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Measurements of the fine-structure of n=2 hydrogen and helium using the FOSOF for determining the proton size and the fine-structure constant

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Two recent precision measurements will be discussed. In the first, the n=2 Lamb shift of atomic helium is measured[1] using microwave techniques. This measurement can be used to determine the charge radius of the proton, and helps to resolve the decade-old proton radius puzzle, which seemed to indicate that the proton size differs for measurements involving muons versus those using electrons. The second is an ultraprecise microwave measurement[2] of the n=2 triplet P fine-structure of atomic helium. This measurement is part of a program aiming to determine the value of the fine-structure constant. Both measurements use the Frequency-Offset Separated-Oscillatory-Fields (FOSOF) technique[3] - an extension of Ramsey technique of Separated Oscillatory Fields (SOF). The simple line shape and other advantages of this technique will be discussed.

[1]N. Bezginov, T. Valdez, M. Horbatsch, A. Marsman, A. C. Vutha, and E. A. Hessels, *Science* **365**, 1007 (2019).
[2]K. Kato, T. D. G. Skinner, and E. A. Hessels, *Physical Review Letters* **121**, 143002 (2018).
[3]A. C. Vutha and E. A. Hessels, *Physical Review A* **92**, 052504 (2015).