PROCEEDINGS OF SPIE

Adaptive Optics Systems VIII

Laura Schreiber Dirk Schmidt Elise Vernet Editors

17–22 July 2022 Montréal, Québec, Canada

Sponsored by SPIE

Cosponsored by A.D.S. International S.r.I. (Italy) ALPAO S.A.S. (France) Microgate (Italy) NuvuCameras (Canada) TNO (Netherlands)

Published by SPIE

Volume 12185

Part One of Three Parts

Proceedings of SPIE 0277-786X, V. 12185

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings: Author(s), "Title of Paper," in *Adaptive Optics Systems VIII*, edited by Laura Schreiber, Dirk Schmidt, Elise Vernet, Proc. of SPIE 12185, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510653511

ISBN: 9781510653528 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.ora

Copyright © 2022 Society of Photo-Optical Instrumentation Engineers (SPIE).

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.



Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

xxi Conference Committee

Part One

	ASTRONOMY WITH AO I
12185 03	A technology and science gap list for habitable-zone exoplanet imaging with ground-based extremely large telescopes [12185-2]
	ASTRONOMY WITH AO II
12185 05	Exoplanet imaging data challenge, phase II: characterization of exoplanet signals in high-contrast images [12185-4]
12185 06	Towards the development of the Infrared Guide Star Catalogue for the adaptive optics observations by the Thirty Meter Telescope [12185-5]
	PROJECT STATUS (ON-SKY)
12185 07	Closing the loop as an inverse problem: the real-time control of Themis adaptive optics (Invited Paper) [12185-6]
12185 08	The ERIS Adaptive Optics System: first on-sky results of the ongoing commissioning at the VLT-UT4 [12185-7]
12185 09	MagAO-X: current status and plans for Phase II [12185-8]
	NEW IDEAS
12185 OB	High contrast and high resolution sensing and correction of atmospheric turbulence without WFSs and DMs using a digital signal modulated satellite beacon and integrated photonics devices [12185-10]
12185 0C	Absolute instruments as laser guide star adaptive optics relays [12185-11]

	POSTPROCESSING AO DATA I
12185 0D	LBT SOUL data as a science test bench for MICADO PSF-R tool [12185-12]
12185 0E	High contrast imaging at the photon noise limit with WFS-based PSF calibration [12185-13]
	POSTPROCESSING AO DATA II
12185 OH	Towards virtual access of adaptive optics telemetry data [12185-17]
	MODELING AND SIMULATION SOFTWARE
12185 OK	Inverse problem approach in Extreme Adaptive Optics: analytical model of the fitting error and lowering of the aliasing [12185-19]
	MODELING, SIMULATION AND ANALYSIS OF AO SYSTEMS
12185 ON	Aliasing effect of rolling shutter readout in laser guide star wavefront sensing [12185-22]
12185 00	Tip-tilt anisoplanatism in MCAO-assisted astrometric observations [12185-23]
	PROJECT STATUS (UPGRADES)
12185 OP	SIGHT: the Palomar 5m telescope LGS AO system maximizing visible-light spectroscopic sensitivity [12185-24]
12185 0Q	Keck All sky Precision Adaptive optics program overview [12185-25]
12185 OR	On the upgrade path to GLAO and MCAO on the Daniel K. Inouye Solar Telescope [12185-26]
12185 OS	Connecting SPHERE and CRIRES+ for the characterisation of young exoplanets at high spectral resolution: status update of VLT/HiRISE [12185-27]
	CONTROL SYSTEMS
12185 OU	HEART: Gemini North Adaptive Optics (GNAO) real-time controller using the Herzberg Extensible Adaptive Real-time Toolkit (HEART) [12185-29]
12185 0V	Keck adaptive optics facility: real time controller upgrade [12185-30]

