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8861 02  The ASTRI SST-2M prototype for the next generation of Cherenkov telescopes: structure and mirrors [8861-1]
R. Canestrari, INAF - Osservatorio Astronomico di Brera (Italy); E. Cascone, INAF - Osservatorio Astronomico di Capodimonte (Italy); P. Conconi, INAF - Osservatorio Astronomico di Brera (Italy); M. Fiorini, INAF - IASF Milano (Italy); E. Giro, INAF - Osservatorio Astronomico di Padova (Italy); N. La Palombara, INAF - IASF Milano (Italy); L. Lessio, INAF - Osservatorio Astronomico di Padova (Italy); G. Pareschi, INAF - Osservatorio Astronomico di Brera (Italy); G. Rodeghiero, INAF - Osservatorio Astronomico di Padova (Italy); G. Sironi, INAF - Osservatorio Astronomico di Brera (Italy); L. Stringhetti, G. Tosi, INAF - IASF Milano (Italy); G. Tosti, Univ. degli Studi di Perugia (Italy); F. Martelli, G. Parodi, BCV Progetti S.r.l. (Italy); P. Rossettini, R. Tomelleri, Tomelleri S.r.l. (Italy)

8861 03  Status of the technologies for the production of the Cherenkov Telescope Array (CTA) mirrors [8861-2]
G. Pareschi, INAF - Osservatorio Astronomico di Brera (Italy); T. Armstrong, Durham Univ. (United Kingdom); H. Baba, Ibaraki Univ. (Japan); J. Bähr, Deutsches Elektronen-Synchrotron (Germany); A. Bonardi, Eberhard Karls Univ. Tübingen (Germany); G. Bonnoli, INAF - Osservatorio Astronomico di Brera (Italy); P. Brun, Commissariat à l’Énergie Atomique (France); R. Canestrari, INAF - Osservatorio Astronomico di Brera (Italy); P. Chadwick, Durham Univ. (United Kingdom); M. Chikawa, The Univ. of Tokyo (Japan); P.-H. Carton, Commissariat à l’Énergie Atomique (France); V. de Souza, J. Dipold, Univ. de São Paulo (Brazil); M. Doro, Univ. degli Studi di Padova (Italy) and INFN Sezione di Padova (Italy); D. Durand, Commissariat à l’Énergie Atomique (France); M. Dyda, Institute of Nuclear Physics (Poland); A. Förster, Max-Planck-Institut für Kernphysik (Germany); M. Gareczczuk, Deutsches Elektronen-Synchrotron (Germany); E. Giro, INAF - Osservatorio Astronomico di Padova (Italy); J.-F. Glicenstein, Commissariat à l’Énergie Atomique (France); Y. Hanabata, Kinki Univ. (Japan); M. Hayashida, The Univ. of Tokyo (Japan); M. Hrabovski, Institute of Physics of the ASCR, v.v.i. (Czech Republic); C. Jeanney, Commissariat à l’Énergie Atomique (France); M. Kagaya, H. Katagiri, Ibaraki Univ. (Japan); L. Lessio, INAF - Osservatorio Astronomico di Padova (Italy); D. Mandat, Institute of Physics of the ASCR, v.v.i. (Czech Republic); M. Mariotti, Univ. degli Studi di Padova (Italy) and INFN Sezione di Padova (Italy); C. Medina, Instituto Argentino de Radioastronomia (Argentina); J. Michalowski, Institute of Nuclear Physics (Poland); P. Micolon, Commissariat à l’Énergie Atomique (France); D. Nakajima, Max-Planck-Institut für Physik (Germany); J. Niemiec, Institute of Nuclear Physics (Poland); A. Nozato, Kinki Univ. (Japan); M. Palatka, M. Pech, Institute of Physics of the ASCR, v.v.i. (Czech Republic); B. Peyaud, Commissariat à l’Énergie Atomique (France); G. Pühlhofer, Eberhard Karls Univ. Tübingen (Germany); M. Rataj, Space Research Ctr. (Poland); G. Rodeghiero, INAF - Osservatorio Astronomico di Padova (Italy);
G. Rojas, Univ. Federal de São Carlos (Brazil); J. Rousselle, Univ. of California, Los Angeles (United States); R. Sakonaka, Kinki Univ. (Japan); P. Schovanek, Institute of Physics of the ASCR, v.v.i. (Czech Republic); K. Seweryn, Space Research Ctr. (Poland); C. Schultz, Univ. degli Studi di Padova (Italy) and INFN Sezione di Padova (Italy); S. Shu, Kinki Univ. (Japan); F. Stinzing, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); M. Stodulski Institute of Nuclear Physics (Poland); M. Teshima, Max-Planck-Institut für Kernphysik (Germany); P. Travnieczek, Institute of Physics of the ASCR, v.v.i. (Czech Republic); C. van Eldik, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); V. Vassiliev, Univ. of California, Los Angeles (United States); Ł. Wiśniewski, Space Research Ctr. (Poland); A. Wörnlein, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); T. Yoshida, Ibaraki Univ. (Japan)

