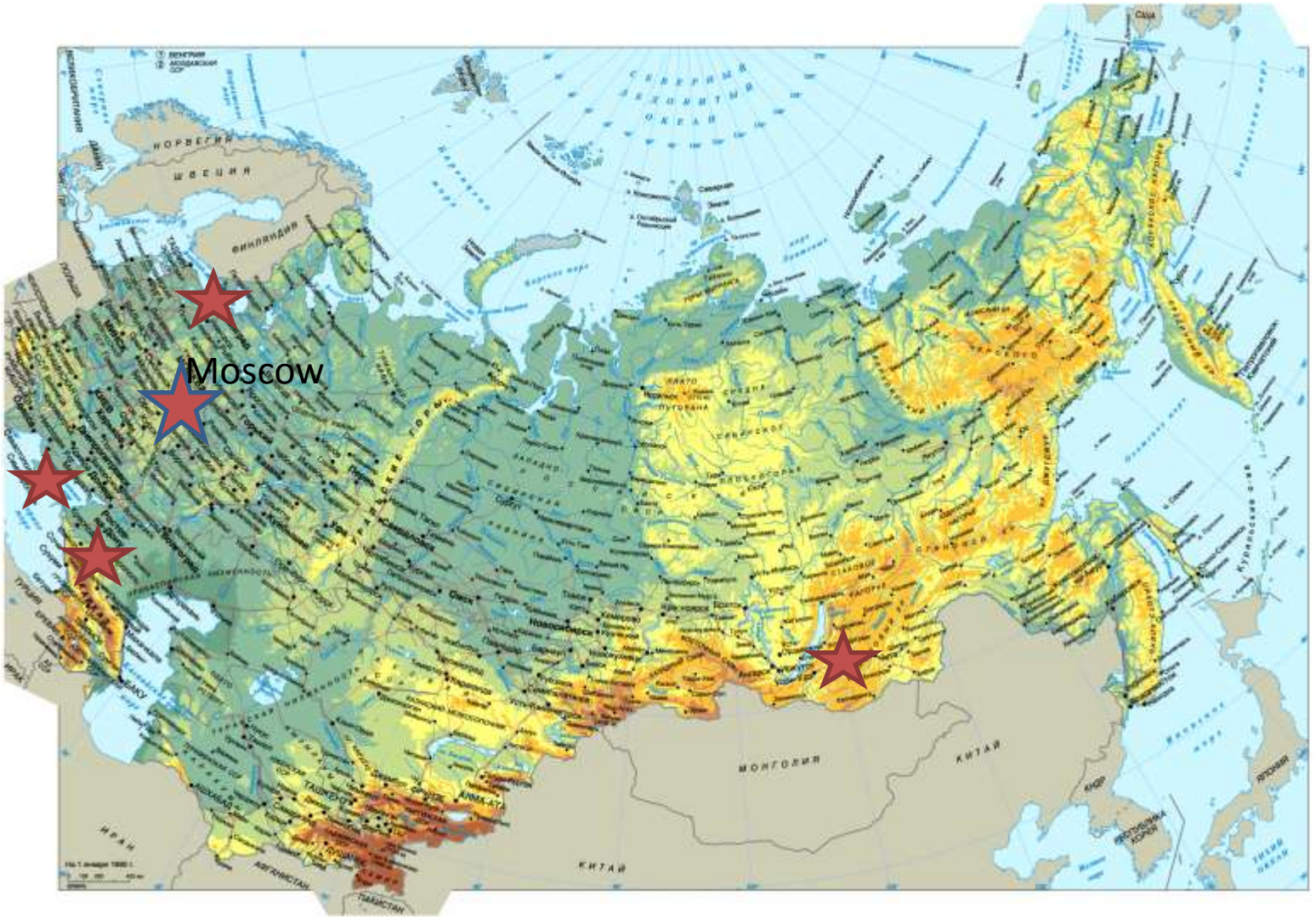
Ground-Based Astronomical Centers in Russia, It's Facilities

V.V.Vlasyuk, SAO RAS

Main Astronomical Centers in Russia



Special Astrophysical Observatory of the Russian Academy of Sciences

• Total staff – about 400 persons, about 100 of them are scientists – astronomers, physisists, mathematician etc. Others are engineers and technician specialists.

• SAO RAS includes more than 20 laboratories and groups in optical and radioastronomical departments.

• Our scientific infrastructure costs about 2 Billions RUR, mean year budget – about 400 MRUR .

• SAO staff supports activity of 2 largest russian astronomical telescopes – 6-meter optical and 600-meter radio ones.

• Observatory was established in 1966, start of telescopes operation – 1976-1977.

• Status of our telescopes: national, they are operating under control of National Committee of Russian Telescopes.

• Main tasks of institute are support of ground-based astronomical studies with large telescopes, development of instrumentation, preparing of specialists: students, post-graduates etc.

• All the telescopes may be used and controlled via INTERNET – http://www.sao.ru

Main astronomical facilities in Russia:

1. Operating in a few astronomical organizations:

SAO of RAS – largest optical (6-m) and radiotelescope (RATAN-600);
Institute of astronomy or RAS – 2-m optical telescope Zeiss-2000;
CrAO of RAS – 2.6-m optical telescope;
Institute of Applied Astronomy - 3x32-m radiotelescopes

2. Current activity of these instruments are organized by local authorities under supervizing of National Programm Committee.

