Newton novel magnetic instrument. Potential application to unveil key questions as the origin of the Moon

José Luis Mesa Uña1, Marina Díaz Michelená1, Francisco Javier de Frutos Hernán1sanz1, Claudio Aroca Hernández-Ros2, Marina Pérez Jiménez2, Marco Maicas Ramos2, María del Mar Sanz Lluch2, Cristina Lavín García3, Reinel Marante3, Benoit Langlais4, Rolf Kilian5, and Miguel Ángel Rivero6

1Instituto Nacional de Técnica Aeroespacial, Payloads and Space Sciences, Torrejón de Ardoz, Spain (mesaujl@inta.es)
2Escuela Superior de Ingeniería de Telecomunicación. Universidad Politécnica de Madrid. Madrid. Spain
3TTI Norte. Santander. Spain
4Université de Nantes. Nantes. France
5Universität Trier. Trier. Germany
6External consultant at INTA. Torrejón de Ardoz, Spain.

The main objective of this contribution is to present the evolution of NEWTON novel magnetic susceptometer for planetary exploration, a state of the art sensor for the measurement of the complex magnetic susceptibility developed in the frame of an EU H2020 funded project [1].

The magnetic susceptibility is a complex parameter dependent on the external magnetic field amplitude, direction and frequency. NEWTON susceptometer has been developed to determine the magnetic susceptibility of rocks and soils, with the capability to determine not only the real part but also the imaginary part of the susceptibility.

The calibration and validation process for the susceptometer prototype casted very good results in comparison with other commercial and high resolution laboratory devices, reaching a resolution in the order of $\chi = 10^{-5}$ (I.S. Vol. Susceptibility), representative of Earth, Moon and Mars rocks. The critical parts of the prototype have been subjected to different tests, i.e. vibration and TVT, to verify the capability to withstand the hard environmental conditions of interplanetary missions.

In this work we discuss the potential contribution of NEWTON instrument on the technical and scientific objectives achievement in future investigations on the Moon, either as payload during in-situ exploration with rovers or in sample return missions, providing a useful tool for fast in place sample analysis.

There are still open questions regarding Moon’s magnetic field and geological characteristics of the satellite. Most hypotheses to explain the magnetic characteristics and anomalies on the lunar surface invoke a thermally driven core dynamo during its Pre-Nectarian and Nectarian history [2]. However, this theory is problematical given the small size of the core and the required strong magnetic field strength of an ancient dynamo. Further investigations on the lunar samples from missions [3] indicate ancient magnetic fields with intensities of $<1$ to $120$ μT for the period
between 4.2 to 4.0 Ga. This huge range of intensities may indicate that the Moon's magnetic field experienced extreme high temporal variations [2]. Even if considering large uncertainties, dynamo models should consider paleointensities of at least ~35 μT for this high-field period.

The use of scientific instruments like NEWTON susceptometer in rover exploration missions could shed some light on the ancient dynamo magnetic field, the magnetic and mineral composition of the lunar crust and other unanswered questions from the Moon.

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References:


