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Physics design of the STCF collider rings.

The Super Tau-Charm Facility (STCF), proposed by the University of Science and Technology of China, represents the next generation of electron-positron colliders. With a target luminosity exceeding 5×10ˆ34 cm-2s-1, the STCF aims to achieve approximately two orders of magnitude higher luminosity compared to the current BEPCII. To reach such high luminosity, a combination of large Piwinski angle collisions and the crab waist scheme, first proposed by P. Raimondi in 2006, is employed. This approach effectively enhances the luminosity. However, the extremely small beta function at the interaction point introduces significant chromaticity. Correcting this chromaticity requires the use of strong sextupoles, which in turn induces substantial nonlinear effects. These nonlinearities impose strict limitations on the dynamic and momentum apertures, thereby presenting challenges for the Touschek lifetime. In this paper, we explore the physical design considerations for the STCF collider ring, with a focus on addressing these challenges. Nonlinear optimization is performed using the Multi-Objective Genetic Algorithm to enhance performance and mitigate the impact of nonlinear effects.

Footnotes

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