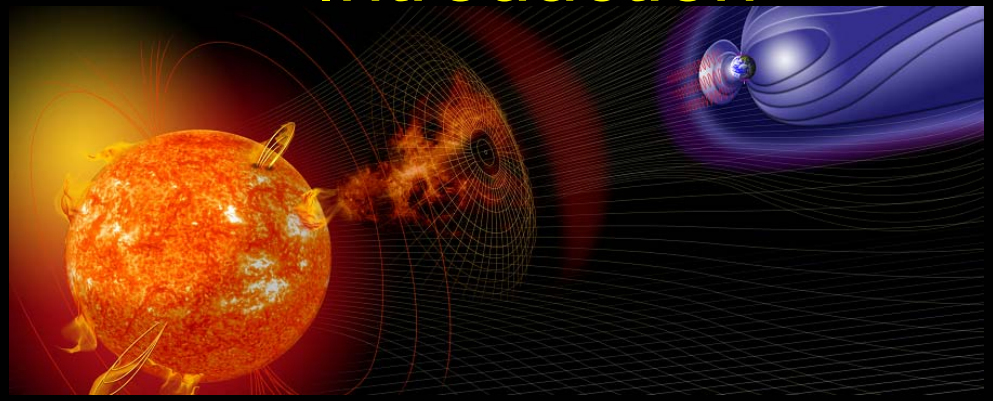
Space weather studies in the Russian Academy of Sciences

S.A. Bogachev, V.D. Kuznetsov, L.M Zelenyi

Russian Academy of Sciences, Russian Federation

Introduction



Russian Academy of Sciences (RAS) is the largest scientific institution in Russia which includes about 60 % of all the scientific organizations. The study of space weather in RAS has a short history (about 10 years). The reason is that RAS (as well as Academy of science in USSR) have always been more focused on fundamental sciences rather than on applied science. As a result, currently there is no any special center in Russia that is responsible for collecting and providing information on space weather. However there are several organizations which show some activity in the field of space weather, sometimes on their own initiative.

List of organizations

1)Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (IZMIRAN) (Moscow Troitsk)

2) Lebedev Physical Institute (FIAN) (Moscow)

3) Space Research Institute (IKI) (Moscow)

4) Geophysical Center (Moscow)

5) Polar Geophysical Institute (PGI) (Murmansk)

6) Main Astronomical Observatory (Kislovodsk, Pulkovo)

7) Institute of Solar-Terrestrial Physics (Irkutsk)

8) Chafer Institute of Cosmo-Physical Research and Aeronomy (Yakutsk)

9) Institute of Cosmo-Physical Research and Radio Wave Propagation (Kamchatka)

List of organizations

Main data types

1) Measurements of the Earth’s magnetic field.

