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### Specialised training event 2

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## Dissemination Level

Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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# 1 Introduction

The training activity of RadioNet is devoted to equipping radio astronomers and engineers with the skills which are essential to take full advantage of the present and future radio astronomical infrastructures by offering a focussed set of schools and forums.

Since 1998, IRAM has been organizing in Grenoble a millimetre interferometry school every two years (with the exception of 2014). Science using interferometric observations in the (sub)millimetre domain is a very active and very important field in modern astronomy, as testified by the large investments that funding agencies are dedicating to develop and operate major instruments. ALMA is now reaching full operations and will be a transformational instrument during the coming decades. NOEMA is approaching completion (10 out of 12 antennas in operations, the last two in construction) and complements ALMA in the Northern sky while also providing unique observational capabilities, e.g. for spectral surveys.

It is therefore critical to train the community and especially the young astronomers (PhD students, postdocs) to the millimetre interferometry techniques, so that the superb scientific capabilities of the instruments available can be fully exploited. The millimetre interferometry school series is an important aspect of the effort devoted by IRAM to the user formation.

Note that, since 2001, IRAM Granada has also been organizing schools dedicated to the millimetre single dish techniques, shifted one year relative to the interferometry school.

## 2 10<sup>th</sup> IRAM Millimetre Interferometry School

The tenth school was organized on October 1-5 2018, in Grenoble, France, hosted by IRAM. The program of the school included general presentations on aperture synthesis techniques in the millimetre domain; specific lectures on calibration and imaging of data; and lectures focused on the NOEMA array. Presentations also covered ALMA. Two afternoons (Thursday + Friday) were dedicated to hands-on tutorials: 8 groups of students were formed, each of them helped by a tutor. Real data set from NOEMA were distributed, so that participants can experience the data analysis techniques and tools. Emphasis was on imaging and data analysis.

### 2.1 Attendance

We received 87 requests for participation to the school, with a large number of countries being represented. The final number of participants was 65 (30 women +35 men). The vast majority of the participants were PhD students or young postdocs.

COUNTRY	No. Participants
France	19
Germany	13
Spain	9
United Kingdom	4
China	4
Italy	4
Denmark	3
Hungary	3
Japan	2
India	1
Netherlands	1
Russia	1
Sweden	1