	SENSING AND CORRECTION OF WAVEFRONT FRAGMENTATION I
12185 0X	The phase-shifted Zernike wave-front sensor [12185-32]
12185 OY	Residual wavefront control of segmented mirror telescopes [12185-33]
12185 OZ	Controlling petals using fringes: discontinuous wavefront sensing through sparse aperture interferometry at Subaru/SCExAO [12185-34]
	MODELING, SIMULATION AND ANALYSIS OF AO SYSTEMS
12185 11	Impact of water vapor seeing on mid-infrared high-contrast imaging at ELT scale (Invited Paper) [12185-37]
12185 12	ELT METIS wavefront control strategy [12185-38]
	STATUS (ELTS)
12185 14	MAORY/MORFEO at ELT: general overview up to the preliminary design and a look towards the final design [12185-40]
	SENSING AND CORRECTION OF WAVEFRONT FRAGMENTATION II
12185 16	First lab results of segment/petal phasing with a pyramid wavefront sensor and a novel holographic dispersed fringe sensor (HDFS) from the Giant Magellan Telescope high contrast adaptive optics phasing testbed [12185-42]
12185 17	The Giant Magellan Telescope natural guidestar adaptive optics mode: improving the robustness of segment piston control $[12185-43]$
12185 18	Phasing the segmented Giant Magellan Telescope: progress in testbeds and prototypes [12185-44]
	SENSING AND CORRECTION OF WAVEFRONT FRAGMENTATION III
12185 1A	Fizeau-interferometry fringe tracking solutions for giant segmented telescope petal modes [12185-46]
12185 1B	HARMONI at ELT: wavefront control in SCAO mode [12185-47]

	CONTROL SYSTEMS (ELTS)
12185 1C	Overview and status of the GMT wavefront control system [12185-48]
12185 1D	The MICADO first light imager for the ELT: final design and prototype of the MICADO SCAO RTC [12185-49]
	WAVEFRONT SENSING WITH LASER GUIDE STARS I
12185 1G	Laser modulation to reduce the dependence on natural guide star for focus sensing: simulations and preliminary results. [12185-52]
	WAVEFRONT SENSING WITH LASER GUIDE STARS II
12185 11	Simultaneous sodium profile estimation and LGS WFS pixel processing optimization using Shack-Hartmann subaperture images [12185-54]
12185 1J	Experimental trials with the optical differentiation wavefront sensor for extended objects [12185-55]
12185 1K	The Ingot WFS on an ELT-like telescope: the project and simulations [12185-56]
	DAVID L. FRIED MEMORIAL SESSION: ATMOSPHERIC DISTURBANCES I
12185 1M	FASS results and comparison with SCIDAR and MASS (Invited Paper) [12185-57]
12185 1N	Wavefront curvature autocovariance: its theoretical properties and potential use for C^2_n profiling [12185-58]
12185 10	Towards higher resolution profiling using filtered laser-based adaptive optics telemetry [12185-59]
	DAVID L. FRIED MEMORIAL SESSION: ATMOSPHERIC DISTURBANCES II
12185 1P	Characterizing atmospheric turbulence over Maunakea through temporal tomography [12185-60]
12185 1Q	Towards operational optical turbulence forecast systems at different time scales [12185-61]
12185 18	Fighting the devil within: improving image quality by thwarting local turbulence [12185-63]

12185 IT	Lessons learned from the NEAR experiment and prospects for the upcoming mid-IR HCI instruments [12185-64]
	CALIBRATION
12185 1U	Imaged-based adaptive optics wavefront sensor referencing for high contrast imaging [12185-65]
12185 1V	Daytime calibration and testing of the Keck All sky Precision Adaptive optics tomography system [12185-66]
	STATUS I
	31A1031
12185 1W	TROIA adaptive optics system for DAG telescope: assembly and laboratory performance prior to on-sky assessment $[12185-68]$
12185 1X	An adaptive optics upgrade for the Automated Planet Finder telescope using an adaptive secondary mirror [12185-69]
12185 1Y	Deployment of focal plane WFS technologies on 8-m telescopes: from the Subaru SPIDERS pathfinder, to the facility-class GPI 2.0 CAL2 system [12185-70]
12185 1Z	Adaptive Optics at the European Solar Telescope: status and future developments [12185-71]
	STATUS II
12185 20	MAVIS: preliminary design of the adaptive optics module [12185-72]
12185 21	ULTIMATE-Subaru: GLAO preliminary design overview [12185-73]
12185 22	SHARK-NIR, ready to "swim" in the LBT Northern Hemisphere "ocean" [12185-74]
12185 23	Laboratory acceptance and telescope integration readiness of the Gran Telescopio Canarias adaptive optics system [12185-75]
	WAVEFRONT MODULATING DEVICES I
	WAVELLOIN MODULATING DEVICES I
12185 24	The optical and mechanical design for the 21,000 actuator ExAO system for the Giant Magellan Telescope: GMagAO-X [12185-76]
12185 26	ESO's ultra-fast wavefront sensor unveils the mysteries of deformable mirrors' temporal behaviour [12185-78]

