

# PROCEEDINGS OF SPIE

## ***Advanced Optical and Mechanical Technologies in Telescopes and Instrumentation***

**Eli Atad-Etchedgui  
Dietrich Lemke**  
*Editors*

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**SESSION 11 TELESCOPE STRUCTURE AND ACTIVE INSTRUMENTS III**

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- 7018 1S **Performance prediction of the TMT secondary mirror support system** [7018-65]  
M. K. Cho, National Optical Astronomy Observatory (United States)
- 7018 1T **Practical considerations of joint friction and backlash in large ground-based telescope secondary optic positioning systems** [7018-66]  
M. Cash, D. Bruch, B. Jahn, P. Keas, CSA Engineering, Inc. (United States)
- 7018 1U **Smart instrument technologies to meet extreme instrument stability requirements** [7018-67]  
C. Cunningham, P. Hastings, UK Astronomy Technology Ctr., Royal Observatory Edinburgh (United Kingdom); F. Kerber, European Southern Observatory (Germany); D. Montgomery, UK Astronomy Technology Ctr., Royal Observatory Edinburgh (United Kingdom); L. Venema, NOVA-ASTRON (Netherlands); P. Vola, Lab. d'Astrophysique de Marseille (France)
- 7018 1V **Deployment technologies for terrestrial planet finding missions** [7018-68]  
C. F. Lillie, D. R. Dailey, A. S. Lo, R. S. Polidan, J. W. Arenberg, T. Glassman, Northrop Grumman Space Technology (United States)

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**SESSION 12 SPACE INSTRUMENTATION AND CRYOGENICS I**

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- 7018 1Y **JWST NIRSpec mechanical design (Invited Paper)** [7018-71]  
J.-C. Salvignol, European Space Agency (Netherlands); K. Honnen, R. Barho, EADS Astrium GmbH (Germany)
- 7018 1Z **The cryogenic refocusing mechanism of NIRSpec opto-mechanical design, analysis, and testing** [7018-73]  
M. Taccola, Galileo Avionica spA (Italy); G. Bagnasco, European Space Agency (Netherlands); R. Barho, EADS Astrium GmbH (Germany); G. C. Caprini, M. Di Giampietro, Galileo Avionica spA (Italy); L. Gaillard, European Space Agency (Netherlands); G. Mondello, Galileo Avionica spA (Italy); J.-C. Salvignol, M. Te Plate, European Space Agency (Netherlands); N. Tonetti, Galileo Avionica spA (Italy)
- 7018 20 **The optical manufacturing of the refocusing mechanism of NIRSpec** [7018-72]  
A. Novi, M. Taccola, Galileo Avionica spA (Italy); J. Koehler, EADS Astrium GmbH (Germany); M. Di Giampietro, Galileo Avionica spA (Italy)
- 7018 21 **High-precision cryogenic wheel mechanisms for the JWST NIRSpec instrument** [7018-74]  
K. Weidlich, M. Fischer, M. M. Ellenrieder, T. Gross, Carl Zeiss Optronics GmbH (Germany); J.-C. Salvignol, European Space Agency (Netherlands); R. Barho, EADS Astrium GmbH (Germany); C. Neugebauer, G. Königsreiter, Austrian Aerospace GmbH (Austria); M. Trunz, Ing.-Büro für Strukturmechanik Trunz (Germany); F. Müller, O. Krause, Max-Planck-Institut für Astronomie (Germany)
- 7018 22 **The optical components of the NIRSpec wheel mechanisms** [7018-75]  
M. M. Ellenrieder, K. Weidlich, B. Nelles, Carl Zeiss Optronics GmbH (Germany); B. Ploss, mso jena Mikroschichtoptik GmbH (Germany); S. Bruynooghe, Carl Zeiss AG (Germany); J. Köhler, EADS Astrium GmbH (Germany); M. Te Plate, European Space Agency (Netherlands)

