

# Contents

- xi *Conference Committee*  
xiii *Introduction*

## **Part One**

### **PLENARY SESSION**

---

- 2 **Geometrical and physical theory of image formation: a synthesis [1780-01]**  
H. H. Hopkins, Univ. of Reading (UK)
- 14 **Global optimization for lens design: an emerging technology [1780-02]**  
T. G. Kuper, T. I. Harris, Optical Research Associates (USA)
- 29 **Generation of lens designs for optimization [1780-03]**  
M. J. Kidger, Kidger Optics Ltd. (UK)
- 36 **Optics in hostile environments [1781-01]**  
P. J. Rogers, Pilkington Optronics (UK)
- 49 **Design of optical interference coatings 1992 [1782-01]**  
A. J. Thelen, Ingenieurbüro Thelen (FRG)
- 55 **ISO standards: a means for quality assurance for optical elements and systems [1781-02]**  
K. W. Hildebrand, Leica Heerbrugg Ltd. (Switzerland)
- 92 **Thin films for magneto-optical recording [1782-04]**  
P. H. Lissberger, Queen's Univ. of Belfast (UK)
- 104 **Characterization of partially coherent beams [1781-04]**  
H. Weber, Technische Univ. Berlin (FRG)
- 117 **Resolution versus depth of focus in the resolution-enhanced optical system for lithography [1780-04]**  
M. Shibuya, T. Tsuruta, Nikon Corp. (Japan)
- 132 **Optical losses in dielectric multilayer coatings and their influence on characteristics of laser resonators [1782-02]**  
Y. V. Troitski, Russian Academy of Sciences (Russia)
- 142 **Principles of adaptive optics [1780-05]**  
F. Merkle, European Southern Observatory (FRG)
- 152 **High-power optical coatings for a megajoule class ICF laser [1782-03]**  
M. R. Kozlowski, I. M. Thomas, J. H. Campbell, F. Rainer, Lawrence Livermore National Lab. (USA)

<b>SESSION 1 DESIGN SOFTWARE I</b>	
168	<b>Standards required for implementation of CIM in optics [1780-06]</b> R. Finkler, B. Y. Cohen, OptRam Ltd. (Israel)
178	<b>Human factor considerations for optical design software [1780-07]</b> S. W. Weller, Genesee Optics Software, Inc. (USA)
186	<b>Development of interactive optical design software under multitasking graphical operating system [1780-08]</b> G. Kovács, Technical Univ. of Budapest (Hungary)
<b>SESSION 2 DESIGN SOFTWARE II</b>	
192	<b>Combination of global-optimization and expert-systems techniques in optical design [1780-09]</b> S. C. Johnston, A. W. Greynolds, D. Y. Wang, Breault Research Organization, Inc. (USA); D. C. Dilworth, Optical Systems Design, Inc. (USA)
197	<b>Small expert system used in lens design [1780-10]</b> X. Chen, Z. Wang, D. Lin, G. Sun, Institute of Optics and Electronics (China)
202	<b>Optical lens design by neural network [1780-11]</b> Y.-J. Hu, D.-C. Chern, R.-S. Chang, National Central Univ. (Taiwan)
210	<b>Simple method for computer-aided lens design with the elements of artificial intelligence [1780-12]</b> I. L. Anitropova, St. Petersburg Institute of Fine Mechanics and Optics (Russia)
<b>SESSION 3 DESIGN SOFTWARE III</b>	
216	<b>New ray-tracing method for radial gradient-index lenses [1780-13]</b> F. Bociort, J. Kross, Technische Univ. Berlin (FRG)
226	<b>Simplified irradiance/illuminance calculations in optical systems [1780-14]</b> D. G. Koch, Optical Research Associates (USA)
241	<b>Adjustment and design criteria of lenses in the case of partially coherent imaging [1780-15]</b> J.-U. Müller, G. Rieche, D. Schmidt, Carl Zeiss (FRG)
253	<b>Optical simulations and analysis of the asymmetric surface form errors [1780-16]</b> T. Kiriki, Konica Corp. (Japan)
259	<b>Knowledge-based optical system design: some optical systems generated by the KBOSD [1780-18]</b> T. Nouri, P.-J. Erard, Neuchâtel Univ. (Switzerland)
263	<b>Diffraction computation of 'focusator' into longitudinal segment and multifocal lens [1780-19]</b> S. N. Khonina, V. V. Kotlyar, V. A. Soifer, Institute of Unique Instrumentation (Russia)
273	<b>Interpolation of indices-of-refraction extended-range UV/IR [1780-20]</b> B.-K. Dieter, Optische Werke G. Rodenstock (FRG)

