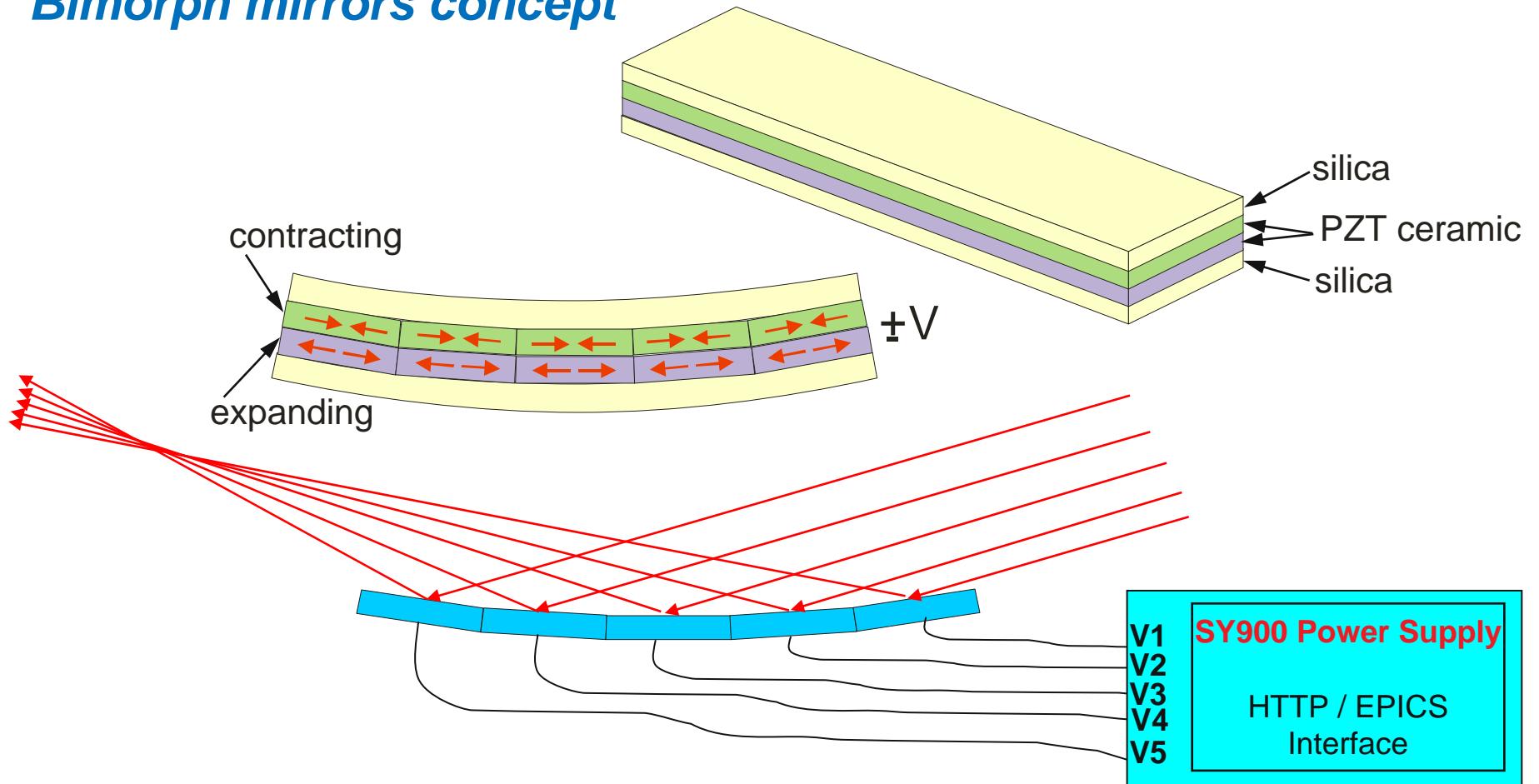


GMCA controls for bimorph mirrors

Sergey Stepanov

GMCA CAT at the APS, BioSciences Division, ANL

Bimorph mirrors concept



ADVANTAGES: multiple focus adjusting parameters vs 1 or 2 with bender (plot above: 5; GMCA VFM: 16, GMCA HFM: 14)

