

Immortal Stars at the Galactic Center

Wednesday, 10 July 2024 15:20 (20 minutes)

Dark matter can be captured in stars and annihilate, providing the star with a new energy source in addition to nuclear fusion. This significantly changes stellar evolution at the Galactic Center, where the dark matter density is extremely high. As dark matter burning replaces nuclear fusion partially or completely, stars become longer-lived, as they use up hydrogen more conservatively, or even become immortal, as dark matter is re-supplied continuously. We show that this results in several prominent features that distinguish stellar populations in dark matter dense environments from populations without dark matter. This may offer an explanation for the unusually young stars at the Galactic Center, called the paradox of youth, as well as their top-heavy mass distribution. In some scenarios, the dark matter annihilation power can become so intense to disrupt star formation entirely, allowing us to derive constraints on dark matter-nucleon cross sections and density profiles based on stellar observations close to the Galactic Center.

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Session Classification: Parallel 2

Track Classification: Parallel session: Astrophysical Observations