A report on the

Workshop on Optical data reduction and Analysis in Rwanda
5-11 May 2013

A 2013-TF1 Project sponsored by the IAU/OAD

Submitted by:

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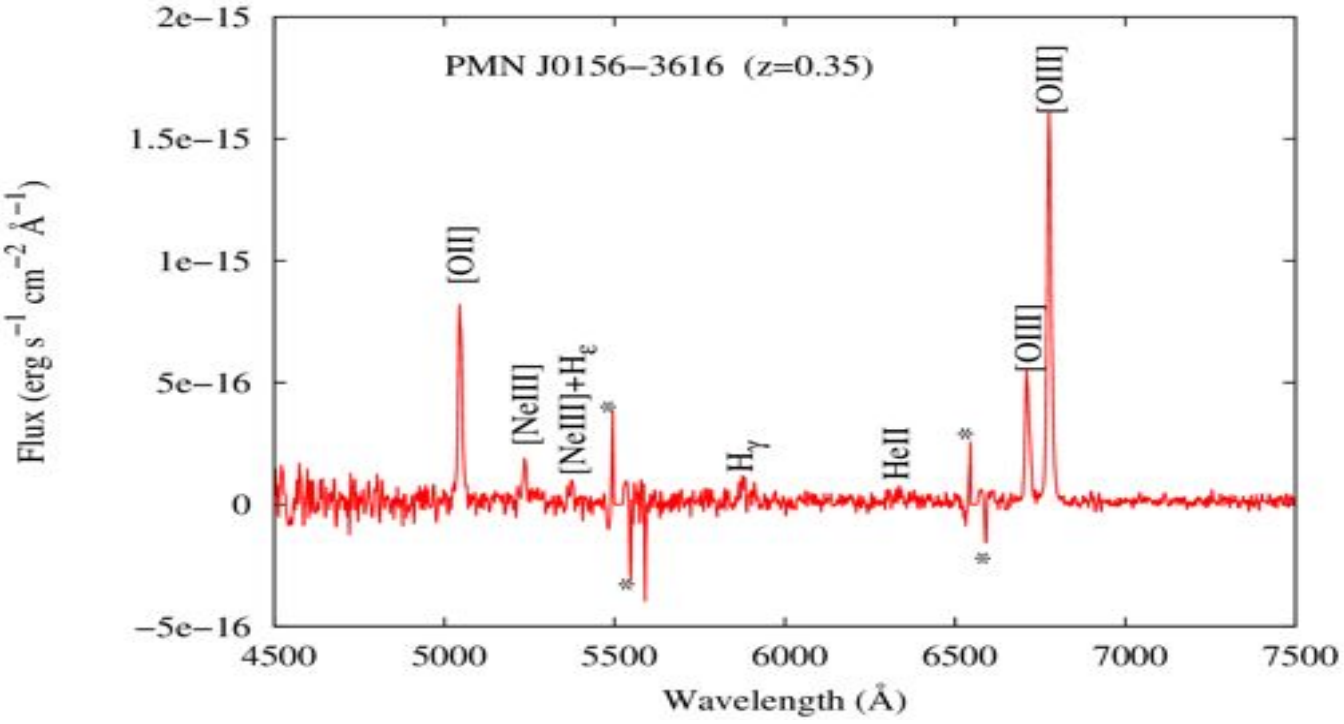

KIE, **August 2013**

Dates: 5-11 May 2013
Venue: Hotel Ishema
Musanze District/ Nothern Province
Host: Kigali Institute of Education (KIE)
Rwanda
Sponsor: Funded by the International Astronomical Union (IAU)/ Office of Astronomy Development (OAD)

Participants:

1. Dr Petri Vaisanen (SAAO) [Facilitator]
2. Dr Mirjana Povic (IAAS- Spain) [Facilitator]
3. Dr Pheneas Nkundabakura (KIE)
4. Mr Mahoro Antoine (KIE)
5. Mr Celestin Sindikubwabo (KIE)
6. Mr Claver Hitimana (KIE)
7. Mrs Agnes Dusabemungu (KIE)
8. Mr Kizito Ndihokubwabo (KIE)
9. Dr Kondakova Elena (NUR)
10. Prof. Kondakov Oleg (NUR)
11. Dr Nzabonayo Pierre (University of Burundi)

Fig.1: Participants. *From left to right: Celestin, Claver, Pierre, Antoine, Petri, Agnes, Elena, Oleg, Mirjana, Pheneas and Kizito. A list containing their full details of the participants can be obtained in Appendix A.*

Acknowledgements

I would like to thank the IAU/OAD office for the financial support of the workshop. Without it the workshop could not have happened.

