



REPORT ON THE RADIONET3 NETWORKING ACTIVITY

TITLE: NORTH-EUROPEAN RADIO ASTRONOMY SCHOOL

DATE:	OCTOBER 4-9, 2015	TIME: 5 DAYS
LOCATION:	TUORLA OBSERVATORY, PIIKKI	ö, Finland
MEETING WEBPAGE	http://www.utu.fi/en/units/finca	a/research/Tuorla2015
HOST INSTITUTE:	FINCA + TUORLA OBSERVATO TURKU	RY, UNIVERSITY OF
PARTICIPANTS NO:	20	
MAIN LEADER:	U.TURKU	





REPORT:

1. Programme of the meeting

- October 4, Arrival
 - 16:00 Arrival at Tuorla

18:00 -> Informal get-together

October 5, Introduction

- 09:00 09:15 Course overview and logistics (Heidi Korhonen, FINCA, Univ. Turku, Finland))
- 09:15 10:45 Introduction to radio astronomy and spectral observations (Jorma Harju, Univ. Helsinki, Finland)
- 10:45 11:15 Coffee break
- 11:15 12:15 Introduction to radio astronomy and continuum observations (Merja Tornikoski, Metsähovi Radio Observatory, Finland)
- 12:15 13:30 Lunch
- 13:30 15:00 Fundamentals of Radio Interferometry (Ivan Marti-Vidal, Onsala Space Observatory, Sweden)
- 15:00 15:15 Break
- 15:15 16:00 Radio Frequency Interference and protection of radio frequencies (Merja Tornikoski, Metsähovi Radio Observatory, Finland)
- 16:00 16:30 Computer tutorial (Kaj Wiik, Tuorla Observatory, Finland)
- 16:30 19:00 Project work in groups
- 19:00 20:00 Dinner

October 6, Interferometry

09:00 – 10:30 Calibration of interferometric data (Kaj Wiik, Tuorla Observatory, Finland)

- 10:30 11:00 Coffee break
- 11:00 12:30 Interferometric imaging (Tuomas Savolainen, Metsähovi Radio Observatory, Finland)
- 12:30 13:45 Lunch
- 13:45 15:45 Aperture synthesis tutorial (Ivan Marti-Vidal, Onsala Space Observatory)
- 15:45 19:00 Project work in groups
- 19:00 20:00 Dinner

October 7, Facilities

09:00 - 10:00 Radio polarimetry (Ivan Marti-Vidal, Onsala Space Observatory,

- Sweden)
- 10:00 11:00 VLBI (Tuomas Savolainen, Metsähovi Radio Observatory, Finland)
- 11:00 11:30 Coffee break
- 11:30 12:30 ALMA (Sebastien Muller, Onsala Space Observatory, Sweden)
- 12:30 13:45 Lunch
- 13:45 19:00 Project work in groups
- 19:00 20:00 Dinner

October 8, Science with radio/sub-mm observations

- 09:00 09:45 Solar radio observations (Silja Pohjolainen, Tuorla Observatory, Finland)
- 09:45 10:30 Starformation (Jorma Harju, Univ. Helsinki, Finland)
- 10:30 11:00 Coffee break
- 11:00 11:45 Radio emission from active galactic nuclei (Anne Lähteenmäki, Metsähovi Radio Observatory, Finland)
- 11:45 12:30 Extragalactic astronomy with ALMA (Sebastien Muller, Onsala Space Observatory, Sweden)
- 12:30 13:45 Lunch
- 13:45 19:00 Project work in groups





19:00 - 20:00 Dinner

Friday October 9, Presenting results

- 09:30 10:45 Student presentations and discussion
- 10:45 11:15 Coffee break
- 11:15 12:30 Student presentations and discussion
- 12:30 12:40 Closing remarks (Heidi Korhonen, FINCA, Univ. Turku, Finland)
- 12:40 14:00 Lunch and leaving Tuorla

Lectures and Project Tutors

Jorma Harju, University of Helsinki, Finland Anne Lähteenmäki, Metsähovi Radio Observatory, Aalto University, Finland Ivan Marti-Vidal, Onsala Space Observatory, Sweden, Sébastien Muller, Onsala Space Observatory, Sweden Silja Pohjolainen, Tuorla Observatory, University of Turku, Finalnd Tuomas Savolainen, Metsähovi Radio Observatory, Aalto University, Finland Merja Tornikoski, Metsähovi Radio Observatory, Aalto University, Finland Kaj Wiik, Tuorla Observatory, University of Turku, Finland

2. Scientific Summary

The main aim of the North-European Radio Astronomy School was to get Northern-European students acquainted with radio and sub-mm observations, and especially interferometric techniques. The course was mainly aimed at students and young postdocs who did not have much prior experience with radio/sub-mm observations.