WAVEFRONT MODULATING DEVICES II 12185 27 Exploration of a large-aperture silicon carbide deformable mirror for use in DKIST MCAO [12185-79] 12185 28 Preliminary design of the Adaptive Secondary Mirror for the European Solar Telescope [12185-80] **WAVEFRONT SENSING FOR HIGH-CONTRAST IMAGING I** 12185 2B Laboratory demonstrations of EFC and spatial LDFC on Subaru/SCExAO [12185-83] 12185 2C Performance of the Fast Atmospheric Self Coherent camera at the NEW-EARTH lab and a simplified measurement algorithm [12185-84] 12185 2E HARMONI at ELT: a Zernike wavefront sensor for the high-contrast module: testbed results with realistic observation conditions [12185-86] **WAVEFRONT SENSING FOR HIGH-CONTRAST IMAGING II** 12185 2F Calibration and performances of the integrated Mach-Zehnder (iMZ) wavefront sensor for extreme adaptive optics [12185-87] 12185 2G Exoplanet detection with photonic lanterns for focal-plane wavefront sensing and control [12185-88] 12185 2H Various wavefront sensing and control developments on the Santa Cruz Extreme AO Laboratory (SEAL) testbed [12185-89] **WAVEFRONT SENSING** 12185 2I Machine learning for wavefront sensing (Invited Paper) [12185-90] 12185 2J Solar wavefront sensing at THEMIS with self-calibrated reference image and estimation of the noise covariance [12185-91] 12185 2K Optimizing wavefront sensor design for partially coherent beacons [12185-92] 12185 2L Image-to-image translation for wavefront and PSF estimation [12185-93]

	DETECTORS AND CAMERAS FOR WAVEFRONT SENSING
12185 2M	MKID: an energy sensitive superconducting detector for the next generation of XAO [12185-94]
12185 2N	C-BLUE One : a family of CMOS high speed cameras for wavefront sensing [12185-95]
	WAVEFRONT RECONSTRUCTION AND CONTROL ALGORITHMS I
12185 20	Advances in model-based reinforcement learning for adaptive optics control [12185-302]
12185 2P	The MICADO first light imager for the ELT: SCAO LQG control performance with windshake, vibrations, and mirror dynamics [12185-309]
12185 2Q	Beyond FRiM, ASAP: a family of sparse approximation for covariance matrices and preconditioners [12185-97]
Part Two	
12185 2R	Linear quadratic Gaussian predictive control for the Gran Telescopio Canarias AO system: design issues and first bench results [12185-98]
12185 2\$	Predictive adaptive optics for satellite tracking applications: optical communications and satellite observation [12185-99]
	WAVEFRONT RECONSTRUCTION AND CONTROL ALGORITHMS II
12185 2T	Optimizing Fourier-filtering WFS to reach sensitivity close to the fundamental limit (Invited Paper) [12185-100]
12185 2U	Model-free reinforcement learning with a non-linear reconstructor for closed-loop adaptive optics control with a pyramid wavefront sensor [12185-101]
	LASER GUIDE STARS
12185 2Z	A brief history of flux, or the ups and downs of the Na layer density [12185-107]
	WAVEFRONT SENSING IN FOCAL PLANES
12185 30	Demonstration of a photonic-lantern focal-plane wavefront sensor using fiber mode conversion and deep learning [12185-108]