My sincere gratitudes are extended to Dr. Petri Vaisanen from the South African Astronomical Observatory (SAAO) and Dr. Mirjana Povic from the Institute of Astrophysics of Andalucia (IAA)-Spain to have accepted to give lectures and share their knowledge during the workshop. Their contribution has been valuable.

My appreciation goes to all the participants, for the way the workshop happened smoothly from the beginning to the end in a friendly environment.

1. Background:

During the year 2009, IAU donated to KIE 5 computers to help students and Lecturers to learn and use astronomy softwares. The computers run completely on linux. With these computers, KIE students have now a possibility to choose astronomy/space science for their undergraduate final year research projects.

In order to make these computers more useful, a permanent astronomy research team is needed. In fact, as we have already entered in the era where Astronomy research can be done locally even in the developing countries using online data mining (some of these data are semi or completely reduced). In order to make use of these data, there is a need to have a research team trained on various softwares for data reduction to ensure quality in data handling and interpretation.

In addition, following the growing initiatives to build telescopes in East Africa e.g. the Entoto Optical observatory project (in Ethiopia) and the extension of the SKA radio dishes up to Kenya, research teams need to be introduced at universities to make use (for long term) of the data output of these infrastructures. In these regards, there will be opportunity to get data for our own planned objects.

Therefore it is necessary to build an astrophysics research team in Rwanda and possibly extend the collaboration to the East African region in building a pana-East-African multi-wavelength research team which will be able to reduce multi-wavelength photometric and spectroscopic data (Radio, Optical, X-ray, gamma-rays).

2. Introduction

Under the sponsorship of the OAD, a Workshop on Optical data reduction (photometry and spectroscopy) and analysis was organised in Rwanda from 05 May to 11 May. Venue: Hotel Ishema (North- 100 km from the Capital city Kigali)

Optical telescopes are producing a lot of quality data which some can even be accessed online. The ability of handling/processing these data plays the most important role in the time scale of scientific production. However this aspect of processing these data remains an issue. This workshop aims at enhancing the audiences' ability in reducing/processing various optical data.

Two facilitators specialists in Astronomy/Astrophysics were invited:

(1) Dr Petri Vaisanen (from South African Astronomical observatory- South Africa). He taught Observational techniques and Spectroscopic data reduction methods.

(2) Dr Mirjana Povic (from Institute of Astrophysics of Andalucia- Spain). She taught Stellar and extragalactic astronomy and Photometric data reduction methods.

In the middle of the workshop, participant were given a project to reduce and analyse data for which they will continue to work on as a starting point of their research group..

Prior to the conference participants were encouraged to revise their knowledge in Linux and IRAF.

3. Aim :

The aim of the workshop was to Strengthen Astronomy Research at university level in Rwanda.

4. Specific Objectives and outcomes:

At the end of this workshop the team will be able to:

- Learn photometric and spectroscopic data reduction techniques
- Learn the background theory on the spectroscopic and photometric properties of stars and galaxies
- Learn how to interpret the online available data
- Use softwares like IRAF, etc.
- Produce at least one research paper

5. **Activities carried out**

Day	Activity	Comments
Sunday 5 May 2013	Arrival of the participants	Due to the road which was cut, there was a delay in arrival. The last arrived at the Hotel at around 9:30 pm.
Monday 6 May 2013	**Opening note** **Lectures:** -Stellar astronomy I and II (by Mirjana) -Optical observational techniques I and II (by Petri)	
Tuesday 7 May 2013	**Lectures:** Extragalactic Astronomy (by Mirjana) Optical observational techniques (by Petri) Multiwavelength database, Virtual observatory, Tools (TopCAT etc) (by Mirjana)	
Wednesday 8 May 2013	-**Astronomy at National University of Rwanda** (by Elena-NUR) **-Lectures:** Photometric and spectroscopic techniques **-Outreach activity at Musanze High school.**	Visit the touristic cave around Musanze
Thursday 9 May 2013	**Parallel sessions**: Photometric and spectroscopic techniques (by Mirjana and Petri)	
Friday 10 May 2013	**Parallel sessions:** Photometric and spectroscopic techniques (by Mirjana and Petri)	