- 7018 23 **Manufacturing and verification of ZnS and Ge prisms for the JWST MIRI imager** [7018-76]  
L. Rossi, Univ. de Liège (Belgium); J.-F. Jamoye, Nanoshape, AMOS Ltd. (Belgium);  
E. Renotte, E. Mazy, J.-Y. Plessier, N. Ninane, Univ. de Liège (Belgium); M. Wielandts,  
Nanoshape, AMOS Ltd. (Belgium); S. Fischer, C. Straubmeier, Univ. zu Köln (Germany);  
J.-L. Augeres, D. Dubreuil, J. Amiaux, S. Poupard, S. Ronayette, CEA/DAPNIA, Service  
d'Astrophysique (France)
- 7018 24 **Cryogenic wheel mechanisms for the Mid-Infrared Instrument (MIRI) of the James Webb  
Space Telescope (JWST): detailed design and test results from the qualification program**  
[7018-77]  
O. Krause, S. Birkmann, T. Blümchen, A. Böhm, M. Ebert, U. Grözinger, Th. Henning,  
R. Hofferbert, A. Huber, D. Lemke, R.-R. Rohloff, S. Scheithauer, Max-Planck-Institut für  
Astronomie (Germany); T. Gross, G. Luichtel, C. Stein, R. Stott, M. Übele, Carl Zeiss Optronics  
GmbH (Germany); J. Amiaux, J.-L. Augères, CEA/IRFU/SAP (France); A. Glauser,  
A. Zehnder, Paul-Scherrer-Institut (Switzerland); M. Meijers, R. Jager, ASTRON (Netherlands);  
P. Parr-Burman, G. Wright, UK Astronomy Technology Ctr., Royal Observatory (United  
Kingdom)

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#### SESSION 13 SPACE INSTRUMENTATION AND CRYOGENICS II

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- 7018 25 **The Herschel-PACS grating mechanism: mechanical and optical performance** [7018-78]  
B. Marquet, J. Y. Plessier, E. Renotte, Ctr. Spatial de Liège (Belgium); P. Royer, Katholieke  
Univ. Leuven (Belgium); R. Vavrek, European Space Agency (Spain)
- 7018 26 **New design for a space cryo-mechanism** [7018-80]  
G. Durand, J. Amiaux, J.-L. Augeres, M. Carty, J. C. Barrière, M. Bouzat, B. Duboué,  
P. O. Lagage, D. Lebeuf, E. Lepage, I. Lemer, N. P. Marlaguey, S. Poupard,  
CEA/Saclay/DSM/IRFU/SAP (France)
- 7018 27 **Parametric cost estimation for space science missions** [7018-81]  
C. F. Lillie, B. E. Thompson, Northrop Grumman Space Technology (United States)
- 7018 28 **Three bipods slicer prototype: tests and finite element calculations** [7018-82]  
T. Pamplona, C. Rossin, L. Martin, G. Moreaux, E. Prieto, P. Laurent, E. Grassi, J.-L. Boit,  
L. Castinel, J. Garcia, B. Milliard, Lab. d'Astrophysique de Marseille, CNRS, Univ. de  
Provence (France)

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#### SESSION 14 GROUND BASED INSTRUMENTATION AND CRYOGENICS

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- 7018 29 **A cryogenic dithering stage for moving SPHERE-IRDIS' detector** [7018-86]  
R.-R. Rohloff, T. Blümchen, M. Feldt, V. Naranjo, J. Ramos, Max-Planck-Institut für Astronomie  
(Germany); K.-D Müller, H. Marth, Physik Instrumente (Germany); P. Pertsch, PI Ceramic  
GmbH (Germany); K. Dohlen, L'Observatoire Astronomique Marseille-Provence (France)
- 7018 2A **Mechanical design and testing of the cryogenic pick-off arms for the VLT KMOS** [7018-83]  
R. J. Bennett, G. H. Davidson, P. Rees, S. P. Todd, UK Astronomy Technology Ctr., Royal  
Observatory (United Kingdom)

