

Prashant PATHAK

RESEARCH INTEREST

- High-contrast imaging of Exoplanets
- Adaptive Optics
- Astronomical instrumentation

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WORK EXPERIENCE

- PostDoc Fellow at [University of Liège](#), Liège, Belgium. 2021-Present
- Engineering and Technology Research Fellow at [European Southern Observatory \(ESO\)](#), Garching, Germany. 2018-2021

PROJECTS

- **Predictive Control:** Development and integration of predictive control techniques for single-conjugate adaptive optics systems.
- **METIS:** Simulating the performance of various High Contrast Imaging (HCI) modes of the instrument. I also co-developed a general purpose HCI simulator called High-contrast End-to-End Performance Simulator ([HEEPS](#)).
- **NEAR:** The work involved packaging (pre-processing) a large amount of science observation and post-processing of the data. The project helped me to gain key insights into working of the mid-IR observation.
- **DM development:** Studying the temporal and spatial dynamics of a deformable mirror at very high-frame rate. The project involved setting of a Shack-Hartmann based wavefront sensor, characterization and data analysis.

EDUCATION

- PhD, Astronomy (Instrumentation) 2014-2017
[The Graduate University for Advance Studies \[SOKENDAI\]](#), Japan
- Integrated Bachelor & Master of Science (BS-MS) 2008-2013
[Indian Institute of Science Education and Research -Thiruvananthapuram](#), India

RESEARCH EXPERIENCE

OCT
2014-SEPT
2017

PhD Research: On-sky closed-loop correction of atmospheric dispersion for high-contrast coronagraphy and astrometry

Supervisor: [Prof. Olivier Guyon](#)

ABSTRACT: For direct detection of habitable exoplanets, located at a small angular separation from the host star, it is crucial to employ small inner working angle (IWA) coronagraphs that efficiently suppress starlight. For ground-based telescopes, atmospheric refraction is also an important factor, since it results in a smearing of the PSF, that can no longer be efficiently suppressed by the coronagraph. For a high-contrast instrument like SCExAO system, which employs very small IWA coronagraphs, refraction-induced smearing of the PSF has to be less than 1 mas in the science band for optimum performance. By using an adaptive speckle grid generated using a deformable mirror with sufficiently large number of actuators, I was able to accurately measure the residual atmospheric dispersion and subsequently correct it in a closed-loop manner to < 1 mas in the H-band.

[\[Link to PhD thesis\]](#)

AUG 2012-APR
2013

Masters Thesis: Optoelectronic studies of ZnO nanostructures

Supervisor: **Prof. Joy Mitra**

ABSTRACT: *Major part of the project involved designing and building a custom-made room temperature optoelectronic characterization setup, capable of performing optical as well as electrical characterization, and in combination such as Photoluminescence (PL), Electroluminescence. It was crucial to choose the design and optics carefully, as luminescence from the studied material was low for the detection. Building the setup involved assembling, optically matched spectrometer, detector, lasers, optical components. Subsequently, the setup was optimized such that its excitation/detection performance was at par with any commercial instrument, and standardized using common fluorescent dyes.*

[\[Link to Masters thesis\]](#)

SOFTWARE/PROGRAMMING SKILLS

Languages	Developed extensively in Python, MATLAB and Bash, and intermediate knowledge of Mathematica, C, C++, HTML, CSS
Packages	AutoCAD, LabView and Latex

OBSERVING EXPERIENCE

31 Engineering and Science nights with Subaru adaptive optics AO188, SCEXAO, Coronagraphic High Angular Resolution Imaging Spectrograph (CHARIS) and high contrast instrument for next generation adaptive optics (HICIAO).

SCHOOLS & WORKSHOPS ATTENDED

- EuroSciPy 2019
Bilbao, Spain. Sept-2019
- Workshop Week @ Durham 2018 on Adaptive Optics
Durham University, UK March-2018
- 17th Annual International Summer School on Adaptive Optics
Center for Adaptive Optics, University of California, Santa Cruz, USA Aug-2017
- Summer School on Introduction to Astronomical Instrumentation
Dunlap Institute for Astronomy, University of Toronto, Canada Aug-2016
- NExSS Arizona Winter School on Consequences of Internal Planet Evolution for the Habitability and Detectability of Life on Extrasolar Planets.
Arizona State University, USA Feb-2016
- Winter school on Ultracold Atoms for fundamental science and enabling technologies
IISER-Pune, India and University of Nottingham, UK Dec-2012
- IndIGO school on Gravitational Waves
University of Delhi, Inter University Centre for Astronomy and Astrophysics (IUCAA), and Tata Institute of Fundamental Research (TIFR), India Dec-2010
- Summer school on Astrophysics
Indian Institute of Astrophysics (IIA) Bangalore, India May-2010
- Winter school on Radio Astronomy
National Centre for Radio Astronomy (NCRA) Pune, India Dec-2009