	Closing ceremony	
Saturday 11 May 2013	Departure of participants	

NB: The timetable is of activities is found in appendix B

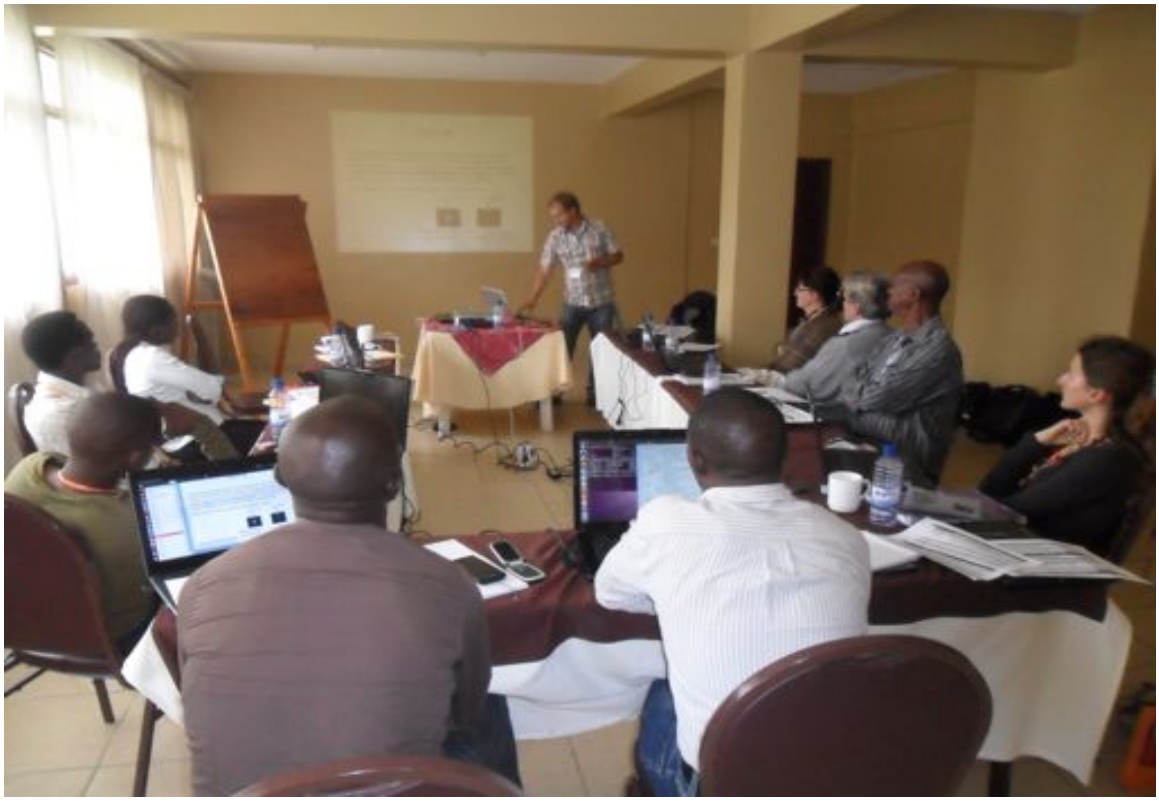

Fig. 2. Lectures during the workshop

6. Workshop achievements:

Objective	Outcome	Indicator
• Learn photometric and spectroscopic data reduction techniques	Knowledge and skills in using softwares of reducing and analysing astronomical data e.g. IRAF were gained.	Participants are able to reduce and analyse independently the data. One Spectrum obtained during the conference were used in the paper of the proceedings of the conference on Multifrequency behaviour of high energy cosmic sour ces (Palermo, Italy)
• Learn the background theory on the spectroscopic and photometric properties of stars and galaxies	Enhancement of the understanding of the nature of stars and galaxies	Ability to identify features of stars and galaxies from a spectrum.
• Learn how to search the online available data	Ability to do a survey of different catalogues of data Skills and knowledge gained in manipulating data using TOPCAT software	Participants in the photometry sub group are currently using different catalogues in the ongoing project.