- 7018 2B **Cryogenic high resolution translation unit (CTU)** [7018-84]  
J. Serrano, J. Moreno Raso, E. Pedrosa, A. Moral, J. L. San Juan, M. Lecina, L. Díez, A. Sanz, LIDAX (Spain); T. Belenguer, G. Ramos, LINES, INTA (Spain)
- 7018 2C **Performance of a cryogenic Michelson interferometer** [7018-85]  
P. Lagueux, M. Chamberland, F. Marcotte, A. Villemaire, M. Duval, Telops, Inc. (Canada); J. Genest, Laval Univ. (Canada); A. Carter, National Institute of Standards & Technology (United States)
- 7018 2D **Opto-mechanical design for transmission optics in cryogenic IR instrumentation** [7018-87]  
G. Kroes, J. Kragt, R. Navarro, E. Elswijk, H. Hanenburg, NOVA-ASTRON (Netherlands)
- 7018 2E **Automatic pre-cooling system for large infrared instruments** [7018-88]  
K. Omata, T. Nishimura, S. Colley, D. Cook, W. Gorman, B. Magrath, L. Ramos, National Astronomical Observatory of Japan (United States); S. Kleinman, Gemini Observatory (United States); C. Tokoku, Astronomical Institute, Tohoku Univ. (Japan); M. Konishi, T. Yoshikawa, I. Tanaka, R. Suzuki, National Astronomical Observatory of Japan (United States)
- 7018 2F **CRAL expertise on image slicer: optical designs, glass or metallic manufacturing, test, and results** [7018-89]  
E. Renault, F. Laurent, J. Kosmalski, L. Adjali, Univ. de Lyon 1, Ctr. de Recherche Astronomique de Lyon, Observatoire de Lyon (France) and CNRS, UMR 5574, Ecole Normale Supérieure de Lyon (France)
- 7018 2G **Optical design of the LSST camera** [7018-90]  
S. S. Olivier, L. Seppala, Lawrence Livermore National Lab. (United States); K. Gilmore, Stanford Linear Accelerator Ctr. (United States)
- 7018 2H **Mechanical design of the LSST camera** [7018-91]  
M. Nordby, G. Bowden, M. Foss, G. Guiffre, Stanford Linear Accelerator Ctr. (United States); J. Ku, Stellar Solutions, Inc. (United States); R. Schindler, Stanford Linear Accelerator Ctr. (United States)

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## SESSION 15 INNOVATIONS IN SPECTROSCOPY

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- 7018 2I **Small solutions to the large telescope problem: a massively replicated MEMS spectrograph** [7018-92]  
N. P. Konidaris II, J. A. Kubby, Univ. of California, Santa Cruz (United States); A. I. Sheinis, Univ. of Wisconsin, Madison (United States)
- 7018 2J **Waveguide image-slicers for ultrahigh resolution spectroscopy** [7018-93]  
E. Beckert, Fraunhofer-Institute for Applied Optics and Precision Engineering (Germany); K. G. Strassmeier, M. Woche, Astrophysical Institute Potsdam (Germany); R. Eberhardt, A. Tünnermann, Fraunhofer-Institute for Applied Optics and Precision Engineering (Germany); M. Andersen, Univ. of Copenhagen (Denmark)
- 7018 2K **An active optics concept for the multi-object spectrograph EAGLE** [7018-94]  
F. Madec, E. Hugot, J.-L. Gimenez, F. Tracol, M. Ferrari, P. Vola, S. Vivès, K. El Hadi, G. Moreaux, E. Prieto, J.-G. Cuby, Lab. d'Astrophysique de Marseille (France)