3. Some smaller instruments - optical telescopes with D<2m operates mostly under local programme commitees.

EQIUPMENT OF THE 6-METER TELESCOPE

Nasmyth focus F/31

Reserved for new equipment

Primary focus F/4

Focal reducers SCORPIO

Speckle interferometer

Integral field spectrograph

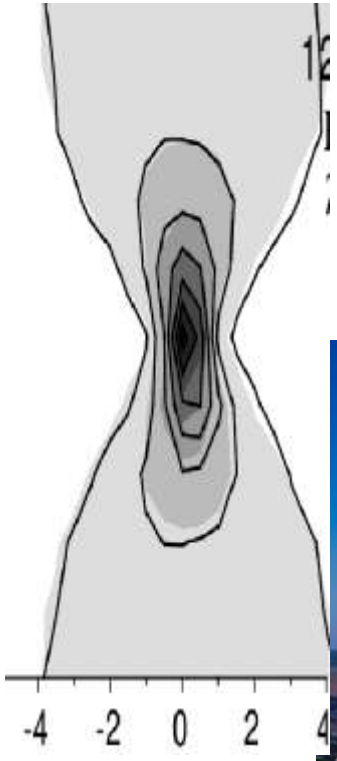
Fast photometer MANIA

Nasmyth focus F/31

Main stellar spectrograph, R =15000

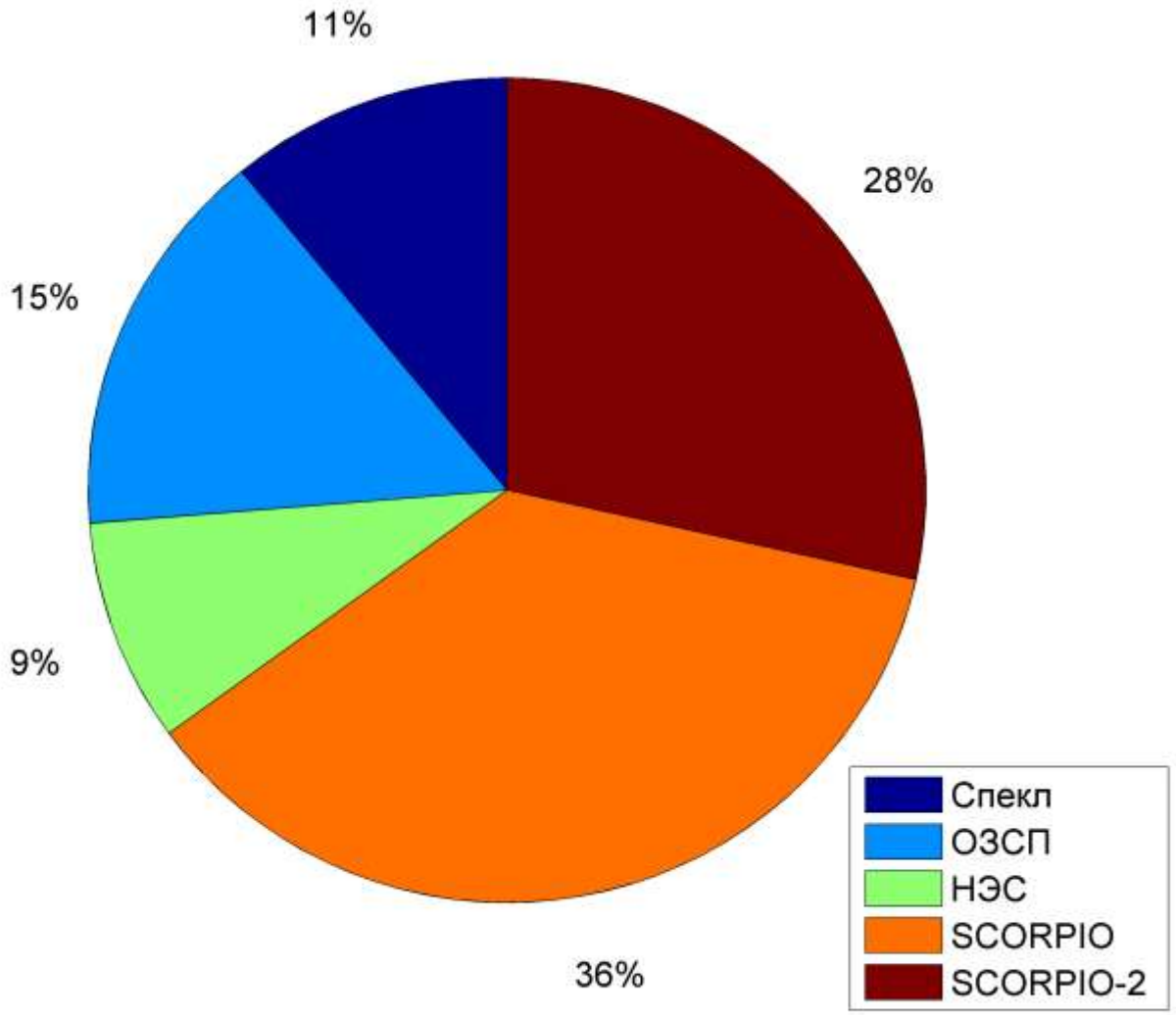
Echelle spectrograph NES, R=60000

Main mirror: parabolic, D=6 m



RATAN-600- aerial view

Typical distribution of scheduled time between observing methods for the 6-m telescope



Spectral **C**amera with **O**ptical **R**educer for **P**hotometrical and **I**nterferometrical **O**bservations

Modes of observation:

- ***Photometry in wide and narrow filters.***

- ***Scanning Fabry-Perot interferometer***

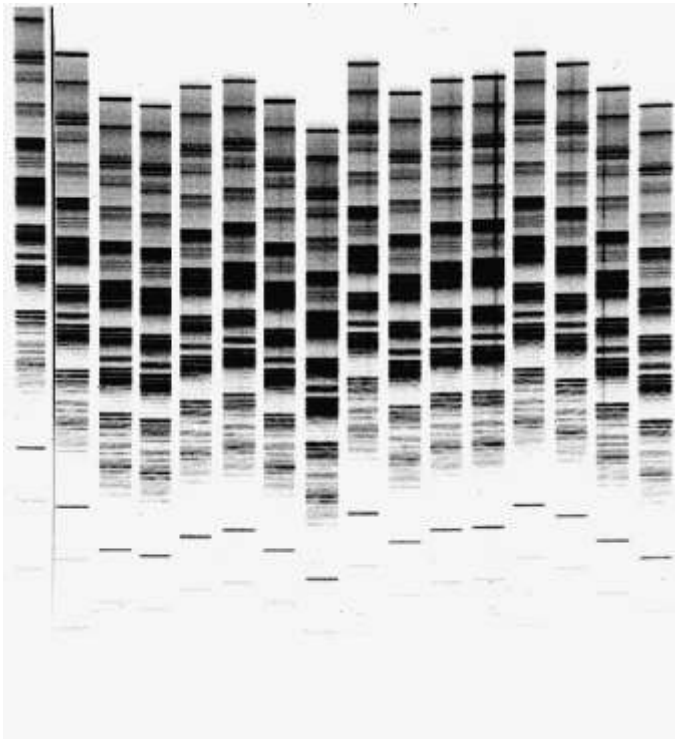
- ***long-slit spectroscopy***

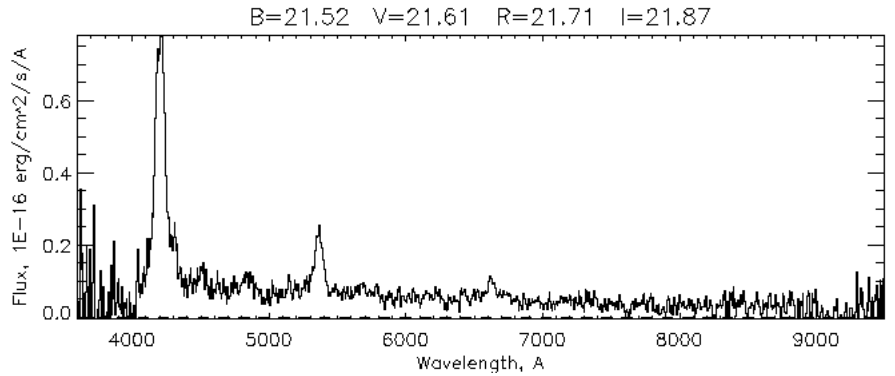
- ***spectropolarimetry***

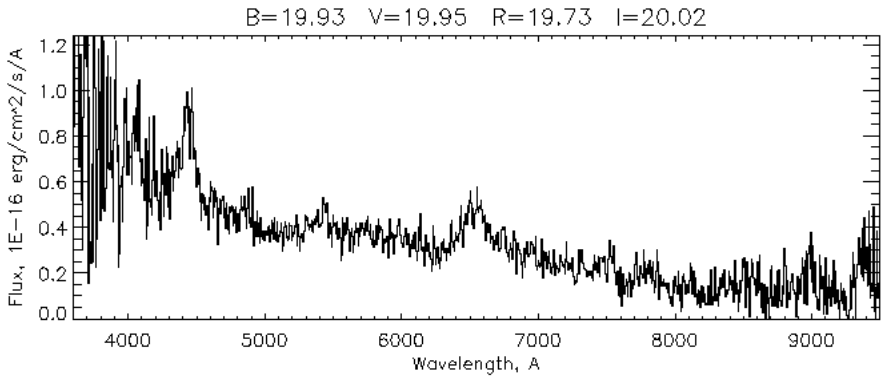
- ***slitless spectroscopy***

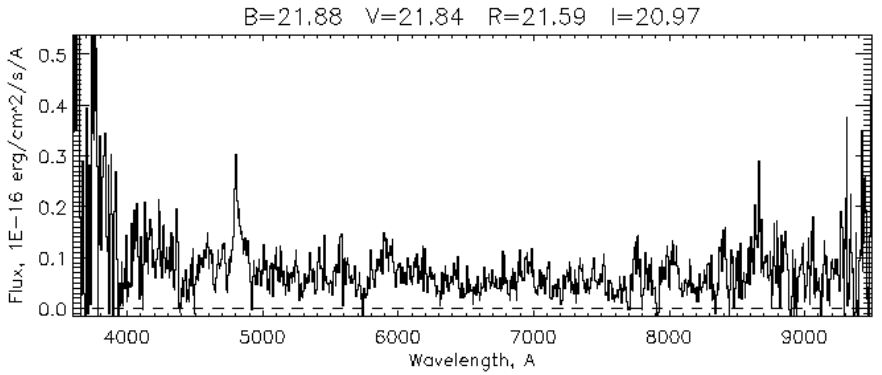
- ***multi-slit spectroscopy (16 movable slits)***

Focal reducer SCORPIO: multi-slit spectroscopy mode







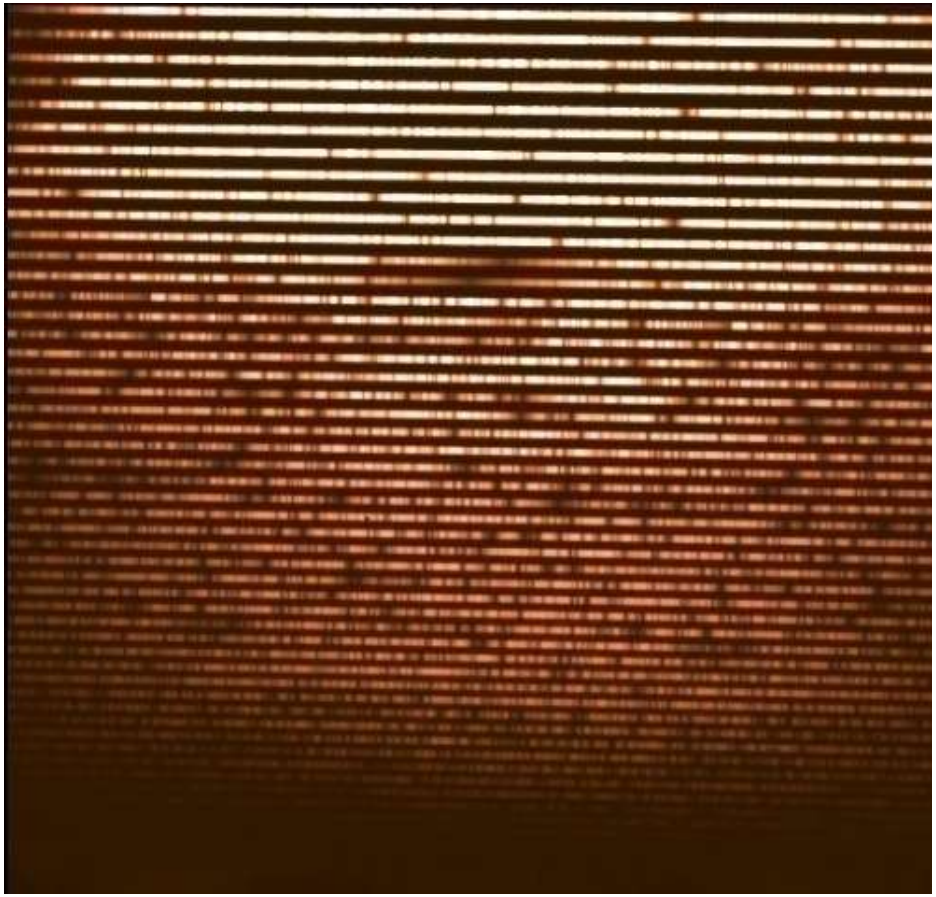


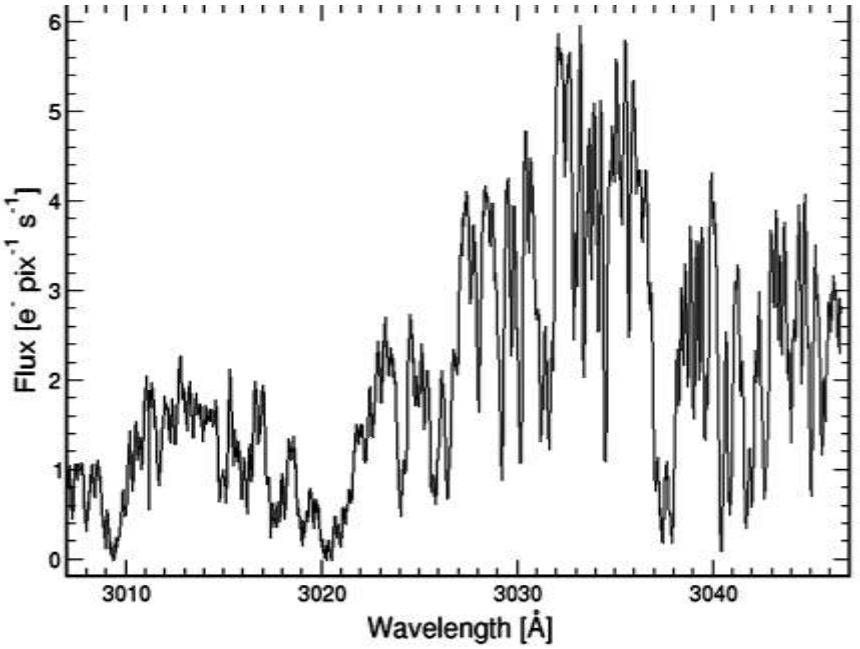
Obtaining up to 16 spectra in 6-m field of view 3'x5'.
Limiting magnitudes – 23-24^{m}
at R=300-500 for 3-4 hours exposure

