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Fine Resolution Epithermal Neutron Detector (FREND) for ExoMarsTrace Gas Orbiter

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ExoMars is now under considerations, as a joint mission of the three agencies, ESA,Roscosmos and NASA to explore the red planet. Planned for launch in 2016, its first element, the Trace Gas Orbiter (TGO) is going to spend one Martian year (687 Earth days) orbiting around the planet. Fine Resolution Epithermal Neutron Detector (FREND), once aboard TGO, 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 since 2002 by HEND instrument on board of Mars Odyssey, but the significant step up in FREND design compared to this previous mission will be its ability to collimate neutrons and thus have a very narrow Field of View of 40 km at a 400 km altitude. Its collimator consists of layers of polyethylene to moderate neutrons and 10B to absorb them. The collimator's design is equal to one used in LEND instrument on board the Lunar Reconnaissance Orbiter and proved to be efficient. The instrument design and detectors will also be very similar to ones used in its both ancestors, LEND and HEND, benefitting from the best heritage there is. FREND will use a set of 3He proportional counters to cover the thermal and epithermal neutrons energy ranges, providing a set of several independent measurements for higher statistics, as well as a stilbene scintillation detector for high energy neutrons. FREND will be the first collimated neutron instrument to fly towards Mars and, like LEND on the Moon, FREND will be able to produce Martian neutron maps that could supersede previously created ones by about 10 times in the linear spatial resolution. This will potentially clarify the available global Mars neutron maps, but could also point out new, never before seen small water/hydrogen rich features and other places of interest on the surface of the planet. Without a doubt, this kind of knowledge is essential for studies of Martian geology and atmosphere as well as for planning next exploration of the planet, especially when selecting landing sites for future missions to Mars.