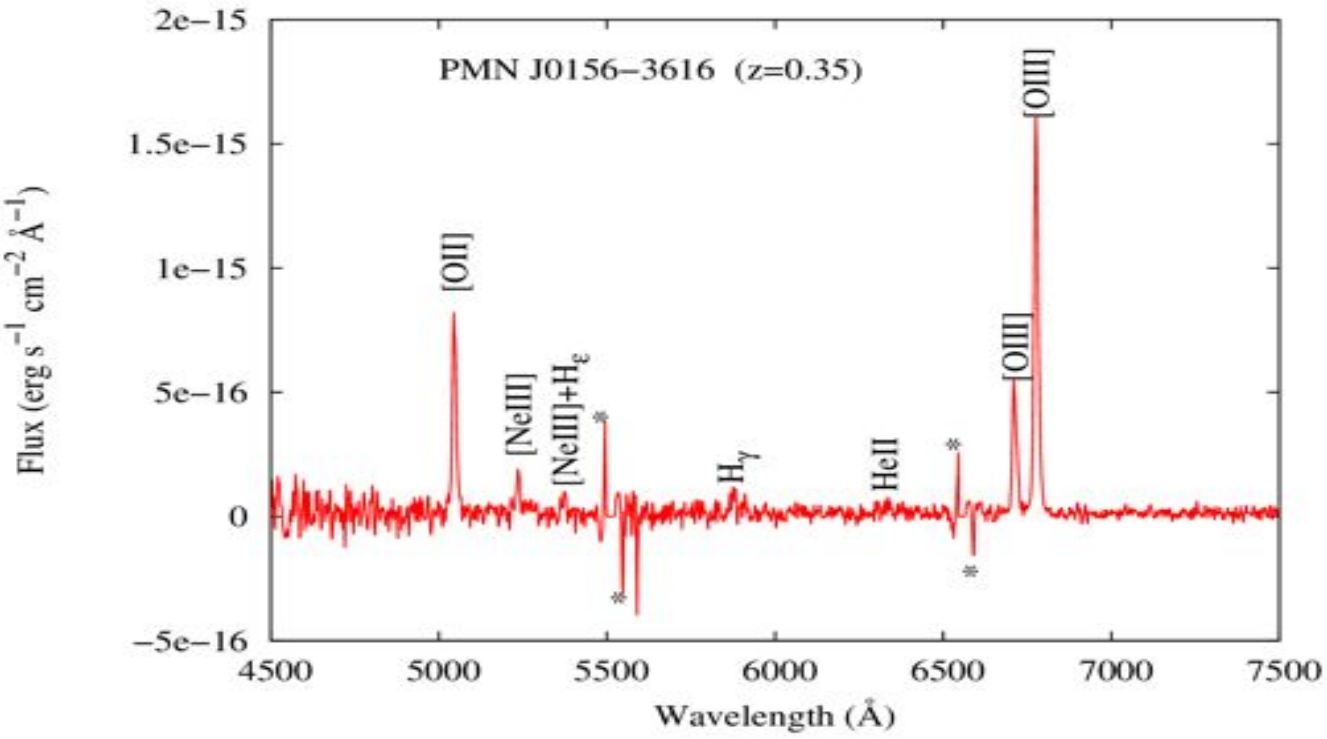

Fig.3: Spectrum of an AGN: Data reduction and identification were processed during the workshop.

7. *Astronomy Outreach at Musanze Science High School.*

"The excitement of astronomy has stimulated large numbers of young people to choose a career in science and technology, thereby contributing to the "knowledge economy" of many countries."

"Because astronomy combines science and technology with inspiration and excitement, it can play a unique role in facilitating education and capacity building and in furthering sustainable development throughout the world."

From the International Astronomical Union's "Astronomy for the Developing World, Strategic Plan 2010-2020", available at: http://iau.org/static/education/strategicplan_091001.pdf

