

# Bertrand MENNESSON

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Jet Propulsion Laboratory, Astrophysics and Space Science Section

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## PROFILE

- Principal scientist with dual background in physical engineering (optics, thermal transfer and material science) and observational astrophysics (exoplanetary systems, debris disks, evolved stars).
- International expert in the technological development and scientific exploitation of state-of-the-art high contrast / high resolution astronomical instruments.
- Over 15 years of experience in technical and science management for NASA missions.
- Currently serving as JPL deputy project scientist for the Wide-Field Infrared Survey Telescope (**WFIRST**) mission and as NASA center scientist for the Habitable Exoplanet Observatory (**HabEx**) concept study. Former Terrestrial Planet Finder Interferometer (**TPF-I**) deputy project scientist (2002-2008).

## PROFESSIONAL EXPERIENCE

### *Jet Propulsion Laboratory*

Science Division, Astrophysics and Space Science section

**Principal Scientist (2009 – present)**

- **JPL WFIRST Deputy Project Scientist** (present).
- **HabEx Study Scientist** (present).  
Co-chair of NASA-appointed HabEx Science and Technology Definition Team. HabEx is one of 4 future large strategic missions being studied by NASA and the astronomical community in preparation for the Astro-2020 decadal survey.
- **LBTI exozodi survey NASA Key Science Team member** (present).  
Leading data reduction / calibration efforts for ultra-precise exozodi measurements, resulting in tenfold improvement over previous state-of-the-art.
- WFIRST Coronagraph Data Post-Processing Task Lead (2014 to 2017)
- Development and scientific exploitation of new high contrast imaging observing and post-processing techniques for coronagraphic and interferometric studies of nearby stars (Keck, Palomar and CHARA telescopes).
- CHARA array observations: Principal Investigator, near-infrared characterization of hot exo-zodiacal disks around nearby stars, NASA APD Exoplanets Research Program grant (2013-2015)
- High contrast observations at the Palomar 200" telescope (NASA APRA grant 2010-14), Science PI
- Extreme Adaptive Optics Observations with a Vector Vortex Coronagraph at Palomar 200", VLT and Subaru telescopes. NASA Origins of Solar Systems grant, 2011-2014, Science PI

### *Fastlite, Inc*

**Chief Technological Officer (2007-2009)**

- High tech start-up (15 employees) manufacturing turn-key acousto-optic systems to shape and measure ultrashort laser pulses at UV to near-infrared wavelengths.
- Main customers are national laboratories (LLNL, LANL, Argon, Sandia, USAF), aerospace companies (Lockheed) and research institutes in biomedical imaging, theoretical chemistry & physics worldwide.
- **Sales increased by 40% between 2007 & 2009, with new product introduced in 2008.**

## ***Jet Propulsion Laboratory***

Instruments and Science Data Systems Division, Large Optical Systems section

**Senior Optical Engineer (2001- 2007)**

- Led the optical integration, test and scientific commissioning of the Keck Interferometer nulling beam combiner. Achieved first coherent recombination of the Keck Telescopes in the mid-infrared obtained in August 2004 (~ 30 people involved). Publication of first science results in 2005. Led Keck Interferometer nulling beam combiner integration & test, on-sky scientific commissioning and completed final scientific data analysis ([NASA-PR 2014-413](#))
- Deputy scientist for the Terrestrial Planet Finder (TPF) interferometer project at JPL. Member of NASA-appointed TPF Science Working Group (SWG) from 2002 to 2008. Main SWG point of contact at JPL for the definition of TPF-I science objectives and architecture trade-offs
- Conducted the first laboratory demonstration of deep white light interferometric cancellation in the mid-infrared (common Keck/ TPF bread-board, 2003)
- Responsible for the on-sky scientific validation of a JPL-made (MDL) four quadrant phase mask coronagraph used for high contrast infrared imaging (Palomar 200" telescope, 2005 to 2007)
- Led laboratory integration and scientific observations with a dual sub-aperture fiber nuller coronagraph used for high contrast infrared imaging at the diffraction limit (Palomar 200" telescope)

