Appendix A

List of acronyms

AES	**A**uger **e**lectron **s**pectroscopy
CD	**C**ircular **d**ichroism
EAL	**E**ffective **a**ttenuation **l**ength
EXAFS	**E**xtended **x**-ray **a**bsorption **f**ine **s**tructure
IMFP	**I**nelastic **m**ean **f**ree **p**ath
LEED	**L**ow **e**nergy **e**lectron **d**iffraction
LEEM	**L**ow **e**nergy **e**lectron **m**icroscopy
LUMO	**L**owest **u**noccupied **m**olecular **o**rbital
Hg-PEEM	**P**hoto**e**lectron **e**mission **m**icroscopy with a mercury short arc lamp
HOMO	**H**ighest **o**ccupied **m**olecular **o**rbital
MEM	**M**irror **e**lectron **m**icroscopy
NEXAFS	**N**ear-edge **x**-ray **a**bsorption **f**ine **s**tructure
OMBE	**O**rganic **m**olecular **b**eam **e**pitaxy
PED	**P**hoto**e**lectron **d**iffraction
PES	**P**hoto**e**lectron **s**pectroscopy
PEEM	**P**hoto**e**lectron **e**mission **m**icroscopy
PTCDA	3,4,9,10-**p**erylene-**t**etra**c**arboxylic acid **d**i**a**nhydride
SEXAFS	**S**urface **e**xtended **x**-ray **a**bsorption **f**ine **s**tructure
SPA-LEED	**S**pot-**p**rofile **a**nalysis **l**ow **e**nergy **e**lectron **d**iffraction
STM	**S**canning **t**unneling **m**icroscopy

SMART	**S**pectro-**m**icroscope for **a**ll **r**elevant **t**echniques
or	**S**pectro-**m**icroscope with **a**berration correction for **r**esolution and **t**ransmission ehnhancement
UPS	**U**ltraviolet **p**hotoelectron **s**pectroscopy
UV-PEEM	**U**ltra-**v**iolet **p**hoto**e**lectron **e**mission **m**icroscopy
VPEEM	**V**alence-band **p**hoto**e**lectron **e**mission **m**icroscopy
XAS	**X**-ray **a**bsorption **s**pectroscopy
XMCD	**X**-ray **m**agnetic **c**ircular **d**ichroism
XNCD	**X**-ray **n**atural **c**ircular **d**ichroism
XPEEM	**X**-ray **p**hoto**e**lectron **e**mission **m**icroscopy
XPS	**X**-ray **p**hotoelectron **s**pectroscopy

Appendix B

Alignment of the SMART using pairs of dipoles

Aligning the microscope is not a simple matter and is very time consuming. Then why should one even bother? The reason is simple: a misaligned microscope will never reach high resolution and may be unusable. The main ingredients for alignment are patience and understanding of what *happens* inside. In the following some problems and relative solutions will be analyzed. It is not meant to be a comprehensive alignment manual, but rather a description of cardinal alignment steps typical of this system.

The idea followed in the alignment of the instrument is that there has to be a ray that perpendicularly leaves the surface, goes through the center of each optical element and reaches the screen in its center. For how simple this is to be written, achieving it can get enormously complicated and time costly. Most of the complication regarding this microscope is related to the presence of new optical elements, such as the electrostatic mirror combined with the non-energy dispersive beam splitter. Fortunately the alignment of the energy filter has been already addressed and fully described from both theoretical [33] and experimental point of view.

As a first step, one of the most recurring alignments is done in the transfer optics using pairs of electrostatic deflectors. Then the problem of the combination of an electrostatic mirror with the beam splitter is addressed.

The alignment of the transfer optics is done by centering the optical path through the center of each lens. Beyond mechanical adjustment, taken care of during assembly