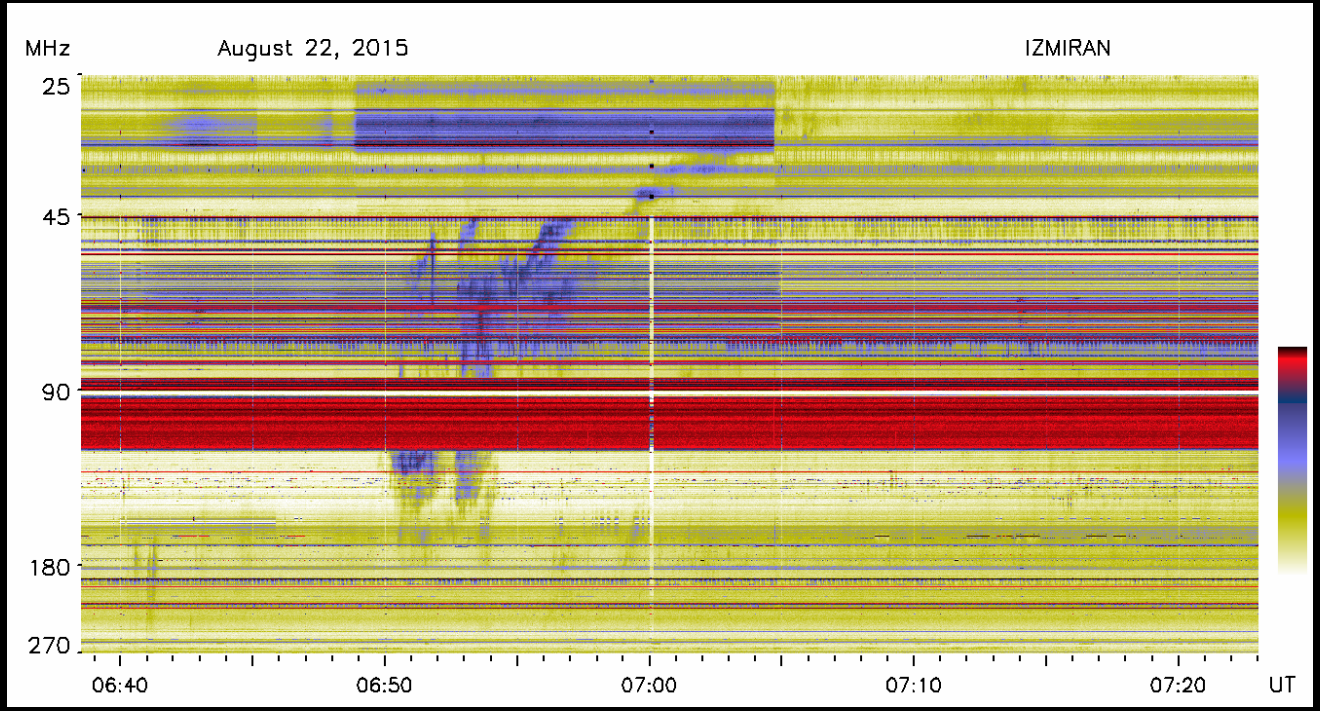
2) Neutron monitors

3) Ionospheric stations – sounding of the ionosphere in radio waves

IZMIRAN

Leading Russian organization in the space weather studies

Scientific data



Solar radio emission in the range 25-270 MHz

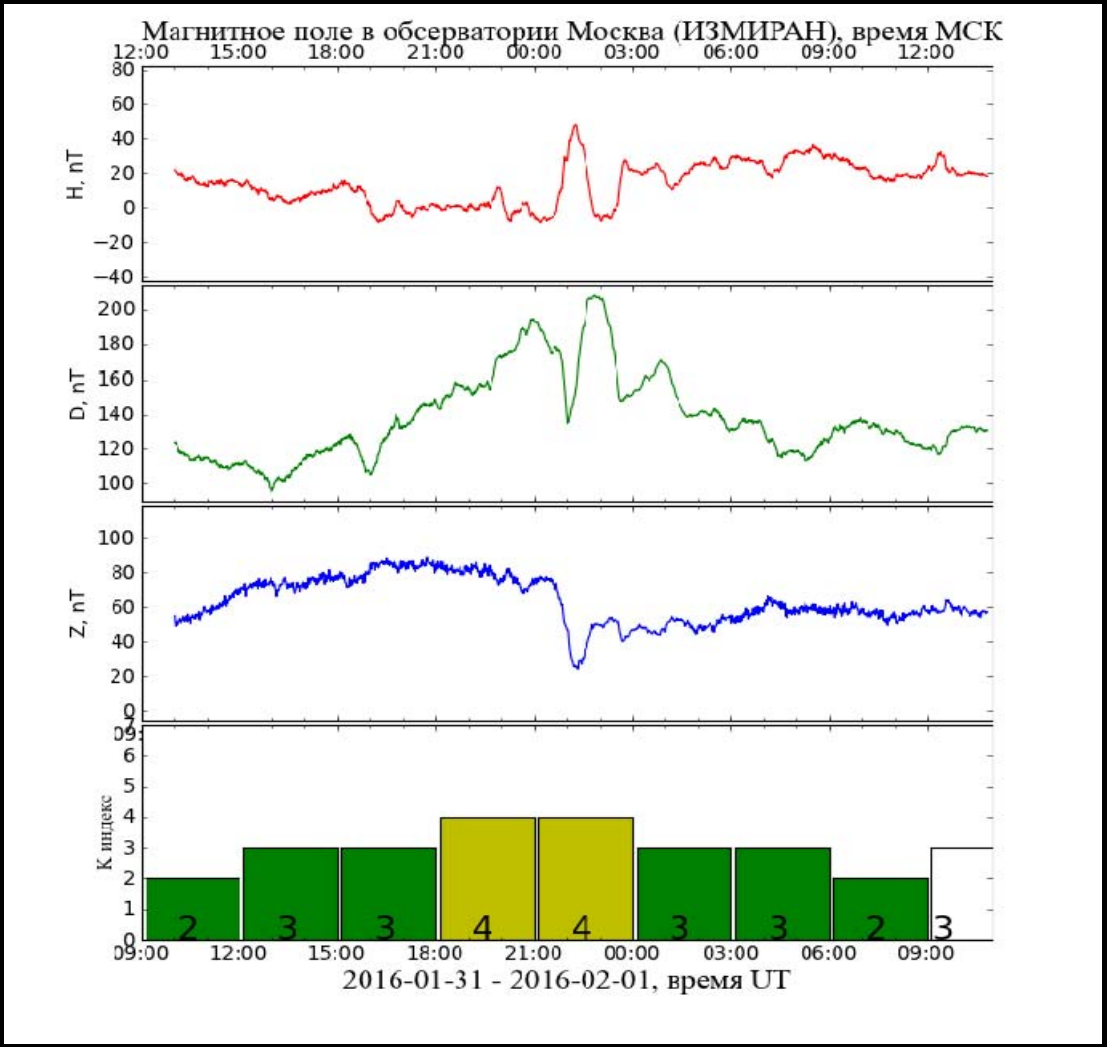
IZMIRAN

Scientific data

Neutron monitoring in the Antarctica (near Mirny Station)

IZMIRAN

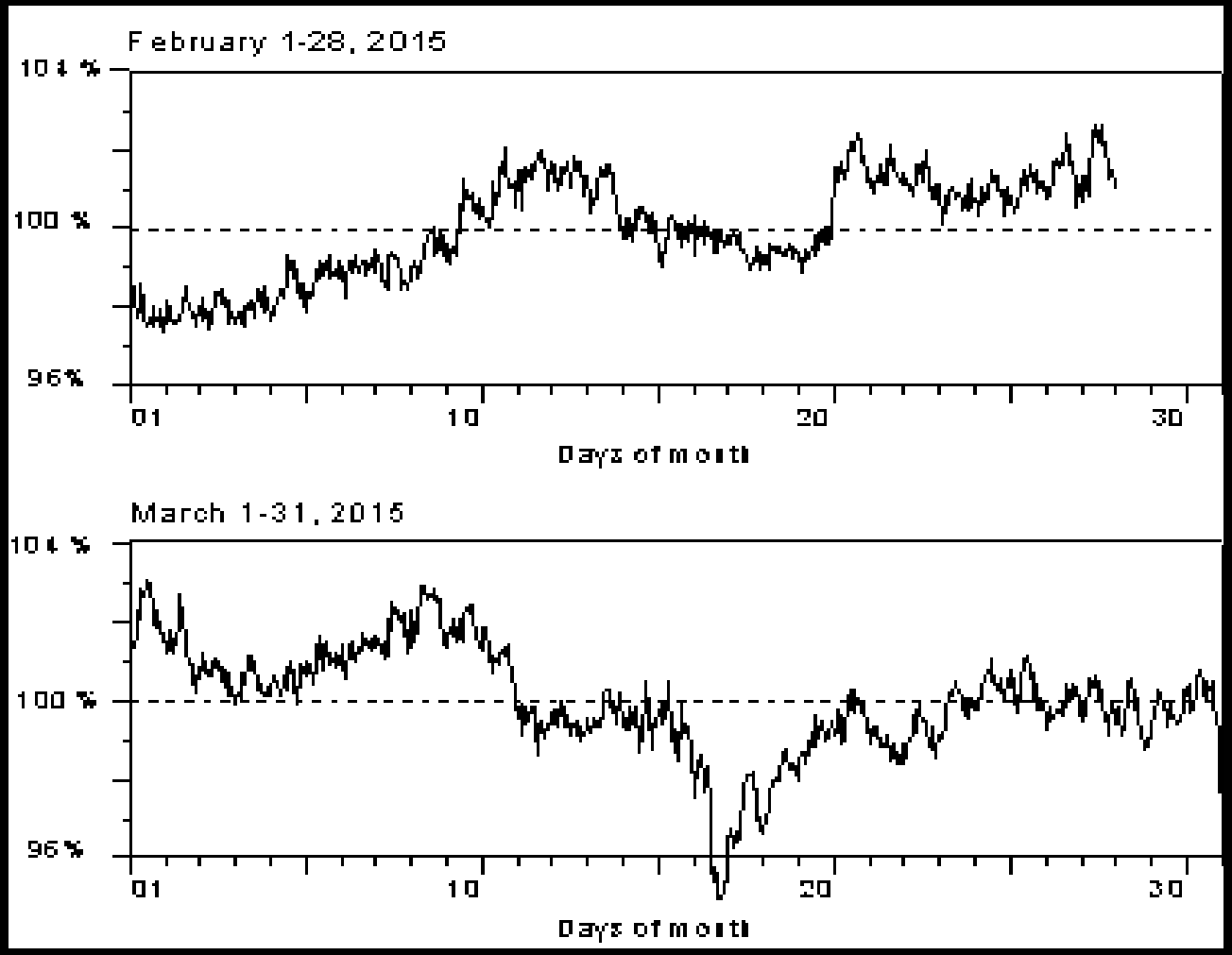
Scientific data



Measurements of the Earth's magnetic field in the Moscow Region

Polar Geophysical Institute (Murmansk)