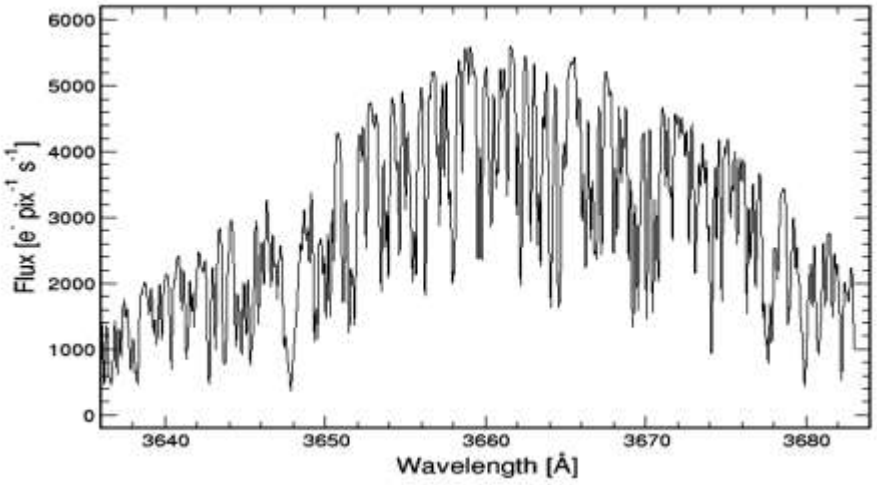
The main parameters of Nesmith Echelle Spectrometer

Parameter	Value	
Focus	Nasmith-2 F=1:30	
Entrance slit	3 x 0.4″, 0.6″, 0.8″	
Collimator focus	7200 мм	
Echelle grating	mosaic	600x300 mm with 37.7 gr/mm
Camera	Quartz Schmidt-Cassegrain, F=600мм	
Spectral range	300 – 1000 nm	
Spectral resolution	R> 60000	
CCD	pixels	2048x2048 or 2048x4608
	Δλ	300 – 680 nm
	Readout noise	$7e^-$
Pre-slit units	Image slicers, Zeeman analyzer, iodine cell	
View cameras	Field viewer, autoguiding cameras	

NES + CCD 2Kx2K
2950÷6700 Å







NES frame (2Kx2K) and some of extracted orders

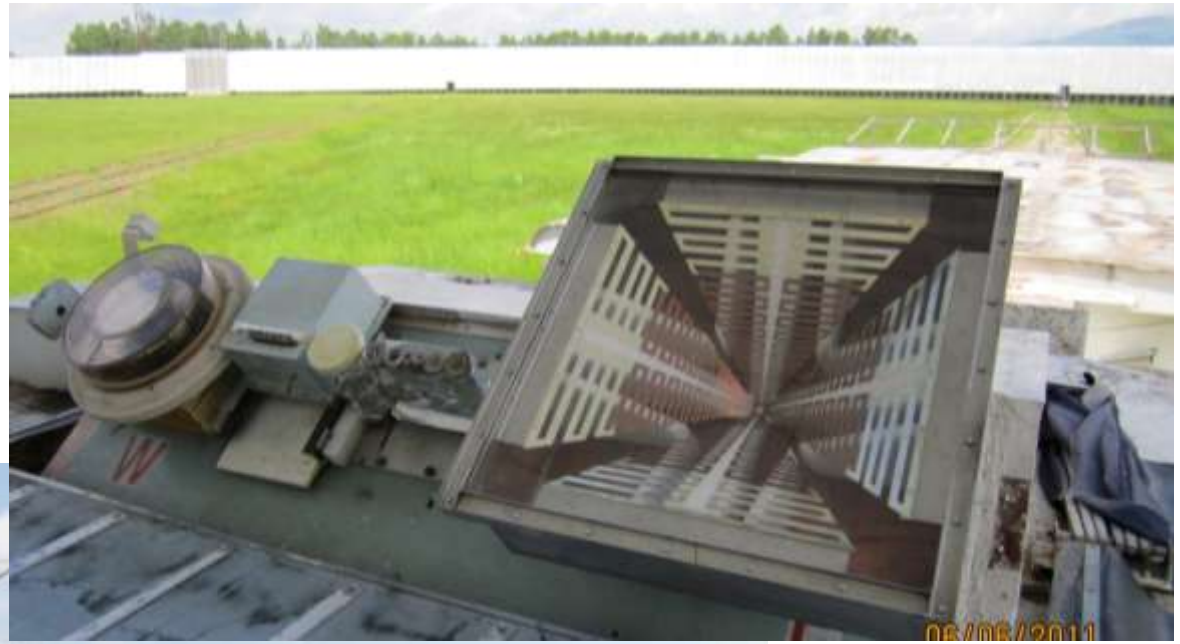
Small-size telescopes

1-meter and 60-sm instruments


RATAN-600

RATAN-600: secondary mirrors and focal line

Quasi-simultaneous
detection of radio-spectra
in range from 0.6 to 30 GHz.



Crymean Astrophysical Observatory of RAS

Main instrument of the Observatory – 2.6-m Shajn optical reflector.

CrAO : other telescopes

Big Solar Telescope:
Largest solar instrument

1.5-m reflector:
photometry

RT-22 radiotelescope:

Peak Terskol Observatory (Institute of Astronomy of RAS&Academy of Science, Ukraine)

One highest observatories in Russia – at 3100 m above sea in Central Caucasus.
Main instrument –2-meter reflector.

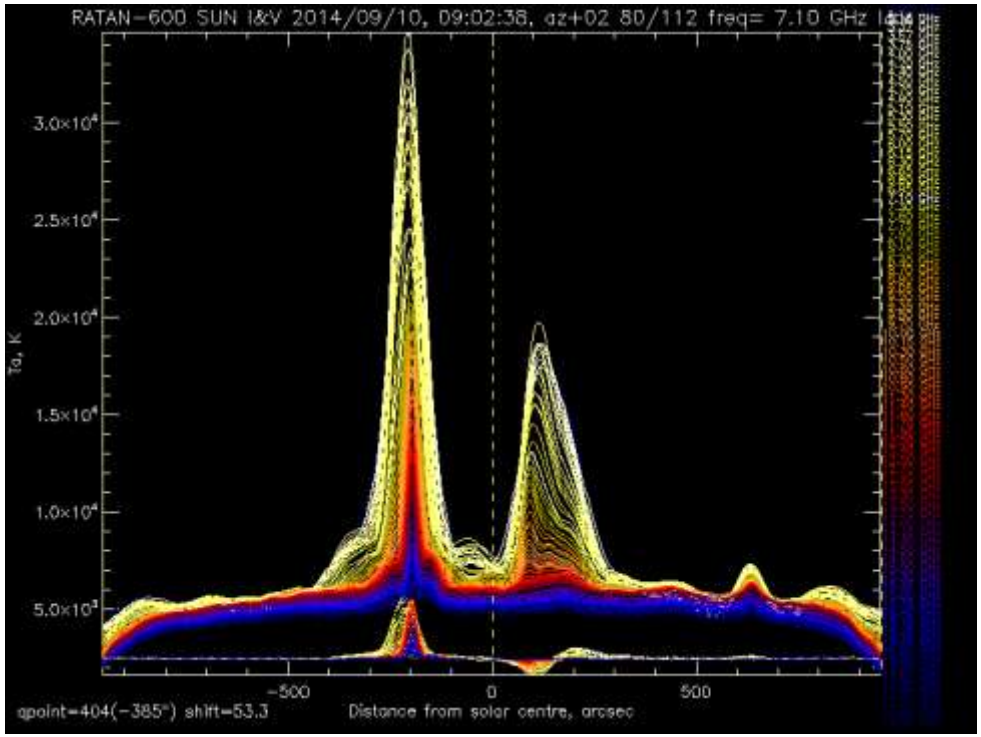
Institute of Applied Astronomy of RAS (S-Petersburg)