12185 31	Study of the LIFT focal-plane wavefront sensor for GALACSI NFM [12185-109]
12185 32	A simulator-based autoencoder for focal plane wavefront sensing [12185-110]
	PROJECT STATUS III
12185 33	AO3000 at Subaru: combining for the first time a NIR WFS using First Light's C-RED ONE and ALPAO's 64x64 DM [12185-111]
12185 34	Status of the SALTO demonstrator: project overview and first on-sky operations [12185-112]
	POSTER SESSION: ASTRONOMY WITH AO
12185 37	Optimal multi-epoch combination of direct imaging observations for improved exoplanet detection [12185-114]
	POSTER SESSION: MODELING AND SIMULATION SOFTWARE
12185 38	DEEPLOOP: DEEP Learning for an Optimized adaptive Optics Psf estimation [12185-117]
12185 39	FitAO: a Python-based platform for algorithmic development AO [12185-118]
12185 3A	Connecting the astronomical testbed community - the CAOTIC project: optimized teaching methods for software version control concepts [12185-119]
	POSTER SESSION: MODELING, SIMULATION AND ANALYSIS OF AO SYSTEMS
12185 3B	Surrogate model-based wavefront sensorless adaptive optics system for correcting atmospheric distorted images [12185-120]
12185 3C	A method to build digital twin of atmospheric turbulence phase screens with comprehensible deep neural networks [12185-121]
12185 3D	Visible extreme adaptive optics for GMagAO-X with the triple-stage AO architecture (TSAO) [12185-122]
12185 3F	The multi-object adaptive optics system for the Gemini infra-red multi-object spectrograph [12185-124]
12185 31	Prediction of AO corrected PSF for AOF NFM/SPHERE [12185-127]
12185 3L	MAVIS: performance estimation of the adaptive optics module [12185-130]

12185 3N	The adaptive optics simulation and improvement plan of CRAO attached to the 1.3m Araki Telescope [12185-134]
12185 30	Comparative performance analysis for double-roof pyramid wavefront sensor [12185-135]
	POSTER SESSION: POSTPROCESSING AO DATA
12185 3P	XPipeline: starlight subtraction at scale for MagAO-X [12185-136]
12185 3Q	Long-slit spectroscopy characterization of substellar objects with the EXOSPEC algorithm [12185-137]
12185 3R	An optical distortion solution for the Keck I OSIRIS Imager [12185-138]
12185 3S	Exoplanet detection in angular differential imaging: combining a statistics-based learning with a deep-based learning for improved detections [12185-139]
12185 3T	Towards robust deconvolution of hyperspectral data cubes [12185-140]
12185 3U	Multispectral image reconstruction of faint circumstellar environments from high contrast angular spectral differential imaging (ASDI) data [12185-141]
	POSTER SESSION: POSTPROCESSING AO DATA (PSF RECONSTRUCTION)
12185 3V	Extending AMIRAL's blind deconvolution of adaptive optics corrected images with Markov chain Monte Carlo methods [12185-142]
12185 3W	Unsupervised blind-deconvolution with optimal scaling applied to astronomical data [12185-143]
12185 40	BRUTE, PSF Reconstruction for the SOUL pyramid-based Single Conjugate Adaptive Optics facility of the LBT [12185-148]
12185 41	Status of the PSF reconstruction work package for MICADO at ELT [12185-149]
	POSTER SESSION: PROJECT STATUS
12185 42	Laboratory results of SCAO: getting ready for the EST MCAO [12185-150]
12185 43	Final design of the GTC laser guide star wavefront sensor [12185-151]
12185 46	An updated preliminary optical design and performance analysis of the Planetary Systems