PRESENTATIONS

- NEAR campaign data reduction.
HCI post-processing workshop, Berlin, Germany. Jan-2020
- A Shack-Hartmann based setup to study deformable mirrors dynamics at very high framerates.
AO4ELT6, Quebec, Canada Jun-2019
- A Shack-Hartmann based setup to study deformable mirrors dynamics at very high framerates.
Wavefront sensing and control in the VLT/ELT era, Paris, France. Oct-2018
- HEEPS: High-contrast End-to-end ELT Performance Simulator package
VORTEX yearly meeting, Liège, Belgium. Aug-2018
- Closed-loop correction of atmospheric dispersion to achieve high-Strehl ratio with TMT.
Thirty Meter Telescope Science Forum 2017, Mysore, India. Nov-2017
- Closed-loop atmospheric dispersion compensation: on-sky demonstration of sub-milliarcsecond residual dispersion across H-band.
AO4ELT5, Tenerife, Spain Jun-2017
- Closed-loop correction of residual atmospheric dispersion in high-contrast imaging systems.
Institute for Astronomy (IfA), Hilo, Hawaii, USA. Oct-2016
- First on-sky closed loop measurement and correction of atmospheric dispersion.
SPIE Astronomical Telescopes & Instrumentation, Edinburgh, UK. Jun-2016

ASTRONOMY OUTREACH

Journey through the Universe educator, a public education program held annually by GEMINI Observatory in Hilo, Hawaii.

EXTRACURRICULAR ACTIVITIES AND HOBBIES

I have participated in organizing various cultural and technical events at my institute and was the leading member of the Photography and the Astronomy club. I have an inherent fascination towards nature and have been part of various bird watching clubs and have gone to several field trips.

REFERENCES

Prof. Olivier Absil

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Dr. Markus Kasper

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Dr. Olivier Guyon

Subaru Telescope, Hawaii/
University of Arizona, USA.
Email: guyon@naoj.org
Contact: +1-808-934-5901

PUBLICATIONS

PEER-REVIEWED PAPERS

1. **Pathak P.**, Kasper M. et al. “*New Earths in Alpha-Cen Region Campaign: technical analysis and lessons learned for the future mid-IR HCI instruments.*”, 2022, under prep.
2. Bowens R., Meyer M., Delacroix C., Absil O., Boekel van R., Quanz S. P., Shinde M., Kenworthy M., Carlomagno B., Orban de Xivry G., Cantalloube F., **Pathak P.**, “*Exoplanets with ELT-METIS I: Estimating the direct imaging exoplanet yield around stars within 6.5 parsecs*”, 2021, [A&A, 653, A8](#).
3. Viswanath G., Janson M., Dahlqvist C. H., Petit dit de la Roche D. J. M., Samland M., Girard J., **Pathak P.**, Kasper M., Feng F., Meyer M., Boehle A., Quanz S. P., Jones H.R.A., Absil O., Brandner W., Maire A. L., Siebenmorgen R., Sterzik M., Pantin E., “*Constraints on the nearby exoplanet ϵ Indi Ab from deep near- and mid-infrared imaging limits*”, 2021, [A&A 651 A89](#).
4. **Pathak P.**, Petit dit de la Roche D. J. M., Kasper M., Sterzik M., Absil O., Boehle A., Feng F., Ivanov V. D., Janson M., Jones H.R.A., Kaufer A., Käufl H.-U., Maire A.-L., Meyer M., Pantin E., Siebenmorgen R., Ancker M. E. van den, Viswanath G., “*High contrast imaging at 10 microns, a search for exoplanets around: Eps Indi A, Eps Eri, Tau Ceti, Sirius A and Sirius B*”, 2021, [A&A, 652, A121](#).
5. Wagner K., Boehle A., **Pathak P.**, Kasper M., Arsenault R., Jakob U., Kaufl H.-U., Leveratto S., Maire A.-L., Pantin E., Siebenmorgen R., Zins G., Absil O., Ageorges N., Apai D., Carlotti A., Choquet E., Delacroix C., Dohlen P., Duhoux P., Forsberg P., Fuenteseca E., Gutruf S., Guyon O., Huby E., Kampf D., Karlsson M., Kervella P., Kirchbauer J.-P., Klupar P., Kolb J., Mawet D., N'Diaye M., Orban de Xivry G., Quanz S.P., Reutlinger A., Ruane G., Riquelme M., Soenke C., Sterzik M., Vigan A., de Zeeuw T., “*Imaging Low-Mass Planets Within α Centauri's Habitable Zone*”, 2020, [Nature Communications, 12, 922](#).
6. Turchi A., Masciadri E., **Pathak P.**, Kasper M., “*High-accuracy short-term precipitable water-vapour operational forecast at the Very Large Telescope and perspectives for sky background forecast*”, 2020, [MNRAS, 497, 4910](#).
7. Carlomagno B., Delacroix C., Absil O., Cantalloube F., Orban de Xivry G., **Pathak P.**, Agocs T., Bertram T., Brandl B., Burtscher L., Feldt M., Glauser A., Hippler S., Kenworthy M., Stuik R., van Boekel R., “*METIS high contrast imaging: design and expected performance*”, 2020, [JATIS, 6\(3\), 035005](#).
8. Maire A., Huby E., Absil O., Zins G., Kasper M., Delacroix C., Leveratto S., Karlsson M., Ruane G., Kaufl H., Orban de Xivry G., **Pathak P.**, Pettazzi L., Duhoux P., Kolb J., Pantin E., Riggs A., Siebenmorgen R., Mawet D., “*Design, pointing control, and on-sky performance of the mid-infrared vortex coronagraph for the VLT/NEAR experiment*”, 2020, [JATIS, 6, 035003](#).
9. **Pathak P.**, Guyon O., Jovanovic N., Lozi J., Martinache F., Minowa Y., Kudo T., Kotani T., Takami H., “*On-sky closed loop correction of atmospheric dispersion for high-contrast coronagraphy and astrometry*”, 2018, [PASP 130, 025004](#).
10. Currie T., Kasdin N.J., Groff T.D., Lozi J., Jovanovic N., Guyon O., Brandt T., Martinache F., Chilcote J., Skaf N., Kuhn J., **Pathak P.**, Kudo T., “*Laboratory and On-sky Validation of the Shaped Pupil Coronagraph's Sensitivity to Low-order Aberrations With Active Wavefront Control*”, 2018, [PASP 130, 044505](#).
11. **Pathak P.**, Guyon O., Jovanovic N., Lozi J., Martinache F., Minowa Y., Kudo T., Takami H., Hayano Y., Narita N., “*A high precision technique to correct for residual atmospheric dispersion in high-contrast imaging systems*”, 2016, [PASP 128, 124404](#).
12. Jovanovic N., Guyon O., Martinache F., **Pathak P.**, Hagelberg J., Kudo T., “*Artificial Incoherent Speckles Enable Precision Astrometry and Photometry in High-contrast Imaging*”, 2015, [ApJ, 813, 24J](#).

