

## Engineering Forum Workshop

### Report

<b>Title</b>	<b>3rd Engineering Forum Workshop</b>	
	<b>RFI2010</b>	
	<a href="http://www.astron.nl/rfi/">http://www.astron.nl/rfi/</a>	
<b>Date</b>	29 – 31 March 2010	
<b>Location</b>	Groningen, The Netherlands	
<b>Host institute:</b>	This workshop has been organized by ASTRON and NAIC with financial support from the Engineering Forum of RadioNet FP7, ASTRON and the SKA Project Development Office (SPDO, Manchester).	
<b>Participants</b>		
	<i>Number</i>	72
	<i>Countries</i>	<i>AU, BE, CN, CA, DE, FI, FR, IN, IT, NL, RU, TR, UK, USA, ZA</i>
<b>Attachments:</b>	<i>Participants List</i>	2
	<i>Photo</i>	8
	<i>Agenda</i>	10
	<i>Summary</i>	15
	<i>Financial Report</i>	17

**Engineering Workshop Report**  
29 - 31 March 2010, Groningen (The Netherlands)

## **PARTICIPANTS LIST**

	<b>Last Name</b>	<b>First Name</b>	<b>Affiliation</b>	<b>COUNTRY</b>
1	<b>Aderhold</b>	Norbert	MPIfR	Germany
2	<b>Agathoklis</b>	Pan	Dep. of ECE, University of Victoria	Canada
3	<b>Ait Allal</b>	Dalal	Nançay Observatory	France
4	<b>Alexe</b>	Laurentiu	CRAF	Belgium
5	<b>Ambrosini</b>	Roberto	Istituto di Radioastronomia	Italy
6	<b>An</b>	Tao	Shanghai Astronomical Observatory	China
7	<b>Baan</b>	Willem	ASTRON	The Netherlands
8	<b>Beaudet</b>	Carla	NRAO	USA
9	<b>Bentum</b>	Mark	University of Twente/ASTRON	The Netherlands
10	<b>Bolli</b>	Pietro	Osservatorio Astronomico di Cagliari	Italy
11	<b>Boonstra</b>	Albert-Jan	ASTRON	The Netherlands
12	<b>Bowman</b>	Judd	Caltech	USA
13	<b>Camino</b>	Pascal	LAB - Observatoire de Bordeaux	France
14	<b>Capdessus</b>	Cécile	Institut PRISME	France
15	<b>Carlson</b>	Brent	DRAO-HIA-NRC	Canada
16	<b>Dagtekin</b>	Nazli	Erciyes Uni., Radio Astronomy Obs.	Turkey
17	<b>Davis</b>	Michael	CORF	USA
18	<b>Deller</b>	Adam	NRAO	USA
19	<b>Dumez-Viou</b>	Cedric	CNRS / Observatoire de Paris	France
20	<b>Eikelboom</b>	Mattheijs	ASTRON	The Netherlands
21	<b>Faulkner</b>	Andrew	Cambridge University	UK
22	<b>Flöer</b>	Lars	Argelander-Institut für Astronomie	Germany
23	<b>Fridman</b>	Peter	ASTRON	The Netherlands
24	<b>Gary</b>	Dale	New Jersey Institute of Technology	USA