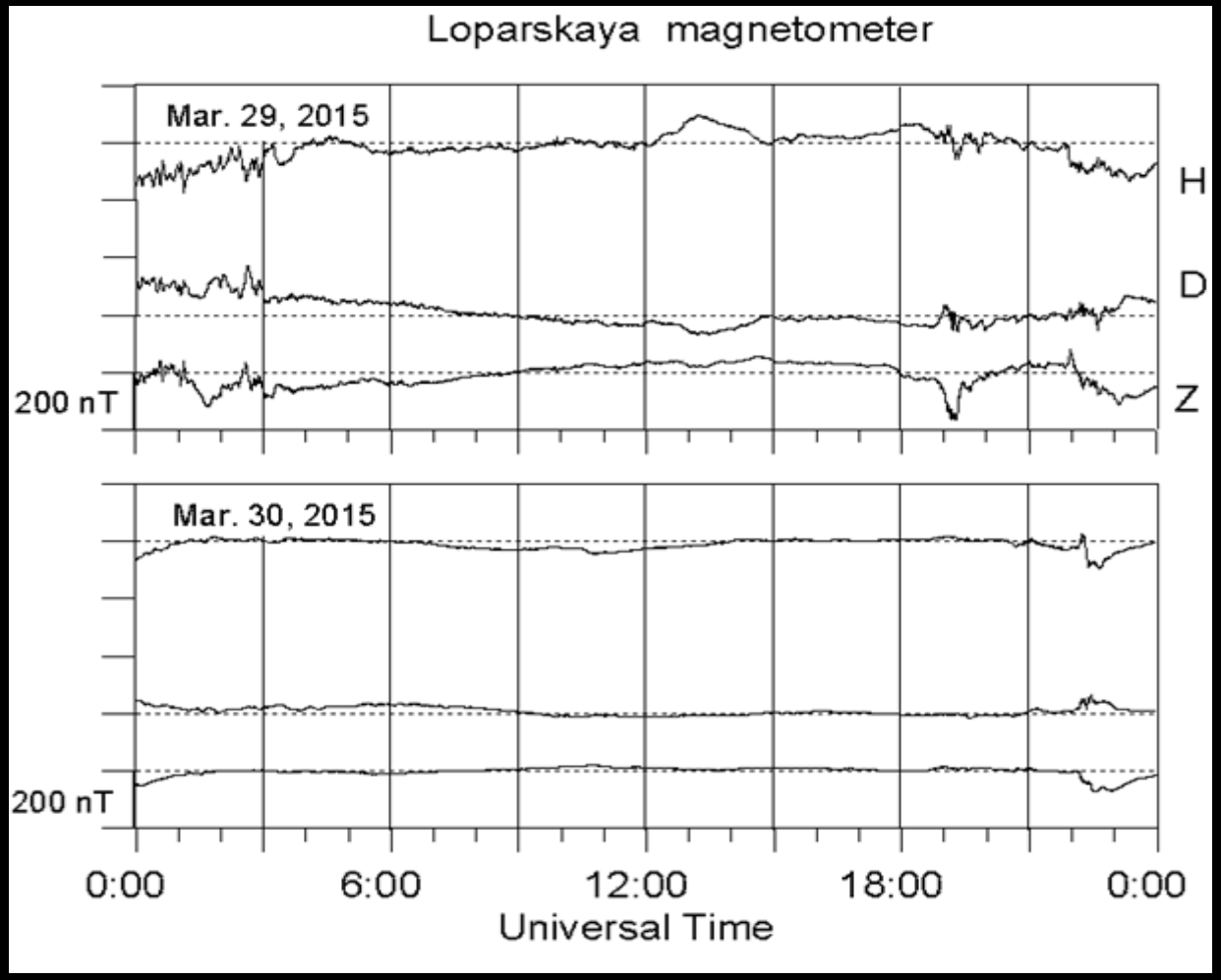
Scientific data



Neutron monitor near Apatity city

Polar Geophysical Institute (Murmansk)

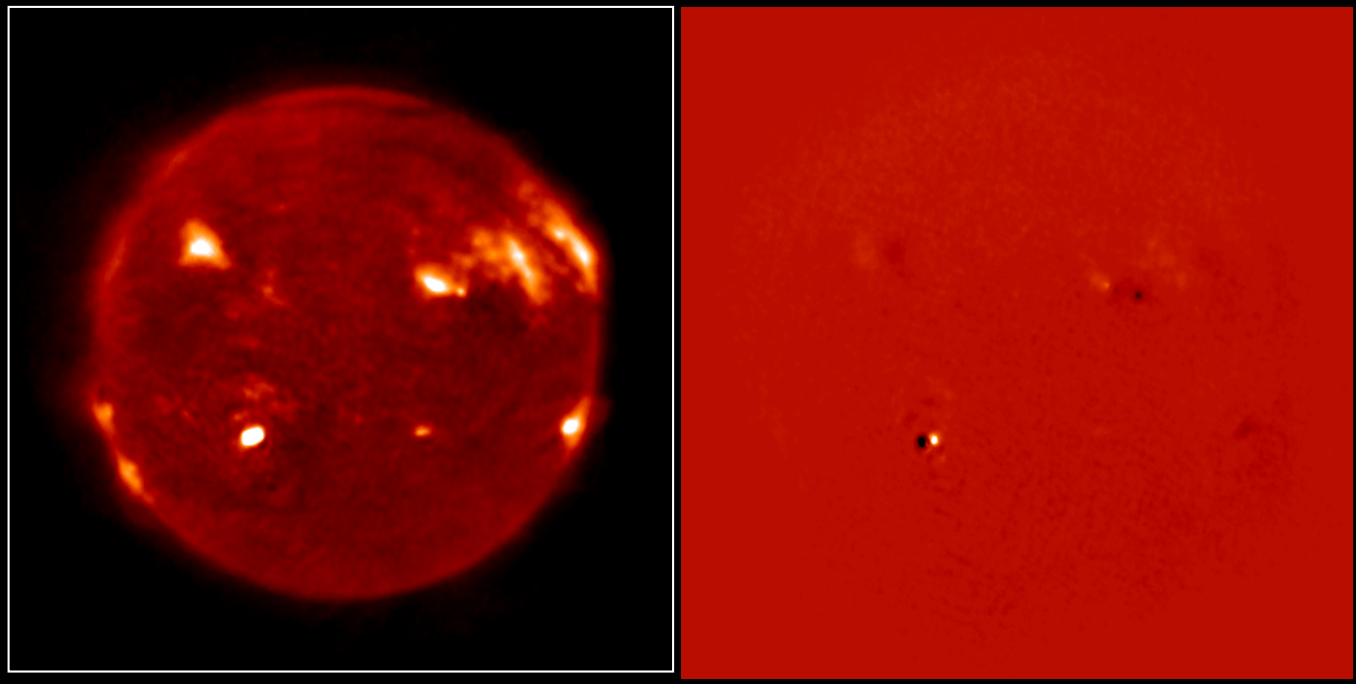
Scientific data



Measurements of the Earth's magnetic field in 2 points near Murmansk city

Institute of Solar-Terrestrial Physics (Irkutsk)