DISADVANTAGES: very slow; cross-talk between segments

Controls supplied by vendor (ACCEL GmbH)

SY900 High Voltage power controller by ELETTRA:

- Embedded Linux (like EPICS brick)
- Web interface (refreshing every 15 seconds)
- EPICS interface: no save/restore, no interrupts, no way to save PV query rate
- MEDM screens: need work (only some samples provided)
- Response matrix calculator: part of WWW interface at extra charge (no EPICS)

http://kbm1:8080/webclient/group1.xcs

SY900
High Voltage Power Supply Controller

Group "23i:HFM" - Cruise

00	01	02	03	04	05	06	07	08	09	10	11	12
●	●	●	●	●	●	●	●	●	●	●	●	●
-90.6 V	-131.2 V	-37.5 V	-186.2 V	-322.7 V	-151.3 V	68.5 V	-100.6 V	-59.4 V	-34.5 V	-163.9 V	-37.1 V	-205.7 V

[Stop Automatic Refresh](#) - Next refresh in 9 secs - [Refresh Now](#)

Activity Indicator ●

MODIFY

Adaptive Correction Matrix Focusing Distance Driver Modify Voltages

Vendor Controls - continued

http://kbm1:8080/webclient/set/group1.html

Group "23i:HFM" - Cruise Group "23i:HFM" - Modify

Group "23i:HFM" - Modify

00	01	02	03	04	05	06	07	08	09	10	11	12
Set (V)	Set (V)	Set (V)	Set (V)	Set (V)	Set (V)	Set (V)	Set (V)	Set (V)	Set (V)	Set (V)	Set (V)	Set (V)
Shift (V)	Shift (V)	Shift (V)	Shift (V)	Shift (V)	Shift (V)	Shift (V)	Shift (V)	Shift (V)	Shift (V)	Shift (V)	Shift (V)	Shift (V)
-90.6 V	-131.2 V	-37.5 V	-186.2 V	-322.7 V	-151.3 V	68.5 V	-100.6 V	-59.4 V	-345 V	-163.9 V	-37.1 V	-205.7 V
Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)	Trgt(V)

ALL CHANNELS

Set Voltages	Shift Voltages	Set Target Voltages	Power	Op. Mode	Last Error
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="ON"/>	<input checked="" type="radio"/> HI accuracy <input type="radio"/> Normal <input type="radio"/> Fast	<input type="button" value="READ"/>
<input type="button" value="Set (V)"/>	<input type="button" value="Shift (V)"/>	<input type="button" value="Trgt(V)"/>	<input type="button" value="OFF"/>	<input type="button" value="CHANGE"/>	<input type="button" value="RESET"/>

GMCA Controls: structure

- MEDM screens
- Scripting library (Perl / Pezca)
- Utility scripts (Perl / Pezca)
- GUI frontends: Tcl/Tk



GMCA MEDM screens-1

Simple controls



Advanced controls



GMCA MEDM screens-2

PV query rate controls

MirrorScan_07.adl 23i:HFM

Mirror PV Scan Controls: <http://kbml.gmca.aps.anl.gov:8080>

Channel	Vout	RqsPos	RqsRel	Vtarget	RqsTgt
CH00	-90.600 V	0.000 V	-15.000 V	-90.60000 V	-201.600 V
CH01	-131.20 V	0.000 V	-15.000 V	-131.2000 V	-241.500 V
CH02	-37.500 V	0.000 V	-15.000 V	-37.50000 V	-102.500 V
CH03	-186.20 V	0.000 V	-15.000 V	-186.2000 V	-198.400 V
CH04	-322.70 V	0.000 V	-15.000 V	-322.7000 V	-267.500 V
CH05	-151.30 V	0.000 V	-15.000 V	-151.3000 V	-222.400 V
CH06	68.5000 V	0.000 V	-15.000 V	68.50000 V	52.800 V

