IMPROVED OPTICAL ATOMIC CLOCK IN THE TELECOM WAVELENGTH RANGE

Tech ID: 33576 / UC Case 2023-088-0

PATENT STATUS

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Published Application	WO 2025/038753	02/20/2025	2023-088

BRIEF DESCRIPTION

Optical atomic clocks have taken a giant leap in recent years, with several experiments reaching uncertainties at the 10^{-18} level. The development of synchronized clock networks and transportable clocks that operate in extreme and distant environments would allow clocks based on different atomic standards or placed in separate locations to be compared. Such networks would enable relativistic geodesy, tests of fundamental physics, dark matter searches, and more. However, the leading neutral-atom optical clocks operate on wavelengths of 698 nm (Sr) and 578 nm (Yb). Light at these wavelengths is strongly attenuated in optical fibers, posing a challenge to long-distance time transfer. Those wavelengths are also inconvenient for constructing the ultrastable lasers that are an essential component of optical clocks.

To address this problem, UC Berkeley researchers have developed a new, laser-cooled neutral atom optical atomic clock that operates in the telecommunication wavelength band. The leveraged atomic transitions are narrow and exhibit much smaller black body radiation shifts than those in alkaline earth atoms, as well as small quadratic Zeeman shifts. Furthermore, the transition wavelengths are in the low-loss S, C, and L-bands of fiber-optic telecommunication standards, allowing the clocks to be integrated with robust laser technology and optical amplifiers. Additionally, the researchers have identified magic trapping wavelengths via extensive studies and have proposed approaches to overcome magnetic dipole-dipole interactions. Together, these features support the development of fiber-linked terrestrial clock networks over continental distances.

SUGGESTED USES

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INVENTORS

» Stamper-Kurn, Dan M.

OTHER INFORMATION

CATEGORIZED AS

- » Optics and Photonics
  - » All Optics and Photonics
- » Communications
  - » Optical
  - » Other
- » Computer
  - » Hardware
  - » Other
- » Engineering
  - » Engineering
  - » Other
- » Research Tools
  - » Other
- » Security and Defense
  - » Other
- » Sensors & Instrumentation
  - » Environmental Sensors
  - » Other
  - » Physical Measurement
  - » Scientific/Research

» Deployment of optical clock networks, particularly clock comparisons over long distances

ADVANTAGES

» Direct access to a telecommunications-band atomic frequency standard (S, C, and L-bands)

» Stable light sources and robust optical amplifiers available across these ranges

» Narrow atomic transitions with smaller black body radiation shifts than alkaline earth atoms

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Three-dimensional Acousto-optic Deflector-lens (3D AODL)

» **Transportation**

» Aerospace

» Other

RELATED CASES

2023-088-0

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