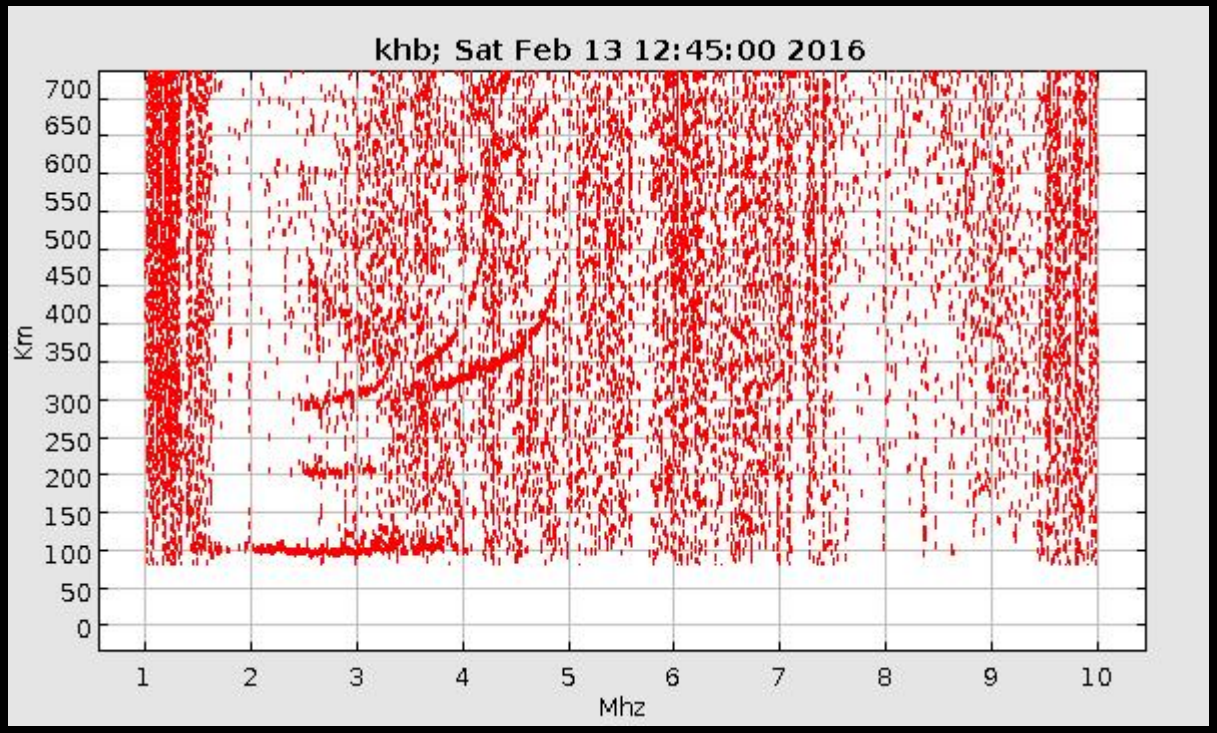
Scientific data



Radio observations of the Sun (intensity and polarization) at 5.7 GHz

Institute of Cosmo-Physical Research and Radio Wave Propagation (Kamchatka)

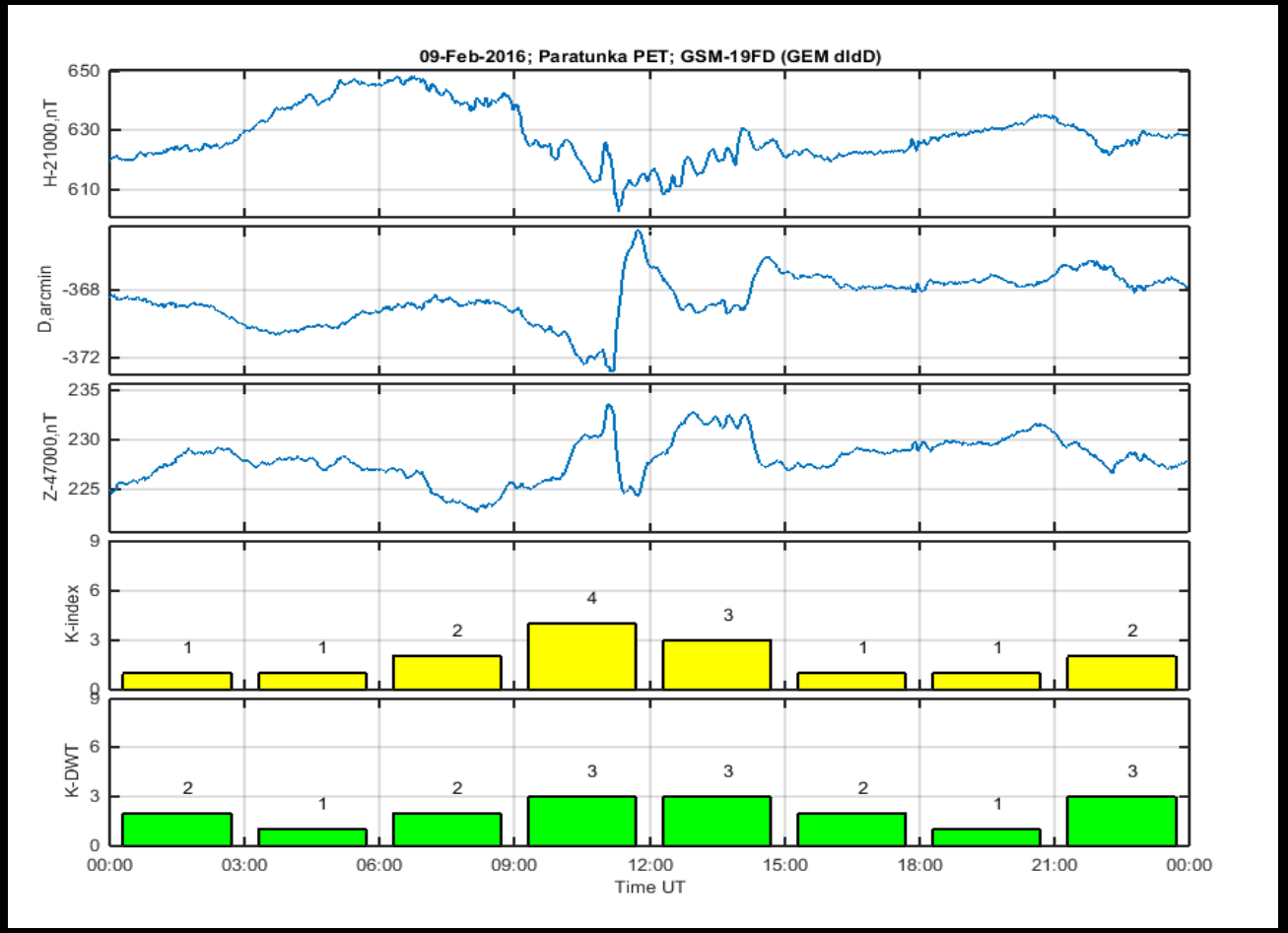
Scientific data



Monitoring of ionosphere in radio waves

Institute of Cosmo-Physical Research and Radio Wave Propagation (Kamchatka)

