VENTSPILS AUGSTSKOLA

Ventspils starptautiskais radioastronomijas centrs VIRAC

Irbene radiotelescope RT-32

V.Bezrukovs

VIRAC, Latvia

EVN TOG
28 June, 2012

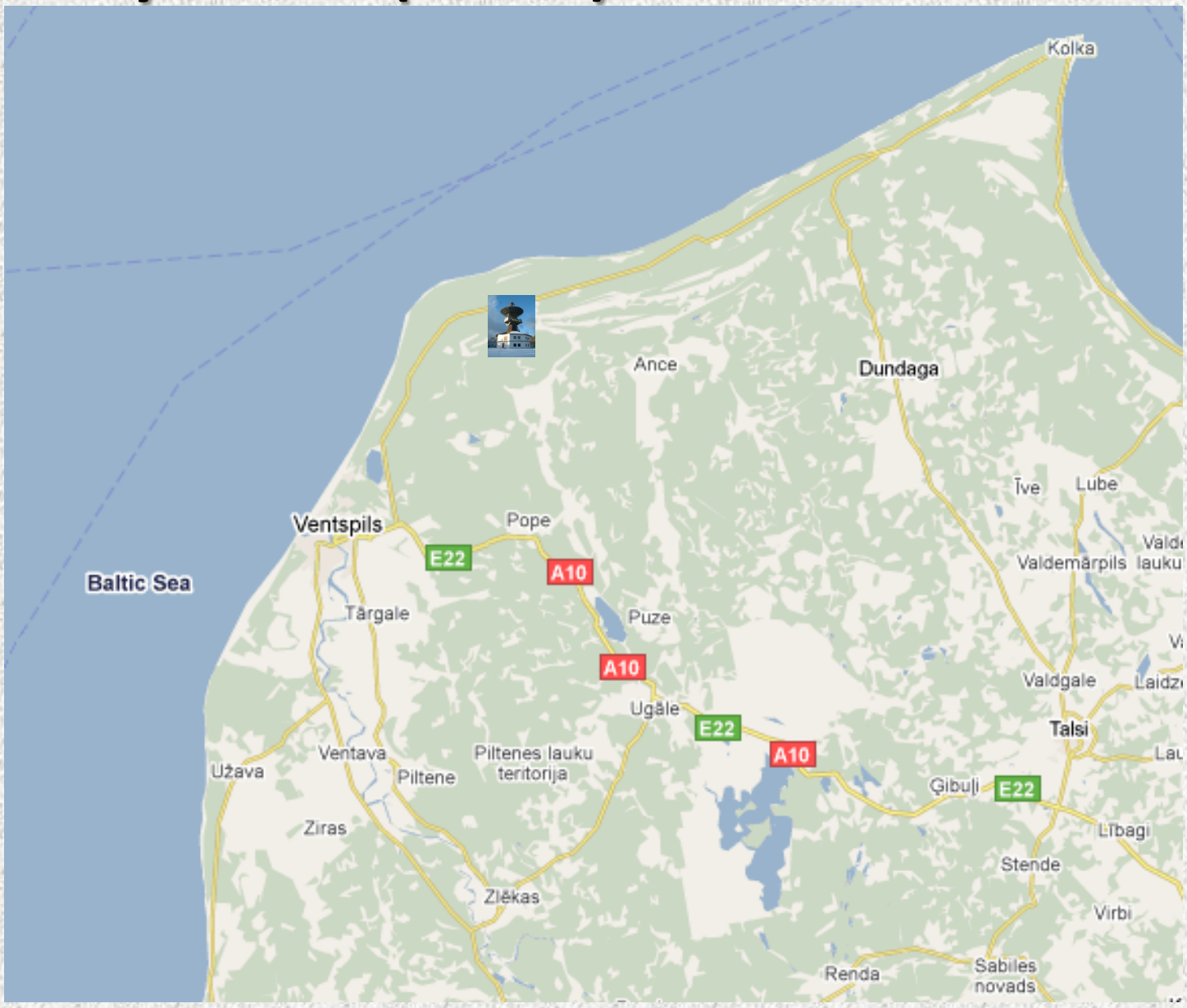
ESF EIROPAS SOCIĀLAIS FONDS

EIROPAS SAVIENĪBA

Outline

- RT-32 Current status
- Irbene Radio telescope RT-32 preparation for observations.
- VLBI observation of navigation satellites, 6 – 10 Apr 2012;
- EVN fringe test, FR012ab,12 Apr 2012
- Space debris observation experiment Debris2012, 16 – 20 Apr 2012;

Ventspils International Radio Astronomy Center (VIRAC)



Engineering Research Institute
“Ventspils International Radioastronomy Center” (ERI VIRAC)
History

•1950. – the secret Soviet military space center is established.

•1960. – 1970. two parabolic antennas with diameters 32 (RT-32) and 16 (RT-16) meters are built

•1994. after withdrawal the Soviet Army antennas become to Latvian Academy of Science. Telescopes are heavy damaged, any documentation is absent. Soon VIRAC is established.

•1998. First antenna movement and radio astronomical observations

• 2004. VIRAC merges with VUC

• 2010. VIRAC merges Engineering Research Instititute of VUC. Engineering Research Institute “Ventspils International Radioastronomy Center” is established.

Ventspils International Radio Astronomy Cente

Fundamental research in astronomy and astrophysics

- Very Long Base Line Interfereometry (VLBI)
  - European VLBI Network (EVN)
  - Low Frequency VLBI Network (LFVN)
  - Space debris and small planets radiolocation
- Astrophysics and astrometry research
  - Solar radio astronomy
  - Astrochemistry
  - Active galactic Nuclei

Applied research in the space field

- Satellite navigation and satellite communication research
  - Satellite navigation (GPS, Galileo, GLONASS)
- Space geodesy
- Satellite signal processing
  - Space communications
- Satellite data processing
  - Signal and image processing
- Satellite components research and development

High performance computing

- VLBI data processing and modeling
- Radiotelescope RT-32 and RT-16 control system optimization
- MHD modeling and solid-state mechanics
- Mathematical modeling
- Medical engineering

Applied engineering and electronics

- Fast prototyping research laboratory
- Renewable energy research and energy efficiency studies
  - Small power generators
  - Wind energy research
- Intelligent network studies
- Smart house applications
- Digital TV applications
- Economical studies group

