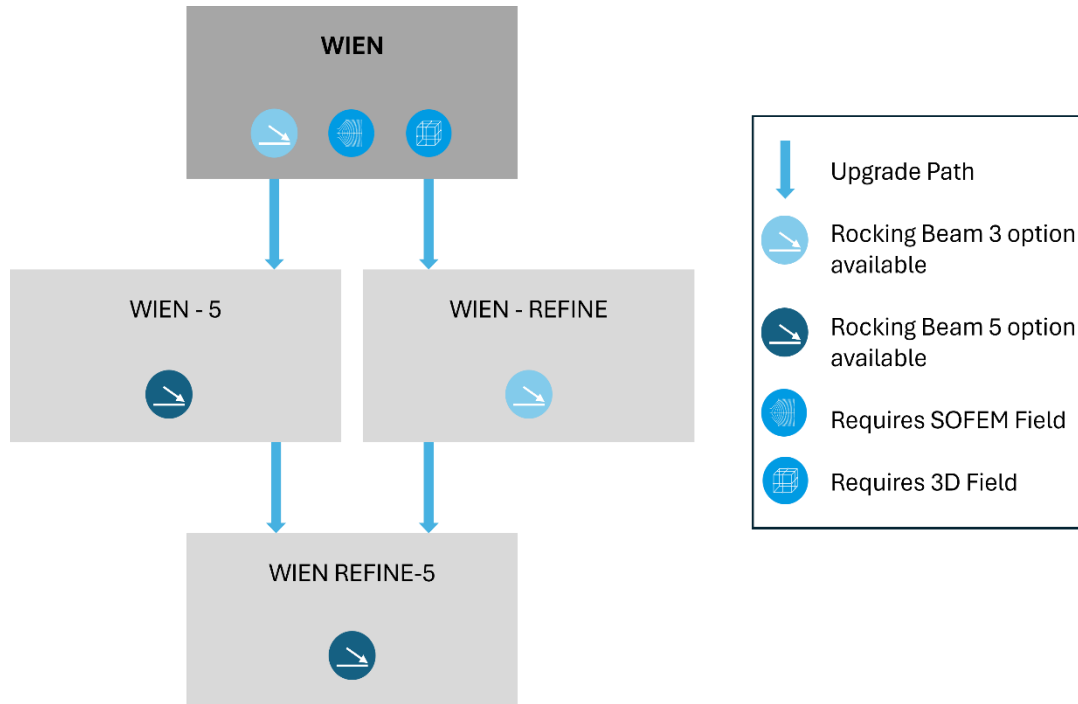




WIEN & WIEN-5

Column design including Wien Filters



Overview

The WIEN software handles the analysis of the optics of straight-axis systems that contain a Wien filter plus any combinations of electrostatic and magnetic round lenses, quadrupole lenses, hexapole lenses and octopole lenses. If a Wien filter is not present, then a deflection system consisting of a magnetic or electrostatic dipole element can also be included. The program can handle both Gaussian round-beam and shaped-beam systems.

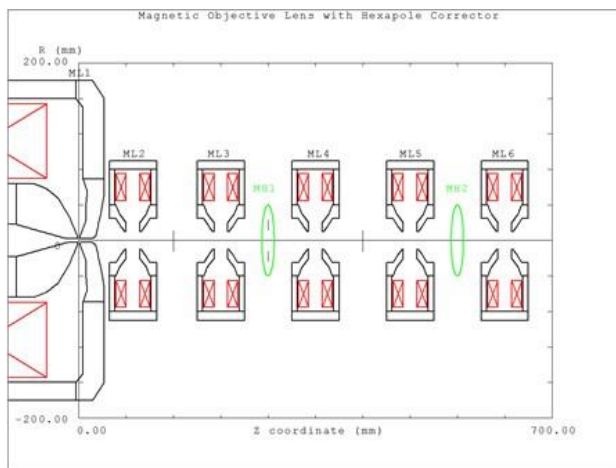
WIEN-5 extends the capabilities of WIEN to include aberrations up to 5th – order.

