ANIKET SANGHI

Astronomy & Physics Senior at the University of Texas at Austin

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APPOINTMENTS

REU Fellow, Institute for Astronomy, University of Hawai'i at Mānoa, <u>advisor:</u> Dr. Michael C. Liu
SURF Fellow, California Institute of Techonology, <u>advisors:</u> Dr. Dimitri Mawet, Dr. Jason Wang, Jerry Xuan
Research Assistant, University of Texas at Austin, <u>advisors:</u> Dr. Brendan P. Bowler, Dr. Yifan Zhou
TIDES Research Fellow, University of Texas at Austin, <u>advisors:</u> Dr. Michael H. Montogomery, Dr. Zachary P. Vanderbosch
Research Assistant, University of Texas at Austin, <u>advisor:</u> Dr. William M.J. Best
Independent Researcher, University of Texas at Austin, <u>advisor:</u> Dr. Mark L. Daniels

EDUCATION

The University of Texas at Austin   **Anticipated May 2023**

Degrees: B.S. Astronomy (2019-2023), B.S. Physics (2019-2023)   GPA: 4.0/4.0
Honors: Distinguished College Scholar (top 4% in the College of Natural Sciences), CNS Second Year Excellence Award
Major Awards: Barry M. Goldwater Scholarship (2022), Universities Space Research Association Distinguished Undergraduate Award (2021), NASA Texas Space Grant Consortium STEM Scholarship (2021), and American Astronomical Society's Chambliss Astronomy Achievement Student Award (2021).

PUBLICATIONS & PROGRAMS

Refereed

- Zhou, Y., **Sanghi, A.,** Bowler, B. P., et al., 2022, ApJL, 934, L13. *"HST/WFC3 Hα Direct-Imaging Detection of a Pointlike Source in the Disk Cavity of AB Aur."*
  https://iopscience.iop.org/article/10.3847/2041-8213/ac7fef

- The Astropy Collaboration, Price-Whelan, A. M., Lian Lim, P., et al. (incl. **Sanghi, A.**), 2022. *"The Astropy Project: Sustaining and Growing a Community-oriented Open-source Project and the Latest Major Release (v5.0) of the Core Package"* Accepted to *The Astrophysical Journal.*
  https://ui.adsabs.harvard.edu/abs/2022arXiv220614220T

- **Sanghi, A.,** Zhou, Y., Bowler, B. P., 2022, AJ, 163, 119. *"Efficiently Imaging Accreting Protoplanets from Space: Reference Star Differential Imaging of the PDS 70 Planetary System using the HST/WFC3 Archival PSF Library."*
  https://ui.adsabs.harvard.edu/abs/2022AJ....163..119S

- **Sanghi, A.,** Vanderbosch, Z. P., Montgomery, M. H., 2021, AJ, 162, 133. *"Identifying Periodic Variable Stars and Eclipsing Binary Systems with Long-Term Las Cumbres Observatory Photometric Monitoring of ZTF J0139+5245."*
  https://ui.adsabs.harvard.edu/abs/2021AJ....162..133S

- **Sanghi, A.,** 2021, The College Mathematics Journal, 52(5), 373-379. *"Visualizing the Complex Roots of Quadratic and Cubic Polynomial Functions in Three Dimensions."*
  https://www.tandfonline.com/doi/10.1080/07468342.2021.1969178

Non-Refereed

- **Sanghi, A.,** Best, W. M., Liu, M. C., Magnier, E. A., & Dupuy, T. J., 2021, American Astronomical Society Meeting Abstracts, Vol. 53, 339.08. *"Measuring the Substellar IMF using a 25 pc Volume-Limited Sample of L0-T8 Brown Dwarfs."* **https://ui.adsabs.harvard.edu/abs/2021AAS...23733908S**

- Best, W., **Sanghi, A.,** Liu, M., Magnier, E., & Dupuy, T. 2021, The 20.5th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun (CS20.5), 278. *"The Initial Mass Function and Birth History of Brown Dwarfs in the Solar Neighborhood from a Volume-Limited Sample."* **https://ui.adsabs.harvard.edu/abs/2021csss.confE.278B**

- Bowler, B., Cochran, W., Endl, M., et al. (incl. **Sanghi, A.**), 2022, BAAS, AASTCS9, Exoplanets 4. *"Dynamical Beacons: Discovering and Characterizing Long-period Giant Planets and Brown Dwarfs with Astrometric Accelerations"* **https://ui.adsabs.harvard.edu/abs/2022BAAS...54e4003B/abstract**

Observing Programs

- **Co-Investigator**. *"Confirming the Protoplanet Candidate AB Aur b with Accretion Light Echoes."* HST Cycle-30 GO Program (PI: Dr. Brendan Bowler; 20 orbits).

- **Co-Investigator**. *"Imaging Giant Planets around Young Accelerating Stars."* NASA/Keck 2022B GO Program (PI: Mr. Kyle Franson; 1 night).

- **Co-Investigator**. *"A Search for Accreting Protoplanets within Transition Disk Gaps."* HST Cycle-29 GO Program (PI: Dr. Yifan Zhou; 30 orbits). **https://ui.adsabs.harvard.edu/abs/2021hst..prop16651Z**
- **Co-Investigator**. *"New Substellar Dynamical Masses from Accelerating Stars."* NASA/Keck 2022A GO Program (PI: Dr. Brendan P. Bowler; 1 night).

RESEARCH EXPERIENCE

SUPER-RDI with the Keck-NIRC2 Vortex Coronagraph   **June 2021 − Present**
Dept. of Astronomy, California Institute of Technology   *Dr. Dimitri Mawet, Dr. Jason Wang & Jerry Xuan*
- Leveraged ∼8000 archival point spread function (PSF) observations by the Keck/NIRC2 vortex coronagraph to develop a suite of metrics to rank reference PSFs by their similarity to the science observations and enable the optimal implementation of the RDI strategy.
- Demonstrated significant improvements in exoplanet detection sensitivity levels with this technique compared to the default strategy of using reference stars observed in the same night as the science target.
- Applying developed techniques to analyze a multi-year Keck/NIRC2 survey to study the demographics of exoplanets around M-dwarf stars.

HST/WFC3 Reference Star Differential Imaging (RDI) of PDS 70   **August 2020 − September 2021**
Dept. of Astronomy, Univ. of Texas at Austin   *Dr. Brendan P. Bowler & Dr. Yifan Zhou*
- Demonstrated the applicability of RDI in space-based exoplanet imaging observations by conducting this method with F656N $H\alpha$ Hubble Space Telescope Wide Field Camera 3 (HST/WFC3) images of PDS 70.
- Compiled a reference PSF library from the HST/WFC3 archival PSF library provided by STScI and developed a set of morphology-significance criteria for pre-selection of reference stars to achieve optimal RDI subtraction.
- Detected the planet PDS 70b at an S/N of 5.3. Calibrated the astrometry and photometry of the detection of PDS 70b using a forward-modeling method and injection-recovery testing.
- Calculated the 5σ mass accretion rate and $H\alpha$ luminosity sensitivity levels for potential planets around select transition disk targets suitable for HST observations.
- **First-author paper** on techniques to implement the RDI strategy in space-based observations published in the American Astronomical Society's Astronomical Journal.

Variable Stars in LCO Photometric Data   **January 2020 − May 2021**
Dept. of Astronomy, Univ. of Texas at Austin   *Dr. Michael H. Montgomery & Dr. Zachary P. Vanderbosch*
- Performed aperture photometry and Fourier analysis on over 2000 stars across 1560 LCO images spanning 537 days to find 28 candidate BY Draconis variables, 3 candidate eclipsing binaries of type EA, and 7 candidate eclipsing binaries of type EW.
- Determined that the improved photometric precision per-exposure, due to the longer exposure time for LCO images, combined with lower noise levels, due to the greater time-sampling of LCO photometry, enables us to improve the total number of detections in our field-of-view.
- Demonstrated the applicability of the *Gaia* color-magnitude diagram (CMD) as a powerful classification tool for variable star studies.
- **First-author paper** detailing our results published in the American Astronomical Society's Astronomical Journal.