## ***Leiden Observatory / ESTEC***

Leiden / Noordwijk, Netherlands

**Research Associate (2000)**

- Conducted study of new optical configurations for the DARWIN space mission at the **European Space Agency (ESTEC)**. Served as a member of ESA-appointed DARWIN Advisory Group
- Advised TRW (now Northrop Grumman) in the study of a mission design for TPF-I
- Led development and scientific exploitation of the IOTA interferometer mid-IR instrument

## **EDUCATION AND TRAINING**

1996-1999	<b>PhD in Astrophysics and Space Techniques (with honors), Observatory of Paris, University Paris 7</b> <i>Contributions to ESA DARWIN exoplanets space mission. Demonstrated first stellar observations worldwide using long baseline broad-band mid-infrared interferometry.</i> Construction, operation and scientific exploitation of a 4-micron single-mode fiber-based beam combiner for the <b>IOTA</b> interferometer. First broad-band mid-infrared coherent recombination of separate telescopes obtained in February 1998. Research work directed and funded by MMS (now AIRBUS Defense and Space), in collaboration with the <b>Harvard-Smithsonian Center for Astrophysics</b>
1995-1996	<b>Graduate Student, Center for Astronomical Adaptive Optics, Steward Observatory, Tucson, USA</b> Contributions to the Multi Mirror Telescope (MMT) Adaptive Optics system, including its pyramid-based wavefront sensor and sodium LASER guide star system
1993-1994	<b>MS Degree in Astrophysics and Space Techniques, Observatory of Paris, University Paris 7 and Institute for Space Astrophysics (Orsay)</b> Majors: Observational Astronomy, High Energy Astrophysics, Cosmology and Gravitational Dynamics. Internship on ESA's exoplanet mission "DARWIN"
1990-1993	<b>MS Degree in Physical Engineering, Ecole des Mines, France</b> Majors: Energy Transfer Phenomena, Process Engineering, Material Sciences and Applied Mathematics

## PROFESSIONAL AWARDS AND TRAINING

2019	NASA Honor Award to the Astrophysics Large Mission Study Teams for the substantial and effective scientific, technical, and management work in developing the Large Mission Concept Studies for the 2020 Astrophysics Decadal Survey.
2019	NASA Honor Award Group Achievement for LBTI, for implementing a project turnaround to deliver world-record measurements of exozodiacal dust to enable the design of future exoplanet imaging missions
2018	Team Award for HabEx Interim Report Team
2017	JPL Voyager Award for exceptional contributions to the WFIRST mission Independent External Technical Review (WIETR)
2015	Selected to participate in JPL Leadership Mentoring Program (class of FY16)
2015	Science Mission Interface Workshop II, JPL, July 2015
2014	Systems Engineering Workshop, Oxnard, December 2-4 2014
2014	Graduated from 2014 UCLA Short Class Program : « Transitioning from Technical to Managerial Responsibilities »
2014	Science Mission Interface Workshop (invitation only), JPL, July 2014
2014	JPL Team Award for outstanding contributions to the AFTA Coronagraph Working Group Team (architecture down-select)
2011	JPL Team Award <i>for excellence in supporting ExEP Public Outreach events</i>
2010 & 2011	JPL Team Award <i>for outstanding contributions to the Exoplanet Exploration Program Technology Demonstration Team</i>
2007	NASA Group Achievement Award <i>for outstanding team work in implementing the Keck Interferometer Nuller</i>
2005	NASA Honors Group Achievement Award <i>for developing the technology for combining light from the two Keck telescopes in the mid-infrared</i>
2005	JPL Team Award <i>for obtaining the first 10 microns fringes with the Keck Telescopes</i>
2004	NASA Tech Brief Award 2004 : <i>A white light nulling interferometer for imaging and spectroscopy of extra-solar planetary systems</i>
2002 & 2004	Spot awards for successful laboratory demonstrations of starlight nulling

