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This study harnesses the exceptional precision of atomic clocks, with uncertainties at least as small as a part in 10ˆ18, to test the boundaries of fundamental physics. By comparing the transition frequencies of different species of atomic clocks can provide constraints on temporal variations in Standard Model fundamental constants, e.g. the proton-to-electron mass ratio (μ) and the fine structure constant (α). We demonstrate an approach to investigate new physics theories beyond the Standard Model, such as those addressing dark matter, dark energy and modified gravity by measuring the variations in μ and α. We focus on sinusoidal oscillations of μ over a one-year period, induced by the Earth's elliptical orbit around the Sun. In this work, I will outline a preliminary study and its results, aiming to search for variations in μ and α by utilizing publicly available clock data, simulated data for the current and future state-of-the-art atomic clocks and forecasts for future experiments. Our findings advocate for a dedicated experiment that uses atomic clocks to take continuous measurements over the course of a few years. This study highlights the need for advancing quantum sensors, including atomic clocks and atom interferometers, as a tool for probing new physics, which aligns with the workshop's theme. It also sets the stage for future large-scale experiments designed specifically for making groundbreaking scientific discoveries.

Session Classification: Poster Session & Wine & Coffee