ALL VOLT 0.000 V ALL SHIFT 0.000 V ALL-ON GO TARGET ALL-OFF

LastErr: 9900 Reset LastErr Err Help mode=0 0=Accu 1=Norm 2=Fast

SY900S controller

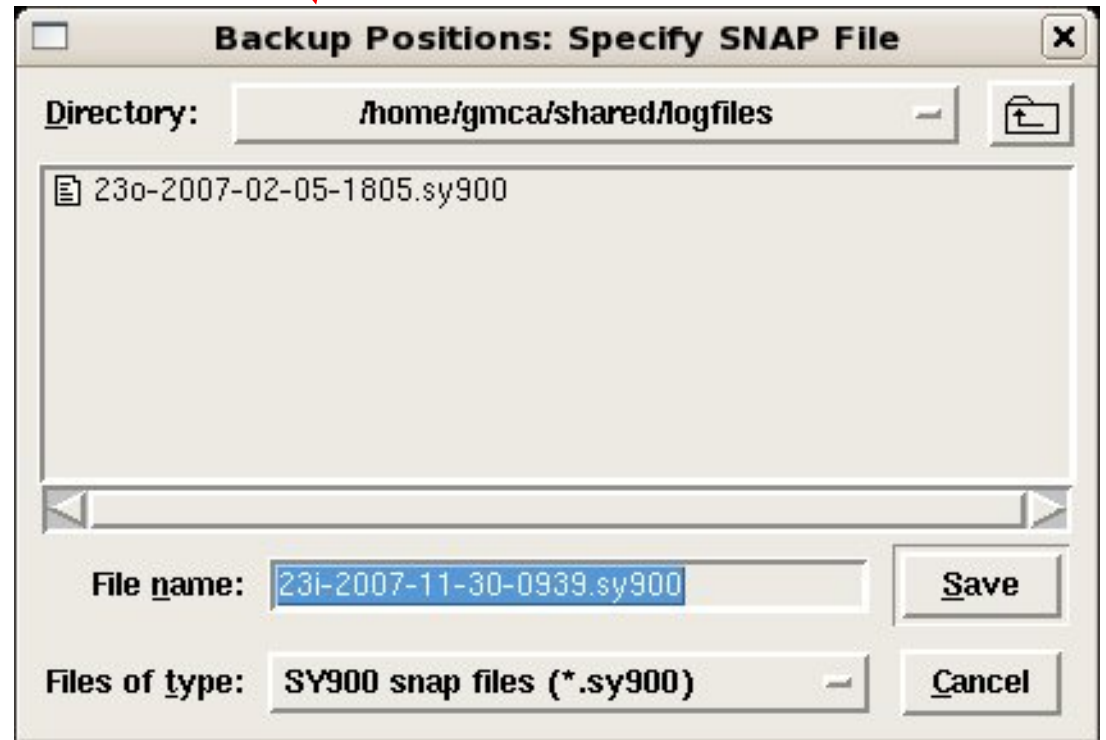
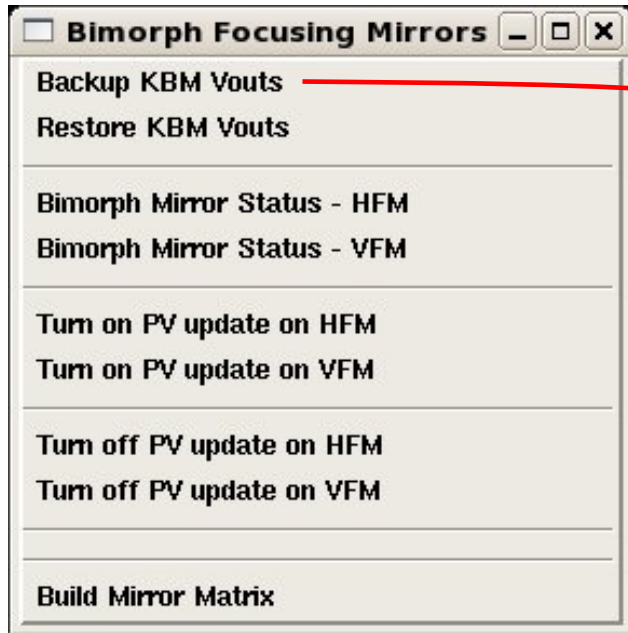
GMCA scripting library for bimorphs (Pezca)

```
1.      $status = &setSY900 ($mirror,$nchannels);
2.      $status = &setSY900refresh ($mirror,$nchannels,$rate);
3.      $status = &checkSY900refresh ($mirror);
4.      $status = &readSY900all ($mirror,$nchannels,\@ActPos);
5.      $status = &readSY900ch ($mirror,$channel,\$ActPos);
6.      $status = &setTgtSY900all ($mirror,$nchannels,\@TgtPos);
7.      $status = &setTgtSY900ch ($mirror,$channel,\$TgtPos);
8.      $status = &goTgtSY900 ($mirror,$nchannels);
9.      $status = &setRqsSY900all ($mirror,$nchannels,\$RqsPos);
10.     $status = &shiftRqsSY900all ($mirror,$nchannels,\$RqsRel);
11.     $status = &setRqsSY900ch ($mirror,$channel,\$RqsPos);
12.     $status = &shiftRqsSY900ch ($mirror,$channel,\$RqsRel);
13.     $status = &waitSY900 ($mirror);
14.     $status = &waitSY900all ($mirror,$nchannels);
15.     $status = &waitSY900ch ($mirror,$channel);
16.     $status = &statusSY900 ($mirror);
17.     $status = &statusSY900ch ($mirror,$channel);
18.     ($channel,$errcode) = &decodeSY900err ($mirror,[$error]);
19.     $status = &getSY900err ($mirror, \$error);
20.     $status = &clearSY900err ($mirror);
21.     $status = &getSY900mode ($mirror,\$mode);
22.     $status = &setSY900mode ($mirror,\$mode);
23.     $status = &SY900on ($mirror,$nchannels);
24.     $status = &SY900off ($mirror,$nchannels);
```