8861 04  Schwarzschild-Couder telescope for the Cherenkov Telescope Array: development of the optical system [8861-3]
J. Rousselle, Univ. of California, Los Angeles (United States); V. Connaughton, The Univ. of Alabama in Huntsville (United States); M. Errando, Barnard College, Columbia Univ. (United States); T. B. Humensky, Columbia Univ. (United States); R. Mukherjee, Barnard College, Columbia Univ. (United States); D. Nieto, Columbia Univ. (United States); A. Okumura, Nagoya Univ. (Japan) and Univ. of Leicester (United Kingdom); V. V. Vassiliev, Univ. of California, Los Angeles (United States)

8861 05  Efficient light collection from crystal scintillators using a compound parabolic concentrator coupled to an avalanche photodiode [8861-4]
P. A. Jenke, M. S. Briggs, P. N. Bhat, P. Reardon, V. Connaughton, The Univ. of Alabama in Huntsville (United States); C. Wilson-Hodge, NASA Marshall Space Flight Ctr. (United States)

SESSION 2  LAUE LENSES I

8861 06  Scientific prospects in soft gamma-ray astronomy enabled by the LAUE project [8861-5]
F. Frontera, Univ. degli Studi di Ferrara (Italy) and INAF - IASF Bologna (Italy); E. Virgili, Univ. degli Studi di Ferrara (Italy); V. Valsan, V. Liccardo, Univ. degli Studi di Ferrara (Italy) and Univ. de Nice Sophia Antipolis (France); V. Carassiti, INFN Sezione di Ferrara (Italy); E. Caroli, INAF - IASF Bologna (Italy); F. Cassese, DTM Technologies S.r.l. (Italy); C. Ferrari, IMEM, CNR, Parma (Italy); V. Guidi, Univ. degli Studi di Ferrara (Italy); S. Mottini, M. Pecora, Thales Alenia Space (Italy); B. Negri, Agenzia Spaziale Italiana (Italy); L. Recanatesi, DTM Technologies S.r.l. (Italy); L. Amati, N. Auricchio, L. Bassani, R. Campana, INAF - IASF Bologna (Italy); R. Farinelli, C. Guidorzi, Univ. degli Studi di Ferrara (Italy); C. Labanti, R. Landi, A. Malizia, M. Orlandini, INAF - IASF Bologna (Italy); P. Rosati, Univ. degli Studi di Ferrara (Italy); V. Sguera, J. Stephen, INAF - IASF Bologna (Italy); L. Titarchuk, Univ. degli Studi di Ferrara (Italy)

8861 07  The LAUE project and its main results [8861-6]
E. Virgili, Univ. degli Studi di Ferrara (Italy); F. Frontera, Univ. degli Studi di Ferrara (Italy) and INAF - IASF Bologna (Italy); V. Valsan, V. Liccardo, Univ. degli Studi di Ferrara (Italy) and Univ. de Nice Sophia-Antipolis (France); V. Carassiti, S. Squerzanti, INFN Sezione di Ferrara (Italy); M. Statera, Univ. degli Studi di Ferrara (Italy) and INFN Sezione di Ferrara (Italy); M. Parise, Univ. di Ferrara (Italy); C. Ferrari, A. Zappettini, E. Buffagni, E. Bonnini, IMEM, CNR, Parma (Italy); M. Pecora, S. Mottni, Thales Alenia Space (Italy); B. Negri, Agenzia Spaziale Italiana (Italy)
The ground support equipment for the LAUE project [8861-7]
E. Caroli, N. Auricchio, A. Basili, INAF - IASF Bologna (Italy); V. Carassiti, Univ. degli Studi di Ferrara (Italy) and INFN Sezione di Ferrara (Italy); F. Cassese, DTM Technologies S.r.l. (Italy); S. Del Sordo, INAF - IASF Palermo (Italy); F. Frontera, Univ. degli Studi di Ferrara (Italy) INFN Sezione di Ferrara (Italy); M. Pecora, Thales Alenia Space (Italy); L. Recanatesi, DTM Technologies S.r.l. (Italy); F. Schiavone, S. Silvestri, INAF - IASF Bologna (Italy); S. Squerzanti, DTM Technologies S.r.l. (Italy); J. B. Stephen, INAF - IASF Bologna (Italy); E. Virgilli, Univ. degli Studi di Ferrara (Italy) and INFN Sezione di Ferrara (Italy)

Results of the simulations of the petal/lens as part of the LAUE project [8861-8]
V. Valsan, Univ. degli Studi di Ferrara (Italy) and Univ. de Nice Sophia-Antipolis (France); F. Frontera, E. Virgilli, Univ. degli Studi di Ferrara (Italy); V. Liccardo, Univ. degli Studi di Ferrara (Italy) and Univ. de Nice Sophia-Antipolis (France); E. Caroli, J. B. Stephen, INAF - IASF Bologna (Italy)

Bent crystal selection and assembling for the LAUE project [8861-9]
V. Liccardo, Univ. degli Studi di Ferrara (Italy) and Univ. de Nice Sophia-Antipolis (France); E. Virgilli, Univ. degli Studi di Ferrara (Italy); F. Frontera, Univ. degli Studi di Ferrara (Italy) and INAF - IASF Bologna (Italy); V. Valsan, Univ. degli Studi di Ferrara (Italy) and Univ. de Nice Sophia-Antipolis (France); V. Guidi, Univ. degli Studi di Ferrara (Italy); E. Buffagni, IMEM, CNR, Parma (Italy)

Quasi-mosaicity as a powerful tool to investigate coherent effects [8861-10]
V. Bellucci, R. Camattari, V. Guidi, Univ. degli Studi di Ferrara and IDASC SENSOR Lab., CNR (Italy)

Fabrication of quasi-mosaic Ge crystals for the LAUE project [8861-11]
R. Camattari, A. Battelli, V. Bellucci, I. Neri, V. Guidi, Univ. degli Studi di Ferrara (Italy) and IDASC SENSOR Lab., CNR (Italy); F. Frontera, Univ. degli Studi di Ferrara (Italy)

SESSION 3 LAUE LENSES II

X-ray diffraction efficiency of bent GaAs mosaic crystals for the LAUE project [8861-12]
C. Ferrari, E. Buffagni, E. Bonnini, A. Zappettini, IMEM, CNR, Parma (Italy)

Crystal bending by surface damaging in mosaic GaAs crystals for the LAUE project [8861-13]
E. Buffagni, E. Bonnini, A. Zappettini, IMEM, CNR, Parma (Italy); G. M. Guadalupi, Venezia Tecnologie S.p.A. (Italy); F. Rossi, C. Ferrari, IMEM, CNR, Parma (Italy)

LAUE lens development at UC Berkeley: status and prospects [8861-14]
N. M. Barrière, J. A. Tomsick, Univ. of California, Berkeley (United States); M. D. Ackermann, cosine Research B.V. (Netherlands); P. Bastie, Lab. Interdisciplinaire de Physique, CNRS, Univ. Joseph Fourier (France), and Institut Laue-Langevin (France); S. E. Boggs, Univ. of California, Berkeley (United States); L. Hanlon, Univ. College Dublin (Ireland); M. Jentschel, Institut Laue-Langevin (France); A. Lowell, Univ. of California, Berkeley (United States); G. Roudil, P. von Ballmoos, Institut de Recherche en Astrophysique et Planetologie (France); C. Wade, Univ. College Dublin (Ireland)
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**8861 0H**  **Calibration of the Soft X-ray Telescopes (SXT) onboard the ASTRO-H satellite** [8861-16]  
Y. Soong, NASA Goddard Space Flight Ctr. (United States) and The Ctr. for Research and Exploration in Space Science and Technology (United States); T. Okajima, P. J. Serlemitsos, NASA Goddard Space Flight Ctr. (United States); D. Hahne, NASA Goddard Space Flight Ctr. (United States) Johns Hopkins Univ. Applied Physics Lab. (United States)

**8861 0I**  **First result from a ground calibration of the Hard X-ray Telescope (HXT) onboard ASTRO-H satellite** [8861-17]  
T. Miyazawa, Nagoya Univ. (Japan); N. Ishida, Tamagawa Engineering Co., Ltd. (Japan); H. Kato, T. Demoto, Y. Kuroda, S. Takizawa, F. Shimasaki, Y. Miyata, T. Iwase, S. Tachibana, S. Saji, Y. Babazaki, H. Mori, K. Tamura, Y. Haba, K. Ishibashi, H. Matsumoto, Y. Tawara, H. Kunieda, Nagoya Univ. (Japan); Y. Maeda, M. Ishida, Japan Aerospace Exploration Agency (Japan); D. Kurihara, S. Sugita, H. Awaki, Ehime Univ. (Japan); K. Uesugi, Y. Suzuki, Japan Synchrotron Radiation Research Institute (Japan)

