

# Search for a Variation of the Fine Structure Constant around the Supermassive Black Hole in Our Galactic Center

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Searching for space-time variations of the constants of Nature is a promising way to search for new physics beyond general relativity and the standard model motivated by unification theories and models of dark matter and dark energy. We propose a new way to search for a variation of the fine-structure constant using measurements of late-type evolved giant stars from the S star cluster orbiting the supermassive black hole in our Galactic Center. A measurement of the difference between distinct absorption lines (with different sensitivity to the fine structure constant) from a star leads to a direct estimate of a variation of the fine structure constant between the star's location and Earth.

In our recent work [1], using spectroscopic measurements of five stars, we obtained a constraint on the relative variation of the fine structure constant below  $10^{-5}$ . This is the first time a varying constant of nature is searched for around a black hole and in a high gravitational potential. This analysis shows new ways the monitoring of stars in the Galactic Center can be used to probe fundamental physics.

Now, with dedicated telescope time we expect to improve on these results by several orders of magnitude. The improved sensitivity comes from improved statistics from dedicated observations, data from stars closer to the black hole (and thus in higher gravitational potential), and from the observation of lines from atomic transitions that have higher sensitivity to the variation of the fine structure constant.

[1] A. Hees, T. Do, B. M. Roberts, Andrea M. Ghez, S. Nishiyama, R. O. Bentley, A. K. Gautam, S. Jia, T. Kara, J. R. Lu, H. Saida, S. Sakai, M. Takahashi, and Y. Takamori, *Phys. Rev. Lett.* **124**, 081101 (2020).