12185 47	Optical design of SPIDERS, a Subaru Pathfinder Instrument for Detecting Exoplanets and Retrieving Spectra [12185-156]
12185 48	A pyramid-based adaptive optics for the high-resolution echelle spectrograph at SAO RAS 6-m telescope $[12185\text{-}158]$
12185 49	The evolution of the ALIOLI instrument [12185-159]
	POSTER SESSION: PROJECT STATUS (GEMINI)
12185 4A	Status of the GIRMOS MOAO demonstrator [12185-160]
12185 4B	An on-sky test bench for the GIRMOS open-loop calibration procedures [12185-161]
12185 4C	GPI 2.0: pyramid wavefront sensor status [12185-163]
	POSTER SESSION: PROJECT STATUS (VLT)
10105 45	
12185 4D	SAXO+ upgrade: system choices and numerical simulations [12185-164]
12185 4E	SAXO+, a second-stage adaptive optics for SPHERE on VLT: optical and mechanical design concept [12185-165]
	POSTER SESSION: PROJECT STATUS (GMT)
12185 4G	A novel hexpyramid pupil slicer for an ExAO parallel DM for the Giant Magellan Telescope [12185-167]
12185 4H	NGWS-P: the natural guide star wavefront sensor prototype of GMT single conjugate AO system NGAO [12185-168]
12185 41	Piston-tip-tilt mirror array in the wide field phasing testbed for the Giant Magellan Telescope [12185-169]
12185 4J	The conceptual design of GMagAO-X: visible wavelength high contrast imaging with GMT [12185-170]
	POSTER SESSION: PROJECT STATUS (ELT)
12185 4K	HARMONI at ELT: development of the high-contrast module [12185-171]
12185 4L	HARMONI at ELT: designing a laser guide star wavefront sensors for the ELT [12185-172]

12185 4M	HARMONI at ELT: full scale prototype of the laser guide star wavefront sensor [12185-173]
12185 4N	MORFEO (formerly known as MAORY) LOR WFS module preliminary electronics design [12185-174]
12185 40	MORFEO/MAORY low-order and reference WFS module preliminary design [12185-175]
12185 4P	MAORY/MORFEO at ELT: Thermal Control System preliminary design [12185-176]
12185 4Q	MAORY/MORFEO at ELT: optomechanical preliminary design [12185-177]
12185 4R	MAORY/MORFEO at ELT: preliminary design of the adaptive optics subsystem [12185-178]
12185 4S	The MICADO first light imager for the ELT: overview of the SCAO module at its final design [12185-180]
	POSTER SESSION: WAVEFRONT SENSING WITH LASER GUIDE STARS
12185 4V	Laboratory testing of the Ingot WFS [12185-183]
12185 4W	Fourier filter LGS wavefront sensing for ELT size telescopes [12185-184]
12185 4X	Laser optical differentiation WFS design and lab characterization for SIGHT [12185-186]
	POSTER SESSION: WAVEFRONT SENSING (ELTS)
12185 4Y	HARMONI at ELT: prototyping for Single-Conjugate AO Sensor subsystem [12185-187]
12185 4Z	The MAORY/MORFEO fine optical alignment and recollimation strategies: preliminary simulations from 'out of focus' PSF images [12185-188]
12185 50	Managing NFIRAOS optical enclosure environment conditions from a high level software system [12185-189]
12185 53	Pupil-plane LLOWFS simulation and laboratory results from NEW-EARTH's high-contrast imaging testbed [12185-192]
	POSTER SESSION: SENSING AND CORRECTION OF WAVEFRONT FRAGMENTATION
12185 56	MAORY/MORFEO and LIFT: can the low order wavefront sensors become phasing sensors? [12185-195]
12185 57	Differential piston sensing with LIFT: application to the GMT [12185-196]