## NASA / JPL RESEARCH GRANTS

2013 – 2016	PI : NASA/ Exoplanets Research Program : <i>Near Infrared Characterization of Hot Exozodiacal Disks around Nearby Stars.</i>
2012 – 2015	PI : NASA/ LBTI Exo-zodi Key Science Team Award: <i>High Accuracy Null Depth Measurements of Nearby Main Sequence Stars with the LBTI.</i>
2012 – 2013	Co-I : JPL/ R&TD: Precision Near Infrared Radial Velocity Instrumentation.
2012 – 2015	Co-I : NASA/ Astrophysics Research and Analysis (APRA) Program : Vortex Phase Mask Coronagraphic Techniques for Exoplanet Detection.
2011 – 2015	Co-I NASA/ Origin of Solar Systems Program: <i>High Contrast Observations close to Stars with Vortex Coronagraphy</i> , 2011 to 2015.
2010 – 2014	Science PI : NASA/APRA Program: <i>High Contrast Nulling Interferometry Techniques</i>
2006 – 2009	JPL/ R&TD: <i>a Fiber Nuller for Close Companion Detection at Palomar.</i> Science PI.
2005 – 2009	Science PI: NASA/APRA Program: <i>Faint near neighbor detection with a Fiber Nuller.</i>
2005 – 2009	NASA/ASTID Program : <i>High contrast coronagraphy with a well-corrected off-axis telescope</i> , co-I, 2005-2009

## MEMBERSHIPS

2016 – present	NASA-appointed HabEx Science and Technology Definition Team (co-chair)
2012 – 2015	NASA-appointed LBTI Exo-zodi Key Science Team
2004 – 2007	NASA-appointed Terrestrial Planet Finder Interferometer Science Working Group
2002 – 2004	NASA-appointed Terrestrial Planet Finder Mission Science Working Group
1998 – 2000	ESA-appointed Darwin Mission Technical Advisory Committee
Since 2001	American Astronomical Society

## SELECTED REFEREED ARTICLES

(see [http://adsabs.harvard.edu/abstract\\_service.html](http://adsabs.harvard.edu/abstract_service.html) for all 200+ publications)

