Exploring Exoplanets with Interferometry

November 28 - December 2, 2022
Overview Schedule

Monday, November 28, 2022
Keck Center Think Tank, Room 155

Short Courses: Exoplanet Science Meets Interferometry
Foundational Interdisciplinary Lectures

Time	Event	Speaker/Lead
7:30 - 8:15	Institute opens early for workshop check in, **SHOW PROOF OF VACCINATION, take your rapid test, affirm you are not symptomatic nor have had contact with anyone who is,** pick up badge and welcome packet, find seat in the Think Tank	
8:15 - 8:45	Enjoy coffee and breakfast in the Keck Center courtyard	
8:45 - 9:15	Quick Welcome and Participant Introductions (1 minute)	Bertrand Mennesson / Chas Beichman
Short Course #1 - Exoplanet Science Motivations for a mid-IR LIFE-like Mission		
9:15 - 9:35	Searching for Life: General Motivation and Approaches	Tiffany Kataria
9:35 - 9:45	Rocky Exoplanet Science with Ground-Based ELTs	Dimitri Mawet
9:45 - 9:55	The Promises of an IROUV-like Future Flagship for Rocky Exoplanet Science	Bertrand Mennesson
9:55 - 10:15	The Necessity for a Multi-Technique Approach to Rocky Exoplanet Characterization	Chas Beichman
10:15 - 10:35	The LIFE Initiative - Science Prospects and Challenges	Sascha Quanz
10:35 - 10:45	Discussion - Q&A	All
10:45 - 11:15	Break	
Short Course #2 - Primer on Science and Technology from Interferometry		
11:15 - 12:15	Introduction to Interferometry	Gerard van Belle
12:15 - 12:30	Challenges/ Advantages of Interferometry from the Ground	Gautam Vasisht
12:30 - 12:45	Challenges/ Advantages of Interferometry from Space	Charles Beichman
12:45 - 2:15	Short Course Ends: Lunch at Athenaeum	

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Workshop

2:15 - 2:45	Workshop Logistics and Introduction to KISS	Michele Judd
2:45 - 3:30	Study Vision and Goals for this Workshop	Team Leads
3:30 - 4:00	Break	
WG 1: Precursor Science Investigations: Theory		
4:00 - 4:25	Atmospheric Retrievals as a Tool to Define the Requirements for LIFE	Eleonora Alei
4:25 - 4:50	Habitability in Relation to Atmospheric Diversity	Michael Meyer
4:50 - 5:30	Discussion: - What would you need from the instrument team to further refine your studies? Connection between science and what you would want the instrument to do? - Opacity? - Synergistic observations IROUV + LIFE - How important is it to go to 4.5 microns to detect methane feature for LIFE? From a strategic point of view, how convenient is for LIFE to rely on IROUV for the detection of CH4 instead of being self-sufficient (e.g., going to 4.5 microns)? Deliverable: Science Requirements towards Mission Requirements as a function of science question (Andrea's diagram)	Tiffany Kataria and Eleonora Alei
5:30 - 6:00	Pack up and walk to the Athenaeum	All
6:00	Dinner at the Athenaeum	

Tuesday, November 29, 2022 - Keck Center - Think Tank, Room 155		
Draw me a Nuller		
Time	**Event**	**Speaker/Lead**
8:00 - 8:30	Institute Opens - FREE THINK TIME Check in, affirm you are not symptomatic nor have had contact with anyone who is	
8:30 - 9:00	Enjoy coffee and breakfast in the Keck Center courtyard	
9:00 - 9:05	Logistics and Team Lead Goals for the Day	Michele Judd / Team Leads
WG 2: Precursor Science - Observations		
9:05 - 9:10	Introduction, what is precursor science?	Steve Ertel
9:10 - 9:20	Review of IROUV precursor science, anything missing for LIFE? Incl. Exoplanet demographics vs. host star	Michael Meyer
9:20 - 9:30	Ground-based imaging of HZ planets, synergies with Roman CGI, JWST, etc.	Kevin Wagner
9:30 - 9:40	Space-based imaging of planets with SPICE	Taro Matsuo
9:40 - 9:50	Exozodiacal dust	Steve Ertel
9:50 - 10:00	Transit spectroscopy (& transit planet searches?) with focus on mid-IR transit spectra. ARIEL. Note on CHEOP	Andrea Fortier
10:00 - 10:10	How to avoid blind searches (EPRV, astrometry, Gaia precision on bright stars?)	Michael Meyer
10:10 - 10:30	Plenary Discussion: Scrutinize the IROUV precursor science topics, evaluate the relevance of the items on this list for LIFE Create and prioritize a list of LIFE-specific precursor observations	Steve Ertel
10:30 - 11:00	Break	

WG 4: Nulling Architecture, Beam Transport and Nulling Approach		
11:00 - 11:01	Session Scope	Eugene Serabyn
11:01 - 11:06	Short Performance requirements recap	Andrea Fortier / Felix A. Dannert
11:06 - 11:23	Configuration architecture history	Bertrand Mennesson
11:23 - 11:40	Configuration architecture: recent LIFE developments; LIFE error budget	Jonah Hansen
11:40 - 11:45	Lessons learned from JWST about beam quality, scattering, background	Chas Beichman
11:45 - 11:50	Why/when use modal filtering (note: not spatial filter HW)	Bertrand Mennesson
11:50 - 12:00	Nulling beam combiner overview (incl adaptive nuller) and null depth levels	Eugene Serabyn
12:00 - 12:10	LBTI/ground-based nullers (HW, incl. dispersion corr)	Steve Ertel
12:10 - 12:20	Potential LIFE nulling beam combiner architecture	Michael Ireland
12:20 - 12:30	NICE (Nulling Interferometry Cryogenic Experiment)	Adrian Glauser
12:30 - 2:00	Group Picture and Lunch at the Athenaeum	

2:00 - 2:15	Selection of possible third break out session topic	All
2:15 - 3:45	**Break out Discussion WG 2: Precursor Science Investigations: Observations** Scrutinize the IROUV precursor science topics, evaluate the relevance of the items on this list for LIFE Create and prioritize a list of LIFE-specific precursor observations	Steve Ertel + Breakout Group A
2:15 - 3:45	**Break out Discussion WG 4: Nulling architecture, beam transport and nulling approach** 1 - What is the best set of metrics for the overall nulling architecture? 2- What should/might a (non-integrated optics) nulling beamcombiner look like? Is bulk optics (other than spatial filter) a reasonable baseline, especially for longer wavelengths? What is a reasonable wavelength range for a single nuller? i.e. how many null channels does LIFE need? (will be critical for cost). NB this relates to the wavelength range of an adequate spatial filter. How coupled are the architecture and the beamcombiner? Can we lock in a general spacecraft architecture (e.g. Emma X-array like design, but where there may be >4 telescopes or a different configuration) without finalising an exact nulling architecture?	Eugene Serabyn + Breakout Group B
2:15 - 3:45	**Break out Discussion #3: TBD topic**	Break out Group C
3:45 - 4:15	Break	
4:15 - 5:30	Breakout group reports (10 mins each) Discussion	Break out groups
5:30 - 7:30	POSTER*ish* SESSION and Informal food truck dinner at the Keck Center (dinner starts at 6:30 pm)	