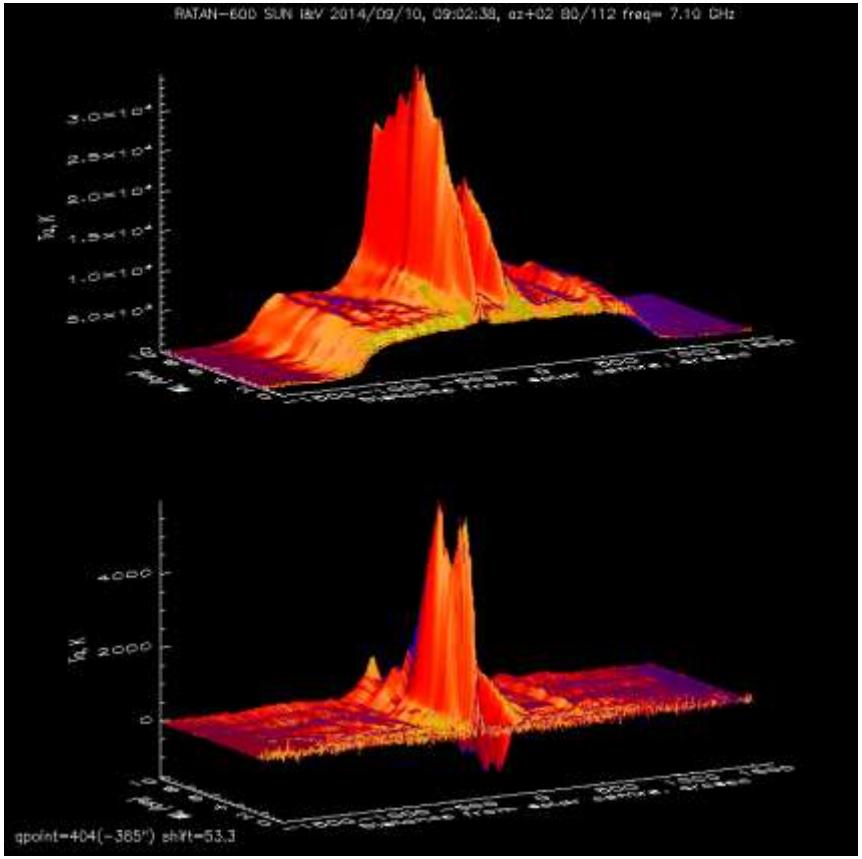
Interferometrical complex of 3
32-meter dish radiotelescopes

Location at 3 places:
near S-Petersburg,
at Northern Caucasus, in Baikal Region.
Main tasks are:
interferometry, astrometry, etc
But telescopes may be used in separate
Regime in astrophysical studies.

Solar activity monitoring and it's prognosis

Multi-wavelength monitoring of solar activity with 3-day prognosis for X and M class flashes



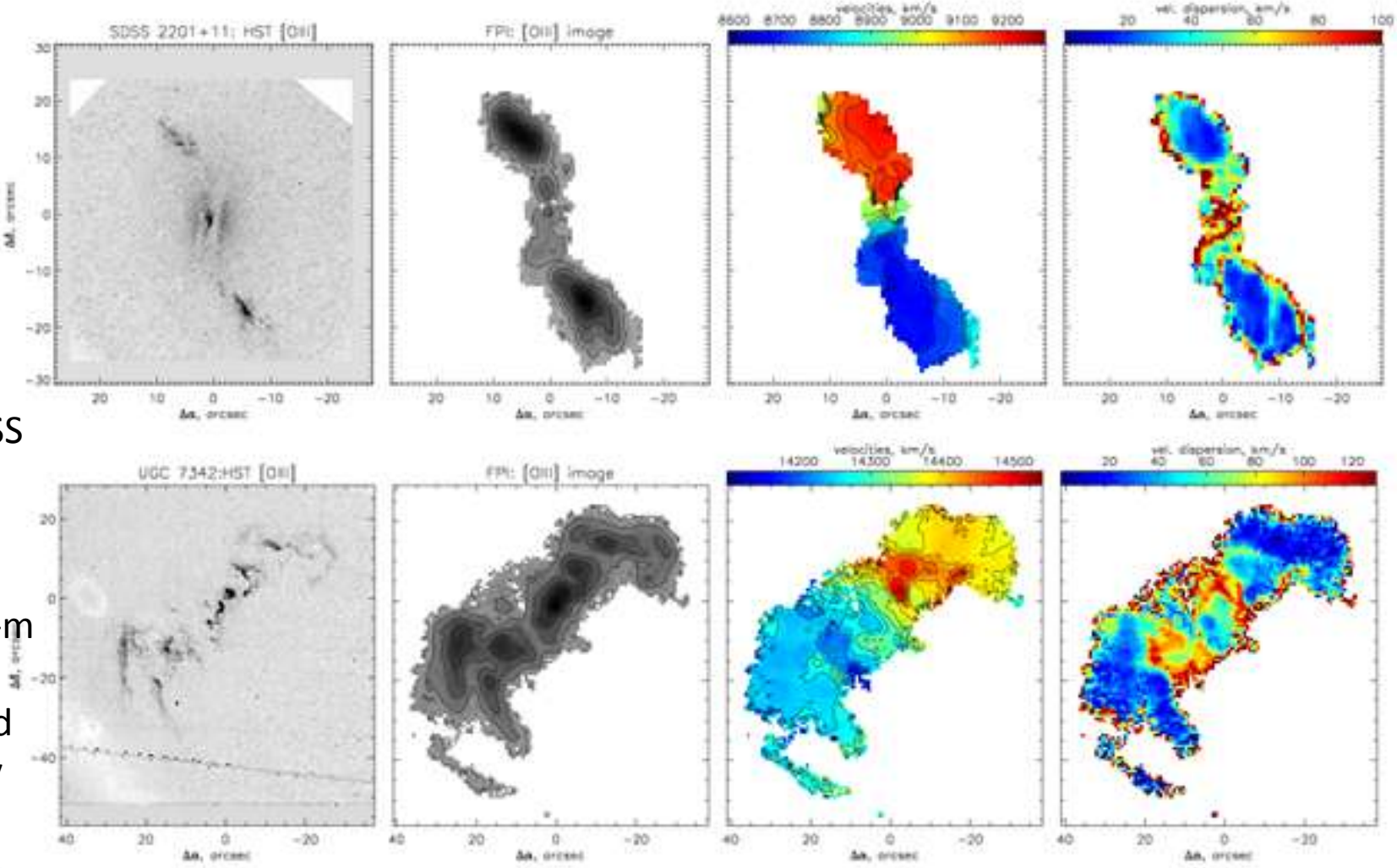


The example of positive prognosis for future solar activity.