**8861 0J**  **Status of the eROSITA Telescope testing and calibrating the x-ray mirror assemblies** [8861-18]  
V. Burwitz, P. Predehl, H. Bräuninger, W. Burkert, K. Dennerl, J. Eder, P. Friedrich, M. Fürmetz, Max-Planck-Institut für extraterrestrische Physik (Germany); G. Grisoni, Media Lario Technologies S.r.l. (Italy); G. Hartner, Max-Planck-Institut für extraterrestrische Physik (Germany); F. Marioni, Media Lario Technologies S.r.l. (Italy); B. Menz, E. Pfeffermann, Max-Planck-Institut für extraterrestrische Physik (Germany); G. Valsecchi, Media Lario Technologies S.r.l. (Italy)

**8861 0K**  **Development of mirror modules for the ART-XC instrument aboard the Spectrum-Roentgen-Gamma mission** [8861-19]  
M. Gubarev, B. Ramsey, S. L. O’Dell, R. Eisner, K. Kilaru, J. McCracken, NASA Marshall Space Flight Ctr. (United States); M. Pavlinsky, A. Tkachenko, I. Lapshov, Space Research Institute (Russian Federation); C. Atkins, NASA Marshall Space Flight Ctr. (United States) and The Univ. of Alabama in Huntsville (United States); V. Zavlin, NASA Marshall Space Flight Ctr. (United States) and Universities Space Research Association (United States)
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8861 0L X-ray optics developments at ESA [8861-20]
M. Bavdaz, E. Wille, K. Wallace, B. Shortt, S. Fransen, N. Rando, European Space Agency, ESTEC (Netherlands); M. Collon, M. Ackermann, G. Vacanti, R. Günther, cosine Research B.V. (Netherlands); J. Haneveld, M. Olde Riekerink, A. Koelewijn, Micronit Microfluidics B.V. (Netherlands); C. van Baren, SRON Netherlands Institute for Space Research (Netherlands); D. Kampf, K.-H. Zuknik, A. Reutlinger, Kayser-Threde GmbH (Germany); F. Christensen, D. Della Monica Ferreira, A. C. Jakobsen, DTU Space, Technical Univ. of Denmark (Denmark); M. Krumrey, P. Müller, Physikalisch-Technische Bundesanstalt (Germany); V. Burwitz, Max-Planck-Institut für extraterrestrische Physik (Germany); G. Pareschi, M. Ghigo, M. Civitani, L. Proserpio, D. Spiga, S. Basso, B. Salmaso, INAF - Osservatorio Astronomico di Brera (Italy); D. Gallieni, M. Tintori, P. Fumi, ADS International S.r.l. (Italy); F. Martelli, G. Parodi, BCV Progetti S.r.l. (Italy); I. Ferrario, Media Lario Technologies S.r.l. (Italy); I. Povey, Tyndall National Institute (Ireland)

8861 0M Aberration-free silicon pore x-ray optics [8861-21]
M. J. Collon, M. Ackermann, R. Günther, cosine Research B.V. (Netherlands); G. Vacanti, cosine Science and Computing B.V. (Netherlands); M. W. Beijersbergen, cosine Research B.V. (Netherlands); M. Bavdaz, E. Wille, K. Wallace, European Space Agency, ESTEC (Netherlands); J. Haneveld, M. Olde Riekerink, A. Koelewijn, Micronit Microfluidics B.V. (Netherlands); C. van Baren, SRON Netherlands Institute for Space Research (Netherlands); P. Müller, M. Krumrey, Physikalisch-Technische Bundesanstalt (Germany); G. Sironi, M. Ghigo, INAF - Osservatorio Astronomico di Brera (Italy)

