

WIEN REFINE & WIEN REFINE-5







Overview

The WIEN-REFINE module takes the initial design of the column, and interactively refines it to optimise the performance. A electron beam column contains many design parameters that can be varied and there are numerous aberrations which each depend on the variable parameters. WIEN-REFINE allows the user to choose which design parameter to vary and which aberration to target. The program then runs several optimisation cycles and generally yields designs with better properties than those obtained through trial and error.

The WIEN-REFINE-5 module extends the functionality of WIEN-REFINE to allow optimisation of the aberrations up to 5^{th} – order terms.



After defining the imaging conditions data, optical element settings and parameter values and the focus constraints for the autofocus scheme, as in WIEN or WIEN-5, the weighting factors can be specified for the optimisation scheme. Use of additional optical elements can reduce the aberrations introduced in the original system. In addition, if we have a deflection system to scan or rock the beam, the deflection aberrations will, in general, scale with deflection field strength: we call these aberrations the dynamic deflection aberrations. We can use additional optical elements whose strength varies with deflection field strength to correct some aberrations introduced by the deflection system: we call these additional optical elements the dynamic correction elements.

Common dynamic correction elements include a round lens to correct for normal deflection field curvature, a quadrupole element to correct for normal deflection astigmatism.

Optimization Process										
BEFORE Optimization										
Jefined properties			2nd order aberration (microns)							
	× direction	y direc 🔺	Dependency	AP	BA	DI A				
Column Magnification	8.859231	8.8592	Aper. Angle	0.000000						
Image Rotation (degree) ∢ III	-10 599639	-10 6991	•							
Spot Diagram @ Axis:			Overall beam blur due to 2nd order aberrations = 0.000000 (microns) 3rd order geometrical and 2nd rank chromatic aberrations (microns)							
			Dependency	AP	CO	FC	AS	DI	CA A	
			Aper. Angle	0.001948					0.0012	
	1								*	
			•						÷	
			Overall beam due	to 3rd order geometr	rical and 2nd ran	k chromatic aberratio	ons		0.002321 (microns)	
AFTER Optimization Cycle 2 Defined properties			2nd order aberra	tion (microns)						
	x direction	y direc 🔺	Dependency	AP	BA					
Column Magnification	8.859231	8.8592	Aper. Angle	0.000005		*				
(III Rotation (dansa)	-10 599638	-10 5991	< III			P.				
			Overall beam blur o	due to 2nd order abe	errations =				0.000005 (microns)	
@ Axis:										
			and order geomet	trical and 2nd ran	K Chromatic at	errations (micron	s)		a	
			Dependency	AP	CO	FC	AS	DI	CA A	
			Aper. Angle	0.000002					0.00128	
	T									
									*	
			٠						•	
			Overall beam due t	o 3rd order geometri	ical and 2nd rank	chromatic aberratio	ns		0.001261 (microns)	
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WIEN-REFINE-5 Optimisation Control Screen

Both WIEN-5 and WIEN-REFINE-5 can handle round lenses and multipole lenses that can be used to compensate the dynamic deflection aberrations. In addition, the optimisation function in WIEN-REFINE-5 can be used to compute the required settings (strength and/or rotation angle) for the dynamic correction elements to compensate the deflection aberrations.

In the software, the dynamic correction elements are not energised during the autofocus procedure, but they are switched on when the beam is in focus and the deflection system is energised. The settings of the dynamic correction elements are then optimised to reduce or eliminate the chosen set of deflection aberrations.