- 287 **Seeking for global minimum with GSA in lens design** [1780-21]  
X. Chen, Z. Wang, D. Lin, G. Sun, Institute of Optics and Electronics (China)
- 294 **Influence of temperature gradients on the performance of ZnSe lenses** [1780-22]  
R. J. Tangelder, L. H. J. F. Beckmann, J. Meijer, Univ. of Twente (Netherlands)
- 303 **Use of the Sellmeier dispersion formula for optical glasses and practical implications** [1780-23]  
H. J. Hoffmann, W. W. Jochs, G. Westenberger, Schott Glaswerke (FRG)

---

**SESSION 4 DIFFRACTIVE OPTICS**

- 316 **Short derivation of aberrations, stop-shift, and object-shift equations for diffractive optics** [1780-38]  
J. L. F. de Meijere, Becton Dickinson Image Cytometry Systems B.V. (Netherlands);  
C. H. F. Velzel, Philips Ctr. for Manufacturing Technology (Netherlands)
- 325 **Holographic collimator for laser diodes** [1780-25]  
R. Hauck, H. Schröder, Krupp Forschungsinstitut GmbH (FRG)
- 333 **Hybrid optics for space applications: design, manufacture, and testing** [1780-26]  
R. H. Czichy, D. B. Doyle, European Space Agency ESA/ESTEC (Netherlands); J. M. Mayor,  
Ctr. Suisse d'Electronique et de Microtechnique (Switzerland)
- 345 **Optimized replication of interferometrically generated deep diffractive structures by embossing into thermoplastics** [1780-27]  
G. Lensch, P. Lippert, NU TECH GmbH (FRG); H. Kreitlow, Fachhochschule Ostfriesland (FRG);  
C. Budzinski, Berliner Institut fuer Optik (FRG)
- 353 **Waveguide Fresnel lenses with curved diopters: a BPM analysis** [1780-28]  
G. C. Righini, M. A. Forastiere, IROE-CNR (Italy)
- 363 **Inclusion of deformed wavefronts into correction of holographic concave gratings** [1780-24]  
R. Güther, Ferdinand-Braun-Institut für Hoehstfrequenztechnik (FRG)
- 375 **Color and spatial aplanatism for corrected holographic gratings** [1780-35]  
R. Güther, Ferdinand-Braun-Institut für Hoehstfrequenztechnik (FRG)
- 385 **Design of an aberration-corrected holographic grating with high spectral and spatial resolution** [1780-36]  
H. Kohn, H.-J. Rostalski, C. Budzinski, A. Mitreiter, Berliner Institut für Optik GmbH (FRG)
- 393 **Special diffractive lenses** [1780-37]  
L. Doskolovich, M. Golub, N. Kazanskiy, V. Soifer, G. Uspleniev, Institute of Unique  
Instrumentation (Russia)
- 403 **Numerical investigations of image quality given by holographic lenses recorded on quadrics of revolution** [1780-39]  
J. Masajada, J. Nowak, Technical Univ. of Wrocław (Poland)
- 411 **Imaging quality of Fourier-transforming diffractive lens** [1780-40]  
M. Zajac, J. Nowak, Technical Univ. of Wrocław (Poland)

---

**SESSION 5 SMART CALCULATIONS**

---

- 420 **Design of a waveguide grating using Lagrange's integral invariant** [1780-29]  
J. J. Braat, M. Laurijs, Delft Univ. of Technology (Netherlands)
- 428 **New optimization method based on a wavefront development generating independent conditions** [1780-30]  
E. Hugues, CERCO (France)
- 439 **Lens design and tolerance calculations** [1780-31]  
C. H. F. Velzel, Philips Ctr. for Manufacturing Technology (Netherlands); B. Kruizinga, TNO Institute of Applied Physics (Netherlands); J. L. F. de Meijere, Becton Dickinson Image Cytometry Systems B.V. (Netherlands)
- 445 **The eikonal function: the common concept in ray optics and particle mechanics** [1780-32]  
M. Krautter (FRG)

---

**SESSION 6 GRADIENT INDEX**

---

- 456 **Design of the optical system using GRIN materials** [1780-33]  
H. Tsuchida, T. Nagaoka, K. Yamamoto, Olympus Optical Co., Ltd. (Japan)
- 464 **Linear axial GRIN lenses: exact ray-trace and paraxial formulas** [1780-34]  
J. P. Angénieux, Ets. P. Angénieux (France)
- 474 **Single-element plastics aspherics: the economical approach to precision optics** [1780-42]  
I. K. Pasco, Combined Optical Industries Ltd. (UK)
- 486 **Ray tracing in gradient-index materials** [1780-43]  
E. Langenbach, Fisba Optik AG (Switzerland)
- 491 **Berlin lens design problem** [1780-99]  
W. Besenmatter, Carl Zeiss and Hensoldt AG (FRG)