Ventspils International Radio Astronomy Centre

Ventspils University College

Kristals

RT-2

RT-16

RT-32

VLBI-station RT-32 (Irbene, VIRAC)

VLBI-equipment:

Working frequency range:

327, 1’600, 5’010, 12’000 MHz

Frequency converter:

DBBC, MK-II

Recording system:

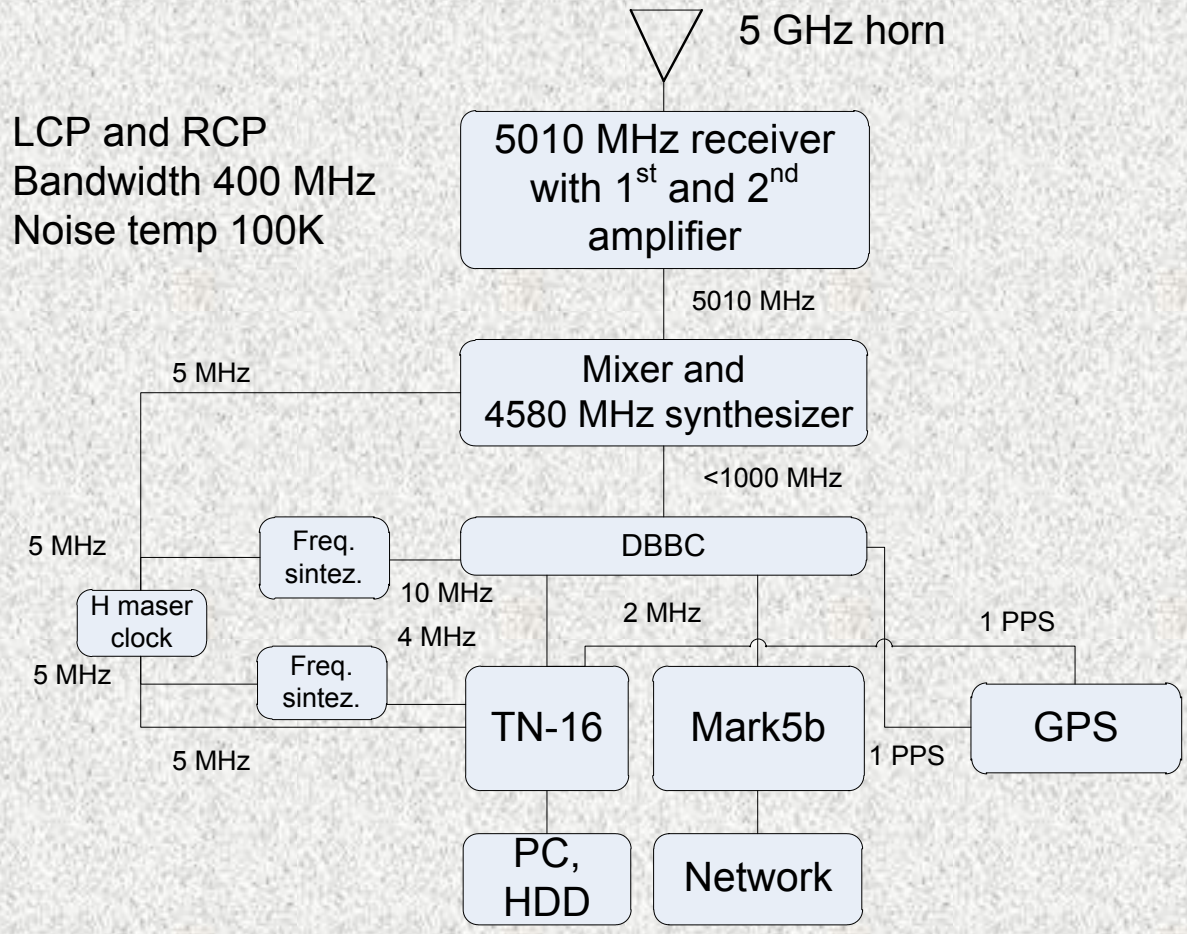
MK-V B,TN-16, MK-II

Synchronization system:

Hydrogen Maser “Quartz” CH-75A, synchronized by GPS

5 GHz receiving system on RT-32

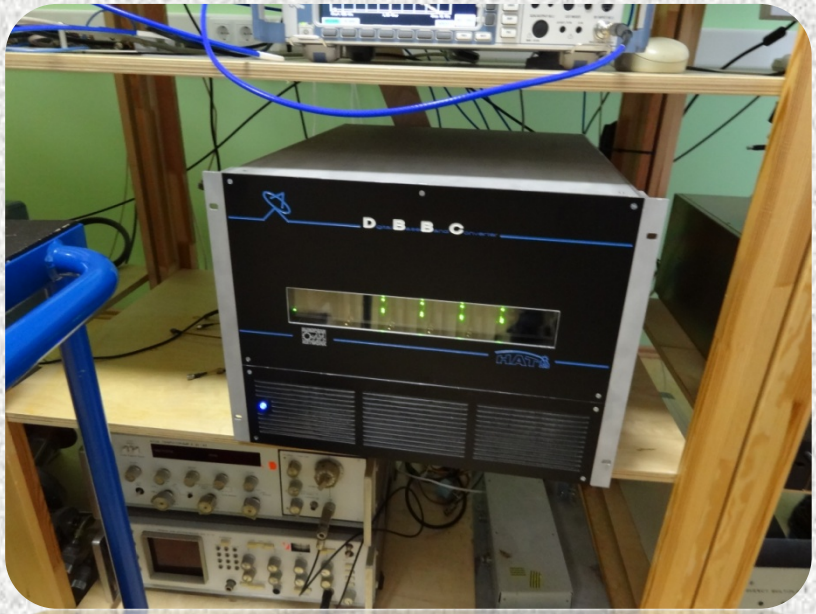
Signal receiving and registration system on radiotelescope RT- 32



5 GHz receiver preparation and installation works on RT-32

- ✓ RT-32 telescope focal cabin reconstructed;
  - new shelves for equipment;
  - RF and power connection;
  - Heated, hermetic room for receiving equipment prepared;
  - Created and installed new system for precise receiver alignment;
- ✓ Feeder for 5 GHz receiver mounted;
- ✓ 5 GHz cryogenic receiver mounted, connected and tested;

5 GHz receiving system on RT-32



VLBI observations:

- EVN network;
- Low Frequency VLBI Network Project;
- Navigation satellites observations and ionosphere research;

EVN experiment FR012a,b; 12 Apr 2012

Equipment used in this test:

Receiver: 5 GHz LCP and RCP receiver (400 MHz Bandwidth, 100 K);

LO: R&S signal generator; LO=4600 MHz;

Synchronization: Hydrogen Maser “Quartz” CH-75A, 5 MHz;

Symmetricom GPS receiver XL-GPS

DBBC system IFB -> LCP ; IFB -> RCP

DBBC synchronization: R&S signal generator (10 MHz);

Data recorder: Mark5b (Red Hat linux).