Wednesday, November 30, 2022 - Keck Center - Think Tank, Room 155

Key Technologies for Space Interferometry

Time	Event	Speaker/Lead
8:00 - 8:30	Institute Opens - FREE THINK TIME **Take your rapid test if you did not take it in your hotel or at home**, check in, affirm you are not symptomatic nor have had contact with anyone who is	
8:30 - 9:00	Enjoy coffee and breakfast in the Keck Center courtyard	
9:00 - 9:05	Logistics and Team Lead Goals for the Day	Michele Judd / Team Leads
WG #3: Free fliers and Technology		
9:05 - 9:20	Technical Requirements for LIFE, with a focus on free flying architectures	Michael Ireland
9:20 - 9:35	Lessons from TPF free fliers	Daniel Scharf (v)
9:35 - 9:50	Lessons from Free Flying missions	Leonid Pogorelyuk
9:50 - 10:10	Funded missions that are relevant but not interferometry	John Monnier
10:10 - 10:20	Unfunded space interferometry missions being developed (one slide each)	TBD
10:20 - 10:30	Callback talk to the TRLs in talk (1) and what shape we are in. What needs to be done next	Taro Matsuo
10:30 - 11:00	Break	
WG 5: LIFE Technology: Integrated Optics and Interferometric Functions		
11:00 - 11:10	Topic introduction (GRAVITY, mid-IR tech, spatial filtering)	Jean-Philippe Berger
11:10 - 11:20	Recent short wavelength photonics nulling experiments	Romain Laugier
11:20 - 11:30	L band Photonics in ASGARD-NOTT	Denis Defrère
11:30 - 11:40	Kernel Nuller conceptsin photonics - laser inscription	Michael Ireland
11:40 - 11:50	Mid-IR photonics at ETH	Adrian Glauser
11:50 - 12:00	LIFE-5 Guyon like combiner concept	Jonah Hansen
12:00 - 12:30	Plenary discussion	All
12:30 - 2:00	Lunch at the Athenaeum	

2:00 - 2:15	Selection of possible topics for Break out sessions #2 and #3	All
2:15 - 3:45	**Break out Discussion WG 3: Free fliers and associated technology** Which technical requirements were missing? How different (more difficult) are requirements for non-nulling missions. How many key technology gaps associated with free fliers can genuinely be advanced in smaller missions? (not freeflying) Can we agree on the simplest possible baseline required technology set?	Michael Ireland + Breakout Group A
2:15 - 3:45	**Break out Discussion #2: TBD topic**	Breakout Group B
2:15 - 3:45	**Break out Discussion #3: TBD topic**	Breakout Group C
3:45 - 4:15	Break	
4:15 - 5:30	Breakout group reports (10 mins each) Discussion	Break out groups
5:30	Personal Think Time / Spontaneous Discussions	All
6:00	No-host dinner in Pasadena (optional, organized by team lead)	

Thursday, December 1, 2022 - Keck Center - Think Tank, Room 155		
Breaking the Diffraction Limit of Exoplanet Direct Detection from the Ground and Space		
Time	**Event**	**Speaker/Lead**
8:00 - 8:30	Institute Opens - FREE THINK TIME Check in, affirm you are not symptomatic nor have had contact with anyone who is	
8:30 - 9:00	Enjoy coffee and breakfast in the Keck Center courtyard	
9:00 - 9:05	Logistics and Team Lead Goals for the Day	Michele Judd / Team Leads
WG 6: Nulling Data reduction and its impact on mission design		
9:05 - 9:25	Precision Nulling with NSC	Bertrand Mennesson
9:25 - 9:45	High dispersion Nulling with KPIC/VFN (and ELTs, and limitations)	Dimitri Mawet
9:45 - 10:05	Interferometric chopping and kernel nulling	Romain Laugier
10:05 - 10:25	Science instrument null servos	Michael Ireland
10:25 - 10:30	Discussion	All
10:30 - 11:00	Break	
WG 7: High Contrast Ground-based Interferometry		
11:00 - 11:20	Exoplanet characterization and astrometry with VLTI/GRAVITY (15 +5)	Mathias Nowak (v)
11:20 - 11:40	Precision closure phases and astrometric detection of exoplanets at CHARA and VLTI (15 +5)	John Monnier
11:40 - 12:00	Nulling at LBTI (15 +5)	Steve Ertel
12:00 - 12:20	Plan for L-band nuller at VLTI (15 +5)	Denis Defrère
12:20 - 12:30	Future visions for ground-based interferometry	Gail Schaefer / John Monnier
12:30 - 2:00	Lunch on your own	

