Lawrence Berkeley National Laboratory
Recent Work

Title
Moment equation approach to chromatic aberrations in final focus systems for heavy ion fusion

Permalink
https://escholarship.org/uc/item/7gj327s6

Authors
Barnard, John J.
Lee, Edward P.

Publication Date
2003-10-30

Session RP1 - Poster Session VIII.
POSTER session, Thursday afternoon, October 30
Fran Hill Southeast Exhibit Hall, ACC

[RP1.083] Moment Equation Approach to Chromatic Aberrations in Final Focus Systems for Heavy Ion Fusion

John J. Barnard (Lawrence Livermore National Laboratory), Edward P. Lee (Lawrence Berkeley National Laboratory)

Ordinarily, the envelope equations provide adequate accuracy for rapid design calculations of rough layouts of a set of magnetic quadrupoles arranged to focus an ion beam to a small spot (for example, for the final focus system of a Heavy Ion Fusion driver.) Typically, such systems consist of four to eight large aperture quadrupole magnets preceded by a drift section. However, chromatic aberrations (depending on momentum spread) and other non-linear terms in the equations of motion may contribute significantly to the final focal spot size. We present here a moment equation approach which includes terms through second order in particle transverse position, angle and fractional momentum spread, (but which drops terms higher than a

specified order) and which treats space charge by assuming it is distributed uniformly over an elliptical cross section. Integrating the derived set of moment equations allows rapid determination of the contribution of chromatic aberrations to spot size. We compare the results of integrating moment equations with an analytic theory, as well as with Particle-In-Cell simulations.

[**Part R of program listing**](#)