INVESTIGATION OF DYNAMIC ALBEDO OF NEUTRONS (DAN) ON MSL. I.G.Mitrofanov[1] (imitrofa@space.ru), M.L.Litvak[1], A.S.Kozyrev[1], M.L.Litvak[1], A.V. Malakhov[1], M.I.Mokrousov[1], A.B.Sanin[1], V.I.Tret'yakov[1] and A.Vostrukhin, [1]Institute for Space Research, Profsoyuznaya 84/32, 177997 Moscow, Russia.

Introduction: Russian contributed experiment for measurements of Dynamic Albedo of Neutrons (DAN) is included into the science program of NASA Mars Science Laboratory. There are two major objectives of DAN investigation:

(1) To evaluate content of H in the soil along the pathway of MSL, which will be based on combination of ***monitoring measurements*** (at least 10^5 tested spots) with moderate sensitivity of 1 wt% of water equivalent and ***precise measurements*** with high sensitivity of about 0.1 wt% of water equivalent (at least 500 tested spots).

(2) To study ***layering structure*** of H/OH/H_2O burring minerals in the soil with vertical resolution of tens of centimeters and horizontal resolution from 50 cm to 100 m along the pathway of MSL.

This investigation will be based on the method of neutron activation, when pulsing neutron generator irradiates the soil by 1 microseconds pulses of 10^7 monoenergetic neutrons at 14 MeV, and sensors records die away profiles of dynamic albedo of neutrons with fine time resolution (units of µs after pulse). This method is used in many practical applications for detection hydrogen-rich substances within 1 meter in depth to the inspected material [1], but DAN will be the first case, when it will be used for investigation of another celestial body.

DAN instrumentation: The instrument contains two separate blocks of Pulsing Neutron Generator DAN-PNG (Figure 1) and of Detectors and Electronics DAN-DE (Figure 2) with the total mass of less than 5 kg.

Figure 1: Block of DAN-PNG (below) and its industrial prototype ING 101 (above).

Block DAN-DE sends to DAN-PNG the sequences of electrical pulses with pulsing frequency < 10 Hz; each of them initiates generation of neutron pulse. DAN-DE has two sensors of neutrons based on identical ^{3}He counters. One of them, CETN, is covered by Cd enclosure, which absorbs thermal neutrons with energies < 0.4 eV; another one, CTN, detect both thermal and epithermal neutrons Digital electronics of DAN-DE builds up integrated time profiles of counts from each sensor in respect to a moment of pulses.

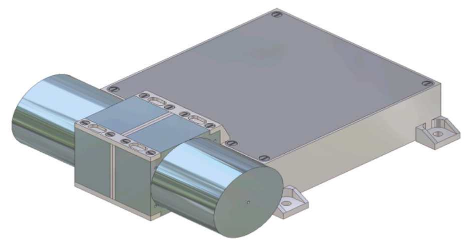

Figure 2: Block of DAN-DE with two sensors of neutrons (left).

Regimes of DAN operations: DAN-PNG is designed for emission of 10^7 pulses during the surface operation. The program of DAN investigation will be created taking into account the most optimal consumption of this pulsing resource for the most efficient science return. There are 5 regimes of DAN operations, which will be selected during the mission implementation according to available data from MSL instruments and another complementary information: (I) monitoring measurements in separate distinct spots along the pathway; (II) standing site inspection with precise measurements; (III) counting profile measurements along the pathway; (IV) 2-D mapping measurements over local site of inspection; (V) passive measurements without emission of neutron pulses.

Heritage of DAN: Pulsing neutron generator is developing by All-Russia Institute for Automatics. Its prototype is industrial generator ING 101 (Figure 1), which is produced for geological, medical; and other applications [2]. Block DAN-DE is developing in Institute for Space Research (IKI), which is responsible for entire DAN implementation under the leadership of Federal Space Agency [3]. DAN-DE is based on heritage of instrument HEND, which is presently operating on board of NASA Mars Odyssey [4].

References: [1] Y.N.Barmakov et al., Proc. of Science conference "Portable neutron generators and related technologies", Moscow (2003). [2] See http://vniia.ru/eng/ng/karotazh.html#ing101; [3] Mitrofanov I.G. et al., LPSC No.36, #1635 (2005); [4] Boynton W.V. et al., Sp. Sci. Rev., v. 110, Issue 1, 37-83 (2004).