8861 0N High resolution and high throughput x-ray optics for future astronomical missions [8861-22]
W. W. Zhang, NASA Goddard Space Flight Ctr. (United States); M. P. Biskach, Stinger Ghaffarian Technologies, Inc. (United States); P. N. Blake, V. T. Bly, NASA Goddard Space Flight Ctr. (United States); J. M. Carter, NASA Marshall Space Flight Ctr. (United States); K. W. Chan, Univ. of Maryland, Baltimore County (United States); J. A. Gaskin, NASA Marshall Space Flight Ctr. (United States); M. Hong, B. R. Hohl, Stinger Ghaffarian Technologies, Inc. (United States); W. D. Jones, J. J. Kolodziejczak, NASA Marshall Space Flight Ctr. (United States); L. D. Kolos, NASA Goddard Space Flight Ctr. (United States); J. R. Mazzarella, R. S. McClelland, K. P. McKeon, Stinger Ghaffarian Technologies, Inc. (United States); T. M. Miller, NASA Goddard Space Flight Ctr. (United States); S. L. O'Dell, NASA Marshall Space Flight Ctr. (United States); R. E. Riveros, NASA (United States); T. T. Saha, NASA Goddard Space Flight Ctr. (United States); M. J. Schofield, M. V. Sharpe, H. C. Smith, Stinger Ghaffarian Technologies, Inc. (United States)

8861 0O Design, construction, and testing of lightweight x-ray mirror modules [8861-23]
R. S. McClelland, M. P. Biskach, Stinger Ghaffarian Technologies, Inc. (United States); K.-W. Chan, Univ. of Maryland, Baltimore County (United States); R. A. Espina, B. R. Hohl, Stinger Ghaffarian Technologies, Inc. (United States); E. A. Matson, T. T. Saha, W. W. Zhang, NASA Goddard Space Flight Ctr. (United States)

8861 0P Development of Four-Stage X-ray Telescope (FXT) for DIOS mission [8861-24]
I. Sakurai, Nagoya Univ. (Japan); S. Sugita, Ehime Univ. (Japan); Y. Tawara, T. Takizawa, Y. Babazaki, R. Nakamichi, Nagoya Univ. (Japan)
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8861 0Q  Light-weight glass mirror systems for future x-ray telescopes [8861-25]
   A. Winter, E. Breunig, V. Burwitz, P. Friedrich, G. Hartner, B. Menz, L. Proserpio, Max-Planck-Institut für extraterrestrische Physik (Germany)

8861 0R  Non-touch thermal air-bearing shaping of x-ray telescope optics [8861-26]
   E. Sung, B. Chalifoux, Massachusetts Institute of Technology (United States); M. L. Schattenuberg, R. K. Heilmann, MIT Kavli Institute for Astrophysics and Space Research (United States)

8861 0S  Evaluation of the surface strength of glass plates shaped by hot slumping process [8861-27]
   L. Proserpio, G. Crimi, M. Ghigo, G. Pareschi, INAF - Osservatorio Astronomico di Brera (Italy); B. Salmasso, INAF - Osservatorio Astronomico di Brera (Italy) and Univ. degl Studi dell'Insubria (Italy); A. D'Este, R. Dall'Igna, M. Silvestri, Stazione Sperimentale del Vetro (Italy); G. Parodi, F. Martelli, BCV Progetti S.r.l. (Italy)

8861 0T  High-precision figure correction of x-ray telescope optics using ion implantation [8861-28]
   B. Chalifoux, E. Sung, Massachusetts Institute of Technology (United States); R. K. Heilmann, M. L. Schattenuberg, MIT Kavli Institute for Astrophysics and Space Research (United States)

8861 0U  Development of light weight replicated x-ray optics [8861-29]
   S. Romaine, R. Bruni, Harvard-Smithsonian Ctr. for Astrophysics (United States); B. Choi, ReliaCoat Technologies, LLC (United States); P. Gorenstein, Harvard-Smithsonian Ctr. for Astrophysics (United States); C. Jensen, ReliaCoat Technologies, LLC (United States); B. Ramsey, National Space Sciences and Technology Ctr. (United States); R. Rosati, Harvard-Smithsonian Ctr. for Astrophysics (United States); S. Sampath, ReliaCoat Technologies, LLC (United States) and SUNY, Stony Brook Univ. (United States)

8861 0V  Thin fused silica optics for a few arcsec angular resolution and large collecting area x-ray telescope [8861-63]
   O. Citterio, M. M. Civitani, G. Pareschi, S. Basso, S. Campana, P. Conconi, M. Ghigo, INAF - Osservatorio Astronomico di Brera (Italy); E. Mattani, INAF - Osservatorio Astronomico di Brera (Italy) and INAF - IASF Milano (Italy); A. Moretti, INAF - Osservatorio Astronomico di Brera (Italy); G. Parodi, BCV Progetti S.r.l. (Italy); G. Tagliaferri, INAF - Osservatorio Astronomico di Brera (Italy)

