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(G*) (POS-31) Touschek lifetime in 4th generation light sources

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This report presents a review of the Touschek lifetime in fourth-generation accelerator machines. Specifically, the report focuses on the Møller scattering differential cross section and the loss rate of electrons within a bunch of electrons defined by longitudinal potential wells.

When electrons in a bunch move towards each other, they can interact and scatter away due to Møller scattering. Electron-electron interactions transfer momentum from the transverse plane into the longitudinal direction. If the exchanged momentum exceeds the acceptance momentum exchange threshold in the longitudinal direction, the electrons may either be left behind or pushed out of the bunch. Beam loss due to Møller scattering is a dominant effect in damping rings, ultra-low emittance storage rings.

The energy-dependent effect of Møller scattering in accelerator machines was first observed by Bruno Touschek and his colleagues in 1963. However, the observed effect was inconsistent with the asymptotic solutions at the time. To maximize the beam lifetime, it is preferable to tune the accelerator machine to have a Touschek effect dominant beam lifetime. By studying the longitudinal and transverse motions, one can calculate the Touschek effect contribution to the beam's lifetime and even decrease the scattering rate.

Overall, this report highlights the importance of understanding Møller scattering and the Touschek lifetime in fourth-generation accelerator machines and the experimental methods to increase the beam's life time in fourth generation light sources.

Keyword-1

Touschek Scattering

Keyword-2

Particle Accelerator

Keyword-3

Moller scattering

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