EVN experiment FR012a,b; 12 Apr 2012

Antennas:

Onsala;

Torun;

Irbene;

Frequency:

5 GHz;

Polarizations:

LCP and RCP;

Channels

FR012a: 2 ch.,64 Mbps

FR012b: 16 ch. 512 Mbps

EVN experiment FR012a,b; 12 Apr 2012: Results

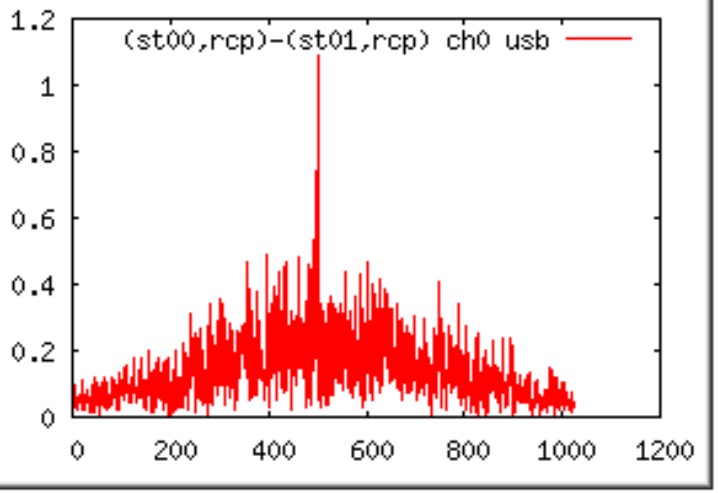
FR012A - Irbene ftp fringe test - selected results from the JIVE software correlator

April, 12 2012 - 64 Mbps, 1 BBC * 8 MHz * 2-bit sampling

scan02 On, Tr, Ir: 2 sec integration time, source = 3C84
scan06 On, Tr, Ir: 4 sec integration time, source = 3C84
scan10 On, Tr, Ir: 2 sec integration time, source = 0234+285
scan14 On, Tr, Ir: 4 sec integration time, source = 0234+285
scan18 On, Tr, Ir: 4 sec integration time, source = 3C84
scan22 Tr, Ir: 4 sec integration time, source = 0234+285

Vex file -- Integration time: 4s -- Start of the integration: 2012y103d10h02m56s0ms

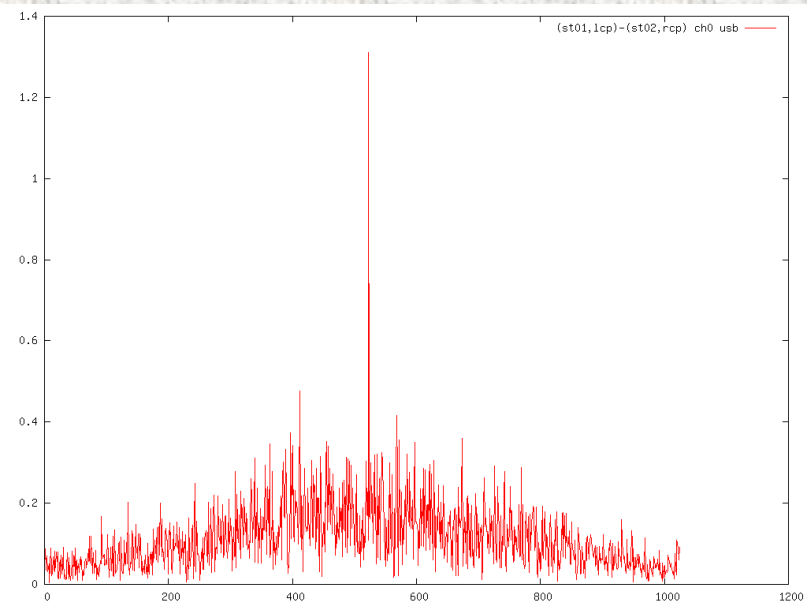
FR012A	Auto correlations			Cross correlations		
	Ir	On	Tr	Ir-On	Ir-Tr	On-Tr
4966.49MHz, USB, Rcp-Rcp	1	2	1	11.17 A P offset: -12	18.92 A P offset: -2	143.7 A P offset: 10
4966.49MHz, USB, Rcp-Lcp	Cross hands			94.21 A P offset: -12	152.9 A P offset: -2	12.76 A P offset: 10
4966.49MHz, USB, Lcp-Lcp	5	1	2	18.84 A P offset: -13	18.13 A P offset: -3	141.3 A P offset: 10
4966.49MHz, USB, Lcp-Rcp	Cross hands			82.14 A P offset: -13	168.2 A P offset: -3	17.22 A P offset: 10



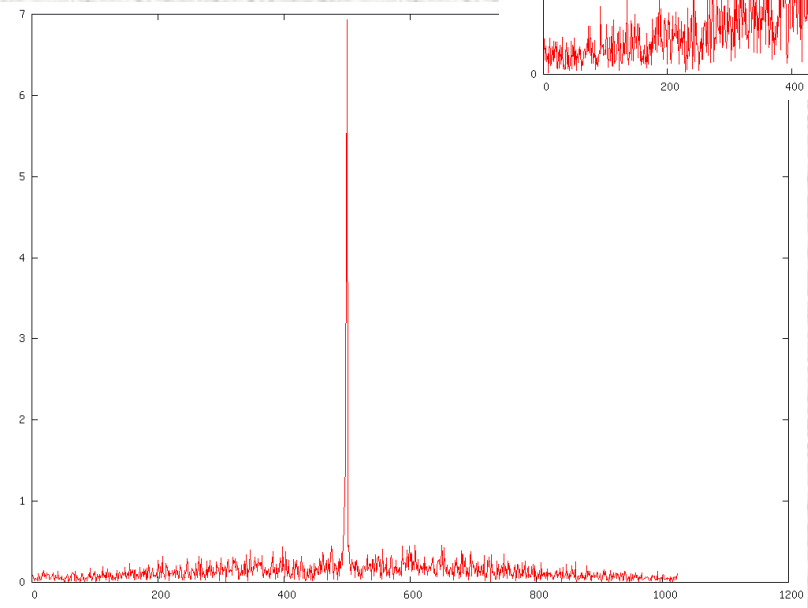
EVN experiment FR012a,b; 12 Apr 2012: Results