Fig. 4: Talking to students at Musanze Science High school

8. Financial report

Account Workshop May 2013					
Description	Quantity	Unit price	Total	Solde	*Note*
Entry					
OAD initial transfer to Rwanda	1	4000 EUR	4000 EUR		*This is the amount was initially allocated to the project*
Amount received after local bank transfer fee	1	4,832.00 USD	4,832.00 USD	4,832.00 USD	*This the amount received on the account of the project after local Bank transfer fee*
OAD to-up (as received)	1	742.00 USD	742.00 USD	5,574.00 USD	*This the top up received. This was put directly on the Hotel account*
Total entry in USD			5,574.00 USD		
Spending					
Item	Quantity	Unit price	Total	Solde	Note
Ticket Petri	1	1,070.75 USD	1,070.75 USD		*Return Ticket Cape Town-Kigali with South African Airways*
Ticket Mirjana	1	878.34 USD	878.34 USD		*Return Ticket Madrid-Kigali with Brussels airlines(this includes the price of the ticket at 601 EUR and the Western union transfer fee)*
Sub total 1 (Total ticket in USD)			*1,949.09 USD*	3,624.91 USD	
Accommodation, Meals (Petri + Mirjana)	1	742.00 USD	742.00 USD		*Accommodation and Meals for facilitators payed as a top-up directly to the Hotel account by OAD*
Sub total 2 (Accommodation meals facilitators)			*742.00 USD*	2,882.91 USD	
Accommodation, Meals for others (Lecturers+ students)	1	1,607,000.00 RWF	1,607,000.00 RWF		*Accommodation and Meals for others*
Block notes, Porte doc, Badges, Pens	11	2,970.00 RWF	32,670.00 RWF		*Workshop pack*
Mouses	5	3,000.00 RWF	15,000.00 RWF		*Mouses for the 5 student computers*
Transport for facilitators to and fro airport	2	50,000.00 RWF	100,000.00 RWF		*Hired cars for transport of the facilitators*
Transport for Lecturers + students	7	15,000.00 RWF	105,000.00 RWF		*Return ticket for 2 lecturers and 5 students*
Transport for to Musanze High school	1	10,000.00 RWF	10,000.00 RWF		*Small bus transport to the high school for Outreach*
Sub total other (in RwF)			1,869,670.00 RWF		1 USD=650 RWF
Sub total 3 other (in USD)			***2,876.42 USD***	6.49 USD	
TOTAL Spending			5,567.51 USD		

8. Conclusion and Recommendation:

Learning how to use astronomical softwares is crucial for Research in astronomy/astrophysics in developing countries. In fact, Telescopes are no longer a priority in starting research in Astronomy/astrophysics since online data from satellites ground-based telescopes are becoming available. What have to be emphasized on is the development in research capacity building to ensure that data are reduced and handled and interpreted in the correct way.

In this sense we can say that the objectives of the workshop were achieved.

For consolidation of the research team already formed, participants recommended the organisation of a second workshop next year to upgrade their knowledge.

Appendix A: **List of participants and contacts**

Name and Surname	Institution	Function	Email address	Phone
Dr Petri Vaisanen	SAAO	SALT Astronomer	petri@saao.ac.za	-
Dr Mirjana Povic (IAAS- Spain)	IAAS-Spain	Post doc	mpovic@iaa.es	-
Dr Pheneas Nkundabakura	KIE	Lecturer	nkundapheneas@yahoo.fr	0785517032
Mr Mahoro Antoine	KIE	Student-teacher	mahoroan@gmail.com	0784043545
Mr Celestin Sindikubwabo	KIE	Student-teacher	sicel11@yahoo.com	0785447881
Mr Claver Hitimana	KIE	Student-teacher	hitaclaver01@yahoo.com	0785201929
Mrs Agnes Dusabemungu	KIE	Student-teacher	dusabemunguagnes@yahoo.com	0783484266
Mr Kizito Ndihokubwabo	KIE	Teacher	doskizitos@yahoo.fr	0788970243
Dr Kondakova Elena	NUR	Lecturer	ekondakova@nur.ac.rw	0788403507
Prof. Kondakov Oleg	NUR	Lecturer	okondakov@nur.ac.rw	0783866132
Dr Nzabonayo Pierre	University of Burundi	Lecturer	doyenzo@yahoo.fr	-

