



# Report from the event supported by RadioNet

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**TITLE** *EUROPEAN RADIO INTERFEROMETRY SCHOOL*

**DATE:** *2017 OCTOBER 16—20*

**LOCATION:** *DWINGELOO, THE NETHERLANDS*

**MEETING WEBPAGE:** [www.astron.nl/eris2017/](http://www.astron.nl/eris2017/)

**HOST INSTITUTE:** *NETHERLANDS INSTITUTE FOR RADIO ASTRONOMY (ASTRON)*

**RADIONET  
BENEFICIARY / NO:** *ASTRON/2*

# Report:

## 1. SCIENTIFIC SUMMARY

The European Radio Interferometry School (ERIS) is a bi-annual graduate level school that forms a fundamental part of the training and development of young radio astronomers primarily from Europe, but also from RadioNet partner countries throughout the world. The school has both lectures and practical tutorials that are given by invited specialists in interferometry who have the expertise and experience in using the main European radio astronomy facilities, which include the Atacama Large Millimetre/Sub-millimetre Array (ALMA), the e-Multi-Element Remotely Linked Interferometry Network (e-MERLIN), the European VLBI Network (EVN), the Low Frequency Array (LOFAR) and the Northern Extended Millimetre Array (NOEMA). The previous schools have been extremely successful in delivering the training needed to prepare radio astronomy students to write their own proposals, reduce interferometry data and interpret their results. The ERIS school is a RadioNet training events deliverable.

This year, the seventh ERIS was organised jointly between the Netherlands Institute for Radio Astronomy (ASTRON) and the Joint Institute for VLBI ERIC (JIVE) at ASTRON headquarters in Dwingeloo from 2017 October 16–20.

The Scientific Organising Committee was J. P. McKean (Co-Chair; ASTRON/RuG), H. J. van Langevelde (Co-Chair; JIVE), A. D. Biggs (ESO), R. Campbell (JIVE), M. Giroletti (IRA-INAF), M. Iacobelli (ASTRON), K. Johnston (Leed U.), R. Laing (ESO), Z. Paragi (JIVE), V. Piétu (IRAM), A. Richards (Manchester U.) and W. Vlemmings (Chalmers U.).

The topics covered by the lectures/tutorials included,

1. calibration and imaging of continuum, spectral line, and polarization data;
2. low frequency (LOFAR domain), cm-wave (e-MERLIN domain), high frequency (ALMA/NOEMA domain), and VLBI interferometry;
3. extracting the information from astronomical data and interpreting the results; and
4. choosing the most suitable array and observing plan for your project.

ERIS is a fundamental part of the training of radio astronomers in Europe since over a period of a week it provides the participants with the theoretical understanding of the complex concepts of interferometry, gives hands-on experience of using standard analysis software (CASA, AIPS), develops critical thinking in the preparation and execution of interferometry observations, and facilitates the networking of early stage researchers. In addition, the school gives the opportunity for experienced researchers (postdocs) to develop their teaching skills through the delivery of lectures and tutorials. As it is the primary training event of RadioNet for basic interferometry techniques, its impact for the RadioNet community is significant.

As part of the review of the school, the students completed a short questionnaire (~30% response), in which 100% of the respondents considered the school to be “useful”. Additional comments and suggestions (mainly about the limited time allotted for tutorials) from the participants will be incorporated into future ERIS.

The teaching materials, including the lecture notes, tutorial guides and datasets used for the school are archived on the school website,

[www.astron.nl/eris2017/](http://www.astron.nl/eris2017/)

which provides an additional route for the transfer of knowledge to students that were unable to attend the school and will form the basis for the material used at future ERIS.

## 2. AGENDA OF THE EVENT

ERIS is carried out over a week, and contains a science programme of 45 minute lectures (including 5 mins for questions), and 1 to 2.5 hour plenary tutorials and a day of in depth tutorials on ALMA, LOFAR and VLBI.

There were 16 lecturers / tutorial leads, of which 5 were female.

