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Improved estimates of the collisional frequency shift for a trapped-ion atomic clock (G)*

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The best trapped-ion atomic clocks today are accurate to better than one part in 10^{18} [1]. To improve their accuracy even further, we must consider small perturbations of the clock frequency due to collisions between the clock ion and background gas atoms. Our group has recently developed a simple analytic formulation [2] to evaluate the collisional frequency shift (CFS) based on a quantum-channel description of the ion-atom scattering process. In this talk, I will present an extension of this formalism. The extended formalism estimates the CFS more accurately by considering effects such as inelastic scattering due to spin-orbit mixing, and the quantized motion of the trapped ion. Improved estimates of the CFS systematic error could lead to ion clocks that are more accurate by an order of magnitude.

References
[1] Nisbet-Jones, P. B. R., et al. "A single-ion trap with minimized ion–environment interactions." Applied Physics B 122.3 (2016): 57.
[2] Vutha, Amar C., Tom Kirchner, and Pierre Dubé. "Collisional frequency shift of a trapped-ion optical clock." Physical Review A 96.2 (2017): 022704.

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