabilistic Cataloging: A Joint Fitting Approach to Point Source Detection and De-blending.** *AJ*, 159:163, Apr 2020, doi:10.3847/1538-3881/ab74cf.
11. Portillo, Lee, Daylan, et al. **Improved Point-source Detection in Crowded Fields Using Probabilistic Cataloging.** *AJ*, 154:132, Oct 2017, doi:10.3847/1538-3881/aa8565.

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#### Contributing author (i.e., significant contribution to analyses, figures, or sections in addition to editing of the manuscripts.)

12. Smith et al. **GRB 191016A: A Long Gamma-Ray Burst Detected by TESS.** *ApJ*, Accepted, Feb 2021, arXiv:2102.11295 .
13. Crossfield et al. **Phase Curves of Hot Neptune LTT 9779b Suggest a High-Metallicity Atmosphere.** *ApJL* 903:L7, Oct 2020, doi:10.3847/2041-8213/abbc71.
14. Dragomir et al. **Spitzer Reveals Evidence of Molecular Absorption in the Atmosphere of the Hot Neptune LTT 9779b.** *ApJL* 903:L6, Oct 2020, doi:10.3847/2041-8213/abbc70.
15. Vanderburg et al. **A giant planet candidate transiting a white dwarf.** *Nature*, Sep 2020, doi:10.1038/s41586-020-2713-y.
16. Günther et al. **Complex Modulation of Rapidly Rotating Young M Dwarfs: Adding Pieces to the Puzzle.** Submitted, Aug 2020, arXiv:2008.11681
17. Kane et al. **Transits of Known Planets Orbiting a Naked-Eye Star.** *AJ* 160:129, Jul 2020, doi:10.3847/1538-3881/aba835.
18. Basturk et al. **A holistic and probabilistic approach to the ground-based and spaceborne data of HAT-P-19 system.** *MNRAS*, 496:4174, Jun 2020, doi:10.1093/mnras/staa1758.
19. Pepper et al. **TESS Reveals HD 118203b to be a Transiting Planet.** *AJ*, 159:243, Jun 2020, doi:10.3847/1538-3881/ab84f2.
20. Wong et al. **Exploring the atmospheric dynamics of the extreme ultra-hot Jupiter KELT-9b using TESS photometry.** *AJ*, 160:88, Oct 2019, doi:10.3847/1538-3881/aba2cb.
21. Yu et al. **Identifying Exoplanets with Deep Learning III: Automated Triage and Vetting of TESS Candidates,** *AJ*, 158:25, Jul 2019, doi:10.3847/1538-3881/ab21d6.
22. Fausnaugh et al. **Early Time Light Curves of 18 Bright Type Ia Supernovae Observed with TESS.** *ApJ*, Accepted, Apr 2019, arXiv:1904.02171.
23. 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.
24. Bouma et al. **WASP-4b Arrived Early for the TESS Mission.** *AJ*, 157:217, Jun 2019, doi:10.3847/1538-3881/ab189f.
25. Günther et al. **Stellar Flares from the First Tess Data Release: Exploring a New Sample of M-dwarfs.** *AJ*, 159:60, Feb 2020, doi:10.3847/1538-3881/ab5d3a.
26. Shporer et al. **TESS Full Orbital Phase Curve of the WASP-18b System.** *AJ*, 157:178, May 2019, doi:10.3847/1538-3881/ab0f96.
27. Schlafly et al. **The DECam Plane Survey: Optical Photometry of Two Billion Objects in the Southern Galactic Plane.** *ApJS*, 234:39, Feb 2018, doi:10.3847/1538-4365/aaa3e2.

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Collaborating author (i.e., based on research work for a collaboration in addition to editing of the manuscripts.)