2:00 - 2:15	Breakout group organization	All
2:15 - 3:45	**Break out Discussion WG 6: Nulling Data reduction and its impact on mission design** Data acquisition strategy/architecture: what is the best strategy for a space nuller? Waveband splitting? Is phase chopping needed? Data reduction: what are the needs / requirements? Can we extend the NSC to chopped nuller? Signal processing: What are the current strategies for signal extraction? What studies/analyses are currently missing? (e.g., multi-planetary systems, exozodis, background contamination sources) PCA background subtraction in nulling. Does it apply to single-mode nuller?	Denis Defrère + Breakout Group A
2:15 - 3:45	**Break out Discussion WG 7: High Contrast interferometry from the ground** What is the current state-of-the-art in terms of detection limits vs separation? What are the current limitations (e.g. polarization effects, dispersion issues)? What are the new instruments promises (Gravity+, Keck VFN, Asgard/NOTT, high res nulling, precise Closure phase). What do we want to achieve in the future (exoplanet spectroscopy, astrometry, exoplanet sizes, exoplanet imaging, planet formation, etc)?	Gail Schaefer + Breakout Group B
2:15 - 3:45	**Break out Discussion #3: Toward a Precursor Space Demo**	Michael Ireland + Break out Group C
3:45 - 4:15	Break	
4:15 - 5:30	Breakout group reports (10 mins each) Discussion	Breakout Groups
5:30	Personal Think Time / Spontaneous Discussions	All
6:00	Dinner at the Athenaeum	

Friday, December 3, 2022 - Keck Center - Think Tank, Room 155		
Toward a Precursor Space Demo		
Time	**Event**	**Speaker/Lead**
8:00 - 8:30	Institute Opens - FREE THINK TIME Check in, affirm you are not symptomatic nor have had contact with anyone who is	
8:30 - 9:00	Enjoy coffee and breakfast in the Keck Center courtyard	
9:00 - 9:05	Logistics and Team Lead Goals for the Day	Michele Judd / Team Leads
WG #10: "Wide" field-of-view Interferometric (spectro)imaging		
9:05 - 9:15	VLTI, CHARA context	Jean-Philippe Berger
9:15 - 9:25	JWST, ELT context	Michael Meyer
9:25 - 9:35	Expected Sensitvity and Imaging Capabilities for LIFE and precursors	John Monnier
9:35 - 9:45	Technical Solutions for Phase Referencing, "wide field", Astrometry	Gautam Vasisht
9:45 - 9:55	Bright Object Science	Gail Schaefer
9:55 - 10:05	Faint Object Science	Eleonora Alei
10:05 - 10:30	Discussion: Other science ideas? How important is phase referencing to LIFE? It has a big effect on architecture and non-exoplanet science. How important is the non-exoplanet science case anyway? is it maybe even a detriment?	All
10:30 - 11:00	Break	

WG #11: Building A Lasting Community		
11:00 - 11:20	Lessons from the Darwin/TPF-I	Malcolm Fridlund / Chas Beichman
11:20 - 11:40	Opportunities for Astronomical Programs with LIFE: Outreach to AStronomical Community	Gael Schaefer / Michael Ireland / Michael Meyer
11:40 - 12:00	Technology and Instrument Opportunties (Ground)-- National/International	Dimitri Mawet / John Monnier / Gerard van Belle
12:00 - 12:30	Technology and Instrument Opportunties (Space) --- National/International	Sascha Quanz / Nicholas Siegler
12:30 - 1:30	Informal box lunch in the Collaboration Courtyard	
1:30 - 2:00	Building an Inclusive and long lasting international community for LIFE in US & Europe	Tiffany Kataria / Andrea Fortier
2:00 - 2:30	Discussion: Community building	All
2:30 - 3:00	Final Report Outline with writing assignments based on 1 final summary chart from each WG	All
3:00 - 3:30	Writing session 1: google doc outline, with introduction and initial prose from each WG	All
3:30 - 4:00	Break	
4:00 - 4:30	Writing session 2	All
4:30 - 4:45	Team Leads summary	Team Leads
4:45 - 5:00	Workshop closeout	Michele Judd
5:00	Workshop ends	