

solensim project documentation

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Summary

TODO

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1 Introduction

TODO

2 Physical model

TODO Few general words

Solenoid geometry *TODO*

2.1 Beam parameters

A symmetrical, axial beam of known radius and energy distribution is assumed; the interactions of electrons within the beam are neglected.

Electron energy distribution *TODO* [2]

Beam radius *TODO* [1]

Electron momentum The formulas involving $p_{z,0}$ call for relativistic momentum [1, p. 27]. The energy-momentum relation is:

$$E^2 = p^2 + m_0^2;$$

With SI factors, this yields

$$p = \frac{1}{c} \sqrt{E^2 - m_0^2 c^4}. \quad (1)$$

2.2 Field calculation

For on-axis electrons, only the on-axis $B_z(x)$ field component is relevant [1]. The models used to describe this field are listed below.

Two-loop approximation *TODO*

2.3 Deriving characteristic values

TODO

2.4 Aberrations

TODO

Spherical aberrations *TODO*

$$1/f = \text{const.} \cdot F^2$$

$$\Delta f \simeq c \cdot x^2$$

$$x = f_1 \tan(\alpha) \simeq f \cdot \tan(\alpha)$$

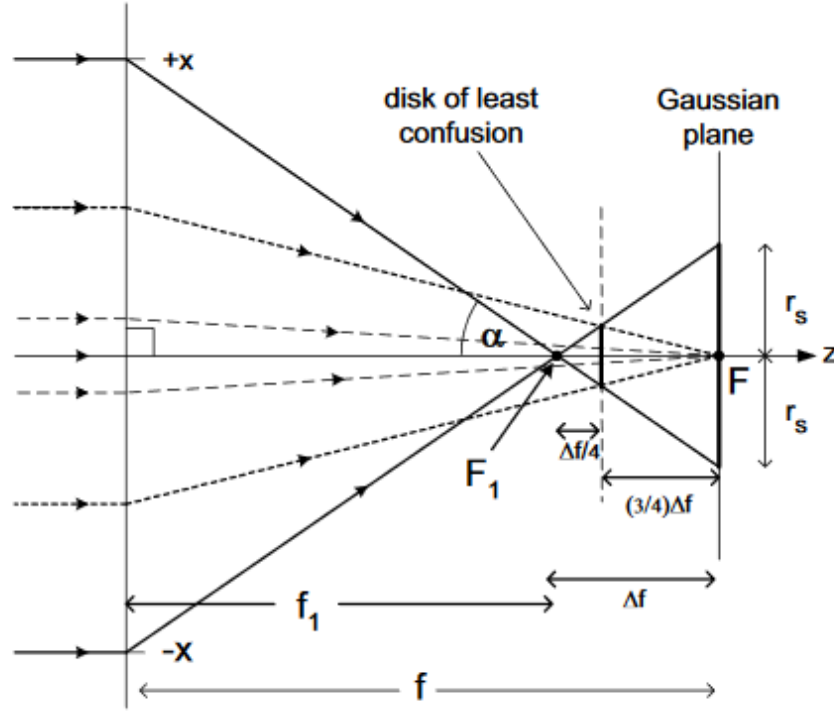


Figure 1: Focus shift due to spherical aberrations

$$r_s = \Delta f \cdot \tan(\alpha) \simeq \Delta f \cdot \alpha \approx \left(c(f \cdot \tan(\alpha))^2 \right) \cdot \tan(\alpha) = C_s \tan(\alpha)^3 = C_s \cdot \left(\frac{\max\{x\}}{f - \Delta f} \right)^3$$

$$\underset{f \approx f_1}{=} C_s \cdot \left(\frac{\max\{x\}}{f} \right)^3 \quad (1)$$

If $f \not\approx f_1$ then replace f in (1) with $f - \max\{x\}^2 \cdot \frac{C_s}{f^2}$

2.4.1 Chromatic aberrations

TODO

3 Project concept and implementation

TODO

4 Software manual

TODO

References

- [1] T. Gehrke. “Design of Permanent Magnetic Solenoids for REGAE”. MA thesis. Hamburg: Universität Hamburg, 2013.
- [2] B. Grigoryan et al. “Status of AREAL RF Photogun Test Facility”. In: *Proceedings of IPAC2014, Dresden, Germany* (Dresden, Germany). International Particle Accelerator Conference 5. <https://doi.org/10.18429/JACoW-IPAC2014-MOPRI017>. Geneva, Switzerland: JACoW, July 2014, pp. 620–623. ISBN: 978-3-95450-132-8. DOI: <https://doi.org/10.18429/JACoW-IPAC2014-MOPRI017>. URL: <http://jacow.org/ipac2014/papers/mopri017.pdf>.