FR012A - Irbene ftp fringe test - selected results from the JIVE software correlator
April, 12 2012 - 64 Mbps, 1 BBC * 8 MHz * 2-bit sampling
scan18 On, Tr, Ir: 4 sec integration time, source = 3C84

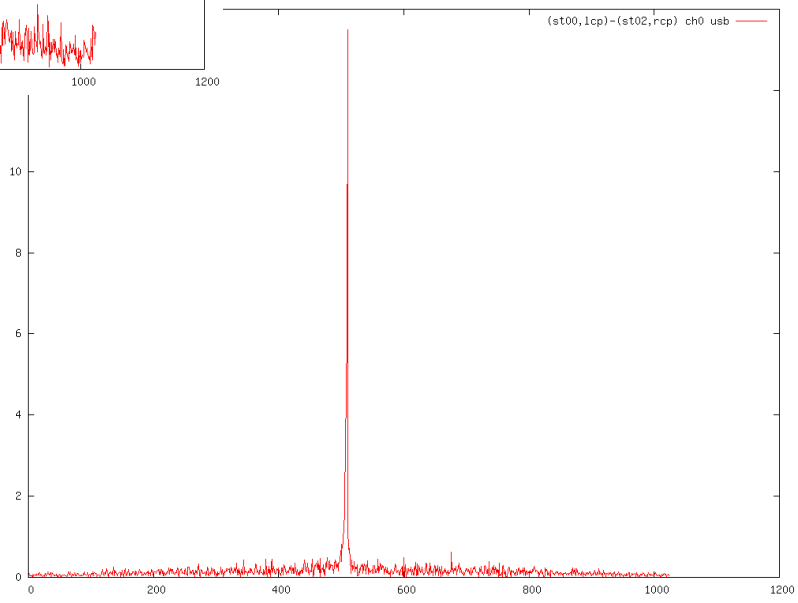
Torun - Onsala



Irbene - Onsala



Irbene - Torun



EVN experiment FR012a,b; 12 Apr 2012: Results

FR012B - Irbene ftp fringe test - selected results from the JIVE software correlator

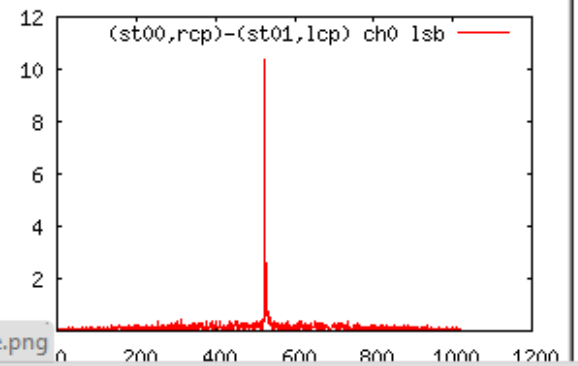
April, 12 2012 - 512 Mbps, 8 BBCs * 8 MHz * 2-bit sampling

scan26 Ir, Tr: 4 sec integration time, source = 3C84
scan30 Ir, Tr, On: 4 sec integration time, source = 0234+285
scan34 Ir, Tr, On: 4 sec integration time, source = 3C84
scan38 Ir, Tr, On: 4 sec integration time, source = 0234+285
scan41 Ir, Tr, On: 4 sec integration time, source = 3C84

EVN experiment FR012a,b; 12 Apr 2012: Results

FR012B - Irbene ftp fringe test - selected results from the JIVE software correlator

FR012B	Auto correlations			Cross correlations		
	Ir	On	Tr	Ir-On	Ir-Tr	On-Tr
4966.49MHz, LSB, Rcp-Rcp	1	2	1	23.37 A P offset: 12	16.68 A P offset: 2	132.7 A P offset: -10
4966.49MHz, LSB, Rcp-Lcp	Cross hands			137.3 A P offset: 12	122 A P offset: 2	17.67 A P offset: -10
4966.49MHz, LSB, Lcp-Lcp	5	1	2	19.25 A P offset: 13	19.53 A P offset: 3	133.6 A P offset: -10
4966.49MHz, LSB, Lcp-Rcp	Cross hands			118.9 A P offset: 13	111.5 A P offset: 3	13.72 A P offset: -10
4966.49MHz, USB, Rcp-Rcp	1	2	1	7.608 A P offset: -12	13.31 A P offset: -2	142.6 A P offset: 10
4966.49MHz, USB, Rcp-Lcp	Cross hands			134.3 A P offset: -12	118.9 A P offset: -2	14.72 A P offset: 10
4966.49MHz, USB, Lcp-Lcp	5	1	2	20.05 A P offset: -13	17.37 A P offset: -3	140.1 A P offset: 10
4966.49MHz, USB, Lcp-Rcp	Cross hands			120.2 A P offset: -13	118.7 A P offset: -3	18.34 A P offset: 10
4982.49MHz, LSB, Rcp-Rcp	2	4	3	11.61 A P offset: 12	13.99 A P offset: 2	140.4 A P offset: -10
4982.49MHz, LSB, Rcp-Lcp	Cross hands			132.8 A P offset: 12	118.6 A P offset: 2	12.39 A P offset: -10
4982.49MHz, LSB, Lcp-Lcp	6	3	4	19.59 A P offset: 13	19.53 A P offset: 3	151.6 A P offset: -10
4982.49MHz, LSB, Lcp-Rcp	Cross hands			124.1 A P offset: 13	123.6 A P offset: 3	14.71 A P offset: -10
4982.49MHz, USB, Rcp-Rcp	2	4	3	14.62 A P offset: -12	23.2 A P offset: -2	136.2 A P offset: 10
4982.49MHz, USB, Rcp-Lcp	Cross hands			130.6 A P offset: -12	115.6 A P offset: -2	11.28 A P offset: 10
4982.49MHz, USB, Lcp-Lcp	6	3	4	17.45 A P offset: -13	12.48 A P offset: -3	142.1 A P offset: 10
4982.49MHz, USB, Lcp-Rcp	Cross hands			114 A P offset: -13	115.6 A P offset: -3	14.22 A P offset: 10
4998.49MHz, LSB, Rcp-Rcp	3	6	5	8.619 A P offset: 11	17.65 A P offset: 2	143.9 A P offset: -10
4998.49MHz, LSB, Rcp-Lcp	Cross hands			126.1 A P offset: 12	113 A P offset: 2	8.57 A P offset: -10



www.evlbi.org/tog/ftp_fringes/FR012B/scan34/st00_rcp-st01_lcp-ch0-lsb-1-2_large.png