- Plavchan et al. 2020, A planet within the debris disk around the pre-main sequence star AU Mic, **Nature**, accepted for publication
- Gaudi, S., Seager, S., **Mennesson, B.** et al. 2019, *The Habitable Exoplanet Observatory (HabEx) Mission Concept Study* [Final report](#)
- **Mennesson, B.** et al. 2019, *The potential of exozodi disks observations with the WFIRST Coronagraph Instrument*, eprint arXiv : 1909.02161
- Serabyn, E., **Mennesson, B.**, Martin S. et al. 2019, *Nulling at short wavelengths: theoretical performance constraints and a demonstration of faint companion detection inside the diffraction limit with a rotating-baseline interferometer*, **MNRAS**, 489, 1
- Gaudi, S., Seager, S., **Mennesson, B.** et al. 2018, *The Habitable Exoplanet Observatory* **Nature Astronomy**, 2, 600
- Ertel, S., Defrere, D., Hinz, P., **Mennesson B.** et al. 2018, *The HOSTS survey – exozodiacal dust measurements for 30 stars*, **AJ**, 155, 194
- Ruane, G., Mawet D., **Mennesson, B.** et al. 2018, *Vortex coronagraphs for the Habitable Exoplanet Imaging Mission (HabEx) concept: theoretical performance and telescope requirements*, **JATIS**, 4a, 5004
- Patru, F. et al. 2017, *The LBTI Fizeau Imager – II. Sensitivity of the PSF and the MTF to adaptive optics errors and piston errors*, **MNRAS** 472, 3288
- Patru, F. et al. 2017, *The LBTI Fizeau Imager – I. Fundamental gain in high contrast imaging sensitivity of the PSF and the MTF to adaptive optics errors and piston errors*, **MNRAS** 472, 3288
- Nunez, P. D., Scott, N.J., **Mennesson, B.** et al. 2017, *A infrared survey of debris-disc stars. VI. Extending the exozodi survey with CHARA/JouFLU*, **A&A**, 608, 113
- Mawet, D. et al. 2017, *Observing exoplanets with high dispersion coronagraphy. II. Demonstration of an active single-mode fiber injection unit*, **ApJ**, 838, 92
- Nunez, P., ten Brummelaar, T., **Mennesson, B.** & Scott, N.J. 2017, *Visibility estimation for the CHARA/JouFLU exozodi survey*, **PASP**, 129, 4002
- Gagne, J. et al. 2016, *A high precision NIR survey of RV variable low-mass stars*, **Astrophysical Journal**, 822, 40
- Gao, P. et al. 2016, *Retrieval of precise radial velocities from near-infrared high resolution spectra of low-mass stars*, **PASP**, 128, 4501
- Defrere, D., Hinz, P., **Mennesson, B.** et al. 2016, *Nulling data reduction and on-sky performance of the Large Binocular Telescope Interferometer*, **ApJ**, 824, 66
- Bottom M., Kuhn, J., **Mennesson, B.** et al. 2015, *Resolving the delta Andromedae spectroscopic binary with direct imaging*, **Astrophysical Journal**, 809, 11
- Kuhn J., **Mennesson, B.**, Liewer K. et al. 2015, *Exploring Intermediate (5-40 au) Scales around AB Aurigae with the Palomar Fiber Nuller*, **ApJ**, 800, 42
- Defrere, D. et al. 2015, *First-light LBT Nulling Interferometric Observations: Warm Exozodiacal Dust Resolved within a Few AU of  $\eta$  Crv*, **Astrophysical Journal**, 799, 42
- **Mennesson, B.**, Millan-Gabet R., Serabyn, E., Colavita M. M. et al. 2014,

*Constraining the Exozodiacal luminosity function of main sequence Stars : Complete Results from the Keck Nuller Mid-Infrared Surveys*, **Astrophysical Journal**, 797, 119