## 2.2 List of participants

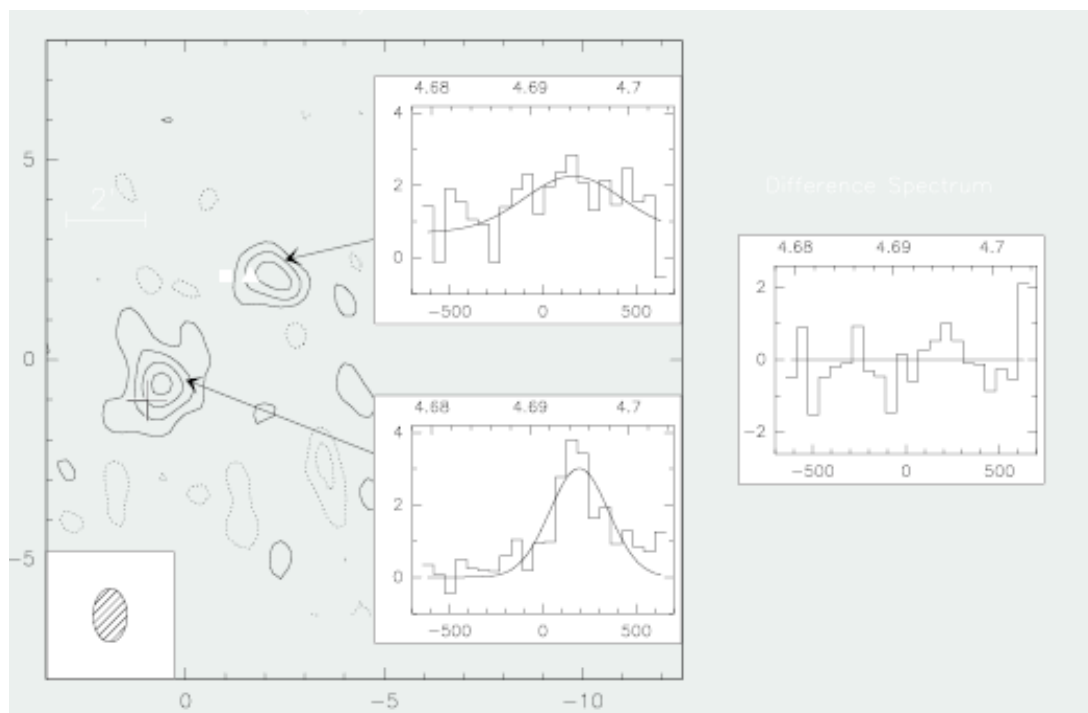
1. ANDERSON Michael, Cardiff Univ, Cardiff United Kingdom
2. BECK Andre, SOFIA institut, Stuttgart Germany
3. BIRKIN Jack, Durham University United Kingdom
4. BOURDAROT Guillaume, IPAG, Grenoble France
5. BOUSCASSE Laure, MPIfR, Bonn Germany
6. BOUVIER Mathilde, IPAG, Grenoble France
7. BUBLITZ Jesse, IPAG, Grenoble France
8. CHANTZOS Johanna, MPE, Garching Germany
9. CORTZEN Isabella, Niels Bohr inst, Copenhagen Denmark
10. CRUZ-SAENZ de MIERA Fernando, Konkoly Obs. Budapest Hungary
11. DAN Michel, IRAM Grenoble France
12. DELL'OVA Pierre, OBSPM, Paris France
13. DE SIMONE, Marta IPAG France
14. de VALON Alois, IPAG, Grenoble France
15. DIAZ-LUIS José Jairo, OAN Spain
16. FENG Jiancheng, Purple Mountain, Nanjing China
17. GARCIA-RODRIGUEZ Axel, OAN Madrid Spain
18. GAVINO Sacha, LAB, Bordeaux France
19. GIESER Caroline, MPIA Germany
20. GONG Yan, MPIfR Germany
21. GORAI Prasanta, Indian center for Space Phys India
22. GUO Wei-hua, Purple Mountain, Nanjing China
23. GUSDORF Antoine, ENS, Paris France
24. HAMANOWICZ Aleksandra, ESO, Garching Germany
25. HERNANDEZ GOMEZ Antonio, IRAP, Toulouse France
26. HOGARTH Lucy, UCL United Kingdom
27. IQBAL Wassim, LAB, Bordeaux France
28. KAASINEN Melanie, MPIA Germany
29. KEPPLER Miriam, MPIA, Heidelberg Germany
30. KRONSKOV Maria, Dark Cosmology Center, Copenhagen Denmark
31. LATZKO Serina, SOFIA Institut, Stuttgart Germany

32. LEE Minju, NAOJ, Nagoya Japan
33. LE RESTE Alexandra, Stockholm University, Sweden
34. LIU Qiancheng, Nanjing University China
35. LOIACONO Federica, INAF, Bologna Italie
36. MANIGAND Sebastien, Univ. Copenhagen Denmark
37. MARKOV Vladan, LERMA, Paris France
38. MAZYED Firas, LAM, Marseille France
39. MININNI Chiara, INAF Italy
40. NAVARRO ALMAIDA David, OAN Spain
41. NOVAK Mladen, MPIA, Heidelberg Germany
42. OLIVARES Valeria, OBSPM, Paris France
43. OSPINA-ZAMUDIO Juan, IPAG, Grenoble France
44. PUNANOVA Anna, Ural Federal Univ, Yekaterinburg Russia
45. PUTAUD Thomas, LERMA, Paris France
46. REDAELLI Elena, MPE Germany
47. RICO Fernando, CAB, CSIC Madrid Spain
48. RITACCO Alessia, IRAM Granada Spain
49. SABATINI Giovanni, Univ. Bologna Italy
50. SALVESTRINI Francesco, Univ. Bologna Italia
51. SANCHEZ GARCIA Maria, OAN Madrid Spain
52. SHU Shibo, IRAM Grenoble France
53. SMIRNOV-PINCHUKOV Grigorii, MPIA, Heidelberg, Germany
  