**Part Two**

---

**SESSION 7 LASERS**

---

- 518 **DEMOS: new possibility for design and modeling of complex optical systems** [1780-100]  
M. A. Gan, D. D. Zhdanov, V. Novoselsky, S. I. Ustinov, A. O. Fedorov, I. S. Potyemin, S. I. Vavilov State Optical Institute (Russia)
- 524 **Output power optimization in laser with nonlinear absorber** [1780-45]  
A. Kujawski, Polish Academy of Sciences (Poland); P. Szczepański, Warsaw Univ. of Technology (Poland); L. Wosinska, Royal Institute of Technology (Sweden)
- 533 **Focusing of diode lasers for high beam quality in high-power applications** [1780-58]  
P. Albers, H.-J. Heimbeck, E. Langenbach, Fisba Optik AG (Switzerland)
- 539 **80-channel optical recording unit for laser plotter** [1780-47]  
M. Okazaki, T. Hayashi, Z. Wakimoto, Dainippon Screen Mfg. Co., Ltd. (Japan)

- 551 **Polychromatic effects of annular color filters in optical systems** [1780-53]  
M. J. Yzuel, J. C. Escalera, Univ. Autónoma de Barcelona (Spain); J. Campos, Univ. de Barcelona (Spain)
- 557 **Solid state pulsed laser with a fiber-based resonator meets requirements for laser lithotripsy** [1780-54]  
P. P. Pashinin, V. V. Tumorin, E. J. Shklovsky, General Physics Institute of Russia (Russia)
- 565 **High-brightness laser pulse at 338.4 nm utilizing the SBS and SRS processes** [1780-55]  
V. Nassisi, A. Pecoraro, Univ. of Lecce (Italy)
- 576 **Modeling of bistable operation of lasers with nonlinear absorber** [1780-56]  
A. Kujawski, Polish Academy of Sciences (Poland); P. Szczepański, Warsaw Univ. of Technology (Poland); L. Wosińska, Royal Institute of Technology (Sweden)
- 584 **Quasi-geometrical model of partially coherent beam propagation in real axially symmetric optical systems** [1780-57]  
J. K. Jabczyński, Military Academy of Technology (Poland)

---

**SESSION 8 OPTICAL INSTRUMENTS**

---

- 592 **Scale-tunable diffractometer for spatial light modulators: a design procedure** [1780-49]  
S. Bosch, S. Vallmitjana, I. Juvells, J. R. de F. Moneo, Univ. de Barcelona (Spain)
- 602 **Aero-optical subsystem design considerations for endoatmospheric interceptors** [1780-69]  
T. A. Street, U.S. Army Strategic Defense Command (USA)
- 612 **SCIAMACHY optical system** [1780-51]  
C. Smorenburg, H. Visser, TNO Institute of Applied Physics (Netherlands)
- 623 **Visible/near-infrared spectrometer (VNIR) for the Mars 94 mission** [1780-50]  
G. Bellucci, V. Formisano, F. Mastracci, CNR IFSI (Italy); A. Adriani, CNR IFA (Italy); F. Capaccioni, CNR IAS (Italy)
- 636 **Calculation of narcissus effect in scanning systems with detector arrays by exact numerical ray tracing** [1780-60]  
W. Kröniger, Optische Werke G. Rodenstock (FRG)
- 644 **Analog-digital electronic stabilization of optical image** [1780-61]  
B. E. Bonshtedt, D. N. Eskov, A. J. Smirnov, Vavilov State Optical Institute (Russia)
- 650 **Piezo-enhanced multireflection cells applied for in-situ measurements of trace-gas concentrations** [1780-64]  
H.-D. Kronfeldt, J. Berger, Technische Univ. Berlin (FRG)
- 658 **Theoretical analysis of optical systems subjected to mechanical stress: an application to ISO star sensor design** [1780-65]  
S. Pieri, A. Romoli, A. Landi, P. Sampaoli, Officine Galileo SpA (Italy)
- 670 **Compact design of a femtosecond single-shot autocorrelator** [1780-66]  
D. Ashkenasi, H.-D. Kronfeldt, T. Nink, Technische Univ. Berlin (FRG)