- Mawet D., Pueyo L., Carlotti A., **Mennesson, B.** et al. 2013, *Ring-apodized Vortex Coronagraphs for Obscured Telescopes. I. Transmissive ring Apodizers*. **ApJ** 209, 7
- **Mennesson B.**, Absil O., Lebreton J. et al. 2013, *An Interferometric Study of the Fomalhaut Inner Debris Disk. II. Keck Interferometer Nuller Mid-Infrared Observations*, **Astrophysical Journal**, 763, 119
- Guyon, O., **Mennesson, B.**, Serabyn, E. and Martin, S. 2013, *Optimal Beam Combiner Designs*, **Publications of the Astronomical Society of the Pacific**, 125, 951
- Serabyn E., **Mennesson B.** Colavita M.M et al. 2012, *The Keck Interferometer Nuller*, **Astrophysical Journal**, 748,55
- **Mennesson B.**, Serabyn E., Hanot C. et al. 2011, *New Constraints on Companions and Dust within a few AU of Vega*, **Astrophysical Journal** 736, 14
- **Mennesson B.**, Hanot C., Serabyn E. et al. 2011, *High Contrast Stellar Observations within the Diffraction Limit at the Palomar Hale Telescope*, **ApJ**, 743, 178
- Mawet D., **Mennesson B.**, Serabyn E. et al. 2011, *A Dim Candidate Companion to epsilon Cephei*, **Astrophysical Journal**, 738, 12
- Hanot C., **Mennesson B.**, Martin S. et al. 2011, *Improving Interferometric Null Depth Measurements using Statistical Distributions: Theory and First Results with the Palomar Fiber Nuller*, **Astrophysical Journal**, 729, 110
- Millan-Gabet R., Serabyn E., **Mennesson B.** et al. 2011, *Exozodiacal Dust Levels for Main-sequence Stars: A Survey with the Keck Interferometer Nuller*, **ApJ** 734, 67
- Serabyn E. et al. 2009, *Imaging Faint Brown Dwarf Companions Close to Bright Stars with a Small, Well-corrected Telescope Aperture*. **Astrophysical Journal** 696, 40
- Absil O., **Mennesson B.**, Lebouquin J.P. et al. 2009, *A Study of the Fomalhaut Inner Debris Disk. I. Near-Infrared Detection of Hot Dust with VLTI/VINCI*. **Astrophysical Journal** 704, 150
- Serabyn E. et al. 2007, *Extreme Adaptive Optics Imaging with a Clear and Well-Corrected Off-Axis Telescope Subaperture*, **Astrophysical Journal** 658, 1386
- Cotton W.D., Vlemmings W., **Mennesson B.** et al. 2006. *Further VLBA observations of SiO masers toward Mira variable stars*. **Astronomy & Astrophysics**, 456, 339.
- **Mennesson B.** et al. 2005, *The Dusty AGB Star RS CrB: First Mid-Infrared Interferometric Observations with the Keck Telescopes*. **Astrophysical Journal Letters**, 634, 169
- Cotton W.D., **Mennesson B.**, Diamond P.J. et al. 2004. *VLBA Observations of SiO Masers towards Mira variable stars*. **Astronomy & Astrophysics**, 414, 275
- Perrin G., Ridgway S. T., **Mennesson B.** et al 2004. *Unveiling Mira stars behind the molecules, Confirmation of the molecular layer model with narrow-band near-infrared interferometry*. **Astronomy & Astrophysics**, 426, 279 (Press Release).
- Swain M. et al. 2003. *Interferometer Observations of Subparsec-Scale Infrared Emission in the Nucleus of NGC 4151*. **Astrophysical Journal**, 596, 163 (Pr. release)
- Colavita M. et al. 2003, *Observations of DG Tauri with the Keck Interferometer*, **Astrophysical Journal** , 592L, 83
- Chagnon G., **Mennesson B.**, Perrin G., et al. 2002. *L' Band observations of evolved stars*. **Astronomical Journal**, 124, 2821
- **Mennesson B.**, Perrin G., Coude du Foresto V. et al. 2002. *Evidence for very extended gaseous layers around O-rich Miras and M giants*. **Astrophysical Journal**, 579, 446
- **Mennesson B.**, Ollivier M., and Ruilier C., 2002. *On the use of single-mode waveguides to correct the optical defects of a nulling interferometer*. *Journal of the Optical Society of America (JOSA A)*, vol. 19, num.3, 596

- **Mennesson B.**, Mariotti J.M., Coude du Foresto V. et al, 1999. *Thermal infrared stellar interferometry using single-mode guided optics: first results with the TISIS experiment on IOTA*. **Astronomy & Astrophysics**, 346, 181
- **Mennesson B.** and Mariotti J.M., 1997. *Array configurations for a space infrared nulling interferometer dedicated to the search for Earth-like extra-solar planets*. **Icarus**, 128, 202
- Leger A., Mariotti J.M., **Mennesson B.** et al. 1996. *Could we search for primitive life on extrasolar planets in the near future? The DARWIN project*. **Icarus**, 123, 249