54. SULEIMAN Nofoz, Budapest University, Hungary
55. SYED Jonas, MPIA, Heidelberg, Germany
56. TAN Qinghua, Purple Mountain, Nanjing China
57. TSUKUI Takafumi, NAO, Tokyo Japan
58. ÜBLER Hannah, MPE, Garching Germany
59. VERBENA CONTRERAS Juan Luis, OAN CSIC Spain
60. VIDAL GARCIA Alba, ENS, Paris France
61. WATKINS Elizabeth, Cardiff Univ, Cardiff United Kingdom
62. WONG Ka Tat, IRAM, Grenoble France
63. ZHANG Siju, LAM, Marseille France
64. ZHOU Ping, Univ. Amsterdam The Netherlands
65. ZSIDI Gabriella, Konkoly Obs, Budapest Hungary

In the registration form, people were asked whether they agreed to be added to the RadioNet newsletter distribution list. 72 persons, out of 87 people who registered, agreed to receive the newsletter.

## 2.3 Agenda

	Monday	Tuesday	Wednesday	Thursday	Friday
09:00-09:30	Registration	NOEMA - <i>R. Neri</i>	Imaging & deconvolution (I) - <i>J.Pety</i>	ALMA - <i>E.Chapillon</i>	Polyfix - <i>J. Boissier</i>
09:30-10:00	Welcome			How to use ALMA - <i>E. Chapillon</i>	How to use NOEMA - <i>M. Krips</i>
10:00-10:30	mm astronomy science - <i>R. Neri</i>	Break	Break	Break	Break
10:30-11:00	Break				
11:00-11:30	Antennas and their calibration - <i>C. Kramer</i>	Calibration principles - <i>F. Gueth</i>	Imaging & deconvolution (II) - <i>J.Pety</i>	Low SN analysis - <i>F. Gueth</i>	Demo PMS - <i>C. Lefevre</i>
12:00-12:30	Lunch break	Lunch break	Lunch break	Lunch break	Lunch break
12:30-13:00	Lunch break	Lunch break	Lunch break	Lunch break	Lunch break
13:00-13:30	Lunch break	Lunch break	Lunch break	Lunch break	Lunch break
13:30-14:00	Tutorials Introduction	Atmospheric Phase correction - <i>M. Bremer</i>	UV plane analysis - <i>C. Herrera</i>	Tutorials (I)	Tutorials (II)
14:00-14:30	Interferometry - <i>J.Pety</i>				
14:30-15:00	Break	Absolute flux calibration - <i>M. Krips</i>	Self-calibration - <i>V. Pietu</i>		
15:00-15:30	Break	Break	Break		
15:30-16:00	mm interferometers - <i>F. Gueth</i>	Real-time calibrations - <i>V. Pietu</i>	NOEMA Pipeline - <i>A. Castro-Carrizo</i>		
16:00-16:30					
16:30-17:00					
17:00-17:30					
17:30-18:00					
18:00-18:30					



*High-redshift data illustrating a talk on analysing low signal-to-noise data (Gueth)*

### 3 Impact

65 astronomers, mostly young PhD students and postdocs, received a solid introduction to the millimetre interferometry techniques, including data processing. After ten such schools, more than 600 astronomers have received this formation. Since the basics of aperture synthesis are obviously common to all wavelength ranges, this school series also support the radio-astronomical community at large, by promoting the use of interferometers in modern science.

A web page was setup to host the information related to this school:

<http://www.iram-institute.org/EN/content-page-367-7-67-367-0-0.html>

The page now gives access to all presentations given during the school. It will remain active on the IRAM web site, as are the pages of the previous schools, which are used as references and training resource material by astronomers throughout Europe and beyond.

### 4 RadioNet financial support

The RadioNet contribution of 9000 € was used to support the organization of the school, more specifically to fund part of the cost of the buffet that was organized every day for all participants. In addition, IRAM also funded a school dinner in a Grenoble restaurant, support for a number of participants (in practice: hotels were paid by IRAM) and a couple of other minor expenses. The total cost of the school was 20625€.

### 5 Acronyms

ALMA	Atacama Large Millimetre/sub-millimetre Array
ASTRON	the Netherlands Institute for Radio Astronomy
e-MERLIN	UK radio interferometry array
ERIC	European Research Infrastructure Consortium
ERIS	European Radio Interferometry School
JIV-ERIC	Joint Institute for VLBI in Europe
LOFAR	Low Frequency Array
NOEMA	NOrthern Extended Millimetre Array
VLBI	Very Long Baseline Interferometry

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