8861 0W  Micro-roughness improvement of slumped glass foils for x-ray telescopes via dip coating [8861-60]
   B. Salmasso, INAF - Osservatorio Astronomico di Brera (Italy) and Univ. degli Studi dell'Insubria (Italy); A. Bianco, O. Citterio, G. Pareschi, G. Pariani, L. Proserpio, D. Spiga, INAF - Osservatorio Astronomico di Brera (Italy); D. Mandelli, M. Negri, Lenti S.r.l. (Italy)
SESSION 7  ALIGNMENT AND ASSEMBLY

8861 0X Coating thin mirror segments for lightweight x-ray optics [8861-30]
K.-W. Chan, Univ. of Maryland, Baltimore County (United States) and NASA Goddard Space Flight Ctr. (United States); M. Sharpe, Stinger Ghaffarian Technologies, Inc. (United States) and NASA Goddard Space Flight Ctr. (United States); W. Zhang, L. Kolos, NASA Goddard Space Flight Ctr. (United States); M. Hong, R. McClelland, B. Hohl, Stinger Ghaffarian Technologies, Inc. (United States) and NASA Goddard Space Flight Ctr. (United States); T. Saha, NASA Goddard Space Flight Ctr. (United States); J. Mazzarella, Stinger Ghaffarian Technologies, Inc. (United States) and NASA Goddard Space Flight Ctr. (United States)

8861 0Y Alignment measurement and permanent mounting of thin lightweight x-ray mirror segments [8861-31]
M. P. Biskach, Stinger Ghaffarian Technologies, Inc. (United States); K.-W. Chan, Univ. of Maryland, Baltimore County (United States) and NASA Goddard Space Flight Ctr. (United States); J. R. Mazzarella, R. S. McClelland, Stinger Ghaffarian Technologies, Inc. (United States); T. T. Saha, NASA Goddard Space Flight Ctr. (United States); M. J. Schofield, Stinger Ghaffarian Technologies, Inc. (United States); W. W. Zhang, NASA Goddard Space Flight Ctr. (United States)

8861 0Z Shape control of modular x-ray optics during integration and alignment: concepts and recent experiments at MPE [8861-32]
E. Breunig, P. Friedrich, A. Winter, Max-Planck-Institut für extraterrestrische Physik (Germany)

8861 10 Direct hot slumping and accurate integration process to manufacture prototypal x-ray optical units made of glass [8861-33]
M. Civitani, M. Ghigo, S. Basso, L. Proserpio, D. Spiga, B. Salmaso, G. Pareschi, G. Tagliaferri, INAF - Osservatorio Astronomico di Brera (Italy); V. Burwitz, G. D. Hartner, B. Menz, Max-Planck Institut für extraterrestrische Physik (Germany); M. Bavdaz, E. Wille, European Space Agency, ESTEC (Netherlands)

8861 11 Exploring EUV near absorption edge optical constants for enhanced and sensitive grazing incidence reflectivity [8861-39]
S. M. Giday, Univ. degli Studi di Padova (Italy) and LUXOR Lab., IFN-CNR (Italy); P. Zuppella, M. G. Pelizzo, LUXOR Lab., IFN-CNR (Italy); P. Nicolosi, Univ. degli Studi di Padova (Italy) and LUXOR Lab., IFN-CNR (Italy)

SESSION 8  COATINGS

8861 12 Coating optimization for the ATHENA+ mission [8861-34]
D. Della Monica Ferreira, F. E. Christensen, A. C. Jakobsen, N. J. Westergaard, DTU Space, Technical Univ. of Denmark (Denmark); B. Shortt, European Space Agency, ESTEC (Netherlands)

8861 13 X-ray optics for axion helioscopes [8861-35]
A. C. Jakobsen, DTU Space, Technical Univ. of Denmark (Denmark); M. J. Pivovaroff, Lawrence Livermore National Lab. (United States); F. E. Christensen, DTU Space, Technical Univ. of Denmark (Denmark)
8861 14  **Improvements of design scheme and fabrication of the hard x-ray supermirror with broad bandwidth and flattop response** [8861-36]
Y. Yao, H. Kunieda, Nagoya Univ. (Japan)

8861 16  **Hard x-ray/soft gamma-ray telescope designs for future astrophysics missions** [8861-38]
D. Della Monica Ferreira, F. E. Christensen, DTU Space, Technical Univ. of Denmark (Denmark); M. J. Pivovaroff, N. Brejnholm, M. Fernandez-Perea, Lawrence Livermore National Lab. (United States); N. S. J. Westergaard, A. C. Jakobsen, DTU Space, Technical Univ. of Denmark (Denmark); M.-A. Descalle, R. Soufl, J. K. Vogel, Lawrence Livermore National Lab. (United States)

