

**Claudio E. Calosso -
Understanding an SI Second
with More Clocks**

**Rapport sur les
contributions**

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Understanding an SI Second with More Clocks

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The redefinition of the second, planned for the 29th General Conference on Weights and Measures (CGPM) in 2030, differs greatly from the 1967 transition to the cesium standard. While cesium was the clear choice then, the current challenge is to utilize standards based on multiple different atomic transitions now clearly outperform cesium. While one option is to simply replace cesium, an alternative approach suggests using a combination of different high-performance clocks. This ensemble-based definition could enhance accuracy by averaging measurements and promote the continued development of diverse co-primary standards, encouraging robust confirmation measurements and reducing the impact of unknown physical phenomena.

The seminar will present a novel and simple formulation for the ensemble definition based on the weighted arithmetic mean of multiple normalized frequencies. It will be demonstrated that this approach is mathematically equivalent to the previously discussed implementation using a geometric mean. In this reformulation, the normalization of frequencies provides defining constants with immediate physical meaning as well as decoupling of assigned weights from the frequencies of the reference transitions. A definition based on this formulation is expected to be significantly more accessible to both experts and non-specialists, enhancing understanding and facilitating broader acceptance. This approach aims to help overcome barriers to the adoption of a redefinition that effectively values all state-of-the-art atomic clocks.

The work was conducted in collaboration with Nils Nemitz from the National Institute of Information and Communications Technology (NICT) in Tokyo, Japan

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