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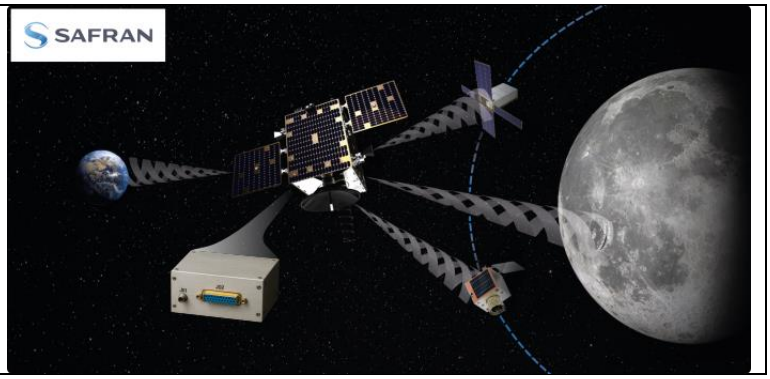
Invitation to an ION-CH - AES-IEEE Joint Lecture on

Miniature Space Atomic Clock for Lunar Navigation Satellite System

Dr. Serge Grop, Safran Timing Technologies, Neuchâtel

Date: 14.10.2025
Time: 17.00 – 18.00
Place: EPFL
Building, Room: GC B1 10

Organiser:
Info@ION-CH.ch
https://ION-CH.ch



Dr. Serge Grop is the director of the Research and Development department at Safran Timing Technologies in Neuchâtel. Serge owns a PhD in Engineering Science (University of Franche-Comté, France) and works in the Time and Frequency domain for more than 15 years. He developed a high-performance cryocooled sapphire oscillator for the deep space ground segment during his PhD and led numerous projects of miniaturized atomic clocks for ground and space applications. He is the author and co-author of over 40 publications in major journals and conferences and 3 patents.

The Artemis program, led by NASA in collaboration with international partners, aims to return humans to the Moon and establish a sustainable lunar presence. This initiative serves as a critical steppingstone for future human missions to Mars. The program includes 11 planned surface missions, with core objectives to:

- Learn how to live and work on another planetary body,
- Identify and utilize lunar resources, and
- Build the technical and operational foundation for Mars exploration.

To achieve these goals, Artemis requires reliable communication and navigation infrastructure to support landers, orbiters, astronauts, and maintain connectivity with Earth.

To fulfill these needs, a dedicated satellite constellation called the Lunar Navigation Satellite System (LNSS) is being developed. LNSS will establish a lunar communications and navigation network by deploying three coordinated mini-constellations, provided by NASA, ESA, and JAXA. These constellations will deliver critical services, including:

- Continuous communication with Earth — even on the far side of the Moon,
- High-precision navigation for landers, astronauts, and autonomous systems,
- Support for surface operations and robotic exploration, and
- Enabling long-term lunar exploration and infrastructure.

A key technical challenge in lunar satellite design is minimizing mass and volume to reduce launch costs and maximize capacity for scientific instruments and supplies. Central to this system is the integration of atomic clocks, which provide the precise timekeeping required for accurate distance measurement, system synchronization, and global time delivery.

Traditional space-grade rubidium atomic clocks, like the RAFS used in GPS and Galileo, are too large for the new generation of compact lunar satellites. To address this, Safran has been selected to develop the miniRAFS (Miniature Rubidium Atomic Frequency Standard) — a high-performance, space-qualified atomic clock specifically designed for small, low-power satellite applications such as LNSS. The miniRAFS is playing a critical role in enabling precise and autonomous operations on the Moon.