Project: “Signals related to Artificial Earth Satellites: Technologies of Receiving, Transmitting and Processing”

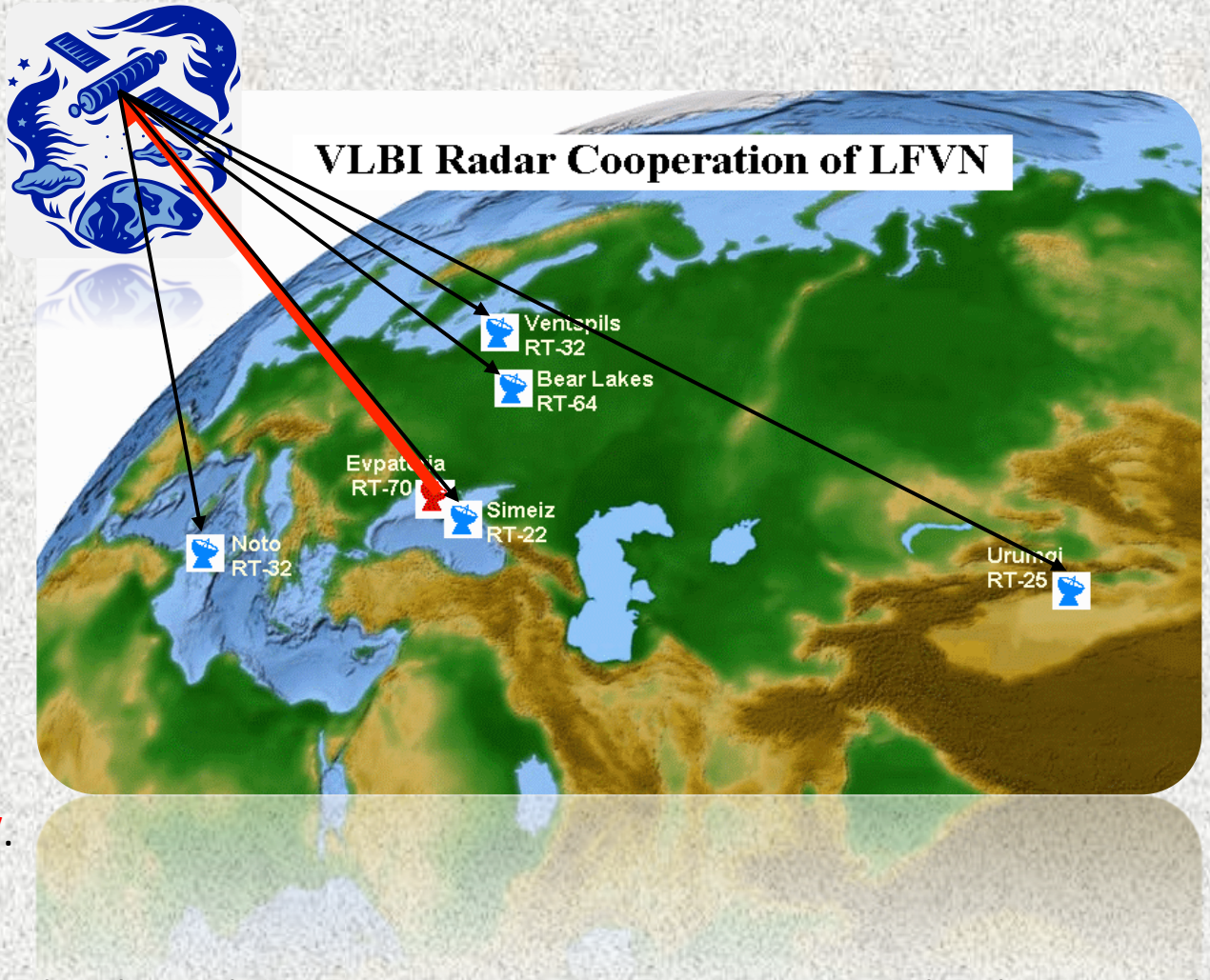
Nr. 2009/0231/1DP/1.1.1.2.0/09/APIA/VIAA/151

- Started: December 2009;
- Involved more then 20 researchers.
- Reconstruction of the telescope RT-16, includes research in the fields of electronics, mechanics and mathematical modeling.
- Developing and applying methods for processing of recorded data.
- **Space debris radiolocation using the radio telescope RT-32 and the VLBI techniques. Software correlator for VLBI data processing and software for computing the orbital elements and future coordinates of the observed objects (debris).**
- Collaboration with Radio physical Research Institute, Nizhnij Novgorod, Russia and LFVN

Low Frequency VLBI Network Project (LFVN)

Radio Telescopes:

- Bear Lakes RT-64
- Pushchino RT-22
- Zimenki RT-15
- St. Pustyn RT-14 (Russia)
- Evpatoria RT-70
- Simeiz RT-22 (Ukraine)
- Noto RT-32
- Medicina RT-32 (Italy),
- Urumqi RT-25 (China),
- Ventspils RT-32 (Latvia).



Frequencies:

- 92 cm, 18 cm, 6 cm.

Recording systems:

- TN16, MK-2, NRTV, MK-V.

Activities:

- Investigations of solar wind, solar spikes, AGN, OH-masers, active stars and radar research of Earth group planets, close asteroids and space debris objects.

VLBI radar method

Planet radar RT-70 (Evpatoria, Ukraine)

VLBI-radar method since 2001 is applied for determination of path of planets, asteroids and space debris objects (disabled satellites, rocket stages, etc.).