The Initial Mass Function and Birth History of Brown Dwarfs   **September 2019 − September 2020**
Dept. of Astronomy, Univ. of Texas at Austin   *Dr. William M.J. Best*
- Used population synthesis analysis to obtain one of the most robust and strict constraints on the substellar IMF with a 25-pc volume limited sample of brown dwarfs identified using state-of-the-art parallax measurements.
- Simultaneously constrained the power law form of the initial mass function and tested multiple birth rate models such as the exponential, single-age, and Dupuy & Liu 2017 age distributions, as well as multiple evolutionary models such as those of Saumon & Marley (SM08), and the COND evolutionary models.
- Delivered proof-of-concept on using a 25-pc volume-limited sample of main-sequence stars and brown dwarfs to constrain the Chabrier (2003) lognormal form of the IMF.

Visualizing the Complex Roots of Quadratic and Cubic Functions   **September 2019 − December 2019**
Dept. of Mathematics, Univ. of Texas at Austin   *Dr. Mark L. Daniels*
- Developed a dimensionality reduction technique to visualize the complex roots of quadratic and cubic polynomials using interactive 3D plots in MATLAB.
- Enhanced classroom learning, stimulated original thinking, and offered unique perspectives on topics in undergraduate mathematics using this novel visualization method.
- **First-author paper** describing the technique and its application published in the Mathematical Association of America's (MAA) College Mathematics Journal.

HONORS & AWARDS

Scholarships & Fellowships

- Hou-Li Scholarship in Natural Sciences ($1500) — College of Natural Sciences, UT Austin 07/2022
- Ralph Nelson Endowed Presidential Scholarship ($2500) — University of Texas at Austin 05/2022
- George H. Mitchell Award (Grand Prize/STEM) ($7000) — University Co-op, UT Austin 05/2021
- Barry M. Goldwater Scholar ($7500) — Barry Goldwater Scholarship and Excellence in Education Foundation 03/2022
- John Kelley Texas Amateur Astronomers' Scholarship ($3000) — Dept. of Astronomy, UT Austin 12/2021
- Thomas McGetchin Memorial Distinguished Undergrad. Award ($5000) — Universities Space Research Association 11/2021
- NASA Texas Space Grant Consortium STEM Scholarship ($2000) — NASA Space Grant Consortium 07/2021
- Nancy and William McMinn Endowed Presidential Scholarship in Physics ($3175) — Dept. of Physics, UT Austin 06/2021
- Emory and Ella Peterson Endowed Presidential Scholarship ($2500) — University of Texas at Austin 05/2021
- Summer Undergraduate Research Fellowship ($6620) — Dept. of Astronomy, California Institute of Technology 04/2021
- Carl Stone Benedict Scholarship ($1000) — College of Natural Sciences, UT Austin 07/2020
- John W. Cox Endowment Award for Advanced Studies in Astronomy ($4320) — Dept. of Astronomy, UT Austin 05/2020
- Harwood Family Endowed Scholarship in Natural Sciences ($1500) — College of Natural Sciences, UT Austin 05/2020

Awards

- Best Poster Design ($500) — Longhorn Research Poster Session, Office of Undergraduate Research, UT Austin 04/2021
- CNS Second Year Excellence Award — College of Natural Sciences, University of Texas at Austin 03/2021
- Distinguished College Scholar — University of Texas at Austin 03/2021
- Honorable Mention Research Communication Video — Texas Research Showdown, University of Texas at Austin 03/2021
- Chambliss Astronomy Achievement Student Award — American Astronomical Society 01/2021
- Conference Travel Award ($200) — Dept. of Astronomy, University of Texas at Austin 11/2020

COMMUNITY ENGAGEMENT, LEADERSHIP & SERVICE

Astronomy Students Association, University of Texas at Austin **August 2019 – Present**
Active Outreach Volunteer in Astronomy and Physics *Austin, TX*