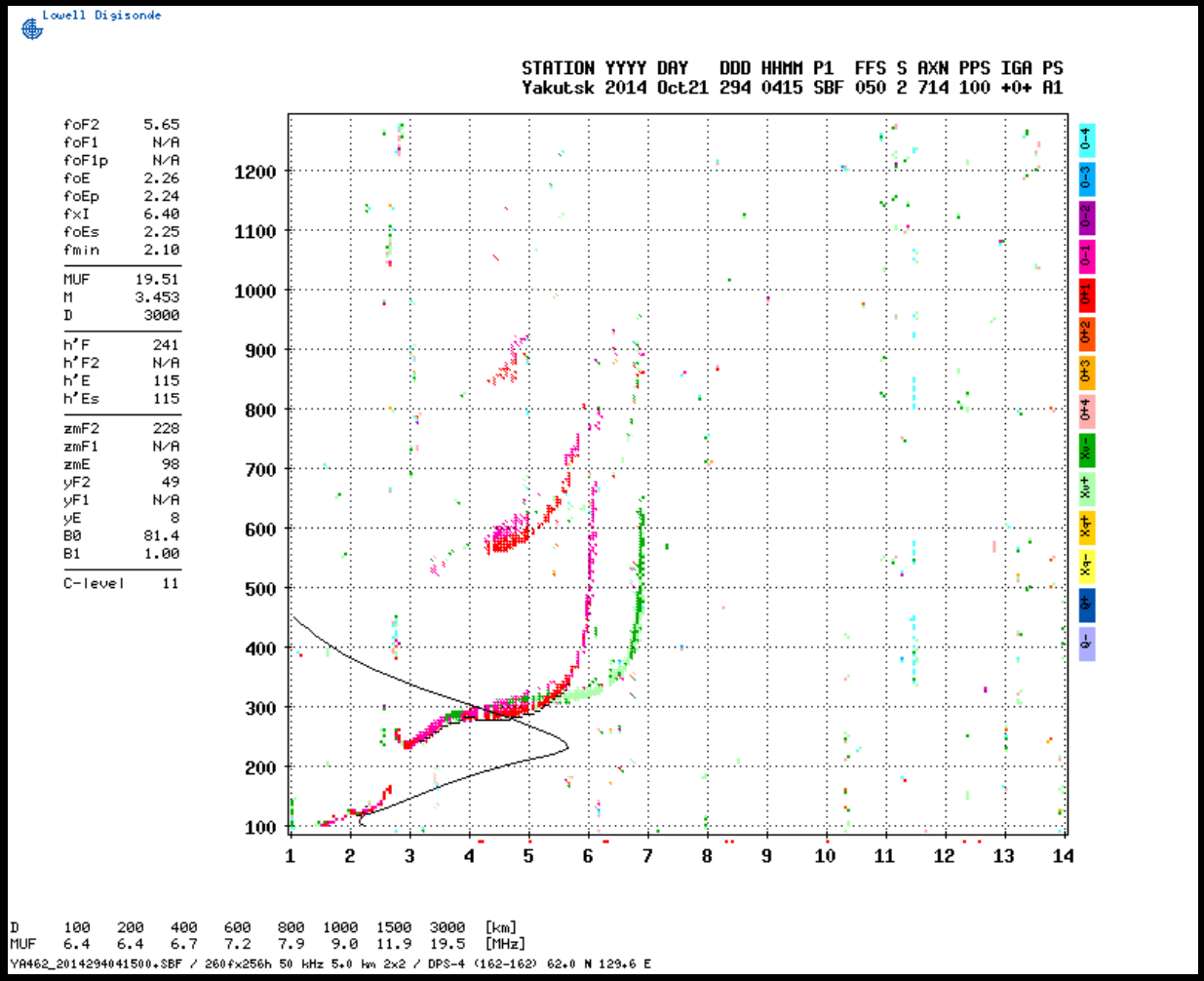
Scientific data



Measurements of the Earth's magnetic field in 3 points in the Kamchatka region

Chafer Institute of Cosmo-Physical Research and Aeronomy (Yakutsk)

Scientific data



Monitoring of ionosphere in radio waves

Space-based segment – brief info

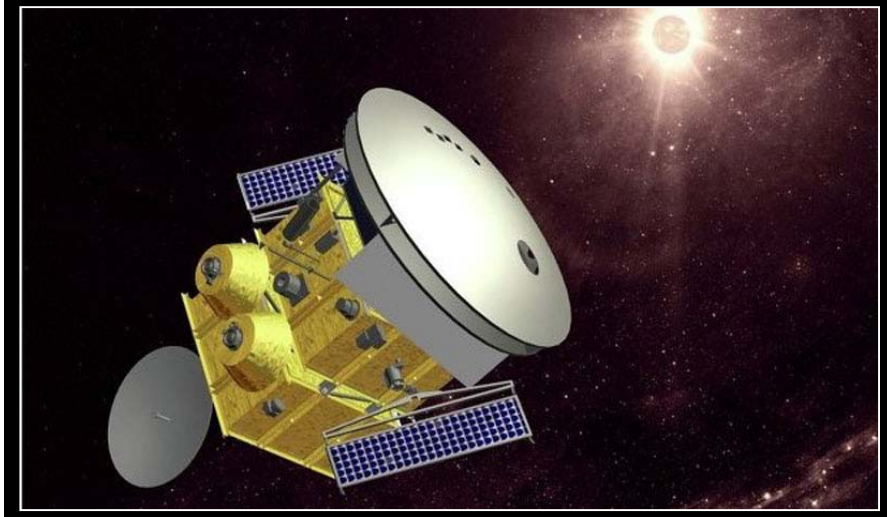
The most serious problem for Russian investigation in space weather is a lack of space-based segment to collect data on solar activity and the state of upper magnetosphere. In general Russia has a lot of experience in space experiments. Particularly, on the last Russian solar observatory, KORONAS-Photon, there worked more than 10 scientific instruments to detect solar particles and hard emissions and to register images of the sun.

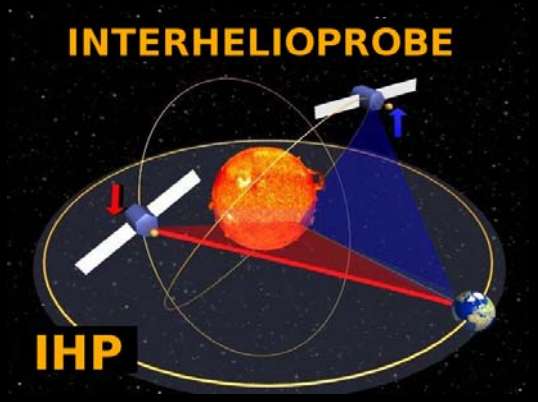
KORONAS-Photon observations (May 2009)

At the end of the last year, the new Federal space project of Russia was approved which includes several mission to be launched between 2020 and 2026.