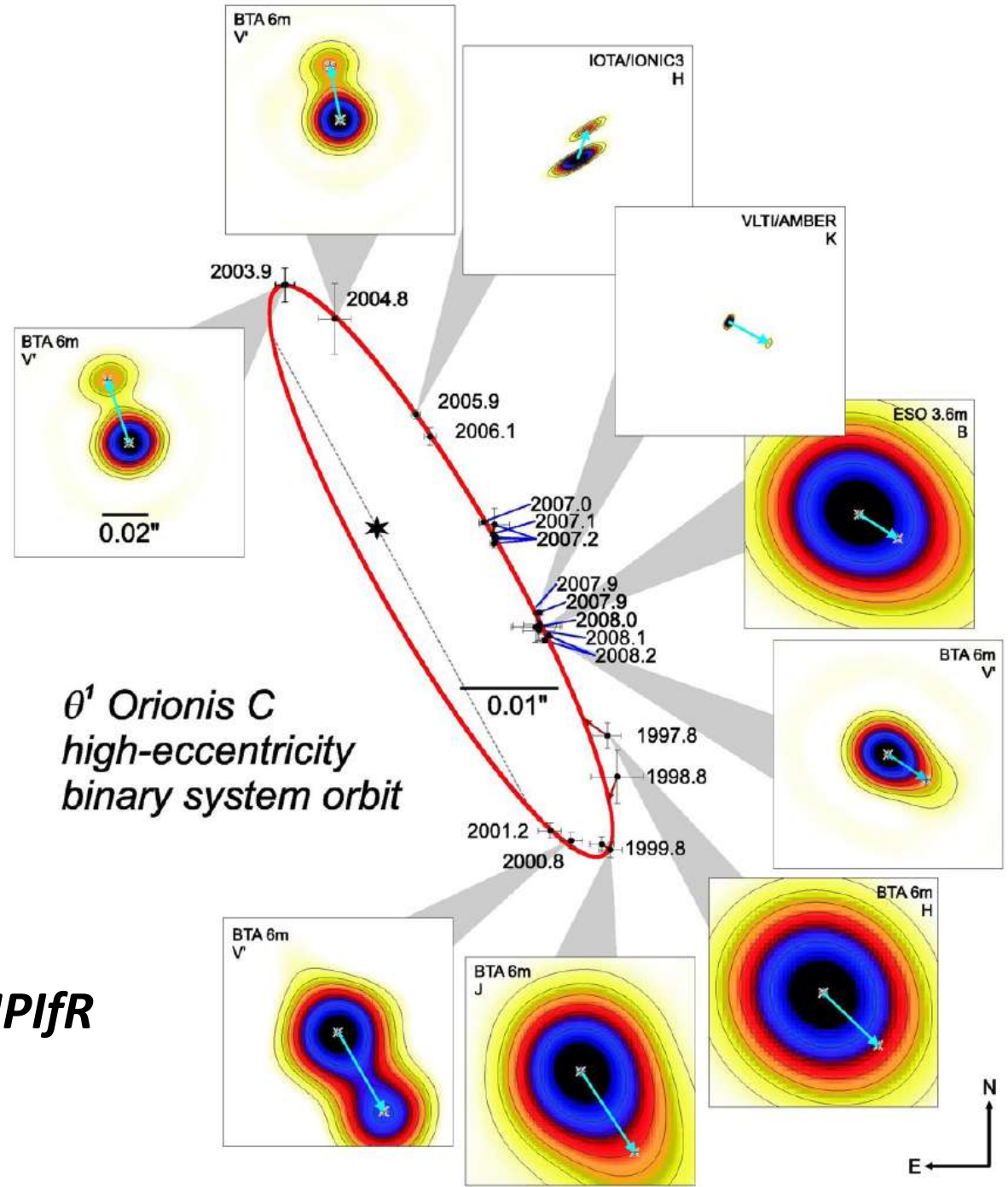
Study of emission regions about local active galaxies (applicant – W.Keel, Alabama Univ., USA)

From left to right:
Data for galaxies SDSS 2201+11 и UGC7342:

HST data, 6-m IFP data, velocity field and velocity dispersion

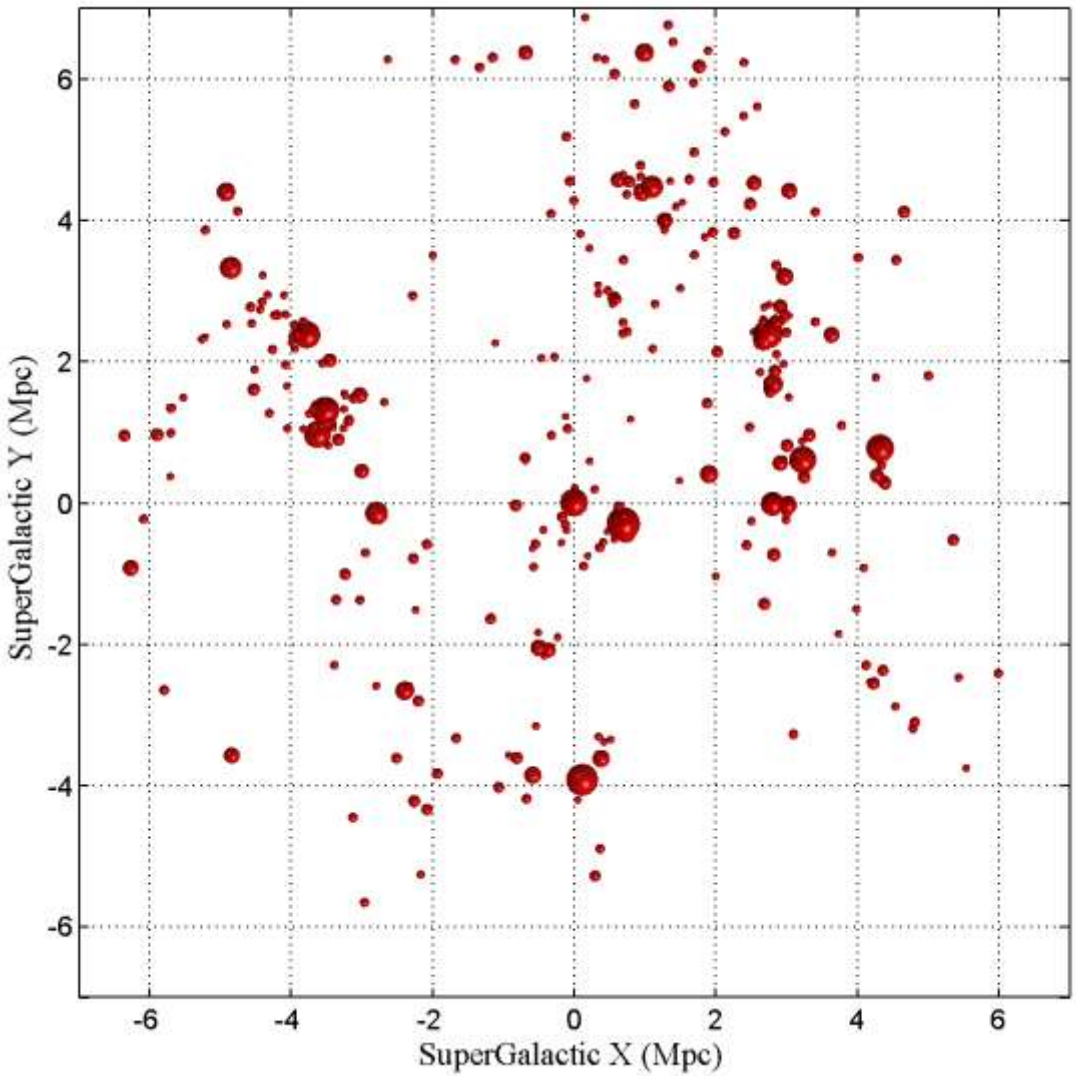


SPECKLE-INTERFEROMETRY OF YOUNG MASSIVE STAR θ^1Ori C



Y.Y.Balega team with MPIfR (Germany)