- Involved in regular outreach efforts to bring astronomy to a wide audience.
- Communicated my research on brown dwarfs to 40 astronomy students at Kealing Middle School through simplified explanations aided by an interactive PowerPoint presentation using simulations and graphs.
- Explained concepts in physics and astronomy to elementary school students attending "Hot Science – Cool Talks" at the Jackson Geoscience Building using a Doppler Ball demonstration, a Rainbow Wheel, a Supernova Bounce demonstration, a Mars Globe, and a Star Map.
- Set-up a public telescope viewing of Jupiter and Saturn at the Bullock Texas State History Museum in Austin, TX, Old Settler's Park in Round Rock, TX, and Enchanted Rock State Natural Area, TX.

Sanger Learning Center, University of Texas at Austin **August 2020 – Present**
Student Educator and Sanger Learning Center Tutor *Austin, TX*

- Work as a trained tutor at the Sanger Learning Center at UT Austin helping students, one-on-one, understand concepts, principles underlying questions, and problems covered in physics, astronomy, and calculus courses.
- Contribute to the University's core purpose and mission by fostering independent learning using active learning techniques rooted in education research.

Student Leadership Team, Leadership and Ethics Institute (LEI) **January 2020 – December 2020**
LEAP Mentor and Advanced Leader *Austin, TX*

- Led a 7-week workshop on ethical, inclusive, collaborative and value-based leadership as a part of the Leadership Education and Progress (LEAP) program.
- Mentored 12 UT students and helped them formulate their personal definition of leadership, by translating their goals into an action plan to guide them as they progress through college.
- Worked as part of the larger Student Leadership Team at LEI to promote leadership development, diversity, equity, and inclusion across campus.

College Readiness Program, College of Natural Sciences **March 2020 – August 2020**
Tutor Coordinator and College Readiness Mentor *Austin, TX*

- Guided a dedicated three-person team in remote tutoring incoming students at UT Austin in college preparatory mathematics.
- Organized new-student orientation programs, shared key strategies on securing research opportunities and scholarships, and served as their go-to support during the COVID-19 pandemic.

ORAL PRESENTATIONS & POSTERS

Contributed Talks

1. Sanghi, A. et al. "Reference Star Differential Imaging of the PDS 70 planetary system with the HST/WFC3 Archival PSF Library," CHAMPs Exoplanet Early Career Highlight Seminar, Virtual Seminar, January 14, 2022. Watch online (starting 27:30) **here**.

2. Sanghi, A. et al. "SUPER-RDI: Improving Exoplanet Detection Limits at Small Angular Separations with the Keck/NIRC2 Imager," SURF Fall Seminar Day, California Institute of Technology, Virtual Seminar, October 16, 2021. Watch online **here**.

3. Sanghi, A. et al. "Reference Star Differential Imaging of the PDS 70 planetary system with HST/WFC3," Capital of Texas Undergraduate Research Conference, University of Texas at Austin, Virtual Conference, January 26, 2021. Watch online **here**.

4. Sanghi, A. et al. "Reference Star Differential Imaging of the PDS 70 planetary system with HST/WFC3," Society of Physics Students General Meeting, University of Texas at Austin, Virtual Meeting, November 4, 2020.

5. Sanghi, A. et al. "Reference Star Differential Imaging of the PDS 70 planetary system with HST/WFC3," Astronomy Students Association General Meeting, University of Texas at Austin, Virtual Meeting, October 17, 2020.

6. Sanghi, A. et al. "Population Synthesis Simulations: Uncovering the Mass Distribution of Brown Dwarfs in the Solar Neighborhood," Summer Undergraduate Research Seminar, Department of Astronomy, University of Texas at Austin, Virtual Seminar, August 14, 2020. Watch online (starting 1:07:28) **here**.

7. Sanghi, A., and Daniels, M. L., "Visualizing the Complex Roots of Quadratic and Cubic Polynomial Functions in Three Dimensions," UGS303 - From Numbers to Chaos, Research Seminar, University of Texas at Austin, Austin, TX, December 5, 2019.