**Engineering Workshop Report**  
16 - 17 November 2009, Bonn (Germany)

	<b>Last Name</b>	<b>First Name</b>	<b>Affiliation</b>	<b>COUNTRY</b>
25	<b>Gergely</b>	Tomas	National Science Foundation	USA
26	<b>Grypstra</b>	Karl J.	MPIfR	Germany
27	<b>Hovey</b>	Gary	National Research Council/DRAO	Canada
28	<b>Jessner</b>	Axel	MPIfR	Germany
29	<b>Kalberla</b>	Peter	Argelander-Institut für Astronomie	Germany
30	<b>Keating</b>	Garrett	Allen Telescope Array	USA
31	<b>Keimpema</b>	Aard	JIVE	The Netherlands
32	<b>Keller</b>	Reinhard	MPIfR	Germany
33	<b>Kesteven</b>	Michael	CSIRO-CASS	Australia
34	<b>Kirves</b>	Petri	Metsähovi Radio Observatory	Finland
35	<b>Kocz</b>	Jonathon	Swinburne University of Technology	Australia
36	<b>Kogan</b>	Leonid	NRAO	USA
37	<b>Kratov</b>	Denis	Special Astrophysical Observatory	Russia
38	<b>Küçük</b>	Ibrahim	University, Radio Astronomy Obs.	Turkey
39	<b>Law</b>	Casey	UC Berkeley	USA
40	<b>Lewis</b>	Brian	Arecibo Observatory	USA
41	<b>Li</b>	Bin	Shanghai Astronomical Observatory	China
42	<b>Liszt</b>	Harvey	NRAO	USA
43	<b>Lord</b>	Richard	SKA South Africa	South Africa
44	<b>Millenaar</b>	Rob	SPDO	UK
45	<b>Mingaliev</b>	Marat	Special Astrophysical Observatory	marat@sao.ru
46	<b>Mitchell</b>	Daniel	Smithsonian Astrophysical Observatory	USA
47	<b>Nigra</b>	Lou	University of Wisconsin	USA
48	<b>Nita</b>	Gelu	New Jersey Institute of Technology	USA
49	<b>Offringa</b>	André	Kapteyn Astronomical Institute	The Netherlands

**Engineering Workshop Report**  
29 - 31 March 2010, Groningen (The Netherlands)

	<b>Last Name</b>	<b>First Name</b>	<b>Affiliation</b>	<b>COUNTRY</b>
50	<b>Oosterloo</b>	Tom	ASTRON	The Netherlands
51	<b>Quertier</b>	Benjamin	LAB - CNRS	France
52	<b>Quintero</b>	Luis	NAIC Arecibo Observatory	USA
53	<b>Raybole</b>	Pravin	GMRT, NCRA-TIFR, Pune	India
54	<b>Shen</b>	Zhiqiang	Shanghai Astronomical Observatory	China
55	<b>Thomasson</b>	Peter	Jodrell Bank Observatory	UK
56	<b>Tiplady</b>	Adrian	SKA South Africa	South Africa
57	<b>Tzioumis</b>	Anastasios	CSIRO ATNF	Australia
58	<b>van Assche</b>	Jean-Paul	Radiocommunications Agency	The Netherlands
59	<b>van Diepenbeek</b>	Chris	Radiocommunications Agency	The Netherlands
60	<b>van der Marel</b>	Hans	ASTRON	The Netherlands
61	<b>van der Veen</b>	Alle-Jan	TU Delft	The Netherlands
62	<b>Wagner</b>	Jan	Aalto Uni. Metsähovi Radio Obs.	Finland
63	<b>Watts</b>	Galen	NRAO	USA
64	<b>Weber</b>	Rodolphe	Observatoire de Paris	France
65	<b>Williams</b>	Peter	Dept. of Astronomy, UC Berkeley	USA
66	<b>Wilson</b>	Carol	CSIRO CASS	Australia
67	<b>Winkel</b>	Benjamin	Argelander-Institut für Astronomie	Germany
68	<b>Witaszczyk</b>	Tomasz	VU / ASTRON	The Netherlands
69	<b>Witvliet</b>	Ben	Radiocommunications Agency	The Netherlands
70	<b>Wu</b>	Xiang-Ping	National Astronomical Observatories	China
71	<b>Xiang</b>	Ying	Shanghai Astronomical Observatory	China
72	<b>Zwiers</b>	Ton	Radiocommunications Agency	The Netherlands

**Engineering Workshop Report**  
16 - 17 November 2009, Bonn (Germany)

nr.	Last Name	First Name	Dinner 30 March	Excursion 30 March	Signature
1	Aderhold	Norbert	yes	yes	
2	Agathoklis	Pan	✓	✓	
3	Ait Allal	Dalal	✓	✓	
4	Alexe	Laurentiu	✓	✓	
5	Ali	Ali Khamis			
6	Ally	Nassor Muhsin			
7	Ambrosini	Roberto	✓	✓	
8	An	Tao	✓	✓	
9	Baan	Willem	✓	✓	
10	Beaudet	Carla	✓	✓	
11	Bentum	Mark	no	no	
12	Bolli	Pietro	✓	✓	
13	Boonstra	Albert-Jan	✓	✓	
14	Bowman	Judd	✓	✓	
15	Camino	Pascal	✓	✓	
16	Capdessus	Cécile	✓	✓	
17	Carlson	Brent	✓	✓	
18	Dagtekin	Nazli	?	?	
19	Davis	Michael	✓	✓	
20	Deller	Adam	✓	✓	
21	Dewdney	Peter			