The VLBI radar method represents the combination of the "classic" radar and VLBI.

As a result, such combination gives the instruments, which can measure the range, radial velocity (like radar) and the angle and angular velocity (like VLBI).

The main task of the experiments is the receiving of information about object's coordinates and velocity on measurements of time delay and Doppler frequency.

VLBI radar method

During VLBI radar experiment the planet radar irradiates the space object, and the array of radio telescopes receives the reflected from object signal in VLBI mode.

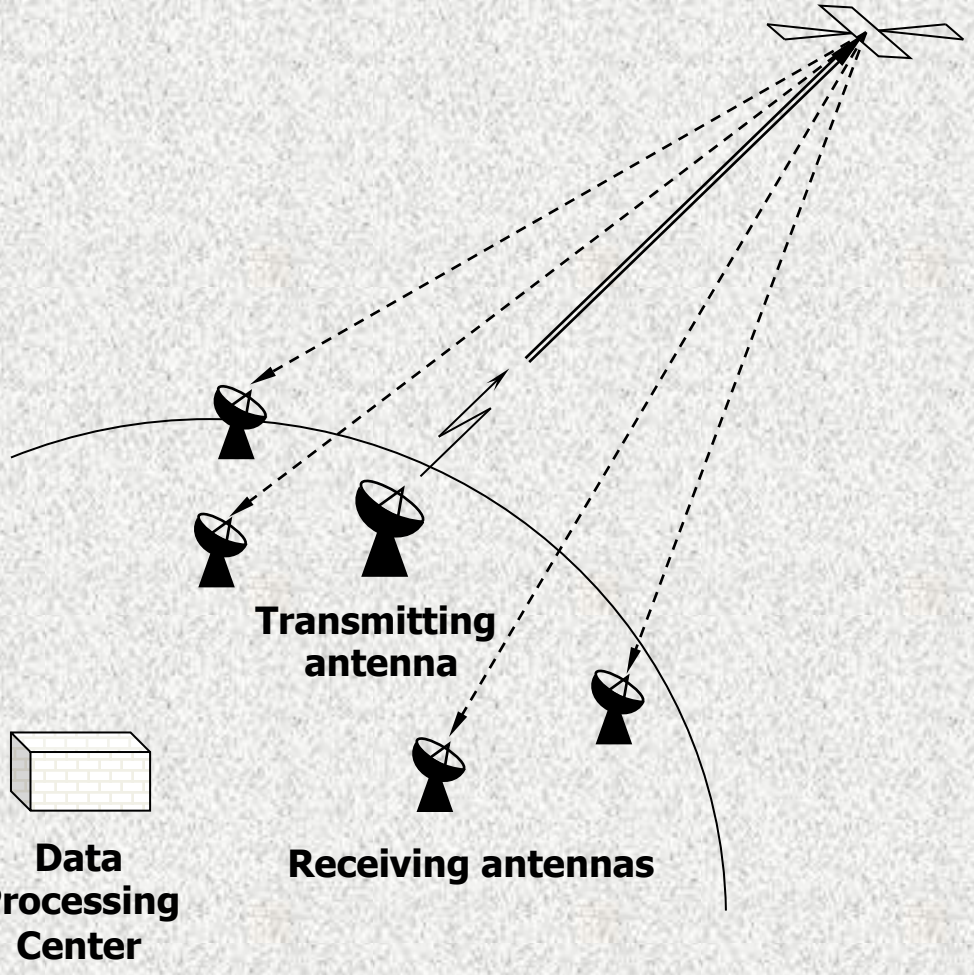
VIRAC took part in radar VLBI experiments since 2007 on LFVN, including:

- planet radar in Evpatoria, Ukraine: RT-70, F=5 GHz, P=20-100 kW (continuous regime of emission);
- VLBI-sites:

  RT-64 (Kalyazin, Russia), RT-22 (Simeiz, Ukraine), RT-32 (Noto, Italy), RT-32 (Medicina, Italy), RT-25 (Urumqi, China) and RT-32 (Irbene, Latvia)

- Data processing centre

  Ventspils University College and "NIRFI-3" (Nizhnij Novgorod, Russia)



Experiment Debris2012

VLBR10.1, 16 - 20 of April of 2012

Transmission mode (Evpatoria locator on RT-70, Ukraine):

Monochromatic radiation and linear modulated radiation;
central frequency of 5010.024 MHz,
polarization RCP,
power P=40 – 100 kW

Observational mode:

Bandwidth: 500 KHz
Central frequency: 5010.0 MHz
Polarization: RCP and LCP

Recording systems:

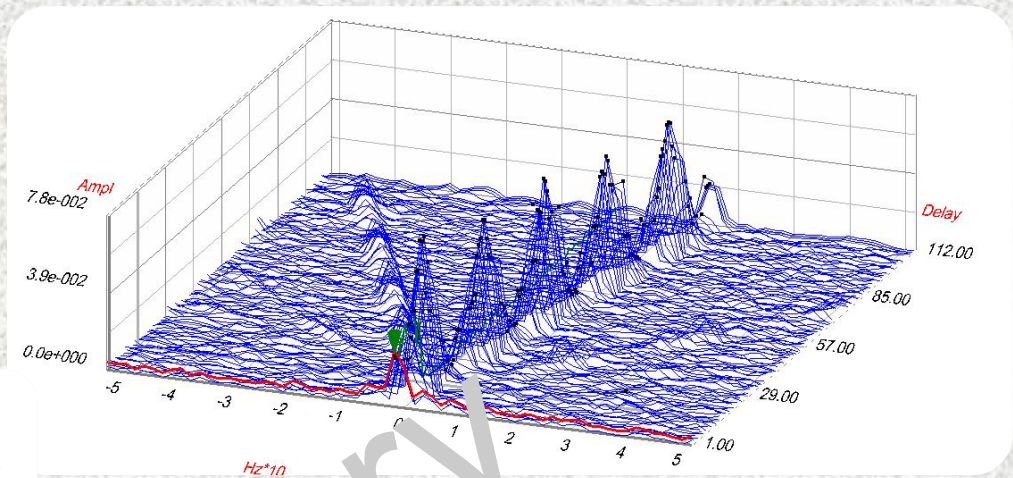
Mark-V (Medicina, Urumqi, Simeiz, Ventspils),
TN-16, Mark-II (Ventspils)