Contributed Posters

1. Sanghi, A. et al. "Reference Star Differential Imaging of the PDS 70 planetary system with HST/WFC3," Sagan Summer Workshop, NExScI, Virtual Workshop, July 19-23, 2021. View the poster online **here**.

2. Sanghi, A. et al. "Reference Star Differential Imaging of the PDS 70 planetary system with HST/WFC3," Undergraduate Research Forum, University of Texas at Austin, Virtual Forum, April 16, 2021. View the poster online **here**.

3. Sanghi, A. et al. "Reference Star Differential Imaging of the PDS 70 planetary system with HST/WFC3," Longhorn Research Poster Session, University of Texas at Austin, Virtual Forum, April 14-15, 2021. *Received award for Best Poster Design.* View the poster online **here**.

4. Sanghi, A. et al. "Identifying Periodic Variable Stars and Eclipsing Binary Systems with Long-Term Las Cumbres Observatory Photometric Monitoring of ZTF J0139+5245," Freshman Research Initiative Poster Session: Exploring the Physics of White Dwarf Stars, University of Texas at Austin, Virtual, December 8, 2020. View the poster online **here**.

5. Sanghi, A. et al. "Measuring the Substellar IMF using a 25 pc Volume-Limited Sample of L0-T8 Brown Dwarfs," 237th American Astronomical Society Meeting, Virtual Meeting, January 13, 2021. *Received Chambliss Astronomy Achievement Award for research poster and presentation.* View the AAS 237 iPoster **here**.

6. Sanghi, A. et al. "Population Synthesis Simulations: Uncovering the Mass Distribution of Brown Dwarfs in the Solar Neighborhood," Undergraduate Research Forum, University of Texas at Austin, Virtual Forum, April 16, 2020. View the poster online **here**.

7. Sanghi, A., and Daniels, M. L., "Visualizing the Complex Roots of Quadratic and Cubic Polynomial Functions in Three Dimensions," Undergraduate Research Forum, University of Texas at Austin, Virtual Forum, April 16, 2020. View the poster online **here**.

8. Sanghi, A. et al. "Population Synthesis Simulations: Uncovering the Mass Distribution of Brown Dwarfs in the Solar Neighborhood," Longhorn Research Poster Session, University of Texas at Austin, Virtual Forum, April 14-15, 2020. View the poster online **here**.

9. Sanghi, A., and Daniels, M. L., "Visualizing the Complex Roots of Quadratic and Cubic Polynomial Functions in Three Dimensions," Longhorn Research Poster Session, University of Texas at Austin, Virtual Forum, April 14-15, 2020. View the poster online **here**.

Public/Outreach Presentations

1. Sanghi, A. et al. "Reference Star Differential Imaging of the PDS 70 planetary system with HST/WFC3," 2021 Texas Research Showdown, Video Competition at the University of Texas at Austin. *Received honorable mention for research communication video (200+ views).* Watch online **here**.

2. Sanghi, A., and Daniels, M. L., "Visualizing the Complex Roots of Quadratic and Cubic Polynomial Functions in Three Dimensions," National Public School, Bangalore, India, January 15, 2020.

3. Sanghi, A. et al. "Population Synthesis Simulations: Uncovering the Mass Distribution of Brown Dwarfs in our Solar Neighborhood," Kealing Middle School, Austin, TX, December 10, 2019.

CONFERENCE & WORKSHOP ATTENDANCE

- CHAMPs Exoplanet Early Career Highlight Seminar, CHAMPs Collaboration, January 13-14, 2022.
- Sagan Summer Virtual Workshop, "Circumstellar Disks and Young Planets," NExScI, July 19-23, 2021.
- Code/Astro Virtual Workshop, "Software Engineering in Astronomy," Heising-Simons Foundation, June 21-25, 2021.
- American Astronomical Society's 237th Virtual Meeting, January 10-15, 2021.
- Keck Science Meeting, W. M. Keck Observatory, Virtual Meeting, September 24-25, 2020.
- SciPy 2020 Virtual Conference, "Scientific Computing with Python," July 5-10, 2020.