**Engineering Workshop Report**  
29 - 31 March 2010, Groningen (The Netherlands)

nr.	Last Name	First Name	Dinner 30 March	Excursion 30 March	Signature
22	Dumez-Viou	Cedric	Yes	Yes	
23	Eikelboom	Mattheijs	Yes	Yes	
24	Faulkner	Andrew	Yes	Yes	
25	Flöer	Lars	Yes	Yes	
26	Fridman	Peter	No	No	
27	Gary	Dale	Yes	Yes	
28	Gergely	Tomas	Yes	Yes	
29	Grypstra	Karl J.	Yes	Yes	
30	Hovey	Gary	Yes	Yes	
31	Jessner	Axel	Yes	Yes	
32	Kalberla	Peter	Yes	Yes	
33	Keating	Garrett	Yes	Yes	
34	Keimpema	Aard	Yes	Yes	
35	Keller	Reinhard	Yes	Yes	
36	Kesteven	Michael	Yes	Yes	
37	Kirves	Petri	X	X	
38	Kocz	Jonathon	Yes	Yes	
39	Kogan	Leonid	Yes	Yes	
40	Kratov	Denis	Yes	Yes	
41	Küçük	Ibrahim	Yes	Yes	
42	Landon	Jonathan			

**Engineering Workshop Report**  
16 - 17 November 2009, Bonn (Germany)

nr.	Last Name	First Name	Dinner	Excursion	Signature
43	Law	Casey	no	✓	
44	Lawrence	Shane			
45	Lewis	Brian	✓	X	
46	Li	Bin	✓	✓	
47	Liszt	Harvey	✓	✓	
48	Lord	Richard	✓	✓	
49	Millenaar	Rob	?	?	
50	Mingaliev	Marat	✓	✓	
51	Mitchell	Daniel	✓	✓	
52	Nigra	Lou	no	✓	
53	Nita	Gelu	✓	✓	
54	Offringa	André	no?	✓	
55	Oosterloo	Tom	nee	eigen vervoer	
56	Quertier	Benjamin	✓	✓	
57	Quintero	Luis	✓	✓	
58	Raybole	Pravin	✓	✓	
59	Shen	Zhiqiang	✓	✓	
60	Thomasson	Peter	✓	✓	
61	Tiplady	Adrian	✓	✓	
62	Tzioumis	Anastasios	✓	✓	
63	van Assche	Jean-Paul	nee	nee	

**Engineering Workshop Report**  
29 - 31 March 2010, Groningen (The Netherlands)

nr.	Last Name	First Name	Dinner 30. March	Excursion 30. March	Signature
64	van der Marel	Hans	V (+1?)	V	
65	van der Veen	Alle-Jan	X	X	
66	van Diepenbeek	Chris	X	X	
67	Wagner	Jan	X	X	
68	Watts	Galen	V	V	
69	Weber	Rodolphe	V	V	
70	Williams	Peter	Yes	Yes	
71	Wilson	Carol	Yes	Yes	
72	Winkel	Benjamin	Yes	Yes	
73	Witaszczyk	Tomasz	V	X(10)	
74	Witvliet	Ben	V	V	
75	Wu	Xiang-Ping	Yes	Yes	
76	Xiang	Ying	Yes	Yes	
77	Zaroubi	Saleem			
78	Zehra	Tashfeen			
79	Zwiers	Ton	NEE	NEE	



**Engineering Workshop Report**  
16 - 17 November 2009, Bonn (Germany)

**PHOTO**



Participants of the 3<sup>rd</sup> Engineering Forum Workshop, 29-31 March 2010, Groningen (The Netherlands)

**Engineering Workshop Report**  
29 - 31 March 2010, Groningen (The Netherlands)

## AGENDA

### Sunday March 28<sup>th</sup>

20:00 Welcome Reception and Registration

### Monday March 29<sup>th</sup>

08:00 Registration

#### Introductory session

Chair Murray Lewis

09:00 *Setting the stage - layers of RFI Mitigation (invited)*  
Willem Baan and Albert-Jan Boonstra, ASTRON

09:45 *Passive spectrum use and upcoming changes in the spectrum environment (invited)*  
Chris van Diepenbeek, Radiocommunications Agency NL