The science programme was:

#### Monday, 16 October 2017

08:30	Registration	
08:50	Opening/Welcome	John McKean (SOC/LOC), Directors
09:00	L1: Introduction to Radio Astronomy	John McKean (ASTRON, Netherlands)
09:45	L2: Introduction to Interferometry	Anna Scaife (JBCA, UK)
10:30	Tea/coffee	
11:00	L3: Fundamentals of Interferometry	Robert Laing (SKA, UK)
11:45	T1: Fun with Interferometers (S)	Robert Laing (SKA, UK)
12:30	Lunch	
13:30	L4: Modern Interferometers	Joe Callingham (ASTRON, Netherlands)
14:15	L5: Data formats and editing	Andre Offringa (ASTRON, the Netherlands)
15:00	T2: Data loading, inspection and flagging	Andy Biggs (ESO, Germany)
16:45	T3: Introduction to Writing a proposal	Robert Laing (SKA, UK)
17:00	Leave for tour of WSRT	
18:30	BBQ@WSRT	
22:00	Arrival to Hotel	

#### Tuesday, 17 October 2017

08:50	LOC announcements	
09:00	L6: Introduction to Millimetre Interferometry	Vincent Pietu (IRAM, France)
09:45	L7: Introduction to Calibration	John McKean (ASTRON, Netherlands)
10:30	Tea/coffee	
11:00	T4: Calibration (Part 1)	Anita Richards (JBCA, UK)
12:30	Lunch	
13:30	T4: Calibration (Part 2)	Anita Richards (JBCA, UK)
14:30	L8: Introduction to Imaging	Anna Scaife (JBCA, UK)
15:15	Tea/coffee	
15:45	T5: Imaging	Joe Callingham (ASTRON, Netherlands)
17:15	L9: Introduction to Low Frequency Interferometry	Vanessa Moss (ASTRON, Netherlands)
18:00	Close	
21:00	Evening lecture	Heino Falcke (RU, Netherlands)
22:00	End of Day	

#### Wednesday, 18 October 2017

08:50	LOC announcements	
09:00	L10: Advanced Imaging	Andre Offringa (ASTRON, Netherlands)
09:45	L11: Spectral Line Interferometry	Katharine Johnston (Leeds U., UK)
10:30	Tea/Coffee	
11:00	T6: Error recognition and Image Analysis	Anita Richards (JBCA, UK)
12:30	Lunch	
13:30	T7: Self-calibration	John McKean (ASTRON, Netherlands)
15:30	Tea/coffee	
16:00	L12: Very Long Baseline Interferometry	Bob Campbell (JIVE, Netherlands)
16:45	T8: Very Long Baseline Interferometry	Minnie Mao (JBCA, UK)
18:15	Close	

#### Thursday, 19 October 2017

08:50	LOC announcements	
09:00	L13: Polarisation	Ivan Marti-Vidal (Onsala, Sweden)
09:45	L14: Pipelines	Benito Marcote/Andy Biggs (JIVE, ESO)
10:30	Tea/Coffee	
11:00	Advanced Tutorials	

T9A	Metre/Wide-field (LOFAR)	Marco Iacobelli (ASTRON, Netherlands)
T9B	Centimetre/Polarisation	Ivan Marti-Vidal (Onsala, Sweden)
T9C	Centimetre/e-VLBI	Minnie Mao (JBCA, UK)
T9D	Millimetre/Spectral line (ALMA/NOEMA)	Katharine Johnstone (Leeds U., UK)
12:30	Lunch	
13:30	Advanced Tutorials (Cont.)	
15:30	Tea/Coffee	
16:00	Advanced Tutorials (Cont.)	
17:00	L15: Proposals and scheduling	Marcello Giroletti (INAF, Italy)
17:45	T10: Writing a proposal	
18:30	Close	
19:30	Conference Dinner	
21:00	(Interferometry) Pub Quiz	

Friday, 20 October 2017

08:50	LOC announcements	
09:00	L16: Archives and legacy data	Marcello Giroletti (INAF, Italy)
09:45	T10: Writing a proposal	
10:30	Tea/Coffee	
11:00	T10: Proposal presentations	
12:30	Lunch	
13:30	T10: Proposal presentations	
15:00	Concluding remarks / Feedback	John McKean (SOC/LOC), Directors
15:30	End of School	

