Toroidal Alfven eigenmodes in the advanced steady-state-tokamak scenario with negative triangularity

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In our earlier work, we explored the advanced steady-state-tokamak scenario with negative triangularity given that the negative triangularity configuration was found to be more effective in generating the field line rotational transform in tokamaks [Fundamental Plasma Phys. Plasma Science Crossroads 2023, vol.10, 100051 (2024)]. We found that negative triangularity configurations with a high bootstrap current fraction (about 95%), high poloidal beta, and peaked pressure profiles can achieve higher normalized beta than positive triangularity configurations. In certain parameter domains, the normalized beta can reach about twice the extended Troyon limit for positive triangularity tokamaks. In this work, we further explore the advanced steady-state-tokamak scenario with negative triangularity, emphasizing the toroidal Alfven eigenmodes (TAEs) and their effects on energetic particle confinement. We found that, because of the large safety factor and reversed magnetic shear in the core plasma region near the magnetic axis, the TAE gap tends to be closed in the on-axis core region and open primarily in the off-axis area. This indicates that energetic particle confinement in the core region near the magnetic axis, where the nuclear fusion reaction prevails, is not seriously affected by the excitation of TAEs in this configuration. The results show that the advanced steady-state-tokamak scenario with negative triangularity also has potentially favorable effects on energetic particle confinement.