10:30 Coffee & tea break

#### Spectrum measurements and characterization (I)

Chair Axel Jessner

10:50 *External sources of RFI at the GMRT: methods for control and coexistence with commercial users*  
Pravin Raybole, GMRT, NCRA-TIFR, Pune, India

11:15 *The RFI Environment at Hat Creek Radio Observatory*  
Peter Williams, Dept. of Astronomy, UC Berkeley

11:40 *Radio Astronomy in Turkey: Site selection studies for radio quiet zones*  
Ibrahim Küçük, Erciyes University, Radio Astronomy Observatory, Turkey

12:05 *Assessment of RFI measurements for LOFAR*  
Mark Bentum, Albert-Jan Boonstra, and Rob Millenaar, ASTRON

12:30 Lunch

**Engineering Workshop Report**  
16 - 17 November 2009, Bonn (Germany)

**RFI mitigation overview and challenges**

**Chair Tasso Tzioumis**

- 14:00 *Overview of RFI mitigation methods in existing and new systems (invited)*  
Michael Kesteven, CSIRO
- 14:45 *Extreme ionospheric anomalies in the environment and their future implications*  
Shane Lawrence, University of Cambridge, APRI and Sci-Tech(South)
- 15:10 *The impact of cognitive radio on radio astronomy*  
Mark Bentum, Albert-Jan Boonstra, and Willem Baan, University of Twente/ASTRON

15:35 Coffee & tea break

**Spectrum Management and radio quiet zones**

**Chair Chris van Diepenbeek**

- 15:55 *Spectrum Management for Science in the 21st Century*  
Michael Davis, CORF
- 16:20 *EMC in an RQZ: the need for buffer zones.*  
Carol Wilson, CSIRO CASS
- 16:45 *RFI Protection at the NRAO Green Bank Site*  
Carla Beaudet, NRAO
- 17:10 *Establishment of a protected radio astronomy reserve in South Africa*  
Adrian Tiplady, SKA South Africa
- 17:35 *RQZs: Recent progress and the Australian experience.*  
Tasso Tzioumis, CSIRO ATNF

**Engineering Workshop Report**  
29 - 31 March 2010, Groningen (The Netherlands)

**Tuesday March 30<sup>th</sup>**

**System approaches**

**Chair Tomas Gergely**

- 08:30 *System approach to RFI mitigation for the SKA*  
Rob Millenaar, Albert-Jan Boonstra, and Mark Bentum, SPDO/ASTRON/TUTwente
- 08:55 *The Murchison Widefield Array*  
Daniel Mitchell, Smithsonian Astrophysical Observatory
- 09:20 *New hints to mitigators from the latest RFI experiences*  
Roberto Ambrosini, Istituto di Radioastronomia
- 09:45 *"Oktave" – Superwide-Band Technologies for the RATAN-600 Continuum Radiometers*  
Marat Mingaliev, Special Astrophysical Observatory

10:10 Coffee & tea break

**Detection**

**Chair Rodolphe Weber**

- 10:30 *Statistics of the Spectral Kurtosis Estimator*  
Gelu Nita, New Jersey Institute of Technology
- 10:55 *A Wideband Spectrometer with RFI Detection*  
Dale Gary, New Jersey Institute of Technology
- 11:20 *RFI mitigation at Nançay Observatory: Impulsive Signal Processing*  
Dalal Ait Allal, Nançay Observatory
- 11:45 *Techniques for excision RFI on RATAN-600 radio telescope in dm ranges*  
Denis Kratov, Special Astrophysical Observatory

12:10 Lunch

**Filtering & pre-correlation**

**Chair Albert-Jan Boonstra**

- 13:10 *Field Trials of a RFI adaptive filter for Pulsar Observations*  
Michael Kesteven, CSIRO-CASS
- 13:35 *Lessons learned from the WSRT Interference Mitigation System*  
Willem Baan and Peter Fridman, ASTRON
- 14:00 *A turn-key Concept for active cancellation of Global Position System L3 Signal*  
Lou Nigra, University of Wisconsin - Madison Department of Astronomy / NAIC
- 14:25 *Space-Time Digital Filtering of Radio Astronomical Signals using 3-D Cone Filters*  
Pan Agathoklis, Dep. of ECE, University of Victoria