8861 17  **Reflective and antireflective coatings for the optical chain of the ASTRI SST-2M prototype** [8861-61]
G. Bonnoli, R. Canestrari, INAF - Osservatorio Astronomico di Brera (Italy); O. Catalano, INAF - IASF Palermo (Italy); G. Pareschi, L. Perri, INAF - Osservatorio Astronomico di Brera (Italy); L. Stringhetti, INAF - IASF Milano (Italy)

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**SESSION 9  SPECTROGRAPHS**

8861 18  **Development of lightweight blazed transmission gratings and large-area soft x-ray spectrographs** [8861-40]
R. K. Heilmann, A. R. Bruccoleri, D. Guan, M. L. Schattenburg, MIT Kavli Institute for Astrophysics and Space Research (United States)

8861 19  **Nanofabrication advances for high efficiency critical-angle transmission gratings** [8861-41]
A. R. Bruccoleri, D. Guan, R. K. Heilmann, MIT Kavli Institute for Astrophysics and Space Research (United States); S. Vargo, SPTS Technologies, Inc. (United States); F. DiPiazza, Silicon Resources LLC (United States); M. L. Schattenburg, MIT Kavli Institute for Astrophysics and Space Research (United States)

8861 1B  **Pushing the boundaries of x-ray grating spectroscopy in a suborbital rocket** [8861-43]
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Introduction

The conference, Optics for EUV, X-Ray, and Gamma-Ray Astronomy VI, met August 27-29 in San Diego, California, as part of the SPIE Optics + Photonics 2013 international symposium Optical Engineering + Applications. As with previous conferences in this series, it provided an effective forum for discussion of recent progress in imaging and spectroscopic optics for EUV, x-ray, and gamma-ray astronomy. With over 60 papers in 12 sessions, this volume attests to the strength of research in this field, more than 50 years after the first discovery of a cosmic x-ray source and the initial concept of an x-ray focussing telescope, proposed by Giacconi and Rossi. Particularly indicative of the continued vitality of this field was the sustained high attendance throughout the 3-day conference and the participation of numerous graduate-student and post-doctoral researchers.

Approximately 30% of the papers address optics for gamma-ray astronomy (Sessions 1–3); 35%, grazing-incidence telescopes (Sessions 4–5) and supporting technologies (Sessions 6–8) for x-ray astronomy. The remaining papers report on technologies for x-ray gratings (Session 9), on analysis and test methods (Sessions 10–11), and on novel optics (Session 12) for high-energy astrophysics.

OPTICS FOR INDIRECT GAMMA-RAY MEASUREMENT (Session 1) mainly discusses technologies for ground-based Imaging Atmospheric Cherenkov Telescopes (IACTs). IACTs—e.g., VERITAS, MAGIC and HESS arrays—measure energetic (>TeV) γ rays through analyzing the blue Cherenkov light that is beamed forward by a γ-ray-induced atmospheric shower of relativistic charged particles. The papers primarily report on implementation of mirrors and telescopes for the forthcoming international Cherenkov Telescope Array (CTA). CTA will utilize nearly 200 telescopes of different sizes, with total reflecting area > 10000 m². Funding limits the areal cost to 2.5 k$/m², which seems achievable given that the required imaging quality for IACTs—typically, a few-arcminute resolution—is much more relaxed than that for an astronomical optical telescope. Adequately supported (normal-incidence) segmented reflectors based upon glass foils (produced via hot or cold replication) appear very attractive and share several technologies with slumped-glass grazing-incidence mirrors being developed for x-ray telescopes.
LAUE LENSES I AND II (Sessions 2 and 3) address the use of Laue lenses, based on natural crystals, for focusing astronomical $\gamma$ rays in the energy band 0.1–1 MeV. Although true imaging may not be possible with Laue lenses—due to severe off-axis aberrations for single-reflection grazing-incidence optics—concentrating $\gamma$ rays into a small area greatly increases the sensitivity for detection and measurement of cosmic $\gamma$-ray sources. Papers in this session describe scientific prospects for soft-$\gamma$-ray astronomy using Laue lenses, potential configurations to broaden the energy range (for continuum measurements), or to enhance effective area over narrow energy bands (for nuclear spectroscopy), and test facilities and results. Several papers report significant progress in fabricating, mounting, and characterizing bent and mosaic crystals for Laue-lens telescopes. As an aside, we note that multilayer-coated grazing-incidence optics (cf. Session 8) may provide an alternative to Laue lenses for soft-$\gamma$-ray focusing.

