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COMMISSION 54 — OPTICAL/INFRARED INTERFEROMETRY

L'INTERFÈROMÈTRIE OPTIQUE/INFRAROUGE

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COMMISSION 54 WORKING GROUPS

Div. XII / Commission 54 WG	**Interferometry Data standards**
Div. XII / Commission 54 WG	**Imaging Algorithms**
Div. XII / Commission 54 WG	**Calibrator Stars**

TRIENNIAL REPORT 2009–2012

1. Introduction

The Commission was created in 2006, in response to an initiative by members of the international interferometry community, and as a natural expansion of the work of the earlier Working Group on Optical/Infrared Interferometry. At that time, optical interferometry had been in regular use in modern astronomy for approximately 20 years, primarily with first and second generation prototype and experimental facilities. Also at this time, the first observatory-scale user facilities were coming into operation at ESO, Keck, and CHARA.

The focus of the Commission is to establish scientific and technical standards that facilitate the future growth of the field. It has also found a natural function in supporting communication within the community, and recognizing and publicizing accomplishments.

2. The Working Group on Interferometry Data Standards

The Working Group on Interferometry Data Standards, chaired by J. Young, continues the work of the earlier Working Group on Optical/Infrared Interferometry, which provided an important service to the community by defining the Optical Interferometry Data Exchange Format.

During 2011, members of the Working Group participated in discussions about possible enhancements to the OIFITS optical interferometry data exchange standard. These discussions started at the instigation of the Jean-Marie Mariotti Center (JMMC) and the

ESO Very Large Telescope Interferometer (VLTI) instrument teams, which had identified several areas where the existing format was inadequate for describing the final and intermediate outputs of the VLTI/AMBER and VLTI/MIDI data reduction pipelines. The desired enhancements can be summarized as follows:

1. A more prescriptive and precise definition of the existing OIFITS standard (while retaining backwards-compatibility with existing files);

2. Specific support for correlated flux and differential phase data at various stages of calibration (alternative to or augmentation of the existing $OI_V IS$ complex visibility tables);

3. Definition of calibrator tables which record information about the model used to calculate the visibilities for each calibrator star. Such tables would allow identification of cases where re-calibration is required, and perhaps (re-)calibration using an alternative model.

Discussions related to [2] and [3] had previously taken place within the Group in late 2008 (in the case of [3] also involving C. Hummel from the Working Group on Calibrator Stars), but the Group had been unable to agree on specific proposals for a new version of the standard.

The chairman reports: Addressing [1] should be straightforward. The Working Group should also aim to collaborate with VLTI in writing a proposal for [2]. The remaining enhancement [3] is more problematic; the root cause of the ongoing disagreement is probably the variety of use cases that stakeholders envisage for the calibrator information, which leads to differing ideas about the most appropriate implementation. We should either define something very simple which supports only the most limited set of use cases, or decide not to alter the current standard in this respect.

3. Working Group on Imaging Algorithms

The Working Group on Imaging Algorithms was formed at a time when the relative performance of different algorithmic approaches to imaging in optical interferometry was not at all clear. The IAU Imaging Beauty Contest is a competition aimed at showcasing the performance of image reconstruction software in optical interferometry. Science cases are selected by the organizers, then synthetic data sets in the OIFITS format are generated from model images (which remain secret during the competition). Images are reconstructed from the data sets, and the reconstruction closest to the model is declared the winner.

The 2010 Imaging Beauty Contest consisted of blind imaging of simulated interferometric datasets of a scaled infrared model of Betelgeuse plus faint companion. Both low resolution (R = 35), broadband, and moderate resolution (R=1500) datasets were used in the judging. The simulated observations were those possible with the ESO AMBER instrument on three configurations of four telescopes of the VLTI.

The contest was organized by F. Malbet of the Laboratoire d'Astrophysique de l'Observatoire de Grenoble (LAOG), the dataset produced by G. Duvert, also of LAOG and the judging by W. Cotton of the National Radio Astronomy Observatory (NRAO). Entries were submitted by J. Young, F. Baron and D. Buscher of the University of Cambridge using the BSMEM package, by S. Rengaswamy of ESO, using the RPR software, by F. Baron, B. Kloppenberg and J. Monnier of the Universities of Michigan and Denver using the SQUEEZE software, and by M. Vannier and L. Mugnier of the Université of Nice

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and ONERA using the Wisard package. The results were announced at the 2010 SPIE meeting in San Diego, California, USA. A description of the contest and the entries is published in Malbet *et al.* (2010). The BSMEM entry of Young, Baron and Buscher was the winning entry.

