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Fine Resolution Epithermal Neutron Detector (FREND) onboard ExoMars Trace Gas Orbiter

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ExoMars is a joint investigation of Mars carried out by Roscosmos and ESA that has 2 launches foreseen, in 2016 and 2018. Planned for launch in 2016, its first element, the Trace Gas Orbiter (TGO) will spend at least one Martian year orbiting the planet. Fine Resolution Neutron Detector (FREND) instrument was proposed by Roscosmos and will be measuring thermal, epithermal and high energy neutrons with energy ranges up to 10 MeV, which variations are an excellent signature of H bearing elements presence in the regolith at up to 1 meter depth.

Neutron mapping of Mars is being performed by HEND instrument since 2002 as part of the Mars Odyssey instrument suite. The important step in Martian exploration from FREND will be its high spatial resolution: FREND contains a collimator structure that narrows the instrument's field of view to a 40 km diameter spot at 400 km altitude. The collimation technology was previously confirmed by LEND, an instrument onboard NASA's Lunar Reconnaissance Orbiter (LRO) mission. FREND collimator is a structure with 2 layers, external polyethylene moderating neutrons and internal layer of ^{10}B absorbing them. The instrument uses as much of LEND heritage (detection systems, electronics etc.) as possible. Like LEND, FREND will have a set of ^{3}He proportional counters covering the thermal and epithermal neutrons range, plus the stilbene scintillator to cover the high energy neutrons range.

FREND's dosimeter module is another important part of the system, providing charged particles measurements of dose and flux with time resolution of up to 1 minute and energy spectra covering the 100 keV to 80 MeV range. This will provide additional information for radiation environment on the orbit around Mars.

When built, FREND will be the first collimated neutron detector to orbit Mars and will improve existing neutron maps by up to 10 times in the linear spatial resolution. This potentially will clarify our knowledge of water/hydrogen rich features and other interesting places on the surface of the planet. This is, for sure, essential for studies of Martian geology and atmosphere as well as for planning next exploration of the planet, including landing sites selection for future missions.