Federal Space Program of Russia for 2016-2025

INTERHELIOPROBE (2026)





Mission information:

Orbit type: heliocentric non-ecliptic orbit

Period: 150 days (2/3 of the Venus period)

Semi-major axis: 82.72×10^6 km

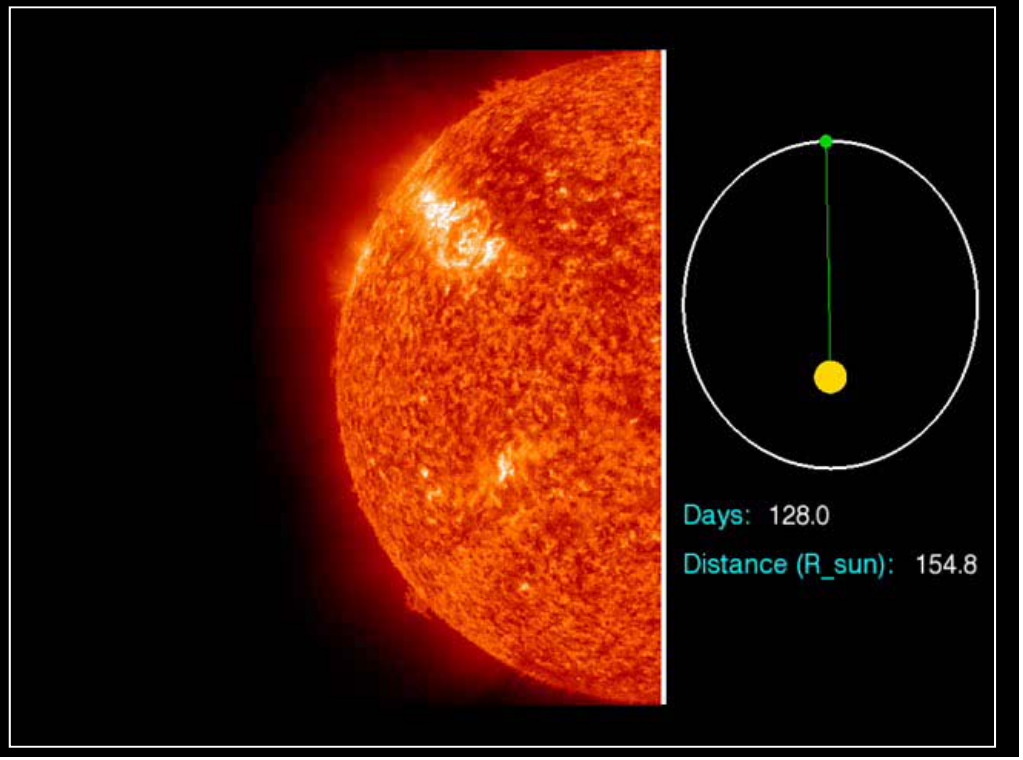
Perihelion: $60 \times R_{\odot} = 41.76 \times 10^6$ km

Eccentricity: 0.5

Instruments:

In situ: 14 instruments

Remote-sensing: 5 instruments



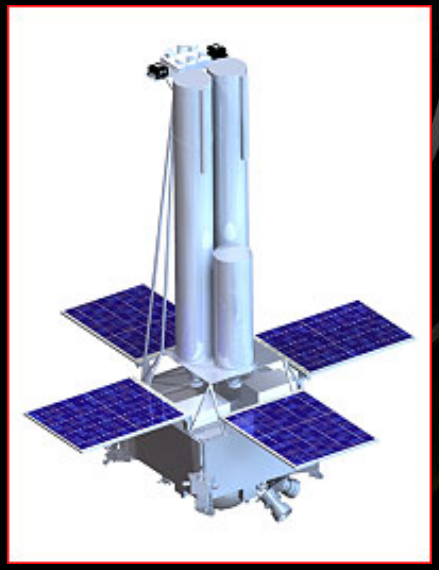
Federal Space Program of Russia for 2016-2025

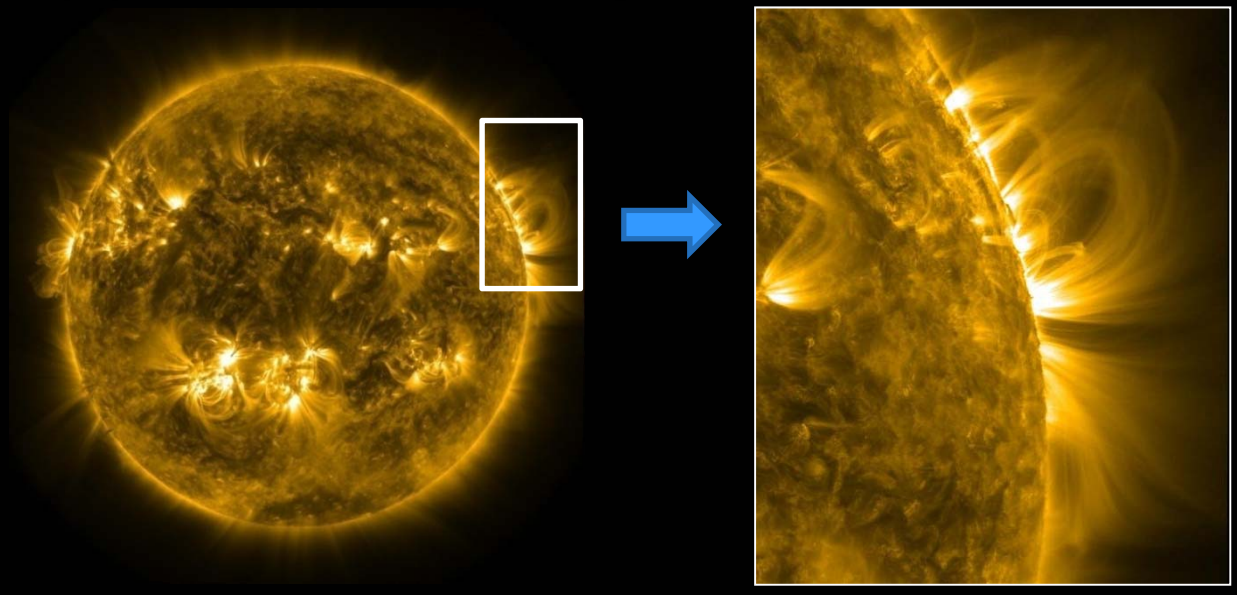
ARKA spacecraft (2023)

ARKA is the first Russian small explorer for investigations of the Sun.

The spacecraft will carry 3 scientific instruments (telescopes and a coronagraph) to provide high quality imaging of the Sun with the spatial resolution of about 0.1” (75 km) in the FOV of 10’×10’ .