DISTRIBUTION OF GALAXIES IN THE LOCAL VOLUME



Distance to 250 galaxies

Velocity dispersion - 25 km/s

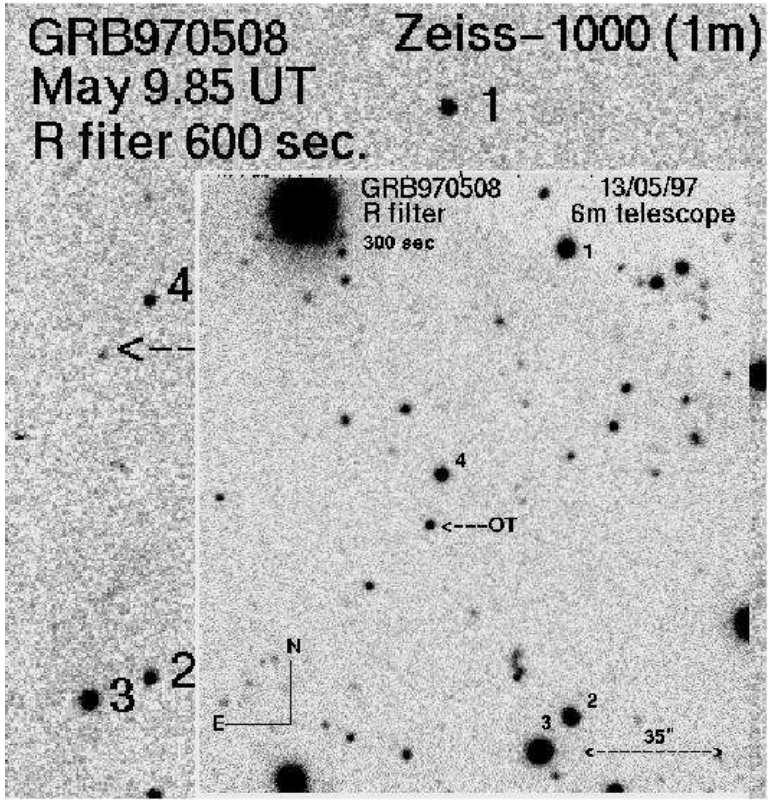
Mass of Local Group 1.9×10^{12} *M*

Mean matter density Ωm = 0.08 from the critical ones

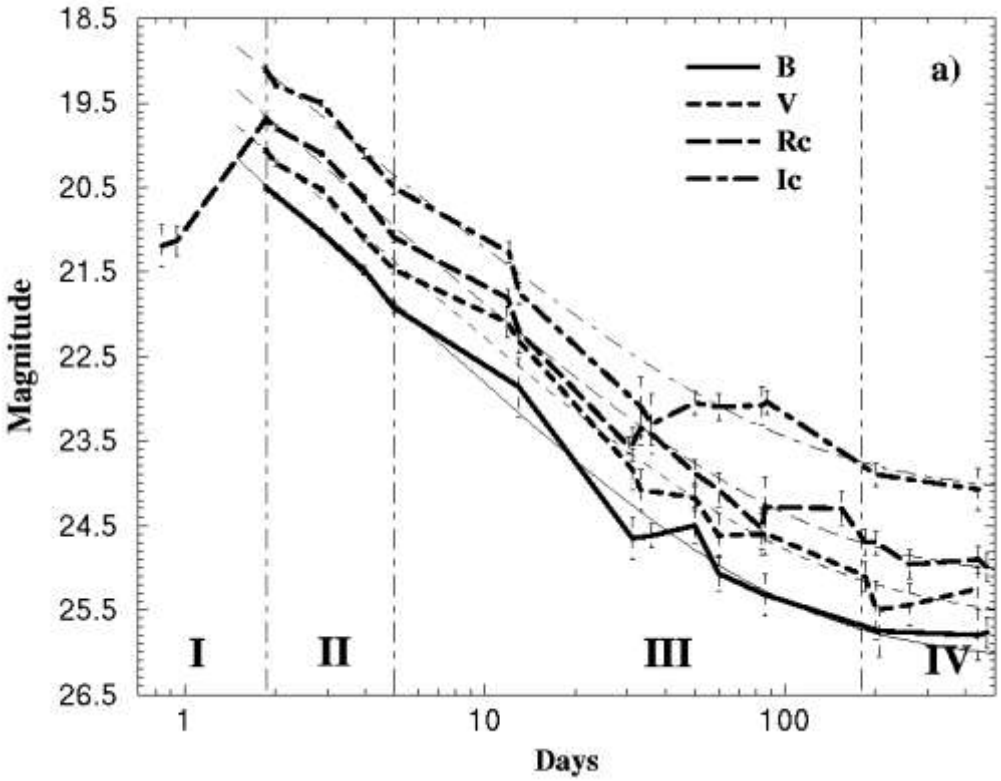
I.Karachentsev, D.Makarov

Photometric observation of GRB970508 in SAO RAS: Zeiss-1000 & BTA-6m (V.Sokolov and Russian/Spain/India cooperation)