Appendix B: Timetable of Activities

Monday	7:30-8:30	Breakfast		
	8:30-9:00	Communication		
	9:00-10:30	Stellar astronomy	Mirjana	ISM, star formation, stellar evolution, and stellar remnants
	10:30-11:00	Tea break		
	11:00-12:300	Optical observational techniques I	Petri	**Observing Basics:** Astronomical coordinate systems; parallax; atmospheric extinction dispersion; time systems. **Telescopes:** telescope lenses, mirrors, tubes, mounts, domes and enclosures; mirror coatings; optical nature of the Earth's atmosphere, Example of modern optical telescopes: the Southern African Large Telescope (SALT). **Detectors:** the magnitude scale;CCD principles;
	12:30-14:00	Lunch		
	14:00-16:00	Stellar Astronomy	Mirjana	EM radiation, characteristics of stars and stellar systems
	16:00-16:30	Tea break		
	16:30-18:00	Observational techniques II	Petri	**Photometry**: Absolute and bolometric magnitudes; colour index; blackbodies; filters and photometric systems; spectral energy distributions; two-colour diagrams; dust extinction and reddening; line blanketing; colour-magnitude diagrams; atmospheric extinction, absorption and emission; reducing photometric data; differential photometry; Fourier theory and period analysis.

Day 2	**Time**	**Title**	**Presenter**	**Indicative content**
Monday	7:30-8:30	Breakfast		
	8:30-9:00	Communication		
	9:00-10:30	Extragalactic Astronomy	Mirjana	Milky way, Galaxy Classifications (Morphology and redshifts), The Tully-Fisher Relation, Quasar Absorption Lines (The Gaseous Halos of Galaxies), Galaxy Clustering, AGN: Their Properties and Evolution, Emission Line Physics, Photometric Evolution of Galaxies (Evolution of Galaxy Luminosities and Colors),
	10:30-11:00	Tea break		
	11:00-12:300	Optical observational techniques I	Petri	**Spectroscopy Principles:** Early history; dispersion and prisms; objective prism spectroscopy; diffraction gratings, the grating equation and grating parameters; échelle gratings; grisms; volume phase holographic gratings (VPHGs); spectrometer design, collimators and cameras; spectrograph examples including the SALT RSS; slit effects; CCD gain and digitization; signal to noise calculations; sky background.
	12:30-14:00	Lunch		
	14:00-16:00	Multiwavelength database, Virtual observatory Tools (TopCAT etc)	Mirjana	Multiwavelength database, Virtual observatory Tools for searching

	16:00-16:30	Tea break		
	16:30-18:00	Introduction to Python	Petri	PYRAF/pysalt

Day 3	Time	Title	Session 1 : Photometry		Session 2: Spectroscopy	
			Presenter	Indicative content	Presenter	Indicative content
Wed-	7:30-8:30	Breakfast				
	8:30-9:00	Communication				
	9:00-10:30	Photometric and Spectroscopic techniques and tools	Mirjana	All processing steps from the raw image to scientific data and nagnitude measurements, etc	Petri	All processing steps from the raw image to scientific data and measurements, line identification etc.
	10:30-11:00	Tea break				
	11:00-12:300	Hands-on session	Mirjana		Petri	
	12:30-14:00	Lunch				
	14:00-16:00	Hand-on session	Mirjana		Petri	
	16:00-16:30	Tea break				
	16:30-18:00	Hands-on session	Mirjana		Petri	

Day 4	Time	Title	Session 1 : Photometry		Session 2: Spectroscopy	
			Presenter	Indicative content	Presenter	Indicative content
Thursday	7:30-8:30	Breakfast				
	8:30-9:00	Communication				
	9:00-10:30	Hands-on session	Mirjana		Petri	
	10:30-11:00	Tea break				
	11:00-12:300	Hands-on session	Mirjana	Extracting photometric information:	Petri	Extracting spectral information: expansion speed, red shift,

				temperature, mass, luminosity, distance, variability: lightcurve etc		distance, equivalent width, electronic density, Black hole mass, etc
	12:30-14:00	Lunch				
	14:00-16:00	Instructions for projects	Mirjana	Projects	Petri	Projects
	16:00-16:30	Tea break				
	16:30-18:00	Projects	Mirjana		Petri	

Day 5	Time	Title	Session 1 : Photometry		Session 2: Spectroscopy	
			Presenter	Indicative content	Presenter	Indicative content
Friday	7:30-8:30	Breakfast				
	8:30-9:00	Communication				
	9:00-10:30	Projects	Mirjana		Petri	
	10:30-11:00	Tea break				
	11:00-12:300	Projects	Mirjana		Petri	
	12:30-14:00	Lunch				
	14:00-16:00	Projects	Mirjana	Projects	Petri	Projects
	16:00-16:30	Tea break				
	16:30-18:30	Presentation of projects + Discussion +Closure	Participants			
	19:00	Diner				