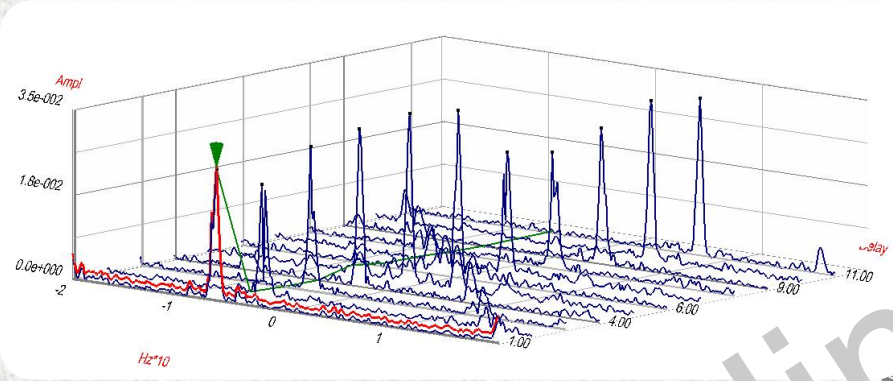
Experiment Debris2012

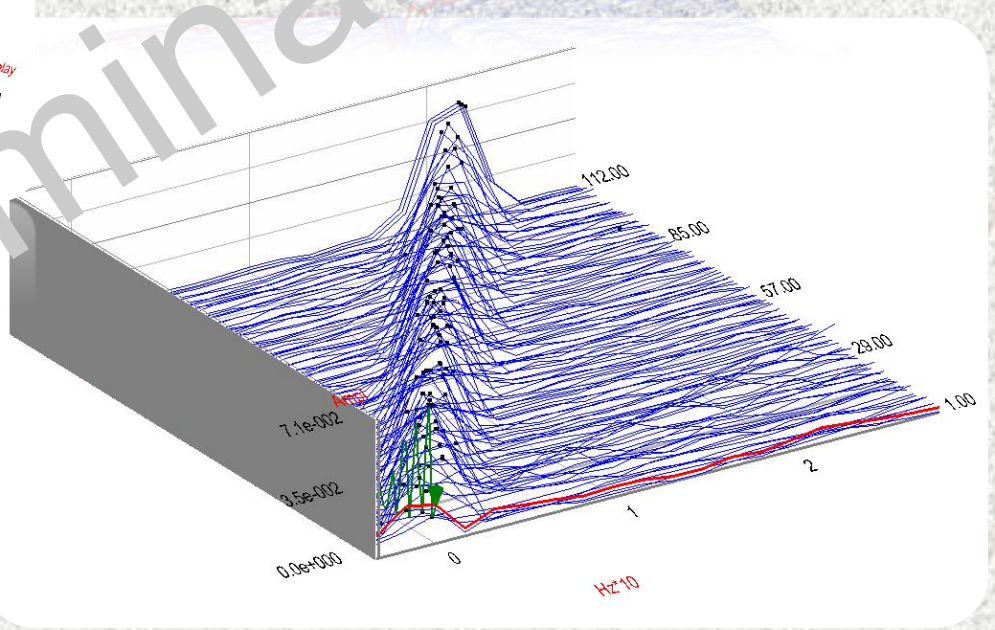
SCANS:

Start	Stop	Source
date = 2012APR17	**day number =108**	
06:00:00	06:10:00	0003-066
06:15:00	06:35:00	09503_radar
06:50:00	07:00:00	3C454.3
07:05:00	07:20:00	22241_radar
07:40:00	07:50:00	1928+738
07:55:00	08:15:00	15223_radar
date = 2012APR18	**day number =109**	
17:00:00	17:10:00	4C39.25
17:15:00	17:40:00	08018_radar
17:50:00	18:00:00	3C237
18:05:00	18:30:00	23720_radar
18:40:00	18:50:00	3C273B
18:55:00	19:20:00	20263_radar
date = 2012APR19	**day number =110**	
16:40:00	16:50:00	OK290
16:55:00	17:20:00	08018_radar
17:30:00	17:40:00	1055+018
17:45:00	18:10:00	12618_radar
18:20:00	18:30:00	3C273B
18:35:00	19:00:00	22087_radar
19:10:00	19:20:00	3C273B
19:25:00	19:50:00	20263_radar
date = 2012APR20	**day number =111**	
10:25:00	10:35:00	Moon
11:00:00	11:10:00	3C120
11:15:00	11:35:00	12618_radar
11:50:00	12:00:00	0528+134
12:05:00	12:25:00	12309_radar
12:40:00	12:50:00	0458-020
12:55:00	13:15:00	23720_2_radar
13:30:00	13:40:00	0745+101
13:45:00	14:05:00	09503_radar
14:20:00	14:30:00	4C-6.18
14:35:00	14:55:00	22087_radar