- 7018 2L **VPHGs tunes** [7018-95]  
E. Molinari, INAF-Osservatorio Astronomico di Brera (Italy); A. Bianco, G. Toso, INAF-Osservatorio Astronomico di Brera (Italy) and Politecnico di Milano (Italy); F. M. Zerbi, INAF-Osservatorio Astronomico di Brera (Italy)
- 7018 2M **Rewritable VPHGs based on photochromic materials** [7018-96]  
A. Bianco, INAF-Istituto di Astrofisica Spaziale e Fisica Cosmica (Italy) and Politecnico di Milano (Italy); G. Toso, Politecnico di Milano (Italy) and INAF-Osservatorio Astronomico di Brera (Italy); G. Dassa, B. Chiara, Politecnico di Milano (Italy); E. Molinari, F. M. Zerbi, INAF-Osservatorio Astronomico di Brera (Italy); G. Zerbi, Politecnico di Milano (Italy); M. Georges, Ctr. Spatial de Liège, Univ. de Liège (Belgium); P. Lemaire, ATHOL S.A. (Belgium)
- 7018 2N **New technological developments in integral field spectroscopy** [7018-97]  
S. Vives, E. Prieto, Lab. d'Astrophysique de Marseille (France); Y. Salaun, P. Godefroy, Winlight Optics (France)
- 7018 2O **SWIFT de-magnifying image slicer: diffraction limited image slicing at optical wavelengths** [7018-98]  
M. Tecza, N. Thatte, F. Clarke, L. Fogarty, T. Goodsall, G. Salter, Univ. of Oxford (United Kingdom); D. Freeman, Consultant (United Kingdom); Y. Salaun, Winlight Optics (France)
- 7018 2P **The AstroPhotonica Europa partnership** [7018-99]  
J. Allington-Smith, Univ. of Durham (United Kingdom)
- 7018 2Q **Evaluation of volume phase holographic gratings at cryogenic temperatures** [7018-100]  
J. A. Arns, Kaiser Optical Systems, Inc. (United States); S. A. Smee, R. H. Barkhouser, Johns Hopkins Univ. (United States); M. Benson, Kaiser Optical Systems, Inc. (United States)
- 7018 2R **Million object spectrograph** [7018-101]  
T. D. Ditto, DeWitt Brothers Tool Co., Inc. (United States); J. M. Ritter, Institute for Astronomy, Univ. of Hawaii (United States)
- 7018 2S **Micromirror array for multi object spectroscopy in ground-based and space telescopes** [7018-102]  
S. Waldis, Univ. of Neuchatel (Switzerland); F. Zamkotsian, P. Lanzoni, Lab. d'Astrophysique de Marseille, CNRS (France); W. Noell, N. de Rooij, Univ. of Neuchatel (Switzerland)

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**SESSION 16 OPTICAL FIBERS**

- 7018 2T **Focal ratio degradation and transmission in VIRUS-P optical fibers** [7018-104]  
J. D. Murphy, The Univ. of Texas at Austin (United States); P. J. MacQueen, G. J. Hill, The Univ. of Texas at Austin, McDonald Observatory (United States); F. Grupp, Univ.-Sternwarte, München (Germany); A. Kelz, Astrophysikalisches Institut Potsdam (Germany); P. Palunas, The Univ. of Texas at Austin, McDonald Observatory (United States) and Las Campanas Observatory (Chile); M. Roth, Univ.-Sternwarte, München (Germany); A. Fry, The Univ. of Texas at Austin (United States)
- 7018 2U **Focal ratio degradation: a new perspective** [7018-105]  
D. M. Haynes, Macquarie Univ. (Australia) and Anglo-Australian Observatory (Australia); M. J. Withford, J. M. Dawes, Macquarie Univ. (Australia); R. Haynes, Anglo-Australian Observatory (Australia); J. Bland-Hawthorn, Univ. of Sydney (Australia)

- 7018 2V **Performance of Echidna fiber positioner for FMOS on Subaru** [7018-106]  
M. Akiyama, Astronomical Institute, Tohoku Univ. (Japan) and Subaru Telescope, National Astronomical Observatory of Japan (United States); S. Smedley, P. Gillingham, J. Brzeski, T. Farrell, Anglo-Australian Observatory (Australia); M. Kimura, Subaru Telescope, National Astronomical Observatory of Japan (United States); R. Muller, Anglo-Australian Observatory (Australia); N. Tamura, N. Takato, Subaru Telescope, National Astronomical Observatory of Japan (United States)

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**SESSION 17 COATINGS AND FILTERS**

