STUDYING MERCURY SURFACE COMPOSITION BY MERCURY GAMMA-RAYS AND NEUTRONS SPECTROMETER (MGNS) FROM BEPICOLOMBO SPACECRAFT. A.S. Kozyrev, L.I. Gurvits, M.L. Litvak, A.A. Malakhov, M.I. Mokrousov, I.G. Mitrofanov, A.A. Rogozhin, A.B. Sanin, A. Owens, V.N. Schvetsov, V.I. Tretyakov, A.V. Vostrukhin, Institute for Space Research, 84/32 Profsojznaja str., Moscow 117997, Russia; kozyrev@mx.iki.rssi.ru; 2ESA/ESTEC, Keplerlaan 1, 2201 AZ, Noordwijk, The Netherlands; 3All-Russia Scientific Research Institute of Mineral Resources named after N.M. Fedorovsky, 31 Staromonetniy per., Moscow 119017, Russia; 4Spectrometer of gamma-rays and neutrons spectrometers from MD, SD1, SD2, and MD) but have polyethylene enclosures and cadmium shield for SD2 and no coverage for SD1. The fourth sensor for detection of high energy neutrons with energy about 1-10 MeV uses organic scintillator styylene (CS/N) with cylindrical shape with size ø30×40 cm. For separation of neutron signal from charge particles in the styylene crystal, it is surrounded by plastic scintillation shield. Both signals from stylen and plastic scintillators are collected by single photomultiplier tube. The separation of different signals is produced by special electronic board with pulse-shape analyzer.

The spectrometer of gamma-rays (GRS) contains scintillation crystal LaBr: for detection of gamma-ray photons with very high spectral resolution of 3 % at 662 keV. This level of resolution is the best for scintillation-based gamma-ray spectrometers. The total mass of MGNS instrument is 5.2 kg; it consumes 4.0 W of power and provides 9.0 Mb of telemetry data per day. The main view of mechanical design of MGNS instrument is presented in the Figure 1.

Instruments development status: At present, the MGNS instrument is in a stage of the final developments of mechanical and electronic design. The instrument team successfully gone through MGNS PDR stage. In accordance of instrument development time schedule, the structural and thermal unit and electrical interface simulator of the MGNS instrument will be created and tested.
Figure 1. The mechanical design for MGNS instrument.

Conclusions: MGNS instrument is shown to have necessary capabilities to characterize the elementary composition of subsurface layer of Mercury and to test the presence of water ice deposits at both polar regions of the planet. The data from MGNS is complementary with the data from other instruments onboard Mercury Planetary Orbiter, which constitute the group of instruments for studies of geochemistry of subsurface [5]. They are SIMBIO-SYS and MERTIS for mineralogy and MIXS for elemental abundance. The data from BELA for Mercury altimetry will also be very useful to determine the contours of permanently shadowed polar regions, which are possible cold traps for water vapor deposition. Therefore, the synergism of the suite of MPO science instrumentation will enforce the capability of each particular investigation.

Instrument MGNS is Russian-made Russian-paid contribution of Federal Space Agency into the ESA’s mission BepiColombo to Mercury.

Instrument MGNS will have space protoflight. Very similar neutron and gamma-ray spectrometer NS HEND will be installed on board of Russian spacecraft “Phobos-Grunt” for Phobos landing and soil return. Instrument NS HEND will have practically the same set of four neutron sensors, as MGNS, and its gamma-ray spectrometer with be down-scaled option of one for MGNS. The crystal of LaBr3 of 2 inches will be used for NS HEND in comparison with 3 inches crystal for MGNS. The main measurements of NS HEND will be performed in the surface of Phobos, when exposure time of landing site could be as long as the time of surface operations. Therefore, smaller sensitivity of gamma-ray detector for NS HEND will be compensated by much longer exposure time for measurements of the spectrum of gamma-rays.

Experiment with NS HEND will allow to test the main design elements of MGNS in the conditions of space flight. The scheduled launch date of October 2009 of “Phobos-Grunt” still allows to take into account for the MGNS all experience of NS HEND operations. On the other hand, the data from these two similar experiments would be very useful for direct comparison of elemental composition of Mercury and Phobos. Difference and/or similarity of elemental abundance of these two bodies, together with available data for Moon and for Mars, will allow to make important step in understanding of origin and evolution of celestial bodies in the internal part of Solar System.