The discovery and characterization of 2020 AV$_2$, the first known asteroid in the class of inner-Venus asteroids

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Near-Earth asteroid population models predict a small population of asteroids located entirely within the orbit of Venus. We report the discovery of the first inner-Venus asteroid (IVA), 2020 AV$_2$, was first detected by the Zwicky Transient Facility (ZTF) on the Samuel Oschin Telescope 48-inch telescope at Palomar Observatory on 2020 January 4. Recovery observations by the Spectral Energy Distribution Machine on the Palomar 60-inch Telescope and the Lulin Optical Telescope at Lulin Observatory in late 2021 November greatly extended its orbit to ~330 days confirm its location inside the orbit of Venus and allowing for detail investigation of its dynamical evolution. In addition, a comparison with the NEO model reveals its likely source location in agreement with recent spectroscopic observations. In addition, we provide an estimate of our observational completeness for detecting inner-Venus asteroids with ZTF with implications on the expected number of their detection.