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- 7018 2W **Narrowband filters and broadband mirrors for the spectral range from 50 to 200 nm** [7018-108]  
M. Fernández-Perea, M. Vidal-Dasilva, J. I. Larruquert, J. A. Méndez, J. A. Aznárez, GOLD, Instituto de Física Aplicada-Consejo Superior de Investigaciones Científicas (Spain)
- 7018 2Z **Coating of large-sized optics for the instruments of observation** [7018-111]  
D. Mouricaud, Sagem DS (France)
- 7018 30 **Near-infrared bandpass filters with improved transparency for 1000nm spectral region using sputtered silicon compound films** [7018-112]  
H. J. B. Orr, M. Wallace, NDC Infrared Engineering Ltd. (United Kingdom); G. B. Dalton, Oxford Astrophysics, Univ. of Oxford (United Kingdom)

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**POSTER SESSION: OPTICAL FABRICATION**

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- 7018 32 **Design of 2.5m optical fabrication machine for astronomical mirrors** [7018-113]  
Y. Zheng, Nanjing Institute of Astronomical Optics & Technology (China) and Graduate School of the Chinese Academy of Sciences (China); Y. Li, D. Wang, B. Liang, Nanjing Institute of Astronomical Optics & Technology (China)
- 7018 33 **New design deforming controlling system of the active stressed lap** [7018-114]  
Y. Li, D. Wang, Nanjing Institute of Astronomical Optics & Technology (China)
- 7018 35 **Removal of diamond-turning signatures on x-ray mandrels and metal optics by fluid-jet polishing** [7018-118]  
A. Beaucamp, R. Freeman, R. Morton, K. Ponudurai, Zeeko Ltd. (United Kingdom); D. D. Walker, Zeeko Ltd. (United Kingdom) and OptIC Technium (United Kingdom)

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**POSTER SESSION: FOCAL PLANE ASSEMBLIES**

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- 7018 36 **High precise measurement of tiny angle dimensional holes for the unit-holes of the LAMOST Focal Plane Plate** [7018-120]  
Z. Zhou, Y. Jin, C. Zhai, X. Xing, Univ. of Science and Technology of China (China)
- 7018 37 **Design and construction of a focal plane slicing mirror** [7018-121]  
D. Magrin, E. Giro, F. Bortoletto, INAF-Osservatorio Astronomico di Padova (Italy); G. Crimi, INAF-Osservatorio Astronomico di Brera (Italy); C. Pernechele, INAF-Osservatorio Astronomico di Cagliari (Italy); R. Tomelleri, Tomelleri Srl (Italy)

- 7018 38 **ALMA front end amplitude calibration device design and measured performances** [7018-122]  
J. M. Casalta, A. Molins, M. Bassas, M. Canchado, E. Creus, A. Tomàs, NTE S.A. (Spain)

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**POSTER SESSION: MATERIALS**

- 7018 39 **Toward a large lightweight mirror for AO: development of a 1m Ni coated CFRP mirror** [7018-123]  
S. J. Thompson, A. P. Doel, D. Brooks, Univ. College London (United Kingdom);  
M. Strangwood, The Univ. of Birmingham (United Kingdom)
- 7018 3A **Rapidly solidified aluminium for optical applications** [7018-125]  
G. P. H. Gubbels, B. W. H. van Venrooy, TNO Science and Industry (Netherlands);  
A. J. Bosch, R. Senden, RSP Technology B.V. (Netherlands)
- 7018 3B **Forty years of ZERODUR mirror substrates for astronomy: review and outlook** [7018-126]  
T. Döhring, R. Jedamzik, A. Thomas, P. Hartmann, SCHOTT AG (Germany)
- 7018 3C **Meter class carbon fiber reinforced polymer (CFRP) telescope program at the Naval Research Laboratory** [7018-127]  
S. R. Restaino, T. Martinez, J. R. Andrews, C. C. Wilcox, F. Santiago, Naval Research Lab. (United States); S. Teare, New Mexico Institute of Mining and Technology (United States);  
R. Romeo, R. Martin, Composite Mirror Applications, Inc. (United States); D. Wick, Sandia National Labs. (United States)
- 7018 3D **Picometer resolution interferometric characterization of the dimensional stability of zero CTE CFRP** [7018-128]  
J. Cordero Machado, EADS Astrium GmbH (Germany) and Escuela Superior de Ingenieros de Sevilla (Spain); T. Heinrich, EADS Astrium GmbH (Germany) and Eidgenössische Technische Univ. Zürich (Switzerland); T. Schuldt, Humboldt-Univ. zu Berlin (Germany) and Hochschule Konstanz (Germany); M. Gohlke, EADS Astrium GmbH (Germany) and Humboldt-Univ. zu Berlin (Germany); S. Lucarelli, D. Weise, U. Johann, EADS Astrium GmbH (Germany); A. Peters, Humboldt-Univ. zu Berlin (Germany); C. Braxmaier, EADS Astrium GmbH (Germany) and Hochschule Konstanz (Germany)
- 7018 3F **Study of simple CFRP-metal joint failure** [7018-130]  
J. Cheng, A. Rodriguez, N. Emerson, A. Symmes, National Radio Astronomy Observatory (United States)