The facilities at the Tuorla Observatory are optimal for having 20 students. Our lecture room can accommodate up to 30 students, 20 comfortably, and we have good places for independent work for four groups. As aimed, we had in total 20 students, from which 14 were male and 6 female. The participants were working/studying in: Finland (8), Denmark (4), Sweden (3), Poland (2), Turkey (2), and Latvia (1). Nationalities of the participants were: Iranian (4), Danish (3), Finnish (3), Indian (2), Polish (2), British (1), Colombian (1), Latvian (1), Pakistani (1), Portuguese (1), and Swedish (1). The group picture with all of the students and several of the teachers/tutors is given on the next page.



The school was structured to have lectures in the mornings and group exercises in the afternoons. The lectures were concentrating on radio and sub-mm astronomy techniques and interferometry. For the afternoons the students were divided into four groups working on one project throughout the school. Information on the groups (tutor, students and project description) can be found below. Results from the group work were presented during the last day of the school. Everyone in the group actively participated in the presentation.

Project supported by the European Commission Contract no.: 283393





Project 1: APEX observations of deuterated ammonia

Tutor: Jorma Harju, University of Helsinki

Students: Isabella Cortzen, Thøger Emil Rivera-Thorsen, Mika Saajasto, Nasrin Talebpour Description: In this project we analyse spectra recorded inMay 2015 using the FLASH+ receiver on APEX. The instrument consists of two dual-sideband receivers operating at 345 and 460 GHz. The receivers are connected to Fast Fourier Transform Spectrometers. The system enables the simultaneous measurement of altogether four 4 GHz wide frequency bands at a high spectral resolution. We concentrate on the lines of deuterated ammonia (NH2D, NHD2, ND3) around 335 and 310 GHz detected towards a dense molecular cloud core. We estimate the column densities of the observed molecules making use of the hyperfine structure of the lines, and constrain the physical conditions in the emission region. The column density ratios are compared with the predictions of a chemistry model in order to get an idea of the evolutionary stage of the core. The spectra contain a number of additional lines we try to identify. The spectra are reduced and analysed using CLASS which belong to the Gildas package of IRAM.

Project 2: The jet of M87

Tutor: Ivan Marti-Vidal, Onsala Space Observatory

Students: Sissi Enestam, Tuomas Kangas, Daniel Lawther, Marjan Marbouti, Artūrs Vrubļevskis Description: We will calibrate multi-frequency observations of the Active Galactic Nucleus (AGN) in galaxy M87 in bands L (1.4 GHz) and C (5 GHz). These observations were taken with the Karl J. Jansky Very Large Array (J-VLA). We will calibrate the data also in polarization, allowing us to construct the full-polarization brightness distribution of the M87 jet at different frequencies. We will compute the spatial distribution of the Rotation Measure (RM) in the jet (i.e., the effect of Faraday Rotation caused by the presence of a magnetic field in a plasma), as well as the spectral-index distribution. All this information will be used to infer physical conditions in the jet of M87.

Project 3: VLBI calibration and imaging

Tutor: Tuomas Savolainen, Metsähovi Radio Observatory

Students: Rafael Jonathan Camilo Vera Rodriguez, Armin Nabizadeh, Mateusz Olech, Sandra Raimundo, Tom Renolds

Description: In this project the students will dive in to the world of very long baseline interferometry (VLBI). VLBI is a technique that offers the highest angular resolution achievable in astronomy. The baseline lengths of thousands of kilometers involved in VLBI observations make this technique in some respects more challenging than observing with connected-element interferometers. Working with VLBI data is an excellent way to develop deep understanding of how interferometry works.

The students will learn how to calibrate and image continuum VLBI data by using AIPS and Difmap packages. They will work on a series of observations of a relativistic jet ejected by an accreting supermassive black hole. The aim of the project is to measure the jet speed. Every student will calibrate and image his/her own data set, and at the end these data sets will be combined to measure the jet kinematics.