### 3. PARTICIPANTS

ERIS was open to all regardless of their ethnicity, gender and academic position. However, there was an effort to actively encourage the attendance of those students from developing countries, by advertising the school as widely as possible. Also, all attendees had to agree to the Dwingeloo Code of Conduct during registration, which ensured a harassment-free school experience for everyone, regardless of gender, sexual orientation, disability, physical appearance, race, age, political opinion or religion

Due to the size of the venue, we restricted the attendance to approximately 80 students, with a “first come, first served” registration policy. In total, 73 participants attended the school from 21 countries (see Figure 1). The vast majority of the participants were at graduate level (Masters/PhD) with a few staff members and a few at bachelor level. The number that was female was 35, giving a gender ratio between male and female of 1:0.92, which was excellent. It is hoped that future ERIS will maintain this gender parity, and that a similar balance can be achieved at the lecturer / tutorial lead level (1:0.45).

In addition to the participants, there were 16 invited lecturers / tutorial leads and 4 LOC members dealing with the daily organisation of the meeting.

The conference photograph is shown in Figure 2.

Below, is the list of participants (Name, Institute, Country):

1	Aghababaei, Atefeh	Physikalisches Institut Universität zu Köln	Germany
2	Algera, Hiddo	Leiden University	Netherlands
3	Amarantidis, Stergios	Institute of Astrophysics and Space Sciences	Portugal
4	Asabre Frimpong, Naomi	University of Manchester	United Kingdom

5	Berlicki, Arkadiusz	Astronomical Institute, Czech Academy of Sciences	Czech Republic
6	Bilimogga, Pooja	Kapteyn Astronomical Institute	Netherlands
7	Blecher, Tariq	SKA SA	South Africa
8	Bright, Joe	University of Oxford	United Kingdom
9	cau, Massimo	Unibo/IRA-INAF Italy	Italy
10	Chen, Sina	University of Padova	Italy
11	Chen, Weiwei	Max Planck Institute for Radio Astronomy	Germany
12	Chen, Wen	Yunnan observatories	China
13	Climent Oliver, Juan Bautista	Universidad de Valencia	Spain
14	Congiu, Enrico	Dipartimento di Fisica e Astronomia "G. Galilei",	Italy
15	Cremonini, Andrea	SKAO	United Kingdom
16	Curylo, Malgorzata	Jagiellonian University	Poland
17	Deb, Tirna	Kapteyn Astronomical Institute (University of Gron	Netherlands
18	Di Mascolo, Luca	Max-Planck-Institut für Astrophysik	Germany
19	Duffy, Ryan	University of Bristol	United Kingdom
20	Feeney-Johansson, Anton	Dublin Institute of Advanced Studies	Ireland
21	Fernandez, Jose	Joint ALMA Observatory	Chile
22	Fraga-Encinas, Raquel	Radboud University Nijmegen	Netherlands
23	Fudamoto, Yoshinobu	Observatoire de Genève	Switzerland
24	Gallego-Calvene, Aurelia Teresa	Instituto de Astrofísica de Andalucía (IAA-CSIC)	Spain
25	Garcia Dabo, Cesar Enrique	European Southern Observatory	Germany
26	Hale, Catherine	University of Oxford	United Kingdom
27	Healy, Julia	Kapteyn Institute/University of Cape Town	Netherlands

