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The rings of (2060) Chiron

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In addition to the giant planets, rings have been found around three small Solar System bodies: Centaur Chariklo (2013), dwarf planet Haumea (2017), and TNO Quaoar (2023), with Quaoar's rings lying beyond its Roche limit. Earlier stellar occultations of Centaur Chiron in the 1990s and 2011 revealed surrounding material interpreted as jets, shells, or rings. To investigate further, new stellar occultations were observed in 2018, 2019, 2022, and 2023. The 2018 event set detection limits for nearby structures, while the 2019 multi-chord event helped constrain Chiron's size, shape, and density. In 2022, large telescopes detected an extended disk (580 km diameter) with two dense regions at 325 ± 16 km and 423 ± 11 km from Chiron's center, consistent with rings. The most recent occultation, on Sept. 10, 2023, was observed using both professional and amateur telescopes in Chile, Argentina, and Brazil. This event produced the highest number of detection chords for Chiron and enabled a detailed study using high SNR and high-cadence data. Several secondary extinction features were seen in the light curve from the 1.6-m Perkin-Elmer telescope at Observatório do Pico dos Dias (Brazil), matching structures from past events. A comprehensive analysis of this and previous occultations supports the existence of a three-ring system around Chiron, located at average distances of 273 km, 325 km, and 438 km, with the outermost ring beyond its Roche limit. The rings share a common mean pole with ecliptic coordinates $\lambda = 151^\circ \pm 4^\circ$ and $\beta = 20^\circ \pm 6^\circ$. They are embedded within a broader disk-like structure whose optical depth decreases outward from 200 km, with another material concentration near 550 km. A faint external feature was also detected at 1,380 km. The variability in the amount and distribution of material observed over the years suggests that Chiron hosts an active and evolving ring system, which may be fed by outbursts, characterizing it as one of the most interesting ring systems discovered so far.

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