### **Part Three**

- 7018 3G **Composite materials applied to the E-ELT structure** [7018-131]  
E. Pajuelo, J. R. Gómez, B. Ronquillo, MEDIA Consultores (Spain); E. Brunetto, F. Koch, European Southern Observatory (Germany)

- 7018 3H **Application of zero-expansion pore-free ceramics to a mirror of an astronomical telescope** [7018-132]  
H. Akitaya, M. Iye, National Astronomical Observatory of Japan (Japan); K. Okita, Okayama Astrophysical Observatory, National Astronomical Observatory of Japan (Japan); M. Sato, National Institute for Fusion Science (Japan); H. Matsuo, Nihon Ceratec Co., Ltd. (Japan); T. Itazu, T. Uno, M. Yamaguchi, Nagase Integrex Co., Ltd. (Japan); Z. Tanaka, Yamagata Research Institute of Technology (Japan); T. Yamashita, K. S. Kawabata, M. Uemura, Hiroshima Astrophysical Science Ctr., Hiroshima Univ. (Japan); M. Kurita, Nagoya Univ. (Japan)

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**POSTER SESSION: SEGMENT MIRROR TECHNOLOGIES**

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- 7018 3I **Design of M<sub>B</sub> sub-mirror handling manipulator for LAMOST** [7018-134]  
H. Zuo, Nanjing Institute of Astronomical Optics & Technology (China) and Graduate School of the Chinese Academy of Sciences (China); G. Li, F. Jiang, Nanjing Institute of Astronomical Optics & Technology (China)

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**POSTER SESSION: TEST AND METROLOGY**

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- 7018 3K **Testing large aspheric surfaces with complementary annular subaperture interferometric method** [7018-137]  
X. Hou, Institute of Optics and Electronics (China) and Graduate School of the Chinese Academy of Sciences (China); F. Wu, Institute of Optics and Electronics (China); B. Lei, Institute of Optics and Electronics (China) and Graduate School of the Chinese Academy of Sciences (China); B. Fan, Q. Chen, Institute of Optics and Electronics (China)
- 7018 3L **Static telescope aberration measurement and correction using lucky imaging techniques** [7018-138]  
M. López Marrero, Univ. of La Laguna (Spain); L. F. Rodríguez Ramos, Instituto de Astrofísica de Canarias (Spain); J. M. Rodríguez Ramos, Univ. of La Laguna (Spain)
- 7018 3M **Mechanical alignment of tertiary mirror and positioner on the LMT telescope** [7018-139]  
D. M. Gale, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico)
- 7018 3N **Camera calibration of the stereo vision measurement system** [7018-140]  
W. Li, B. Li, X. Li, Univ. of Science & Technology of China (China)
- 7018 3Q **Correlation functions formed by a femtosecond pulse interferometer** [7018-143]  
M. Cui, N. Bhattacharya, H. P. Urbach, Technical Univ. Delft (Netherlands); S. A. van den Berg, NMI Van Swinden Lab. (Netherlands)
- 7018 3R **Theoretical study of long-distance measurement using frequency comb laser** [7018-144]  
M. Zeitouny, N. Bhattacharya, H. P. Urbach, Technical Univ. Delft (Netherlands); S. A. van den Berg, NMI Van Swinden Lab. (Netherlands)
- 7018 3S **Diamond machining of aspherical mirrors and mirror arrays for Integral Field Units: Part II. Metrology** [7018-145]  
S. Rolf, D. R. Robertson, Univ. of Durham (United Kingdom)