Experiment Debris2012



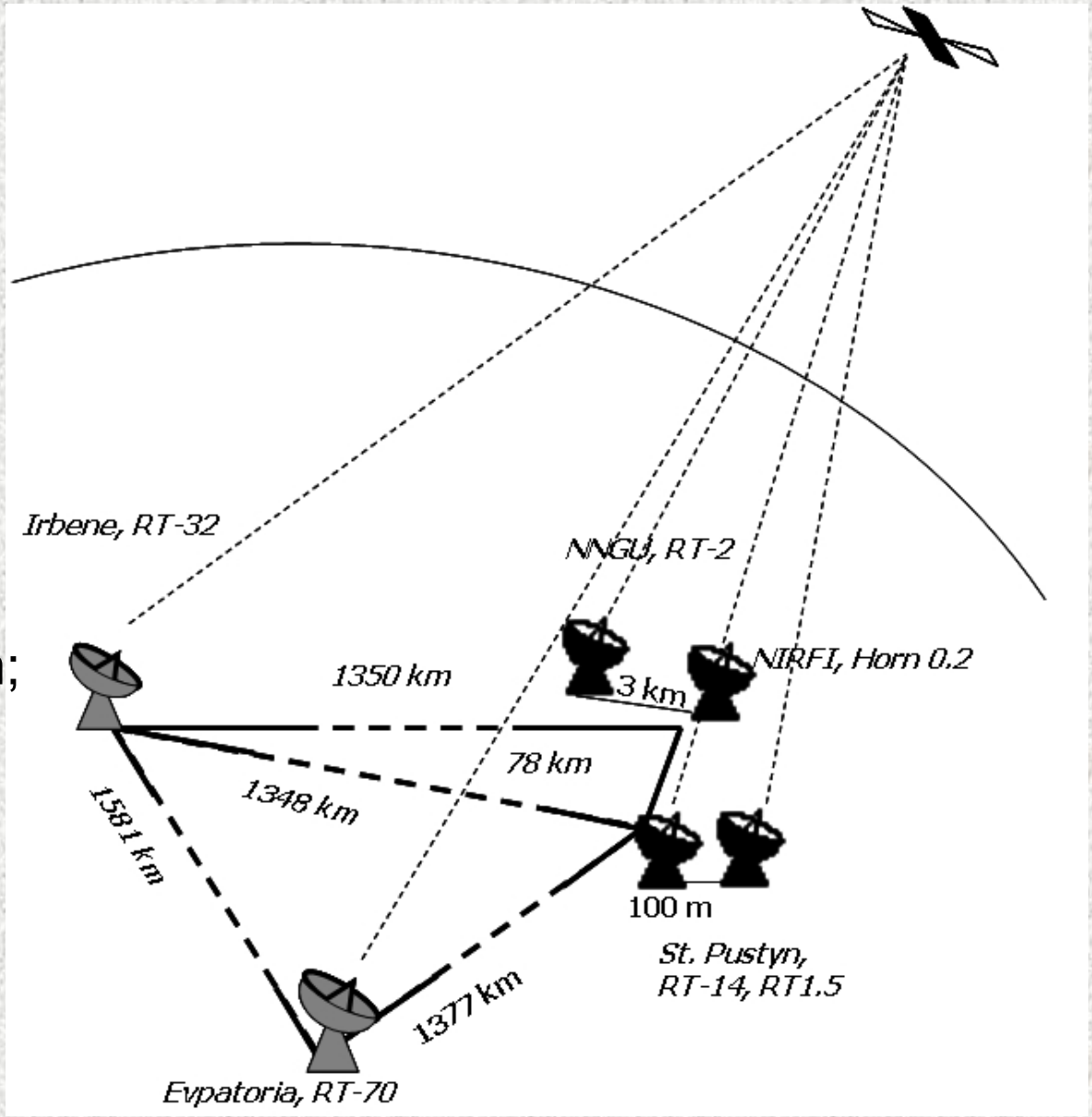




VLBI observations of navigation satellites, 6 – 10 apr 2012

Frequency: 18 cm;
One circular polarization;
Data acquisition system:
TN-16;
DBBC + Mark5b;

Antennas:
Irbene RT-32;
NIRFI, RT 2 m;
NIRFI, horn 0.2 m;



VLBI observations of navigation satellites, 6 – 10 apr 2012

New 18 cm receiver made in IRI VIRAC;

Able to observe NAVSTAR GPS and GLONASS navigation satellites;

Tested in VLBI regime with two NIRFI receivers.

First light: 9 Apr 2012 ☺

Conclusions

RT-32 VLBI station? YES ☺

5 GHz: EVN and LFVN;
1.6 GHz: EVN (future), tested in the NIRFI – Irbene baseline.

This is just a beginning….

~5 MEuro infrastructure upgrade:
cryogenic receivers and data acquisition system;
antenna control system;
antenna support structure;
primary and secondary mirrors surface calibration;

Ventspils International Radioastronomy Conference (VIRAC-2012)

"Advances in Radioastronomy of Near-Earth Environment"

August 13 – 15, 2012

Ventspils, Latvia

OBJECTIVES

The Conference is dedicated to methods and instrumentation of radio astronomy research of near-Earth environment. Our attention is mainly focused on two important problems: the studies of the state of the ionosphere and studies of the population of near-Earth satellites and space debris.

The conference will provide an opportunity for both formal presentations and informal discussions about related scientific and technical aspects. A limited number of posters and exhibition opportunities for products and services will be available during the conference.

Conference is organized by the Engineering Research Institute "Ventspils International Radioastronomy Center" of Ventspils University College and is on activity of the European Social Fund project of "Receiving, transmitting and processing technologies of signals related to artificial Earth satellites" (2009/0231/1DP/1.1.1.2.0/09/APIA/VIAA/151).

CONFERENCE TOPICS

Radar, VLBI and single dish observations of artificial and natural near-Earth objects and determination of their trajectories.

Radioastronomy research of the ionosphere, including investigations of radio waves propagation, methods of plasma parameter measurements and studies of phenomena in ionosphere plasma, originated by natural or artificial impact.

The official language of the conference is English.

Conference proceedings will be published after the conference in the "Baltic Astronomy", "Latvian Journal of Physics an Technical Sciences", and the Conference Proceedings.

IMPORTANT DATES

May 7	Second Announcement
June 15	Deadline for abstracts and registration for presenters
June 29	Notification of authors
July 6	Final program and third announcement
July 15	Deadline for registration (Please note that maximum 50 participants are planned)
August 13–15	**VIRAC 2012 "Advances in Radioastronomy of Near-Earth Environment"**
September 14	Deadline for papers

SOC

A.A. Konovalenko (Ukraine) (Chair)
Vl. Bezrukovs (Latvia) (Secretary)
M. Abele (Latvia)
M. Nechaeva (Latvia)
A.N. Karashtin (Russia)
I. Shmeld (Latvia)
S. Snegirev (Russia)
G. Tuccari (Italia)

LOC

I. Shmeld
Vl. Bezrukovs
E. Vitola
I. Kozlova
N.Jekabsons
I.Jaunzeme
I. Pakalnite

CONTACTS:

Questions regarding the conference should be addressed to the local organizing committee (e-mail: virac2012@venta.lv).

Phone: +371 29209960, contact person: Ieva Kozlova (LOC)
Phone: +371 27134283, contact person: Vladislavs Bezrukovs (SOC)
Fax: +371 63629660

Address for the correspondence: VIRAC2012
Ventspils University College
Inženieru Street 101
Ventspils, LV-3601, Latvia

INVESTMENT IN YOUR FUTURE!

VIRAC

VENTSPILS AUGSTSKOLA

ESF
EIROPAS SOCIĀLAIS FONDS

EIROPAS SAVIENĪBA


Thank you for attention.