The input data for WIEN includes the imaging condition data (e.g. the positions of object and image planes) and the optical element parameters (e.g. the positions and strengths of the elements). The field functions of the round lenses, quadrupole lenses and Wien filters are computed with our software packages SOFEM and 3D (available separately). The axial field functions are fitted with Hermite series to enable their high-order derivatives to be computed accurately. The program can handle both Gaussian round-beam and shaped-beam systems.

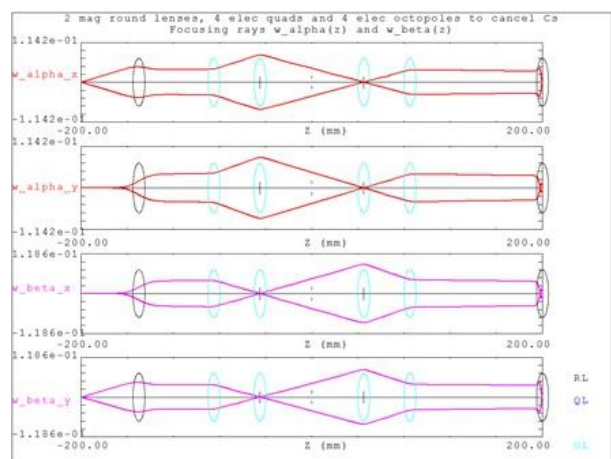
The program will compute the first-order optical properties for any setting of the electric and magnetic deflection parts of the Wien filter. This enables the required strength of the deflectors to be chosen to give the desired deflection of the return beam. For the primary beam, the user can set the strength of the electrostatic dipole field and the program will adjust the strength of magnetic dipole field in the filter in order to satisfy the Wien condition to allow the beam to pass through the filter with zero net deflection. The first-order optical properties are computed by numerical solution of the paraxial ray equation. The aberrations are computed by evaluating a differential algebra ray-trace.

The computed optical properties include: the optical element settings after focusing and filter adjustment (e.g. the lens excitations, the filter deflector strengths); the first-order optical properties (e.g. column magnifications and dispersions) and tables of the second and third-order geometric and first order chromatic aberration coefficients. This numerical output can subsequently be displayed graphically as aberration spot diagrams and is used to compute the aberration values for the given initial conditions.

If the Wien filter is replaced by a single-channel deflection system, the program can operate the deflectors in two modes: scanning or rocking. In scanning mode, the deflectors move the beam linearly over the target. In rocking mode, the beam does not move linearly over the image plane but is fixed on the optical axis: instead, the deflector can be used to tilt the beam.



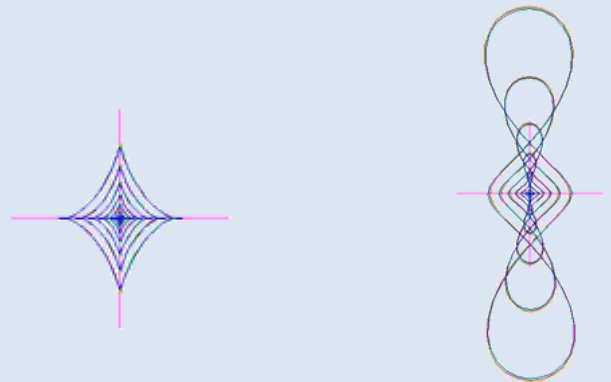
Layout of Hexapole Cs Corrector



Paraxial Rays in quadrupole/octopole Cs corrector

WIEN-5 is an extension of WIEN which computes the second, third, fourth and fifth-order geometrical aberrations and chromatic aberrations up to fourth-rank. Intermediate images do not need to be stigmatic, however the computed aberration coefficients are meaningful only if the beam is stigmatically focused in both x and y directions at the final image plane.

WIEN-5 also has an integrated aberration spot generator to visually show the aberration effects using the computed aberration coefficients and given initial image conditions, such as beam half angle, beam size, deflection parameter at either object or image plane. The spot plots can include only the primary aberrations or a combination of all aberrations up to 5th-order.



Spot for Cs Corrector – 3rd-order aberrations

Spot for Cs Corrector – 5th-order aberrations