- 7018 3T **Scanning pentaprism measurements of off-axis aspherics** [7018-146]  
P. Su, College of Optical Sciences, The Univ. of Arizona (United States); J. H. Burge, College of Optical Sciences, The Univ. of Arizona (United States) and Steward Observatory, The Univ. of Arizona (United States); B. Cuerden, Steward Observatory, The Univ. of Arizona (United States); J. Sasian, College of Optical Sciences, The Univ. of Arizona (United States); H. M. Martin, Steward Observatory, The Univ. of Arizona (United States)
- 7018 3U **Measurements of large optical surfaces with a laser tracker** [7018-147]  
T. L. Zobrist, College of Optical Sciences, Univ. of Arizona (United States); J. H. Burge, College of Optical Sciences, Univ. of Arizona (United States) and Steward Observatory, Univ. of Arizona (United States); W. B. Davison, H. M. Martin, Steward Observatory, Univ. of Arizona (United States)
- 7018 3V **Improved telescope focus using only two focus images** [7018-149]  
G. Barrick, T. Vermeulen, J. Thomas, Canada-France-Hawaii Telescope (United States)
- 7018 3W **Increasing observing efficiency by modeling telescope focus positions** [7018-150]  
S. Gajadhar, D. Salmon, G. Barrick, Canada-France-Hawaii Telescope (United States)

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**POSTER SESSION: ATMOSPHERIC COMPENSATION AND ADAPTIVE OPTICS**

- 7018 3Y **Principle of a linear phase retrieval method and its application in adaptive optics system** [7018-53]  
X. Li, Institute of Optics and Electronics (China); M. Li, B. Chen, Institute of Optics and Electronics (China) and Graduate School of the Chinese Academy of Sciences (China); W. Jiang, Institute of Optics and Electronics (China)
- 7018 40 **Free-forms optics into astronomical use: the case of an all-mirror anamorphic collimator** [7018-153]  
P. Spanò, INAF-Osservatorio Astronomico di Brera (Italy)
- 7018 41 **VILLAGEs: opto-mechanical design of an on-sky visible-light MEMS-based AO system** [7018-154]  
B. Grigsby, C. Lockwood, UCO/Lick Observatory, Univ. of California, Santa Cruz (United States); B. Baumann, Lawrence Livermore National Lab. (United States); D. Gavel, J. Johnson, S. M. Ammons, D. Dillon, K. Morzinski, M. Reinig, UCO/Lick Observatory, Univ. of California, Santa Cruz (United States); D. Palmer, Lawrence Livermore National Lab. (United States); S. Severson, Sonoma State Univ. (United States); E. Gates, UCO/Lick Observatory, Univ. of California, Santa Cruz (United States)

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**POSTER SESSION: TELESCOPE STRUCTURES AND ACTIVE INSTRUMENTS**

- 7018 42 **One Arc PMSM for telescope tracking system** [7018-61]  
C. Ren, Nanjing Institute of Astronomical Optics & Technology (China) and Graduate School of the Chinese Academy of Sciences (China); Z. Zhang, D. Wang, Nanjing Institute of Astronomical Optics & Technology (China); W. Hu, Nanjing Institute of Astronomical Optics & Technology (China) and Graduate School of the Chinese Academy of Sciences (China); Z. Zhu, Nanjing Univ. of Aeronautics and Astronautics (China)