GMCA utility scripts built on top of bimorph scripting library

- mirrorBimorph_PVstart.pl
- mirrorsBackup.pl
- mirrorsRestore.pl
- mirrorMatrix.pl → filesCentroid.pl → mirrorMatrixUpload.pl
- centerMirror.pl (*no focusing operations*)

Saving bimorphs voltages in named backups



Restoring voltages from named backups

Bimorph Focusing Mirrors

Backup KBM Vouts
Restore KBM Vouts

Bimorph Mirror Status - HFM
Bimorph Mirror Status - VFM

Turn on PV update on HFM
Turn on PV update on VFM

Turn off PV update on HFM
Turn off PV update on VFM

Build Mirror Matrix

Restore SY900 Vout: Open SNAP File

Directory: /home/gmca/shared/logfiles

- 23i-2007-11-30-0939.sy900
- 23o-2007-02-05-1805.sy900

File name:

Files of type: SY900 snap files (*.sy900)

Open Cancel

MirrorsRestore.tcl

/home/gmca/shared/logfiles/23i-2007-11-30-0939.sy900

Date = Fri Nov 30 09:40:37 2007
User = gmca
Line = 23i

Select All
Unselect All
Another File
RESTORE

- Mirror 23i:HFM
 - * 00 -> -90.600
 - * 01 -> -131.200
 - * 02 -> -37.500
 - * 03 -> -186.200
 - * 04 -> -322.700
 - * 05 -> -151.300
 - * 06 -> 68.500
 - * 07 -> -100.600
 - * 08 -> -59.400
 - * 09 -> -345.000
 - * 10 -> -163.900
 - * 11 -> -37.100
 - * 12 -> -205.700
 - * 13 -> -323.600
- Mirror 23i:VFM
 - * 00 -> 57.600
 - * 01 -> -115.300
 - * 02 -> 7.900
 - * 03 -> 121.200
 - * 04 -> 80.000
 - * 05 -> 58.200
 - * 06 -> 106.500
 - * 07 -> 99.800
 - * 08 -> 198.100
 - * 09 -> 256.100
 - * 10 -> 139.700
 - * 11 -> 177.400
 - * 12 -> 148.000
 - * 13 -> 29.800
 - * 14 -> 9.100
 - * 15 -> -70.100

Building and uploading adaptive correction matrix

Advanced operations in SY900 controller (extra charge)

Group "23i:HFM"