The 5th Beauty Contest will take place in early July 2012 during the SPIE Astronomical Telescopes and Instrumentation conference in Amsterdam under the leadership of F. Baron. In this edition of the contest, two imaging scenarios will be offered for reconstruction: imaging a Young Stellar Object (YSO) with VLTI, and imaging a spotted star with the CHARA Array. In both case the data will have realistic signal-to-noise and UV coverages, simulating actual combiners currently installed at VLTI and CHARA. As in the previous contest, the YSO data set will be based on a polychromatic model and will include differential visibility data. The spotted star data set will be broadband data but its reconstruction will constitute a challenging imaging exercise inspired by actual CHARA data. Due to the higher difficulty, the organizers expect the submissions to be much more varied than they were the previous years, and thus to reflect more the capabilities of individual algorithms.

The Commission would like to acknowledge the essential work by P. Lawson in developing and carrying forward the contest, which has proven to be a popular and successful mechanism for advancing the Group's objectives.

4. Other Working Groups

Most optical interferometry observing techniques require calibrator stars, small enough to be near-point-like, and preferably with known diameter. It was recognized early that it can be difficult to ensure that a candidate calibrator is not a binary or otherwise poorly suited. The Working Group on Calibrator Stars was formed to systematize the exchange of information on methods and actual calibrator lists. This group is currently chaired by Christian Hummel. The Bad Calibrator Registry, originally operated by John Monnier at Michigan, has moved to an ESO server, at

http://www.eso.org/sci/observing/tools/catalogues/bcr.html.

It has been updated to work with Simbad 4.

A planned Working Group on future large arrays proved to be premature, as the consensus in interferometry turned from planning larger and more ambitious facilities to fully exploiting existing facilities. However, work in this area may be ramping up again, with planned discussion in 2012 and the possibility of considering anew an IAU Working Group as a locus of activity.

Intensity interferometry involves very different technology than the now widely used amplitude interferometry, but the two techniques have much in common in data interpretation and science goals. Intensity interferometry has excited new interest in recent years, owing to developments in high speed electronics and to the increasing deployment of large light collectors for Cherenkov arrays, which might be used for intensity interferometry. Also it was demonstrated that phase reconstruction algorithms make imaging possible with intensity interferometry provided a dense enough coverage of the reciprocal plane is available. A webpage with overview and links to other information is maintained at http://www.cta-observatory.org/?q=node/92. A number of Commission members work in this area and the possibility of forming a Working Group on Intensity Interferometry is under consideration.

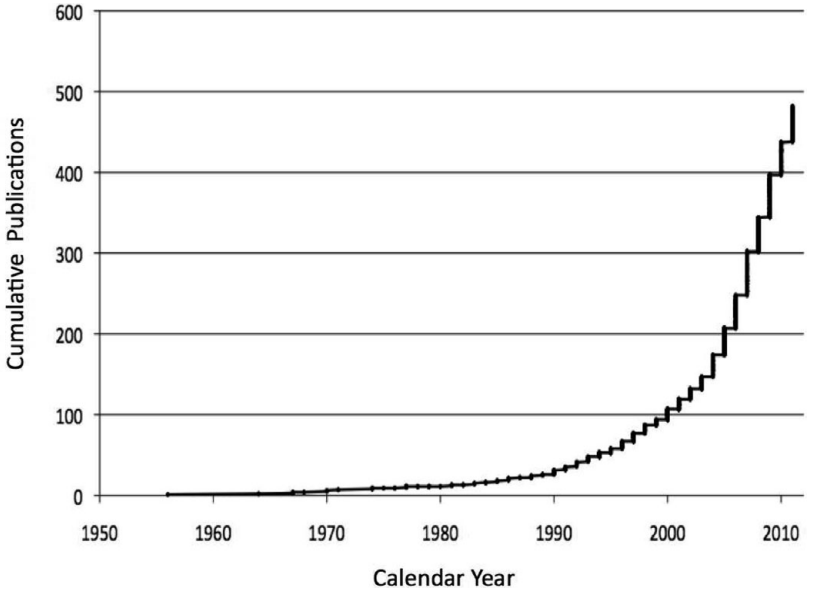

Figure 1. Refereed science publications from optical interferometry, as compiled on the OLBIN web page, on November 1, 2011