- 677 **Planetary Fourier spectrometer (PFS) for the MARS 94 mission** [1780-67]  
H. Hirsch, DLR (FRG); A. Adriani, CNR (Italy); F. Angrilli, Univ. of Padova (Italy); F. Capaccioni, CNR (Italy); S. Fonti, Istituto Univ. Navale (Italy); V. Formisano, A. Matteuzzi, CNR (Italy); G. Michel, Observatoire de Paris-Meudon (France); V. Moroz, Academy of Sciences (Russia)
- 685 **Predicting the image nonuniformities on IR devices: a dedicated software** [1780-68]  
J. Rollin, Thompson-TRT-Defense (France)

---

**SESSION 9 LENS DESIGN I**

- 698 **New methods of calculating most-effective aspherical surfaces** [1780-71]  
R. Zimmermann, F. Gretzschel, F. Guse, J. Kross, Technische Univ. Berlin (FRG)
- 711 **Innovative binocular design** [1780-72]  
M. H. Freeman, Optics and Vision, Ltd. (UK); D. E. Freeman, Kidger Optics Ltd. (UK)
- 721 **Front-stop photo lenses** [1780-73]  
E. Dietzsch, Jenoptik Jena GmbH (FRG)
- 727 **Keratoscope** [1780-74]  
D. T. Puryaev, A. V. Laskin, Moscow Bauman State Technical Univ. (Russia)

---

**SESSION 10 LENS DESIGN II**

- 738 **Design and structure of high-performance zoom lenses for 35-mm photography** [1780-76]  
W. Wöltche, Carl Zeiss (FRG)
- 748 **Ultrahigh-performance long-focal-length close-focusing zoom lens for the visible waveband** [1780-77]  
I. A. Neil, Panavision International L.P. (USA)
- 765 **Zoom lens designs for use in sheet-metal cutting by high-power CO<sub>2</sub>-lasers** [1780-78]  
L. H. J. F. Beckmann, Univ. of Twente (Netherlands); O. Maerten, Fraunhofer-Institut für Lasertechnik (FRG)

---

**SESSION 11 ASPHERES AND REFLECTING SYSTEMS**

- 778 **Ductile grinding of ultraprecise aspherical optical lenses** [1780-41]  
W. König, V. Sinhoff, Fraunhofer Institute for Production Technology (FRG)
- 789 **Two-mirror/three-surface system for large optical astronomical telescopes** [1780-82]  
J. Pan, X. He, Astronomical Instruments Research Ctr. (China)
- 797 **Reflecting collimator systems with no central obscuration** [1780-79]  
J. Pan, X. Li, Astronomical Instruments Research Ctr. (China)
- 805 **Very high pointing accuracy star-tracker optics trade-off analysis** [1780-80]  
M. Magnani, S. Pieri, A. Romoli, Officine Galileo SpA (Italy)
- 817 **Wide-angle reflective optical systems for infrared applications** [1780-81]  
A. G. Dall'Era, Lockheed Missiles & Space Co., Inc. (USA)

- 825 **Large-objective optical system for TV night observation [1780-83]**  
X. He, J. Pan, Astronomical Instruments Research Ctr. (China)
- 833 **Glasses election to provide aplanatic cemented doublets [1780-84]**  
M. J. Toledo, Univ. of Zaragoza (Spain)

---

**SESSION 12 ADAPTIVE OPTICS I**

---

- 846 **Active optics for large telescopes [1780-86]**  
L. Noethe, European Southern Observatory (FRG)
- 850 **New adaptive optics prototype system for the ESO 3.6-m telescope: Come-on-Plus [1780-87]**  
N. Hubin, European Southern Observatory (FRG); J. K. Beuzit, P. Gigan, P. J. Léna, Univ. de Paris VII (France); P. Madec, G. Rousset, ONERA (France); C. Boyer, J.-P. Gaffard, Laserdot Groupe Aerospatiale (France); J.-C. Richard, M. Vittot, Labs. d'Electronique Philips (France); F. Rigaut, Univ. de Paris VII (USA); E. Gendron, F. Merkle, European Southern Observatory (FRG)
- 862 **Statistical model of phase conjugation adaptive optical system with measurements and control noise [1780-90]**  
E. A. Ivanova, V. I. Kislov, S. A. Chetkin, General Physics Institute (Russia)