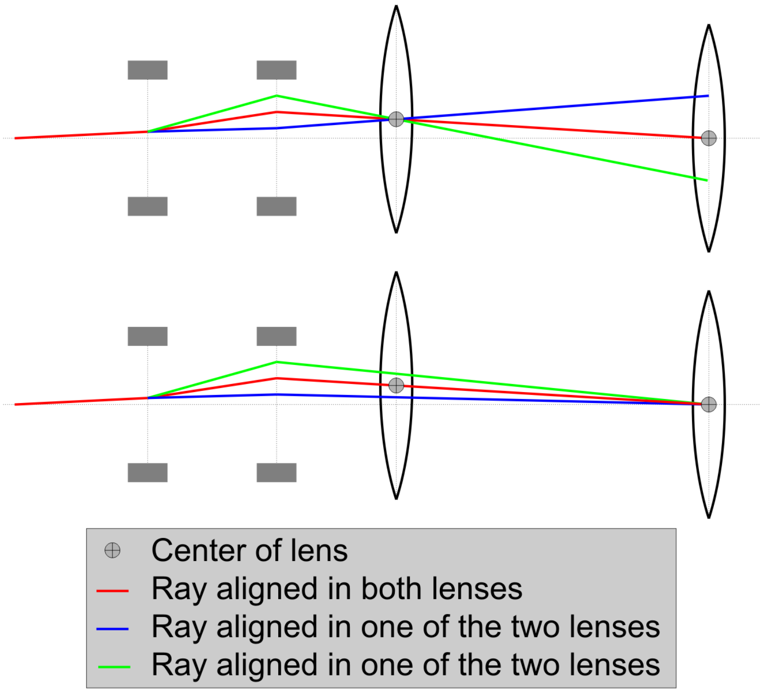

Figure B.1: Side view of the effect of the combined mode on the alignment with two deflectors of two lenses. In the top part the rays are pinned inside the first lens and the position inside the second lens is scanned; in the bottom part the rays are pinned inside the second lens and the position of the rays inside the first lens is scanned. In both cases only the red line is centered in both lenses.

of the optical components, electrostatic adjustment comes into play by means of electrostatic deflectors. Because of space constrain, lenses are often coupled together, and the alignment is done by centering the beam using two deflectors in front of the lenses. Since the deflection is linear with the voltage applied to the deflector, it is possible to combine the effect of both deflectors. The best way to combine the two deflectors is to have the beam position change only in one lens at a time. An example of this is shown in figure B.1.

Although each deflector deflects along the two axis perpendicular to the optical axis, the problem can be approached analyzing only one of the two. Let V_1 and V_2 be the voltage applied to deflectors D_1 and D_2. The two voltages can be combined using

C_1 and C_2 as given by the equations:

$$\begin{cases} V_1 = \alpha_1 C_1 + \beta_1 C_2 \\ V_2 = \alpha_2 C_1 + \beta_2 C_2 \end{cases} \tag{B.1}$$

The parameters α_1, α_2, β_1 and β_2 can be easily obtained experimentally by solving the previous set of equations for C_1 and C_2, which results in:

$$\begin{cases} C_1 = \frac{1}{\alpha_1\beta_2 - \alpha_2\beta_1}(\beta_2 V_1 - \beta_1 V_2) \\ C_2 = \frac{1}{\alpha_1\beta_2 - \alpha_2\beta_1}(\alpha_2 V_1 - \alpha_1 V_2) \end{cases} \tag{B.2}$$

For each linear equation only two measurement points are needed. Once all parameters are determined, which depend on the initial geometrical assembly of the system (the mechanical center of each lens and relative distances) and on the initial position and tilt of the incoming beam, equation (B.1) can be used to define two new axes. These axes are named C_1 and C_2 and control at the same time both voltage parameters of the deflectors. Now with a two-step procedure, the optimal alignment is reached as shown in figure B.2.

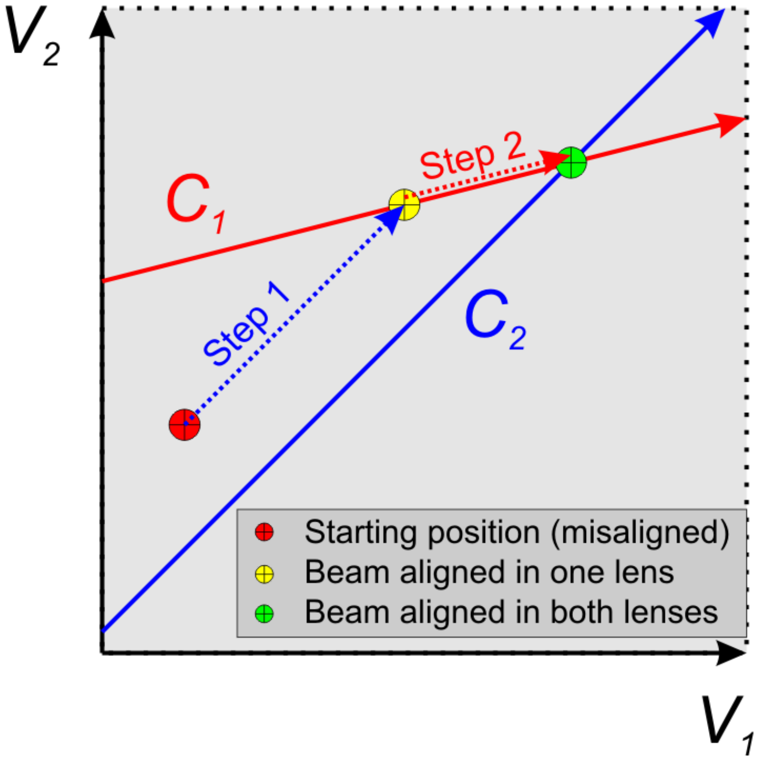

Figure B.2: Theoretical plot of the linear combination of deflector voltages V_1 and V_2 in order to obtain the new axes C_1 and C_2 which allow for the pinning in lenses 1 or 2 respectively. The use of this combined mode allows for a two-step alignment as shown from a hypothetical starting point through steps 1 and 2.

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