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Correlation spectroscopy between two $^{27}Al^+$ clocks[1] MAY E. KIM, E. R. CLEMENTS, A. M. HANKIN, S. M. BREWER, J.-S. CHEN, National Institute of Standards and Technology, Boulder, CO; University of Colorado, Boulder, CO, C. W. CHOU, National Institute of Standards and Technology, Boulder, CO, D. J. WINELAND, National Institute of Standards and Technology, Boulder, CO; University of Colorado, Boulder, CO; University of Oregon, Eugene, OR., D. B. HUME, National Institute of Standards and Technology, Boulder, CO, D. R. LEIBRANDT, National Institute of Standards and Technology, Boulder, CO; University of Colorado, Boulder, CO — A comparison between highly accurate clocks, which is necessary to evaluate and verify their accuracy, requires commensurate measurement precision. While the atomic systems used as clocks have long coherence times, noise from the local oscillator often limits the measurement stability. One way to overcome this limitation is by performing correlation spectroscopy, in which a Ramsey pulse sequence derived from the same probe laser is applied to both clocks synchronously. The coherent differential frequency measurements between two atomic systems permit interrogation times beyond the laser coherence time. We report on the demonstration of correlation spectroscopy between two independent optical atomic clocks in separate systems. By removing the limitation set by the coherence time of the local oscillator, we extend the interrogation time of the two single $^{27}Al^+$ ion quantum-logic clocks from 150 ms to several seconds. The corresponding reduction in quantum projection noise limit results in a frequency comparison instability significantly lower than is possible for incoherent comparisons using the same local oscillator.

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