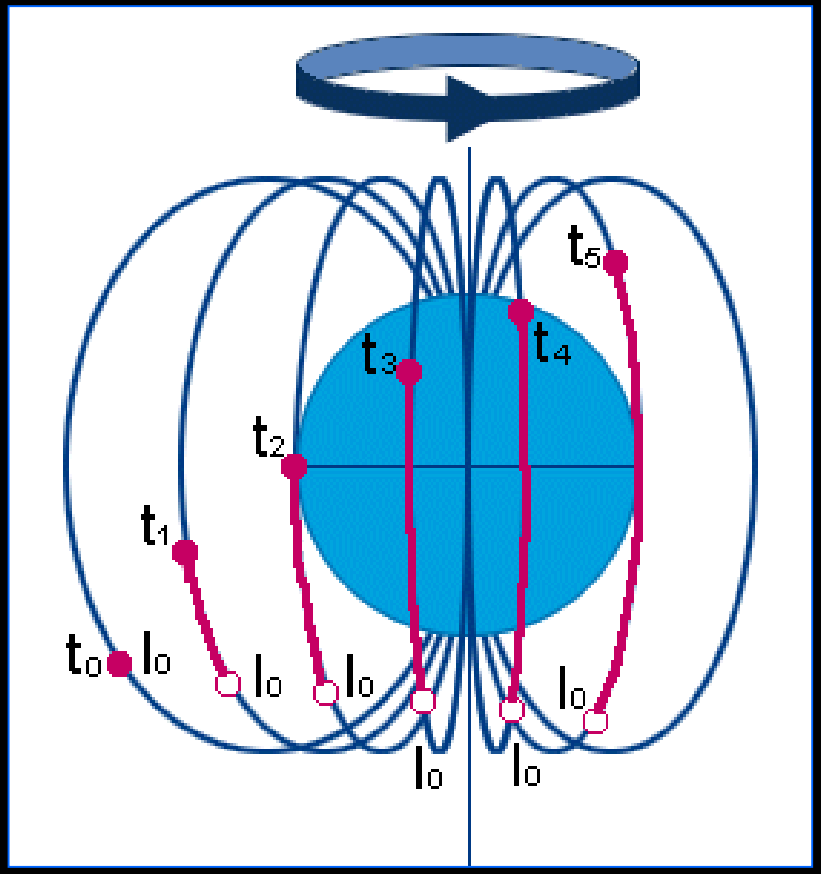
The total weight of the scientific equipment is about of 100 kg.

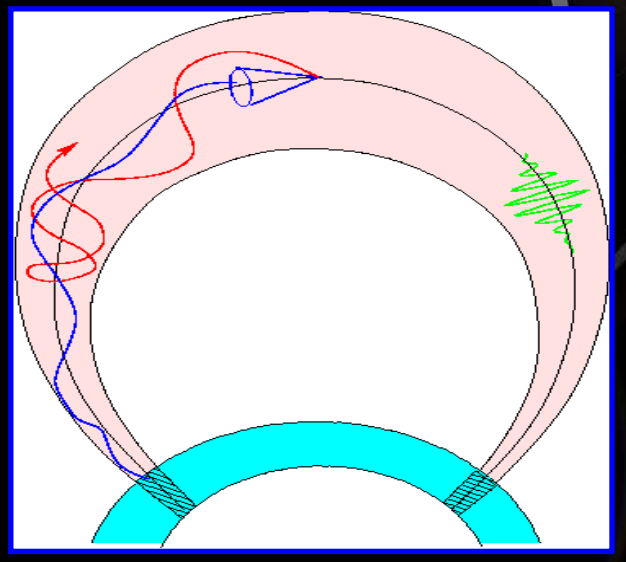


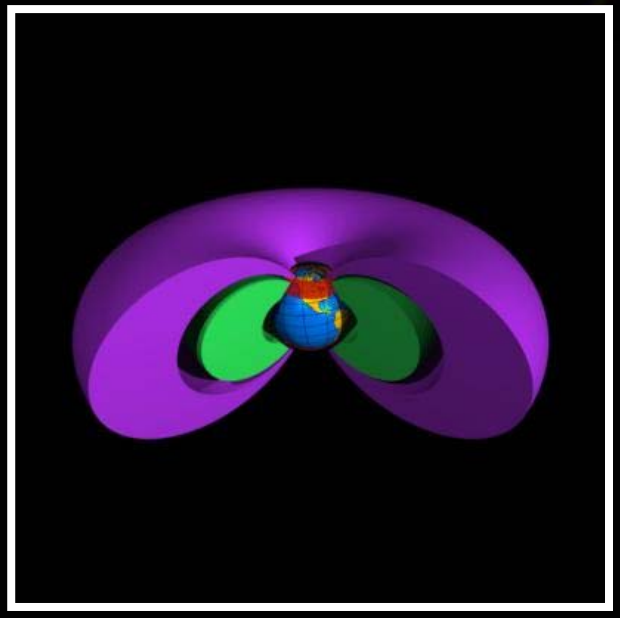


Federal Space Program of Russia for 2016-2025

RESONANSE (2024)





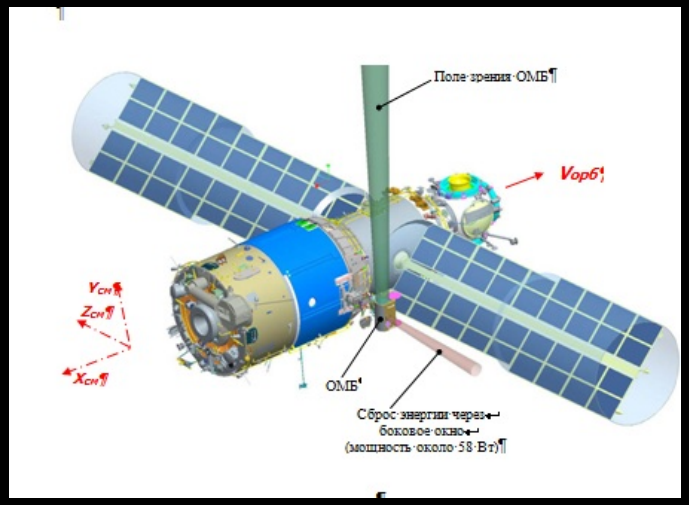


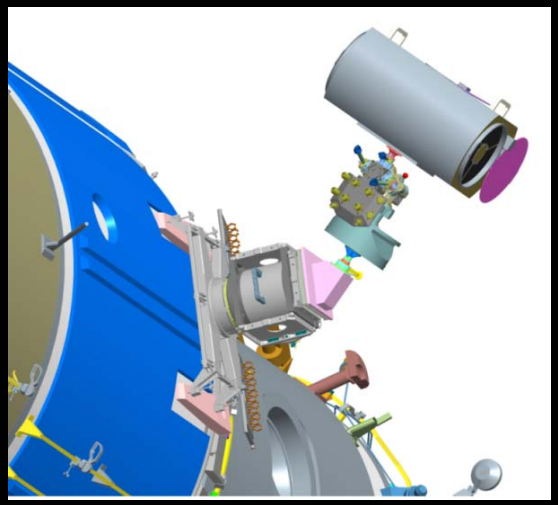
The RESONANCE project is aimed to study wave-particle interactions and plasma dynamics in the inner magnetosphere from magnetosynchronous orbit.

Federal Space Program of Russia for 2016-2025

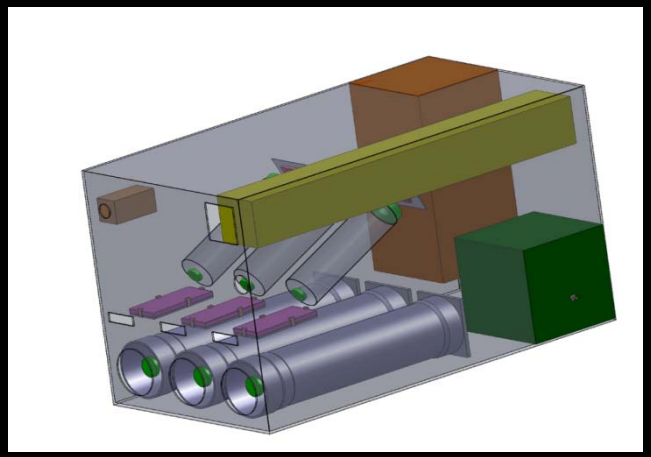
ISS

TAKHOMAG – solar magnetometer (2023)

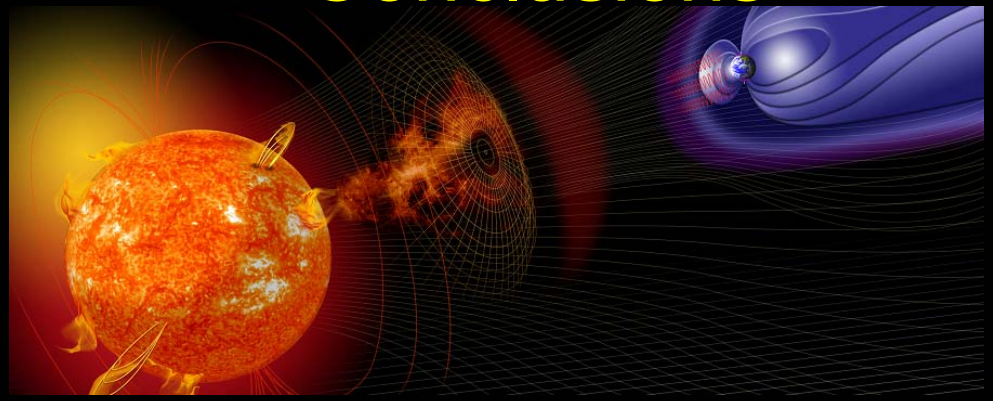




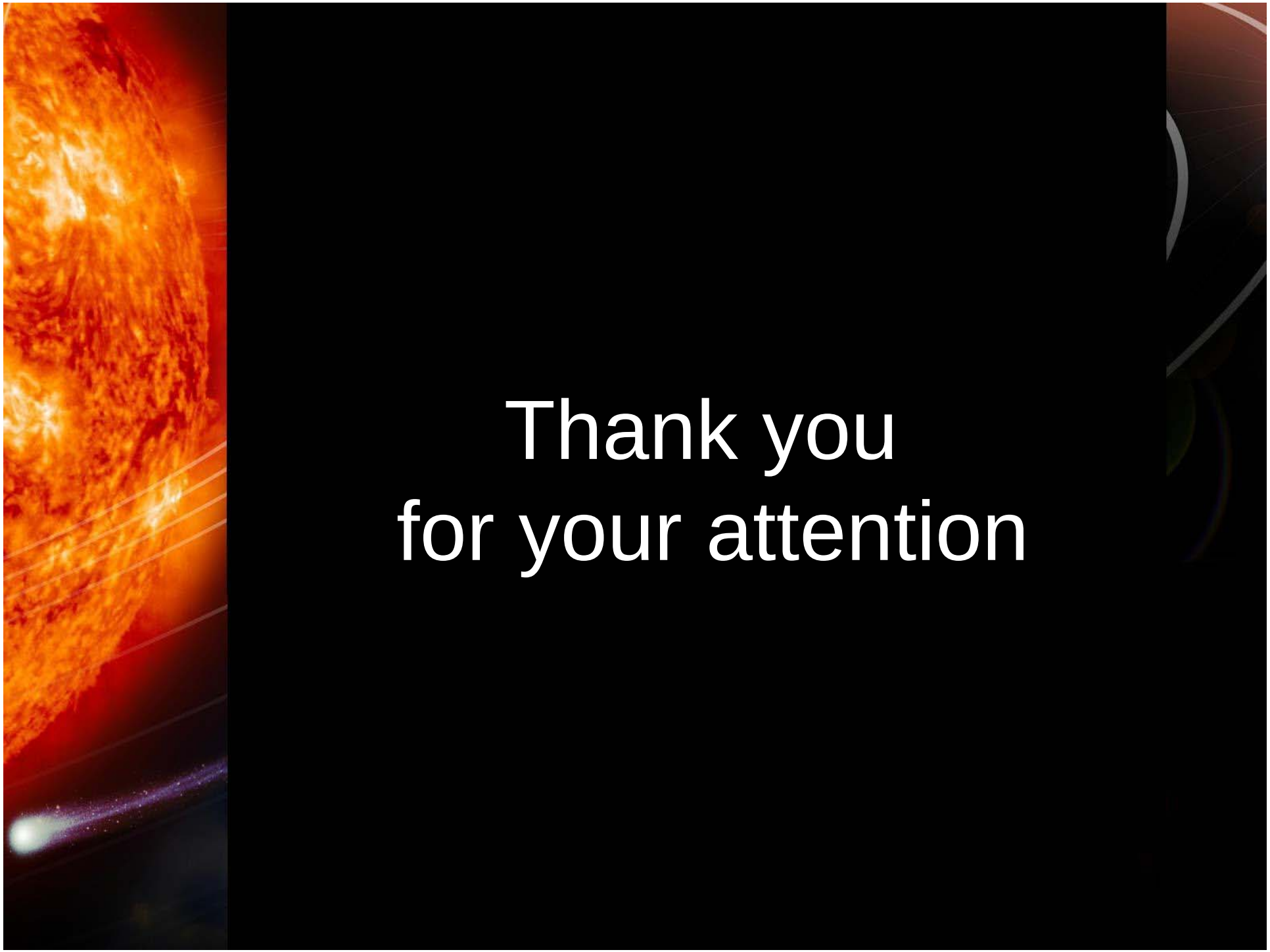
KORTES – telescopes and spectrometers (2021)



Conclusions



In general, I want to conclude that Russia has a well developed ground-based segment to collect some information on space weather (network of magnetic observatories, neutron monitors and ionospheric stations). However those centers are not correlated each other and may be the main task for the next several years is to collect all the data into one online center. Concerning space segment, in Russia we understand its importance, especially the necessity to monitor the solar activity in real-time mode. If the current federal space program of Russia is fulfilled, we hope to have our own space network to get information on space weather within next 7-10 years.


Thank you
for your attention