---

**SESSION 13 ADAPTIVE OPTICS II**

---

- 880 **Adaptive optics: different fields of application and experience at Laserdot [1780-91]**  
P. Jagourel, J.-P. Gaffard, Laserdot Groupe Aerospatiale (France)
- 891 **Adaptive optics for high-resolution imagery: optimization of corrections [1780-92]**  
J.-P. Gaffard, P. Gosselin, Laserdot Groupe Aerospatiale (France); G. Ledanois, CEA-CEL V (France)
- 905 **Optimization of auxiliary optics in active-optics telescopes [1780-93]**  
R. Ragazzoni, Astronomical Observatory of Padova (Italy)
- 913 **Current laser guide-star adaptive optics systems and concepts for the future [1780-97]**  
B. L. Ellerbroek, R. Q. Fugate, Starfire Optical Range/KAFB (USA); J. M. Spinhirne, Rockwell Power Systems (USA)
- 923 **Wide-field-of-view astronomical imaging using a guide-star reference [1780-98]**  
J. D. Gonglewski, J. S. Fender, Air Force Phillips Lab. (USA); D. C. Dayton, Applied Technology Associates, Inc. (USA); G. A. Tyler, Optical Sciences Co. (USA)
- 933 **Potential capabilities of adaptive optical systems in the atmosphere [1780-94]**  
V. P. Lukin, B. V. Fortes, F. Y. Kanev, P. A. Konyaev, Institute of Atmospheric Optics (Russia)
- 943 **Adaptive optics for high-resolution imagery: control algorithms for optimized modal corrections [1780-96]**  
C. Boyer, E. Gendron, Laserdot Groupe Aerospatiale (France); P.-Y. Madec, ONERA (France)
- 953 *Author Index*





# Conference Committee

## *Conference Chair*

**Hannfried Zügge**, Carl Zeiss (FRG)

## *Cochairs*

**Leo H. J. F. Beckmann**, University of Twente (Netherlands)

**Andre Masson**, Ets. P. Angénieux (France)

**Fritz Merkle**, European Southern Observatory (FRG)

**Philip J. Rogers**, Pilkington Optronics (UK)

**Adam Kujawski**, Polish Academy of Sciences (Poland)

## *Session Chairs*

Session 1—Design Software I

**Walter Besenmatter**, Carl Zeiss and Hensoldt AG (FRG)

Session 2—Design Software II

**Thomas I. Harris**, Optical Research Associates (USA)

Session 3—Design Software III

**Leo H. J. F. Beckmann**, University of Twente (Netherlands)

Session 4—Diffractive Optics

**Harold H. Hopkins**, University of Reading (UK)

Session 5—Smart Calculations

**Philip J. Rogers**, Pilkington Optronics (UK)

Session 6—Gradient Index

**Adam Kujawski**, Polish Academy of Sciences (Poland)

Session 7—Lasers

**Michael J. Kidger**, Kidger Optics Ltd. (UK)

Session 8—Optical Instruments

**Klaus W. Hildebrand**, Leica Heerbrugg Ltd. (Switzerland)

Session 9—Lens Design I

**Gerd Rieche**, Carl Zeiss (FRG)

Session 10—Lens Design II

**Andre Masson**, Ets. P. Angénieux (France)

Session 11—Aspheres and Reflecting Systems

**Maria J. Yzuel**, Universidad Autónoma de Barcelona (Spain)

Session 12—Adaptive Optics I

**Christiaan H. F. Velzel**, Philips Centre for Manufacturing Technology (Netherlands)

Session 13—Adaptive Optics II

**Andrea Romoli**, Officine Galileo SpA (Italy)

## Introduction

This proceedings provides a record of papers presented at Conference 1780, Lens and Optical Systems Design, part of the International Symposium on Optical Systems Design held at the Technical University, Berlin, FRG, 14-18 September 1992. Two other conferences on related subjects took place during the same week: Specification and Measurement of Optical Systems (SPIE Vol. 1781) and Thin Films for Optical Systems (SPIE Vol. 1782).

Bearing in mind that this symposium was the first to be held on this subject in the new EUROPTO series of meetings, the high level of support was particularly pleasing. Several delegates commented favorably on the choice of topics for the three events and on the subjects dealt with in the plenary papers. Almost all found some subjects to match their own particular interests.

The papers, which cover a wide field due to the increasing use of nonconventional optics, encompass the following topics:

- Design Software
- Design of Lens Systems
- Diffractive Optics
- Gradient Index Optics
- Laser Components and Systems
- Active and Adaptive Optics

A special feature of the event was a selected lens-design task employing a decentered central element. Several people provided solutions to this problem, and these are included in this proceedings.

We hope that all those active in lens design as well as users of new lens types will find something of interest in this volume.

Thanks are due to all the session chairs, the delegates, and, most important, to the presenters, without whom there would be no conference and the opportunity such an event provides to make new contacts and friends worldwide working in optics.

**Hannfried Zügge**