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加速器

Matching by solenoids in space charge dominated LEBTs

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摘要

The betatron matching of a rotationally asymmetric beam in space charge dominated low-energy beam transports (LEBTs) where solenoids are used for the transverse matching has been studied. For better understanding, the coupling elements of a beam matrix are interpreted in special forms that are products of a term defined by the Larmor rotation angle and another by the difference between the beam matrix elements in the two transverse planes. The coupling form originally derived from the rotationally symmetric field in solenoids still holds when taking into account the rotationally asymmetric space charge forces that are due to the unequal emittance in the two transverse planes. It is shown in this paper that when an LEBT mainly comprising solenoids transports a beam having unequal emittance in the two transverse planes and the linear space charge force is taken into account, the initial Twiss parameters can be modified to obtain the minimum and equal emittance at the LEBT exit. The TRACE3D calculations also prove the principle. However, when quadrupoles that are also rotationally asymmetric are involved in between solenoids, the coupling between the two transverse planes becomes more complicated and the emittance increase is usually unavoidable. A matching example using the CSNS (China Spallation Neutron Source) LEBT conditions is also presented.

关键词

betatron matching, solenoid, coupling terms, space charge force, rotationally asymmetric

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