## INVITED PRESENTATIONS & REVIEW TALKS

- **Mennesson B. 2017**, “NASA’s next astrophysics flagship: the Wide Field Infrared Survey Telescope (WFIRST)”, Sagan Exoplanet Summer Workshop, Caltech, Pasadena, August 10 2017
- **Mennesson B. 2016**, IPAC Tutorial Seminar Series: “High Contrast Imaging of Exoplanetary systems and the WFIRST Coronagraph”, Pasadena, 7 September 2016
- **Mennesson, B. 2016**, Thirty Mirror Telescope Science Colloquium, “The Habitable Exoplanet (HabEx) Imaging Mission”, TMT Headquarters, Pasadena, 10 August 2016
- **Mennesson B. 2016**, Special Session on NASA 2020 Decadal survey studies: “The Habitable Exoplanet (HabEx) Imaging Mission: preliminary science drivers and technical requirements”, Astronomical Telescopes and Instrumentation SPIE international meeting, Edinburg, UK, 27 June 2016
- **Mennesson B. 2016**, Exoplanet Exploration Program Advisory Group Meeting #14, “HabEx Mission concept study Update”, San Diego, 12 June 2016
- **Mennesson B. 2016**, NASA Astrophysics Subcommittee Meeting, “HabEx Imaging Mission Concept Study Planning”, NASA HQ, 16 March 2016
- **Mennesson B. 2016**, AAS Special Session on NASA 2020 Decadal survey STDT studies: “The HabEx Mission Study”, Kissimmee, Florida, 6 January 2016
- **Mennesson B. 2015**, Workshop on “Hot Dust around Main Sequence Stars: Observations, Theory and future Prospects”, Scientific Chair, Caltech May 20-22
- **Mennesson B. 2014**. *Constraining the exo-zodiacal luminosity function of main sequence stars*, Keck Science Meeting, Pasadena, Oct 2 2014
- **Mennesson B. 2013**. *Some Astronomical Applications of High Accuracy Stellar Interferometry*, Invited Speaker, OHP Colloquium on Improving the performance of current optical interferometers & future designs, France, 23-27 September 2013
- **Mennesson B. 2012**. *Nulling Interferometry from Keck: Science Highlights*. Review talk, SPIE Meeting, Amsterdam July 1-6, Astronomical Telescopes and Instrumentation, Optical and Infrared Interferometry Conference
- **Mennesson B. 2006**. *Studying evolved stars: what can be learnt from optical/infrared interferometry?* Course of the 2006 Michelson Summer School, Pasadena, USA.
- **Mennesson B. 2001**. *The FLUOR instrument of the IOTA interferometer: data reduction and physical interpretation*. Course of the May 2001 Michelson Summer School. P Lawson Editor, JPL Press, Pasadena.
- **Mennesson B.** and Woolf N. **1999**. *Review paper: nulling interferometry from space: recent concepts*. DARWIN and Astronomy Conference, Stockholm, November 1999
- **Mennesson B. 1995**. *Plans in Europe for Remote sensing of Earth-like extrasolar planets. Exploration of neighboring planetary systems*. NASA Kick-off workshop for Road Map Study Teams. S. Unwin Editor, JPL, Pasadena, 19 April 1995.

## REVIEWER / CONTRACT MANAGER ROLES

- Subject Matter Expert reviewer for R&TD Topic Proposals 2016 & 2019
- Subject Matter Expert reviewer for R&TD Strategic Initiatives 2016 & 2019
- Subject Matter Expert reviewer for SURP Proposals 2018 & 2019
- Preparation / Management (CTM) of WFIRST Data Post-processing sub-contracts to Space Telescope Science Institute and Caltech/IPAC
- Preparation/ Management of ROSES grant sub-contract to Georgia State University: software development in support of CHARA observations
- Reviewer: Exoplanet Science Initiative JPL internal proposals (2014)
- Reviewer: postdoc recruitments, JPL Astrophysics and Space Science Section
- Reviewer: NASA Exoplanet Research Program (2013 & 2014)
- Scientific Journals Referee : *Astrophysical Journal* (since 2004), *Astronomy and Astrophysics* (since 2003), *Monthly Notices of the Royal Astronomical Society*
- Reviewer *NASA Small Business Innovative Research (SBIR) Awards* 2005 - 2007, and 2011-2012 SBIR Technical Monitor (Deformable Mirrors Developments)