Photometry of optical transients

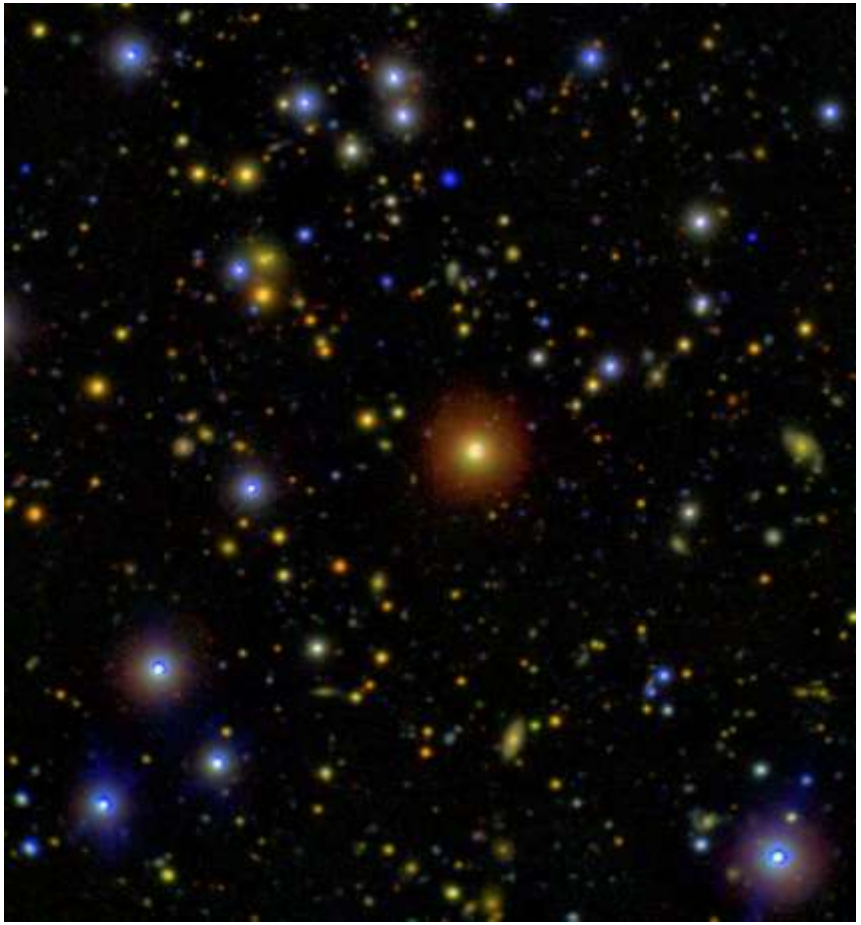


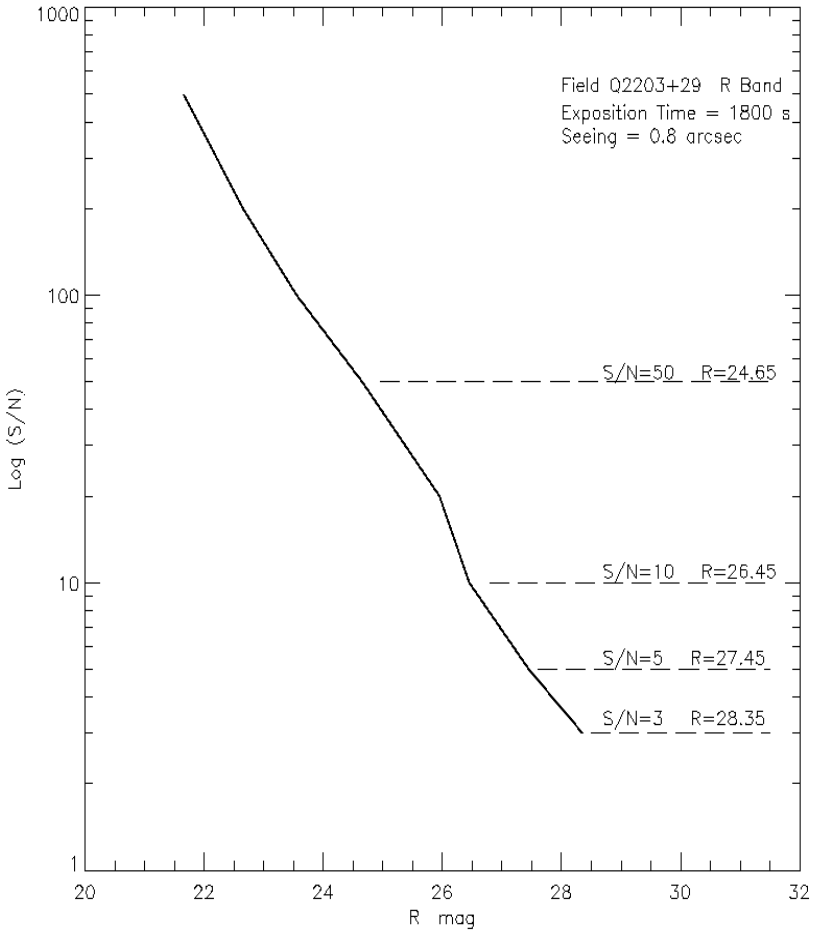
CCD images of the optical transient of GRB970508 (Zeiss-1000 and BTA)



Light curves of the optical transient of GRB970508 in B, V, Rc and Ic bands (Zeiss-1000 and BTA)

Deep photometry at 6-m telescope (program " Search of distant galaxies" by S.Dodonov (SAO))





Direct images of radiosource 3C441 field were taken in 11 filters (B, V, R, SED607, SED665, SED707, SED755, SED812, SED860, SED915, SED967) under seeing ~ 1 arcsec. Objects with $R_{AB} \sim 27^m$ were detected with S/N ratio ~5. (Программа «Поиск далёких галактик» Додонов С.Н.)

BRICS Countries' Scientists Activity on SAO Telescopes in 2006-2016

1. Brasil – 6 nights (BTA, stellar spectroscopy)
2. India - 23 nights (BTA, SN, gamma-bursts, galaxies's spectra +
   30 days (RATAN-600, radiogalaxies study)
3. China – 11 nights (BTA, stellar spectroscopy)
4. South Africa – 5 night (BTA, spectra of galaxies)

Cooperation between SAO RAS and BRICS Institutions

1. India: Integrated Long Term Programme
NCRA – National Center for Radioastronomy –
Local Universe studies
ARIES – Ariabata Research Institute – transients study

2. China: Agreement between SAO RAS and NAO CAS on Collaborative Astrophysical Studies and Development of Equipments: Spectrographs, CCD cameras etc.
Agreement on Solar Physics between NAO CAS, SAO RAS and IZMIRAN.

3. South Africa: common programs on 6-meter and SALT telescopes.

CCD systems for the LAMOST project

Spectrograph LRS:

- Red channel: CCD203 4096x4096 DD
- Blue channel: CCD203 4096x4096 BI

What SAO plan to do in future?

1. Project of new medium-size optical/IR telescope

It's parameters:

1. Main mirror diameter from 3 to 4 meters
2. FOV >1 degree
3. Active main mirror from astrositall and adaptive secondary mirror
4. Cassegrain for wide-field imaging: mosaics up to 20kx20k pixels (optical) and 8Kx8K (IR)

Nasmith foci for spectral instruments: integral field spectrograph and scanning Fabry-Perot interferometer, multi-object spectrograph for 1000 (?) objects.

Between main tasks for the new telescope: studying of transient phenomena, as GRBs, SN detecrtion, neutrino events identification, deep wide-field sky surveys etc.

It is only preliminary projects which is in preparing now and should be agreed by government of Russia.

Expected time of creation:2017-2022.

2. Small-sized telescopes – from 1 to 5

1. D~ 0.5 m
2. FOV ~ 1 degree
3. Equipment – CCD photometers with large-field cameras.

Tasks: square degree fields monitoring; photometry of bright objects.

Project now under consideration and can be realized in nearest future.

3. Upgrade of RATAN-600 antennae and instrumentation.

We hope to realize new facilities especially for solar studies within project of russian heliogeophysical complex.

Brief conclusion

1. Our instruments are in good condition and our staff members are able to provide modern astrophysical studies

2. We open for wide international cooperation on different levels, like as
- cooperative studies on our telescopes
- common scientific and engineering programs
- preparing of young specialists: students and post-graduates

3. Our plans of instrumental development suppose possible participation in new observational programs

4. SAO of RAS – as bridge in astronomy between Russia and BRICS countries.

Thanks for your attention

http://www.sao.ru