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AHS London Lecture Thursday 18 January 2018

Helen Margolis, **How to Make an Atomic Clock**

Fifty years ago, the General Conference on Weights and Measures decided that the time had come for a new definition of the second, and declared that 'The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.' This decision marked a fundamental shift in philosophy, representing a move away from previous astronomical definitions to one based on a quantum phenomenon.

The underlying concept behind the atomic clock – that a transition between discrete energy levels in an atomic system could serve as a natural unit of frequency – had been understood for decades. But technology lagged behind, and it was only twelve years earlier that Louis Essen and Jack Parry had built the first caesium atomic clock at the UK National Physical Laboratory (NPL). They rapidly showed that their new clock was much more stable than astronomical time scales based on the motion of celestial bodies, and since then caesium clocks have steadily improved in precision.

But a single atomic clock is only part of the picture. Coordinated Universal Time (UTC), which is used for civil timekeeping worldwide, is a time scale constructed by averaging the time kept by more than 450 atomic clocks in around 80 national laboratories around the globe. In this lecture Helen Margolis will describe the technology that goes into making up an atomic clock system, considering not only the clock itself, but also the network of devices and connections that turn the clock into part of a global system. She will also discuss how this system is likely to change over the coming years.

Principal research scientist Krzysztof Szymaniec with NPL's caesium fountain primary frequency standard (2014).

Dr Helen Margolis works at the UK National Physical Laboratory (NPL), which was officially declared the birthplace of atomic timekeeping by the European Physical Society in January 2014. As an NPL fellow in optical frequency standards and metrology, she leads part of NPL's research programme to develop a new generation of optical atomic clocks, work that is expected to lead to a future redefinition of the second.

TICKETS

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