Project 4: Molecules in absorption in the distant universe

Tutor: Sebastien Muller

Students: Henrik Rhodin, Maryam Saberi, Jimit Sanghvi, Rafał Sarniak, Carlton Xavier Description: We will play with fresh ALMA observations of the radio-bright and lensed blazar PKS1830-211. There is a galaxy, the lens, located at z=0.89 just in the line of sight of the blazar. By chance, the continuum emission of the blazar is absorbed by molecules in the interstellar medium (ISM) of this galaxy. This provides us with the unique opportunity to investigate the physical conditions and chemical contents of the ISM in such a distant object (at a lookback time of half the present age of the universe). First, you will reduce the ALMA data, using a provided CASA script. Then, you will form the image of the blazar, and search for absorption features in the spectrum. One of your goal will be to identify which molecules are there. Do all molecules have same absorption signature ? What do they tell us ? We will do chemistry at z=0.89 ! Finally, one of the molecule detected in the spectrum (I keep it secret, you will have to identify it !) has two isotopic variants detected. Thus we will be able to measure the isotopic ratio of this secret element. We will compare the value at z=0.89 and in the local universe. We will try to interpret this in term of nucleosynthesis history in the universe.





3. Attendance list (incl. participant names, affiliation and country) signed by the participants and confirmed by the organizer

1) Isabella Chi Gieseler Cortzen, Danish, DARK, Uni. of Copenhagen, Denmark, MSc student, female

2) Sissi Enestam, Finnish, International Space University, Helsinki, Finland, MSc student, female

3) Tuomas Kangas, Finnish, Tuorla Observatory, Finland, PhD student, male

4) Daniel Lawther, Danish, DARK, Uni. of Copenhagen, Denmark, PhD student, male

5) Marjan Marbouti, Iranian, Sodankyla Geophysical Observatory, Finland, PhD student, female

6) Armin Nabizadeh, Iranian, Middle East Technical University, Ankara, Turkey, MSc student, male

7) Mateusz Olech, Polish, Nicolaus Copernicus University, Torun, Poland, PhD student, male

8) Yasir Abdul Qadir, Pakistani, Luleå University of Technology, Sweden, MSc student, male

9) Sandra Raimundo, Portuguese, DARK, Uni. of Copenhagen, Denmark, young postdoc, female

10) Thomas Reynolds, British, Tuorla Observatory, Finland, PhD student, male

11) Henrik Rhodin, Swedish, DARK, Uni. of Copenhagen, Denmark, PhD student, male

- 12) Thøger Emil Rivera-Thorsen, Danish, Stockholm University, Sweden, PhD student, male
- 13) Mika Saajasto, Finnish, University of Helsinki, Finland, PhD student, male
- 14) Maryam Saberi, Iranian, Chlamers University, Göteborg, Sweden, PhD student, female
- 15) Jimit Sanghvi, Indian, Tuorla Observatory, Finland, PhD student, male
- 16) Rafał Sarniak, Polish, Nicolaus Copernicus University, Torun, Poland, PhD student, male
- 17) Nasrin Talebpour Sheshvan, Iranian, Middle East Technical University, Ankara, Turkey, PhD student, female
- 18) Rafael Jonathan Camilo Vera Rodriguez, Columbian, Metsähovi Radio Observatory, Finland, PhD student, male
- 19) Arturs Vrublevskis, Latvian, Ventspils University College, Latvia, Young postdoc, male
- 20) Carlton Xavier, Indian, Tuorla Observatory, Finland, MSc student, male

4. Financial Report / RadioNet3 contribution

Radionet3 covered logistical costs of 5259.76 EUR. In addition, travel support was paid for some of the students and lectures/tutors. Total travel costs: approx. 3.200 EUR Total support from RadioNet3 was approximately 8500 EUR.

Students travel costs paid by RadioNet3: Isabella Chi Gieseler Cortzen, Danish Sissi Enestam, Finnish, Dabiel Lawther, Danish, Marjan Marbouti, Iranian, Armin Nabizadeh, Iranian, Mateusz Olech, Polish, Sandra Raimundo, Portuguese, Henrik Rhodin, Swedish, Rafał Sarniak, Polish, Nasrin Talebpour Sheshvan, Iranian, Arturs Vrublevskis, Latvian, Lecturer travel costs paid by RadioNet3: Jorma Harju, Finnish, Anne Lähteenmäki, Finnish, Tuomas Savolainen, Finnish,

Merja Tornikoski, Finnish,

5. Conference Proceedings and Web page

The school webpage can be found from: http://www.utu.fi/en/units/finca/research/Tuorla2015 All the lectures given during the school can be found from the website under programme.