28. Hobson et al. **A transiting warm giant planet around the young active star TOI-201.** AJ, Accepted, Mar 2021, arXiv:2103.02685.
29. Osborn et al. **A hot mini-Neptune in the radius valley orbiting solar analogue HD 110113.** MNRAS, Accepted, Jan 2021, arXiv:2101.04745.
30. Powell et al. **TIC 168789840: A Sextuply-Eclipsing Sextuple Star System.** Submitted, Jan 2021, arXiv:2101.03433.
31. Zhou et al. **Two young planetary systems around field stars with ages between 20-320 Myr from TESS.** Submitted, Nov 2020, arXiv:2011.13349.
32. Dreizler et al. **The CARMENES search for exoplanets around M dwarfs – LP 714-47b (TOI 442.01): Populating the Neptune desert.** Submitted, Nov 2020, arXiv:2011.01716.
33. Dai et al. **TKS III: A Stellar Obliquity Measurement of TOI-1726 c.** Submitted, Aug 2020, arXiv:2008.12397.
34. 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
35. Ikwut-Ukwa et al. **The K2&TESS Synergy I: Updated Ephemerides and Parameters for K2-114, K2-167, K2-237, & K2-261.** AJ, 160:209, Jul 2020, arXiv:2007.00678.
36. Dalba et al. **The TESS-Keck Survey. I. A Warm Sub-Saturn-mass Planet and a Caution about Stray Light in TESS Cameras.** AJ, 159:241, May 2020, doi:10.3847/1538-3881/ab84e3.
37. Addison et al. **TOI-257b (HD 19916b): A Warm sub-Saturn on a Moderately Eccentric Orbit Around an Evolved F-type Star.** MNRAS, Accepted, Dec 2020.
38. Gilbert et al. **The First Habitable Zone Earth-sized Planet from TESS. I: Validation of the TOI-700 System.** AJ, 160:116, Jan 2020. doi:10.3847/1538-3881/aba4b2.
39. Shporer et al. **GJ 1252 b: A 1.2  $R_{\oplus}$  planet transiting an M3-dwarf at 20.4 pc.** ApJL, 890:L7, Feb 2020, doi:10.3847/2041-8213/ab7020.
40. Jordan et al. **TOI-677 b: A Warm Jupiter ( $P=11.2d$ ) on an eccentric orbit transiting a late F-type star.** AJ, 159:145, Apr 2020, doi:10.3847/1538-3881/ab6f67.
41. Dawson et al. **TOI-216b and TOI-216c: Two warm, large exoplanets in or slightly wide of the 2:1 orbital resonance,** AJ, 158:65, Aug 2019, doi:10.3847/1538-3881/ab24ba.
42. 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, 491:2982, Jan 2020, doi:10.1093/mnras/stz3150.
43. 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, 157:191, May 2019, doi:10.3847/1538-3881/ab11d9.
44. Quinn et al. **Near-resonance in a system of sub-Neptunes from TESS.** AJ, 158:177, Nov 2019, doi:10.3847/1538-3881/ab3f2b.

#### Proceedings

45. S. Schael et al. **Precision measurements of the electron spectrum and the positron spectrum with AMS,** ICRC 2013, Rio De Janeiro, 2013
46. J. Casaus et al. **Determination of the positron anisotropy with AMS,** ICRC 2013, Rio De Janeiro, 2013
47. V. Choutko et al. **Precision Measurement of the Cosmic Ray Helium Flux with AMS Experiment,** ICRC 2013, Rio De Janeiro, 2013
48. S. Haino et al. **Precision measurement of the proton flux with AMS,** ICRC 2013, Rio De Janeiro, 2013
49. A. Oliva et al. **Precision Measurement of the Cosmic Ray Boron-to-Carbon Ratio with AMS,** ICRC 2013, Rio De Janeiro, 2013
50. B. Bertucci et al. **Precision measurement of the  $e^+ + e^-$  spectrum with AMS,** ICRC 2013, Rio De Janeiro, 2013

## 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 Invited Talks

- *Discovery of the HD 108236 multiplanetary system with a bright Sun-like star*, Ohio State University, Remote, 26 January 2021
- *Taking a census of dark matter substructure via transdimensional gravitational imaging*, Stanford University, Remote, 15 December 2020
- *Recharacterization of the atmosphere of WASP-121b*, University of Florida, Remote, 9 April 2020
- *Hot Jupiters and the TESS phase curve of WASP-121b*, Yale University, New Haven CT, 19 November 2019
- *TESS phase curve of WASP-121b*, University of Arizona, Tucson AZ, 30 October 2019
- *Probing the small-scale structure in strong lenses with PCAT*, Caltech/JPL, Pasadena CA, 4 March 2019
- *Inner Milky Way Gamma Ray Excess*, Cape Cod Astronomical Society, South Yarmouth MA, 5 January 2017

## Selected Contributed Talks

- *TOI 1233: A quartet of exoplanets discovered by TESS*, TESS Science Meeting 20, Remote, 11 June 2020
- *TESS observations of the WASP-121b phase curve*, AAS235, Honolulu HI, 5 January 2020
- *TESS phase curve of WASP-121b*, BAESM, Cambridge MA, 5 April 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
- *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 at University of Delaware, Lewes DE, 31 May 2014
- *Anomalous Gamma-Ray Emission from the Inner Galaxy*, Harvard University, Cambridge MA, 07 May 2014
- *Photon Reconstruction In Calorimetric Mode*, AMS Collaboration Meeting at CERN, Geneva Switzerland, 14 February 2013

## Selected Poster Presentations

- *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 Catalogs*, 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