12185 59	Adapting the pyramid wavefront sensor for pupil fragmentation of the ELT class telescopes [12185-198]
12185 5A	Segment phasing for giant telescopes using moving horizon estimation [12185-199]
12185 5B	Detection of discontinuous phase steps with a pyramid wavefront sensor [12185-200]
12185 5C	Understand and correct for the low wind effect on the SPHERE and GRAVITY+ adaptive optics [12185-201]
12185 5D	Machine learning techniques for piston sensing [12185-202]
	POSTER SESSION: CALIBRATION (ELTS)
12185 5E	HARMONI at ELT: adaptive optics calibration unit from design to prototyping [12185-203]
12185 5F	MAORY/MORFEO at ELT: calibration unit overview [12185-204]
12185 5G	The calibration and test unit of MAORY/MORFEO: analyses and performance evaluation [12185-205]
12185 51	MORFEO (formerly known as MAORY) at ELT: concept for the deformable mirrors test facility [12185-207]
	POSTER SESSION: CONTROL SYSTEMS (ELTS)
12185 5K	MORFEO at ELT: preliminary design of the real-time computer [12185-209]
	POSTER SESSION: MODELING, SIMULATION AND ANALYSIS OF AO SYSTEMS
12185 5L	HARMONI at ELT: system analysis and performance estimation of the high-contrast module [12185-211]
12185 5M	MORFEO optical design and performances: status at preliminary design review [12185-212]
12185 5N	Chromaticity in solar adaptive optics: a case study for the European Solar Telescope [12185-213]
12185 50	The MICADO first light imager for the ELT: FDR numerical simulations for the SCAO mode [12185-214]
12185 5P	A preliminary design review study of the scientific performance of MAORY (MORFEO)

12185 5R	The Infrared Imaging Spectrograph (IRIS) for TMT: achieving high sky coverage through the On-Instrument Wavefront Sensor design $[12185-217]$
12185 5S	Effects of wind velocity profiles on turbulence-induced quasi-static aberrations [12185-218]

Part Three

POSTER SESSION: ATMOSPHERIC DISTURBANCES

	FOSTER SESSION. ATMOSF HERIC DISTURBANCES
12185 5T	Turbulence profiling neural networks using imaging Shack-Hartmann data for wide-field image correction [12185-219]
12185 5U	Wavefront profiling via correlation of GLAO open loop telemetry [12185-222]
12185 5V	PSF nowcast using PASSATA simulations: towards a PSF forecast [12185-223]
12185 5W	Optical turbulence forecast over short timescales using machine learning techniques [12185-224]
12185 5X	Estimating effective wind speed from Gemini Planet Imager's adaptive optics data using covariance maps [12185-225]
12185 5Y	The upgraded Calern Atmospheric Turbulence Station [12185-226]
12185 5Z	ANAtOLIA: a new mobile site-testing station for astronomy and optical communications [12185-227]
12185 60	Towards an optimal prediction of the optical turbulence in the ground layer by means of an instrumented drone $[12185\text{-}228]$
12185 64	Monitoring the surface-layer turbulence at the Calern Observatory with a sonic anemometer [12185-232]
12185 65	Knowing your atmosphere: key to optimized and faithful AO simulations [12185-233]
12185 66	Speckle simulation tool for automated modelling of a large range of telescope aperture to fried parameter ratios $[12185-234]$
	POSTER SESSION: CALIBRATION
12185 67	MAVIS: astrometric calibration technique [12185-235]
12185 68	Improving VLT/SPHERE without additional hardware: comparing quasi-static correction strategies [12185-236]

12185 69	In-lab calibration and testing of adaptive secondary mirrors using phase measuring deflectometry [12185-237]
12185 6A	The simulator of the VLT Deformable Secondary Mirror: a test tool for adaptive optics instruments for the Yepun-UT4 Telescope [12185-238]
12185 6C	Optomechanical integration of the MCAO prototype testbed for EST [12185-240]
12185 6D	WIVERN: a laboratory experiment for testing novel laser-based wavefront sensing techniques [12185-241]
12185 6E	HARMONI at ELT: a telescope simulator for laser tomographic AO [12185-242]
	POSTER SESSION: CONTROL SYSTEMS
12185 6F	The real-time computing and instrument control software for CaNaPy [12185-243]
12185 6H	HEART: Gemini Planet Imager upgrade (GPI2.0) Real-Time Controller (RTC) using the Herzberg Extensible Adaptive Real-time Toolkit (HEART) [12185-245]
12185 6I	HEART: REVOLT RTC using Herzberg Extensible Adaptive Real-time Toolkit (HEART) [12185-247]
	POSTER SESSION: PROJECT STATUS (SUBARU)
12185 6J	High contrast and high angular imaging at Subaru Telescope [12185-248]
12185 6K	Wavefront sensing over a 20-arcmin field in the ULTIMATE-Subaru Ground Layer Adaptive Optics system [12185-249]
12185 6L	ULTIMATE-START: current status of the Subaru Tomography Adaptive optics Research experimenT [12185-250]
12185 6M	Optical design of the wavefront sensing in the ULTIMATE-Subaru Ground Layer Adaptive Optics system [12185-251]
	POSTER SESSION: PROJECT STATUS (VLT)
12185 6N	MAVIS: preliminary design overview of the natural guide star wavefront sensor submodule [12185-252]