- 7018 43 **The MMT f/5 optical baffles** [7018-155]  
S. Callahan, MMT Observatory (United States); N. Caldwell, Smithsonian Astrophysical Observatory (United States); G. G. Williams, C. Chute, T. E. Pickering, MMT Observatory (United States)
- 7018 44 **The VST tracking system and its preliminary performance** [7018-156]  
P. Schipani, M. Brescia, INAF-Osservatorio Astronomico di Capodimonte (Italy); S. Sandrock, European Southern Observatory, Paranal Observatory (Chile); T. Erm, European Southern Observatory (Germany)
- 7018 45 **The VST secondary mirror support system** [7018-157]  
P. Schipani, F. Perrotta, INAF-Osservatorio Astronomico di Capodimonte (Italy); C. Molfese, O. Caputi, L. Ferragina, L. Marty, INAF-VSTCeN (Italy); M. Capaccioli, INAF-VSTCeN (Italy) and Univ. degli Studi Federico II (Italy); D. Gallieni, P. Fumi, E. Anaclerio, P. Lazzarini, ADS International s.r.l. (Italy); G. De Paris, INAF-Sede Centrale Viale del Parco Mellini (Italy)
- 7018 46 **Introduction of a 2.5m telescope mount** [7018-158]  
B. Gu, G. Wang, J. Xiang, Nanjing Institute of Astronomical Optics and Technology (China)
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## Introduction

This conference, hosted in sunny and hot Marseille, gave an opportunity and a forum for opto-mechanical engineers and scientists to present and discuss the state-of-the-art technologies in astronomical telescopes and instrumentation. The topics covered were: optical fabrication, materials, segment mirror technologies, test and metrology, atmospheric compensation and adaptive optics, telescope structure and active instruments, cryogenic space and ground-based instrumentation, innovations in spectroscopy, optical fibers, and coatings and filters. The good response to the call for papers (205 papers) resulted in oral presentations from Monday morning until Saturday evening, and in a large number of poster presentations (about 40% of all papers).

In optical fabrication, we are looking at a revolution in technologies used in polishing and testing lightweight mirrors with extreme aspheric surfaces (up to 14-mm asphericity). Computer generated holograms (CGH) and laser trackers are currently used to test those challenging components. A 4-m F/1 Zerodur aspherical mirror (1-mm asphericity) was manufactured with a 25nm rms WFE across the full clear aperture. The optical design of the new generation of survey and giant telescopes such as the E-ELT, the TMT or the GMT require very large and very fast mirrors. Moreover, the making of these telescopes relies on mastering major design and technological challenges, one of which is the production of giant primary mirrors (with up to thousands of large segmented mirrors of 1- to 2-m size) which need to be reliably pipeline manufactured and tested over several years. The primary blank for a large telescope of today can now only serve as a secondary to these future giants.

In materials, we are also looking at a mini revolution with the introduction of novel materials (Al-Be) and the improvement of existing materials (Zerodur, SiC) for mirrors. Although Zerodur was considered to be outdated already at past conferences, its superior qualities in polishing, transparent testing, and CTE still give it a future. New are optical materials with a high degree of homogeneity for very large lenses (N-BK7/LLF1...) used in field correctors and atmospheric dispersion correction.

The situation is similarly challenging for space-based astronomy. Due to the limited transportation volume and mass, large space telescopes need highly reliable deployment mechanisms combined with sensors and actuators for their figuring, all to be operated in the space cryo-vacuum as well as under laboratory conditions. Space focal plane instruments combine many observing modes in a very limited volume and therefore require a diversity of precise optical cryo-mechanisms to be operated with a minimum of power and to be rigid enough to survive the harsh rocket launch.

As we embarked on developing the structures and mechanisms for these sophisticated and ever more complex telescopes and their instrumentation, we examined the state-of-the-art, the lessons learned, the new tools available, and explore what may lie ahead for the future of this ever-growing area. Several of these talks were presented in a very exciting and entertaining style; in particular, the commissioning of the 11 m SALT telescope sounds like a detective story.

Innovations in spectroscopy are now almost ready to be implemented: massively replicated MEMS spectrograph, very large image slicers, introduction of volume phase holographic components at cryogenic temperatures, and multi-object spectroscopy using micromirror arrays. These techniques will be used in future large survey telescopes and instruments.

We extend special thanks to the program committee and presenters for their contributions and look forward to see you again in San Diego in 2010.

**Eli Atad-Ettedgui**  
**Dietrich Lemke**