15:00 Afternoon: visit to the WSRT and LOFAR telescopes and dinner

**Engineering Workshop Report**  
16 - 17 November 2009, Bonn (Germany)

**Wednesday March 31<sup>th</sup>**

**Spectrum measurements (II)**

**Chair Reinhard Keller**

- 08:30 RFI in Metsähovi Radio Observatory - measurements and effects  
Petri Kirves, Metsähovi Radio Observatory
- 08:55 RFI measurements at the WSRT  
Hans van der Marel, ASTRON
- 09:20 The RFI monitoring systems for the Medicina and the Sardinia Radio Telescope  
Pietro Bolli, Osservatorio Astronomico di Cagliari
- 09:45 VHF-band RFI in Geographically Remote Areas  
Judd Bowman, Caltech

10:10 Coffee& tea break

**Spatial filtering techniques**

**Chair Mike Kesteven**

- 10:30 Spatial filtering of RFI using a reference antenna  
Alle-Jan van der Veen and Albert-Jan Boonstra, TUDelft, ASTRON
- 10:55 Spatial filtering using a multi-beam receiver  
Jonathon Kocz, Swinburne University of Technology
- 11:20 Cyclostationarity for phased array  
Rodolphe Weber, Observatoire de Paris
- 11:45 ASTRON, LOFAR RFI Mitigation  
Albert-Jan Boonstra, Mark Bentum, and Mattheijs Eikelboom ASTRON, TUTwente

12:10 Lunch

**In- & Post-correlation techniques**

**Chair Alle-Jan van der Veen**

- 13:40 Software correlators as testbeds for RFI algorithms  
Adam Deller, NRAO
- 14:05 Post-correlation RFI detection  
Andre Offringa, Kapteyn Astronomical Institute
- 14:30 RFI mitigation in AIPS. The new task UVRFI.  
Leonid Kogan, National Radio Astronomy Observatory
- 14:55 RFI Mitigation for the Parkes Galactic All-Sky Survey (GASS)  
Peter Kalberla, Argelander Institut für Astronomie (AlfA)

**Engineering Workshop Report**  
29 - 31 March 2010, Groningen (The Netherlands)

15:20 Coffee & tea break

<b>Miscellaneous techniques</b>
---------------------------------

<b>Chair Willem Baan</b>
--------------------------

- |  |
|--|
| 15:40 Robust statistical estimates as a tool in RFI mitigation<br>Peter Fridman, ASTRON                          |
| 16:05 RFI Mitigation Techniques at the Allen Telescope Array<br>Garrett Keating, Allen Telescope Array           |
| 16:30 RFI Protection at the Shanghai Sheshan Site<br>Zhi-Qiuan Shen, Bin Li, and Tao An, Shanghai Observatory    |
| 16:55 RFI mitigation for the Effelsberg Bonn HI Survey (EBHIS)<br>Lars Floër, Argelander-Institut für Astronomie |

17:20 Wrap-up and general discussion
--------------------------------------

18:00 End of day three

## SUMMARY

Radio interference is increasingly affecting the quality of radio astronomy and remote sensing observational data. The increased sensitivity of instrumentation for passive use of the spectrum and the intensifying active use of the spectrum have led to increasing data loss for the passive radio services. The avoidance of this interference and its removal if it enters the data are of great interest for the observatories. Simple excision of the affected data by visualization and accepting the data loss has been the remedy under most circumstances. However, this method becomes more cumbersome when using of broadband systems and multi-station interferometer systems. Therefore, the recent advances in technology and computing may be exploited for mitigating the effects of certain classes of interference.

Mitigation is needed to remove unwanted signals from allocated and protected bands allocated to the RAS. However, this ability should not be an excuse for creating unwanted emissions in these bands. Interference mitigation in spectral bands allocated to other services may facilitate partial use of these bands for passive observations. Astronomers use these other bands to perform (highly sensitive) broadband continuum studies and to search for redshifted spectral line emissions from galaxies in the distant Universe.

Interference in allocated and protected bands always leads to data loss for the passive users of the spectrum even if interference mitigation is applied, either in the time domain or in the frequency domain. Permissible percentages of data loss defined in the ITU-R literature amount to some 5% for RAS bands. Data loss for observations in bands allocated to other services needs to be accepted because the astronomers operate there under a no-protection principle.

There is no generic method to mitigate each class of interference. Because all methods depend on the detectability of the interference (i.e. Interference-to-noise ratio), a multi-layered implementation at different points in the data stream may be advisable to reduce detrimental effects of several types of radio interference. The different methods of mitigating radio frequency interference considered in the RFI2010 workshop constitute such a multi-layer approach to address the first issue of avoiding RFI and the later issue of removing interference from astronomical data.

The subjects discussed during the RFI2010 meeting covered a very wide range:

- a) Measurements of the spectrum environment and characterization of the RFI at the telescope and ways to eliminate sources of interference,
- b) Spectrum management approaches, the regulatory methods of protecting the radio telescopes,
- c) Existing quiet zones and those for new generation radio telescopes,
- d) Spectrum challenges for radio telescopes such as cognitive radio and ultra-wide band applications,
- e) RFI mitigation methods and at which in the detection systems they may be optimally used,
- f) Digital filtering and sub-space filtering using peculiar characteristics of the RFI,

## Engineering Workshop Report

29 - 31 March 2010, Groningen (The Netherlands)

- g) Various methods of pre-correlation thresholding of RFI in the time and frequency domains used in wide-band spectrometers,
- h) Adaptive noise cancellation of specific RFI signals,
- i) Spatial filtering with array instruments,
- j) Statistical methods to identify RFI in the data and to remove these signals,
- k) RFI mitigation algorithms built into software correlators,
- l) Automatic post-correlation RFI detection and flagging algorithms applied to newly build telescopes with high data rates such as the Allen Telescope and LOFAR, and
- m) Methods to identify and remove the signals of stationary (terrestrial) sources (at the horizon) from their fringe rate as compared with that of celestial sources during post-correlation processing.

The RFI2010 Workshop successfully presented the great variety of mitigation options and displayed encouraging results with both on-line and off-line data processing. Since there is no universal method for RFI mitigation, the choice of the mitigation method depends on the RFI characteristics, the type of telescope and the type of observations being done. Multiple methods should be used to remove both strong and weaker RFI from the data. Because RFI algorithms generally are non-linear processes that depend on the INR and the characteristics of the RFI, a quantitative evaluation of the methods is not always possible.

Furthermore, the RFI removal raises the noise level and affects the gain calibration of the instrument. The cumulative effect of the implementation of RFI mitigation at subsequent stages is not a linear sum since the RFI characteristics change after each mitigation step. This sum of what is practically possible at each step. Further implementation of RFI mitigation in single-dish and array instruments will show the potential of each of these methods.

This third Workshop considered RFI mitigation in radio astronomy in all its facets with the aim of facilitating the implementation of instrumental and data processing techniques. This workshop aimed to take a forward look at applications for the next generation of radio astronomy instruments, such as the SKA and its pathfinders and LOFAR, as well as considering their application to existing instruments. RFI mitigation has been given relatively low priority by many observatories and by their users. The changing operational conditions and the objective of increased sensitivity of new instruments will force observatories and their users to address these RFI mitigation solutions.

The 41 presentations of this meeting can be found at [www.astron.nl/rfi/](http://www.astron.nl/rfi/). The refereed papers will be published at the free-access web-based Proceedings of Science. There were 72 registered participants in the Meeting held at the Hampshire Plaza Hotel in Groningen.

This workshop has been organized by ASTRON and NAIC with financial support from ASTRON, URSI International, the Engineering Forum of RadioNet FP7, and the SKA Project Development Office (SPDO, Manchester). Earlier Workshops have been held in Bonn, DE (2001) and Penticton, CA (2004).



**Engineering Workshop Report**  
16 - 17 November 2009, Bonn (Germany)

## **FINANCIAL REPORT**

3<sup>rd</sup> Engineering Forum Workshop organised in Groningen (The Netherlands) on 29-31 March 2010 was supported by the European Community Framework Programme 7, Advanced Radio Astronomy in Europe, grant agreement no.: 227290.

The ASTRON hosted the meeting. The RadioNet-Engineering workshop was the main sponsor of the workshop with 57% of the total sponsor budget. The two others were ASTRON R&D and SPDO.

The organisation cost covered from the RadioNet-FP7 WP3: Engineering Forum were at the level of ~900€. Additionally travel expenses of several participants were supported from the project in the total range of ~6200€.