CONFERENCE PROCEEDINGS / NON PEER-REVIEWED

1. Kasper M., Arsenault R., Käufl U., Jakob G., Leveratto S., Zins G., Pantin E., Duhoux P., Riquelme M., Kirchbauer J. P., Kolb J., **Pathak P.**, Siebenmorgen R., Soenke C., Fuenteseca E., Sterzik M., Ageorges N., Gutruf S., Kampf D., Reutlinger A., Absil O., Delacroix C., Maire A. L., Huby E., Guyon O., Klupar P., Mawet D., Ruane G., Karlsson M., Dohlen K., Vigan A., N'Diaye M., Quanz S., Carlotti A., “*NEAR: First Results from the Search for Low-Mass Planets in α Cen*”, 2019, [The Messenger 178: 5-9](#)

2. Lozi J., Guyon O., Jovanovic N., Goebel S., **Pathak P.**, Skaf N., Sahoo A., “SCE_{ExAO}, an instrument with a dual purpose: perform cutting-edge science and develop new technologies”, 2018, [SPIE, 10703, 1070359](#).
3. Jovanovic N., Guyon O., Lozi J., Currie T., Hagelberg J., Norris B., Singh G., **Pathak P.**, Doughty D., Goebel S., Males J., Kuhn J., Serabyn E., Tuthill P., Schworer G., Martinache F., Kudo T., Kawahara H., Kotani T., Ireland M., Feger T., Rains A., Bento J., Schwab C., Coutts D., Cvetojevic N., Gross S., Arriola A., Lagadec T., Kasdin J., Groff T., Mazin B., Minowa Y., Takato N., Tamura M., Takami H., Hayashi M., “The SCE_{ExAO} high contrast imager: transitioning from commissioning to science”, 2016, [Proc. of SPIE, 9909-9W](#).
4. **Pathak P.**, Guyon O., Jovanovic N., Lozi J., Martinache F., Minowa Y., Kudo T., Takami H., Hayano Y., Narita N., “First on-sky closed loop measurement and correction of atmospheric dispersion”, 2016, [Proc. of SPIE, 9909-56](#).
5. Lozi J., Guyon O., Jovanovic N., Singh G., Doughty D., **Pathak P.**, Goebel S., Kudo T., “SCE_{ExAO}: the most complete instrument to characterize exoplanets and stellar environments”, 2015, [AAS/Division for Extreme Solar Systems Abstracts, 3, 104.03](#).
6. Lozi J., Jovanovic N., Guyon O., Males J., Singh G., Doughty D., **Pathak P.**, Goebel S., Kudo T., Martinache F., “SCE_{ExAO}: the first high contrast exoplanet imager on an ELT?”, 2015, [Proc. of AO4ELT4,31711](#)