5. Developments within the past triennium

The Commission has a web site hosted by the Optical Long Baseline Interferometry News (OLBIN) and maintained by P. Lawson (at http://olbin.jpl.nasa.gov/iau/index.html). The email exploder associated with OLBIN communicates with a larger community of 419 subscribers, many of whom participate in spite of having not chosen to formally join the Commission. The Commission makes liberal use of this mailing list for communicating with the broader interferometry community. The OLBIN site also offers a very complete bibliography of publications in the main scientific and technical areas of interest to the Commission. It also offers tools develped by F. Malbet and colleagues at the Jean-Marie Mariotti Center for analyzing the bibliography content.

With continuing full-time operation of the VLTI, CHARA Array, and NOI, the OLBIN database of optical interferometry publications has been recently growing at nearly 100 per year. Figure 1, prepared with data and tools at the OLBIN web site, shows the cumulative publication count just for refereed science papers.

The main venue for interferometry community meetings has proven, in recent years, to be the biennial SPIE conference, Astronomical Telescopes and Instrumentation. In 2008 and 2010, the IAU collaborated with conference organizers to host special discussion sessions, at which IAU activities were included on the agenda. One idea that originated in these sessions was the possibility of offering a prize in the area of the Optical/Infrared Interferometry.

In 2009, the Commission officers initiated a prize program, with two prizes to be offered at intervals of no more frequently than every 2 years. The Fizeau Prize, sponsored by the Observatoire de la Côte d'Azur, recognizes either lifetime or recent accomplishments in the technical areas of interferometry. The Michelson Prize, hosted by the Mt Wilson Institute, recognizes either lifetime or recent accomplishments in the astrophysical sciences applications of interferometry. Both prizes also may recognize related efforts in education and public outreach. The Commission approached IAU then-General Secretary

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K. van der Hucht with a request for IAU endorsement of these prizes. This required a policy decision by IAU officers, and this decision was presented in the following statement communicated to the Commission: "IAU Divisions and Commissions are encouraged to support new developments in their fields of astronomical research and technology. Subject to the approval of the IAU Officers, they are allowed to endorse prizes in their fields which have no financial consequences for the IAU." Subsequently our proposed prizes were formally endorsed by the IAU, lending them considerable additional gravitas, which will be valuable to the Commission, the field, and the recipients.

In 2010, the first Michelson Lifetime Award was presented to Dr. Michael Shao "for his pioneering work on ground-based and space-based interferometers, including the Mark I, Mark II, Mark III, Palomar Testbed Interferometer, Keck Interferometer, and Space Interferometry Mission. Dr. Shao has been a prominent leader in the interferometry community, developing new avenues of research, including narrow-angle astrometry and nulling."

The first Fizeau Lifetime Award was presented to Pr. Antoine Labeyrie "for his invention of speckle interferometry, the development of the I2T and GI2T interferometers, and contributions to the development and implementation of the VLTI. Pr. Labeyrie's innovative genius challenges conventional wisdom with ideas such as the hypertelescope, laser-trapped space mirrors, and pupil densification; his visionary work has meant much to the community, and has been a forceful reminder that our scientific ambitions are limited only by our imaginations."

It is currently expected that nominations for the prizes will be invited in conjunction with the 2012 General Assembly.

6. Closing remarks

From an initial 14 members, scarcely more than the organizing committee, the Commission has grown to, at this writing, 109 members and 2 consultants, with 10 additional member and consultant applicants in process. In growing, the Commission has been partially responsible for some dozens of astronomers choosing to join the IAU in order to enable Commission membership. Since Commission 54 is very young, and many of the members are new to the IAU, the membership is still developing consensus on objectives and paths toward them. The officers will meet with the community at the SPIE meeting in Amsterdam in July, 2012, and at the General Assembly in Beijing in August, 2012, to discuss plans for the next three years.

Stephen T. Ridgway
president of the Commission

Reference

Malbet, F. *et al.* 2010, *SPIE* 7734, 83

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