POSTER SESSION: PROJECT STATUS

	FOSIER SESSION. FROJECT STATUS
12185 6Q	SHARK-VIS ready for the stars: instrument description and final laboratory performance test [12185-255]
12185 6R	A near-infrared pyramid wavefront sensor for the MMT [12185-256]
12185 6S	Status update for MAPS, the MMT AO exoPlanet characterization System [12185-257]
	POSTER SESSION: PROTOTYPING, PATHFINDERS AND CONSTRUCTION PROJECTS
12185 6V	Spatial light modulator on Santa Cruz Extreme AO Laboratory (SEAL) testbed [12185-261]
12185 6W	Deformable lens for testing the performance of focal plane wavefront sensing using phase diversity [12185-262]
12185 6X	Direct expansion gas cooling system for the ESO's ELT M4 adaptive mirror [12185-263]
12185 6Y	Interferometry at the pillars of Hercules: or measurements in high holes density, low reflectivity, low modulation regime [12185-264]
12185 6Z	Characterization of sensitivity and responses of a 2-element prototype wavefront sensor for millimeter-wave adaptive optics attached to the Nobeyama 45m Telescope [12185-265]
12185 70	Adaptive Optics system of the Evanescent Wave Coronagraph (EvWaCo): optimised phase plate and DM characterisation [12185-266]
12185 71	The MAORY/MORFEO MAIT strategy in Europe [12185-267]
12185 73	RISTRETTO: coronagraph and AO designs enabling High Dispersion Coronagraphy at 2 λ/D [12185-269]
12185 74	PULPOS: a multi-purpose adaptive optics test bench in Chile [12185-270]
12185 75	Blinking the fringes: initial development and results of the Ultra-Low Speed Optical Chopper for the Self-Coherent Camera [12185-271]
12185 76	Making adaptive optics available to all: a concept for 1m class telescopes [12185-272]
12185 77	Optical-component-only adaptive optics improved setup [12185-273]
12185 78	Laboratory demonstration of optimal identification and control of tip-tilt systems [12185-311]

POSTER SESSION: DETECTORS AND CAMERAS FOR WAVEFRONT SENSING Electron multiplying CCDs for sensitive wavefront sensing at 3k frames per second [12185-275] 12185 7A 12185 7B Final performance of the ESO's ALICE and LISA wavefront sensing cameras [12185-276] **POSTER SESSION: LASER GUIDE STARS** 12185 7C The new Laser Launch Telescopes for Gemini North AO: design and status update [12185-277] 12185 7D Design of the laser beam transfer system for the new Gemini North adaptive optics laser guide **star** [12185-278] 12185 7E GTC Laser Guide Star Facility thermal design [12185-279] 12185 7F An asterism generator for Keck All-sky Precision Adaptive optics [12185-280] Preliminary design of the Laser Guide Star Facility for the ULTIMATE-Subaru Ground Layer 12185 7G Adaptive Optics system [12185-281] 12185 7H TMT Laser Guide Star Facility preliminary design [12185-282] 12185 7I MAVIS: two for one, the art of LGS multiplication [12185-283] 12185 7K Development of a beam conditioning and diagnostics system for the Laser Guide Star Facility **of the ELT** [12185-285] POSTER SESSION: WAVEFRONT MODULATING DEVICES 12185 7M Impact of local turbulence on high-order adaptive optics [12185-287] 12185 7N MORFEO (formerly known as MAORY) at ELT: deformable mirror WFE stability strategy for SCAO operations [12185-288] 12185 70 On-orbit operations summary for the Deformable Mirror Demonstration Mission (DeMi) CubeSat [12185-289] 12185 7Q High density, low power, contactless VCM-based adaptive mirror prototype [12185-291] POSTER SESSION: WAVEFRONT MODULATING DEVICES (PROJECT STATUS) 12185 7R Deformable mirrors for the EST testbed: testing and characterization [12185-292]