TELESCOPES (FLIGHT) (Session 4) reports on the status and on recent calibration of mirror assemblies for two x-ray-astronomy satellites to be launched in 2015. The JAXA Astro-H satellite will carry 2 Soft-X-ray Telescopes (SXT, provided by NASA Goddard Space Flight Center) and 2 Hard-X-ray Telescopes (HXT, provided by Nagoya University). The SXT and HXT mirror modules utilize epoxy-replicated formed aluminium foils, similar to those flown aboard JAXA’s Suzaku satellite. The Russian Spectrum-Röntgen-Gamma satellite will carry 7 eROSITA (soft-x-ray) mirror modules (provided by the Max-Planck-Institut für extraterrestrische Physik, MPE) and 7 ART-X (medium-x-ray) mirror modules (provided by the Russian Space Research Institute, IKI). The eROSITA and ART-X mirror modules utilize electroformed-nickel replicated shells, similar to those flown aboard ESA’s XMM-Newton satellite.

TELESCOPES (DEVELOPMENT) (Session 5) summarizes technology development for future x-ray telescopes. Most prominent are potential ESA or NASA large x-ray missions, with effective area > 1 m$^2$ and angular resolution < 10$^\circ$ half-energy width (half-power diameter). Achieving such large aperture areas calls for a scalable, modular design using segmented grazing-incidence optics. In terms of performance and technology readiness, the currently most advanced approaches employ either silicon pore optics (ESA’s leading candidate) or slumped-glass mirrors (NASA’s leading candidate, ESA’s back-up).

MIRROR TECHNOLOGIES (Session 6) addresses research into fabrication of precision grazing-incidence mirrors—both segmented and full-shell. Papers on slumped-glass segments discuss various approaches to slumping, glass-strength issues, and post-slumping figure correction. Papers on full-shell grazing-incidence mirrors report on research into plasma-spray replication and into direct fabrication of monolithic thin shells.

ALIGNMENT AND ASSEMBLY (Session 7) describes various issues in alignment, mounting, and assembly of slumped-glass mirrors. Owing to their flimsy nature, the ability to align and mount thin glass foils without significant distortion is essential to achieving the angular resolution needed for future missions.
COATINGS (Session 8) emphasizes depth-graded multilayer x-ray optical coatings, which enhance reflectance at high energies. Successfully implemented in NuSTAR and the up-coming Astro-H, multilayer or complex coatings for x-ray telescopes are a reality. This demonstrated technology is now under study for future x-ray telescopes (e.g., ATHENA+) and as an alternative to Laue lenses (Sessions 2 and 3) for soft-$\gamma$-ray telescopes. In addition, we note that multilayer coatings have wide applicability outside x-ray astronomy—e.g., biomedical, neutron, and cosmic-ray instrumentation.

SPECTROGRAPHS (Session 9) reports on research into gratings for high-resolution dispersive spectroscopy for x-ray astronomy. Combined with sub-aperturing to minimize image size in the dispersion direction, either critical-angle transmission (CAT) gratings or off-plane reflection gratings offer the prospect of achieving resolving powers $R > 3000$ below 1 keV, as needed for plasma diagnostics in future x-ray astrophysics missions. The last paper of the session describes a novel polarimeter using laterally-graded multilayer-coated optics matched to a grating spectrometer.

DESIGN AND ANALYSES (Session 10) includes diverse topics. The papers report on designs for baffling stray x rays, on analysis of intrafocal x-ray images as a metrology tool, and on modeling mirror mounting schemes to minimize distortions.

TEST METHODS (Session 11) describes facilities, instrumentation, and techniques for precision metrology and for EUV and x-ray performance testing of mirrors and of telescopes.

NOVEL OPTICS (Session 12) concludes these Proceedings with concepts for advanced x-ray imaging telescopes, ranging from wide-field x-ray telescopes to x-ray interferometers. Papers on technology development for active (adjustable) x-ray telescopes address possible approaches for alignment adjustment and figure correction of mounted, thin, grazing-incidence mirrors—either on-ground or in-space. Such techniques might be needed to realize the next next-generation x-ray observatory—a large-aperture-area (few m²) telescope with Chandra-class (sub-arcsecond) angular resolution.

We thank the Program Committee for helping to organize the technical program and for fostering broad participation, and the session chairs and presenters for a successful and stimulating conference. We also appreciate the efforts of the SPIE staff in organizing and implementing the Conference and in publishing these Proceedings.

Giovanni Pareschi
Steven L. O'Dell