28	Hesterly , Katie	University of Manchester	United Kingdom
29	Hoang, Thanh Dat	University of Bonn	Germany
30	Jimenez, Camilo	Instituto de Astrofísica de Canarias	Spain
31	Jurlin, Nika	Kapteyn Institute/ASTRON	Netherlands
32	Klindžić, Dora	JIVE/University of Zagreb	Netherlands
33	Kolwa, Sthabile	European Southern Observatory	Germany
34	Kondapally, Rohit	University of Edinburgh	United Kingdom
35	Lau, Chun Wai	Argelander-Instituts für Astronomie	Germany
36	Li, Ting	Shanghai Astronomical Observatory	China
37	Linhoff, Lena	TU Dortmund	Germany
38	Liu, Wenjuan	Astronomical Institute, Czech Academy of Sciences	Czech Republic
39	Mahatma, Vijay	University of Hertfordshire	United Kingdom
40	Mandlik, Ayushi	Argelander-Institut für Astronomie	Germany
41	Mantri, Aakash	Argelander-Institut für Astronomie	Germany
42	Mingo, Beatriz	Open University	United Kingdom
43	Modak, Ziad	Argelander-Institut für Astronomie	Germany
44	Montesino Pouzols, Federico	European Southern Observatory	Germany
45	Mooney, Sean	University College Dublin	Ireland
46	Munjal, Sonia	Argelander-Institut für Astronomie (AlfA)	Germany
47	Muratova, Natalia	Astronomical Institute, Czech Academy of Sciences	Czech Republic
48	Murthy, Suma	Kapteyn Astronomical Institute	Netherlands
49	Mutie, Isaac	Technical University of Kenya	Kenya
50	Ngo, Thanh Liem	I. Physikalisches Institut - University of Cologne	Germany

51	Nguyen, Anh	Bonn-Cologne Graduate School of Astrophysics	Germany
52	Olech, Mateusz	Nicolaus Copernicus University, Centre for Astrono	Poland
53	Parker, Raeesa	University of Central Lancashire	United Kingdom
54	Perger, Krisztina	Eötvös Loránd University	Hungary
55	Peters, Josephine	University of Oxford	United Kingdom
56	Piotrowska, Julia	Jagiellonian University	Poland
57	Rolfe, Samantha	University of Hertfordshire	United Kingdom
58	Romano, Domenico	UNSW	Australia
59	Roskowinski, Carole	Torun Centre for Astronomy	Poland
60	Sabzali, Vajihah	Ipm(Research Institute for Fundamental Science)	Iran, Islamic Republic Of
61	Sadaghiani, Mahya	University of Cologne	Germany
62	Sanchez, Maria	Nacional de Tecnica Aeroespacial	Spain
63	Santamaría Miranda, Alejandro	ESO Chile/Universidad de Valpara'iso	Chile
64	Sarniak, Rafal	Centre for Astronomy at Nicolaus Copernicus Univer	Poland
65	Schaap, Jorrit	Astron	Netherlands
66	Schmidt, Kevin	Technische Universität Dortmund	Germany
67	Stacey, Hannah	RuG / ASTRON	Netherlands
68	Sweijen, Frits	Leiden University	Netherlands
69	terni de gregory, beatrice	IRA-INAF Bologna	Italy
70	van der Vlugt, Dieuwertje	Leiden University	Netherlands
71	Webster, Brendan	The Open University	United Kingdom
72	Wolowska, Aleksandra	Nicolaus Copernicus University	Poland

73	Zhang, Maolin	Leiden University	Netherlands
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The persons stated above attended all, or part, of the school.



John McKean (Groningen; 1 December 2017)

On behalf of the LOC



Figure 1 - Map of the world showing the locations of the participants of ERS 2017.

#### 4. RADIONET FINANCIAL CONTRIBUTION

The RadioNet contribution was used to cover the costs associated with the logistics and running of the school (15k Euros), with up to an additional (5k Euros) used to cover the costs of the invited lecturers and tutors.

The supported participants were,  
 Andrew Biggs (ESO, Germany), Male, British  
 Marcello Giroletti (INAF, Italy), Male, Italian  
 Katherine Johnston (Leeds, UK), Female, British  
 Robert Laing (SKA, UK), Male, British  
 Ivan Marti-Vidal (Chalmers, Sweden), Male, Spanish  
 John McKean (ASTRON, Netherlands), Male, British  
 Minnie Mao (JBCA, UK), Female, Australian  
 Vincent Pietu (IRAM, France), Male, French  
 Anita Richards (JBCA, UK), Female, British



Anna Scaife (JBCA, UK), Female, British

The persons stated above attended all, or part, of the school.



John McKean (Groningen; 1 December 2017)

On behalf of the LOC

## 5. PUBLICATIONS

There are no publications from the school, but the lectures notes (slides), tutorial material and datasets are archived on the school website.



**Figure 2 - Conference photograph of the participants of ERIS 2017 at the WSRT.**