12185 7S	MORFEO (formerly known as MAORY) at ELT: preliminary design of the adaptive mirrors [12185-294]
12185 7T	ULTIMATE-Subaru: adaptive secondary mirror system [12185-295]
12185 7U	Progress on the University of Hawaii 2.2-meter adaptive secondary mirror [12185-296]
12185 7V	GMT ASM co-phasing numerical simulation and experimental results [12185-297]
	POSTER SESSION: WAVEFRONT MODULATING DEVICES (CONTROL)
12185 7X	GMT ASM prototype dynamic and optical tests results [12185-300]
12185 7Y	ESO's ELT M4 dynamic control and computational performance [12185-301]
	POSTER SESSION: WAVEFRONT RECONSTRUCTION AND CONTROL ALGORITHMS
12185 81	Advanced wavefront sensing and control demonstration with MagAO-X [12185-305]
12185 82	Battle of the predictive wavefront controls: comparing data and model-driven predictive control for high contrast imaging [12185-306]
12185 83	The use of spatial-temporal correlations to identify dynamic environmental changes affecting adaptive optics system performance [12185-307]
12185 84	High-bandwidth tip-tilt compensation for small telescope systems [12185-308]
	POSTER SESSION: WAVEFRONT SENSING
12185 87	Experimental verification of NN and PCA for NCPA mitigation. [12185-314]
12185 88	Exploration of convolutional neural networks to handle non-linearity estimation issues in pyramid wavefront sensors. [12185-315]
12185 89	Joint optimization of wavefront sensing and reconstruction with automatic differentiation [12185-316]
12185 8A	Adaptive optics mediated Sub-Pixel Super Resolution [12185-317]
12185 8C	Open-loop wavefront sensing of multiple laser sources using the geometric wavefront sensor on an optical test-bench [12185-319]

12185 8D	MAORY/MORFEO and rolling shutter induced aberrations in laser guide star wavefront sensing [12185-320]
12185 8F	Preliminary lab demonstration of a 3-sided reflective pyramid wavefront sensor for Shane AO using SEAL testbed [12185-322]
12185 8G	A new wavefront sensing technique for satellite-ground laser communication [12185-323]
12185 8H	Spatial frequency response and sensitivity of the nonlinear curvature wavefront sensor [12185-324]
12185 81	Laboratory demonstration of focal plane wavefront sensing using phase diversity: a way to tackle the problem of NCPA in SHARK-NIR: Part II: new characterization tests and alternative wavefront sensing strategies [12185-325]
12185 8J	Correction of photometric scintillation noise via tomographic wavefront sensing: simulation and on-sky demonstration [12185-326]
	POSTER SESSION: WAVEFRONT SENSING FOR HIGH-CONTRAST IMAGING
12185 8M	Vector Zernike wavefront sensor on the Santa Cruz Extreme AO Lab (SEAL) testbed [12185-331]
12185 8N	Fabrication of pupil masks for a new infrared exoplanet imager at Keck Observatory [12185-332]
12185 80	Experimental validation of exoplanet centring strategies for high dispersion coronagraphy [12185-333]
12185 8P	Nulling interferometry: high contrast science for single large apertures [12185-334]
	POSTER SESSION
12185 8Q	Photonic phase correctors based on grating couplers: proof of concept simulations and preliminary performance metrics [12185-336]
12185 8R	Numerical modelling of the planetary adaptive optics mode of AOC, the adaptive optics project at Calern Observatory [12185-337]