03	04	05	06
-186.2 V	-322.7 V	-151.3 V	68.5 V

Stop Automatic Refresh - Next refresh in

Activity Indicator

MODIFY

Adaptive Correction Matrix **Focusing Distance Driver**

23i:HFM

Pulse Files Upload

Remember to upload PULSE files in the right sequence
1st: no pulse on any electrode; 2nd: pulse on first electrode; 3rd: pulse on first & second electrode; ... ; (N+1)th: pulse on ALL n electrodes of the mirror

Shape [00..00]	<input type="text"/>	<input type="button" value="Browse..."/>
Shape [10..00]	<input type="text"/>	<input type="button" value="Browse..."/>
Shape [11..00]	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
....	<input type="text"/>	<input type="button" value="Browse..."/>
Shape [11..10]	<input type="text"/>	<input type="button" value="Browse..."/>
Shape [11..11]	<input type="text"/>	<input type="button" value="Browse..."/>

Pulse Voltage (Volt):

23i:HFM

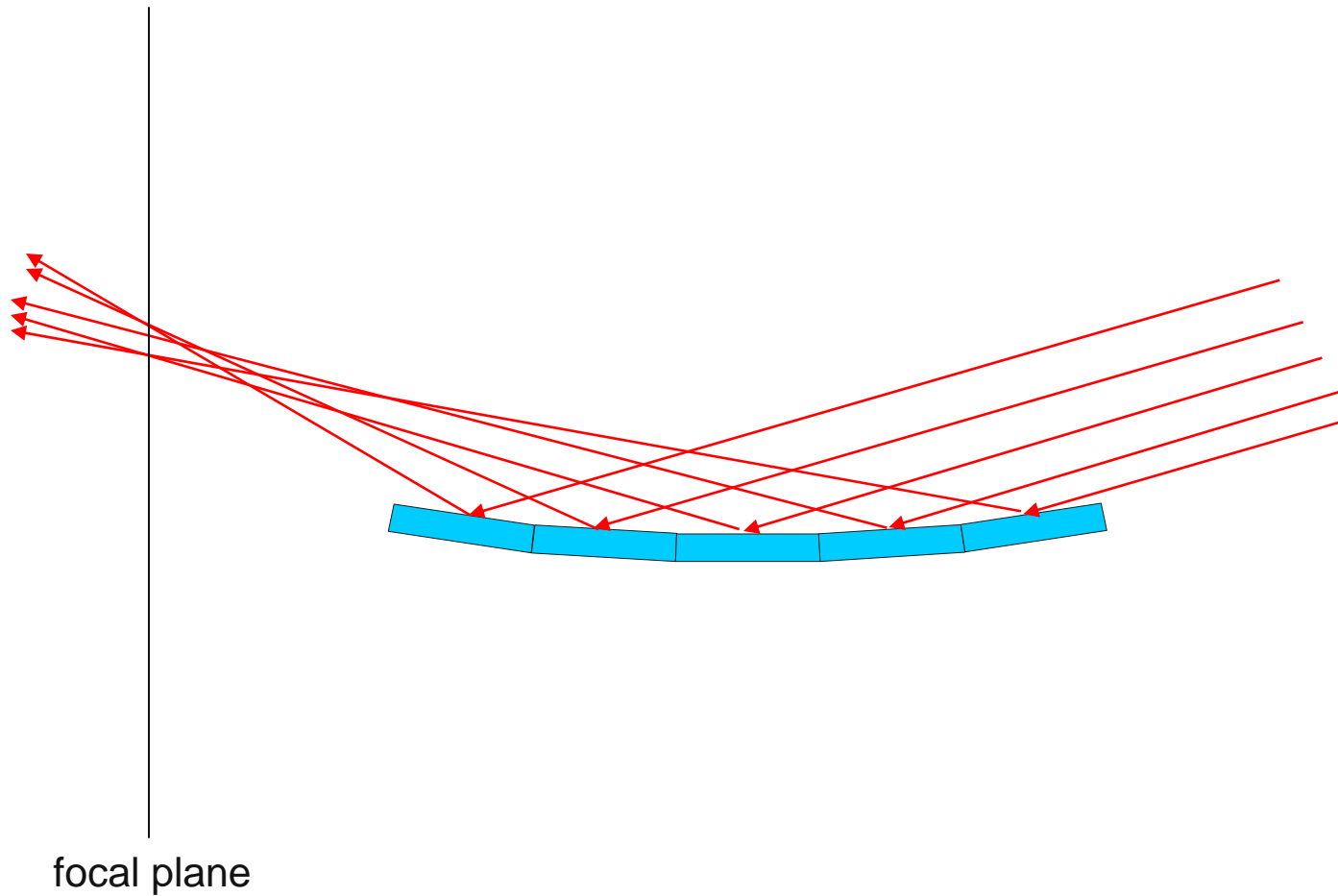
Calculate New CORRECTION vector

Input error file

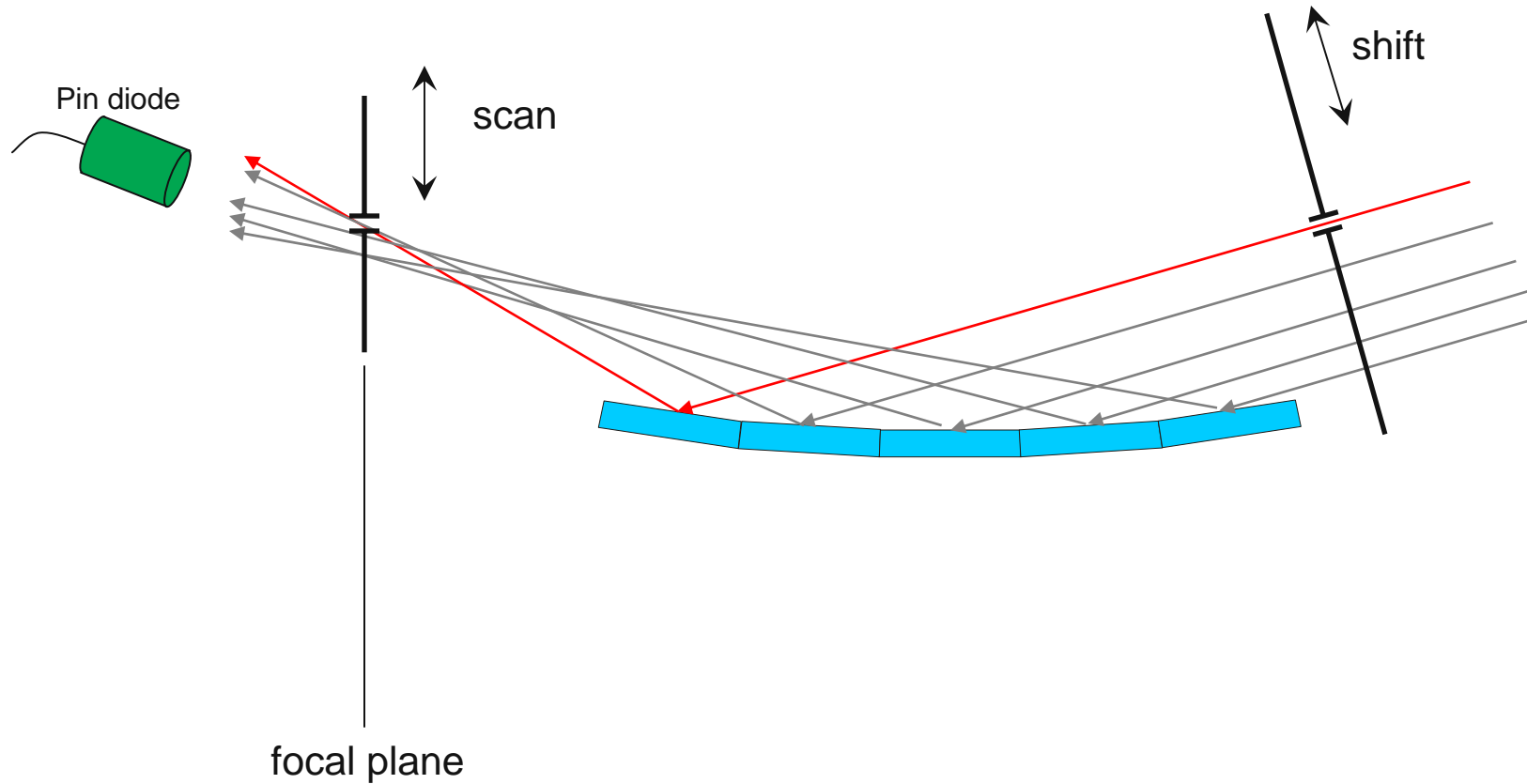
Calculate New INTERACTION MATRIX

Number of Pulse files

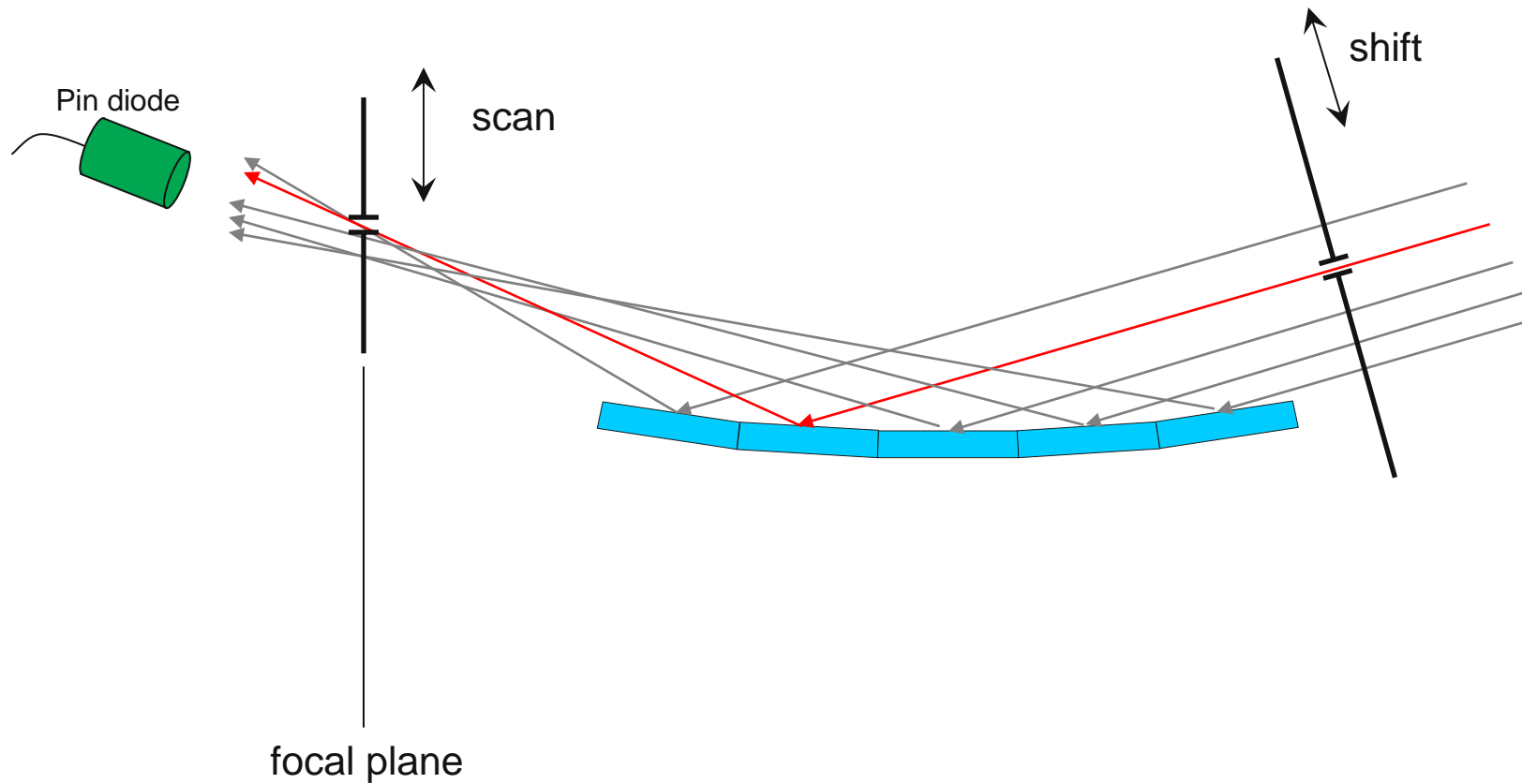
How correction matrix data is collected



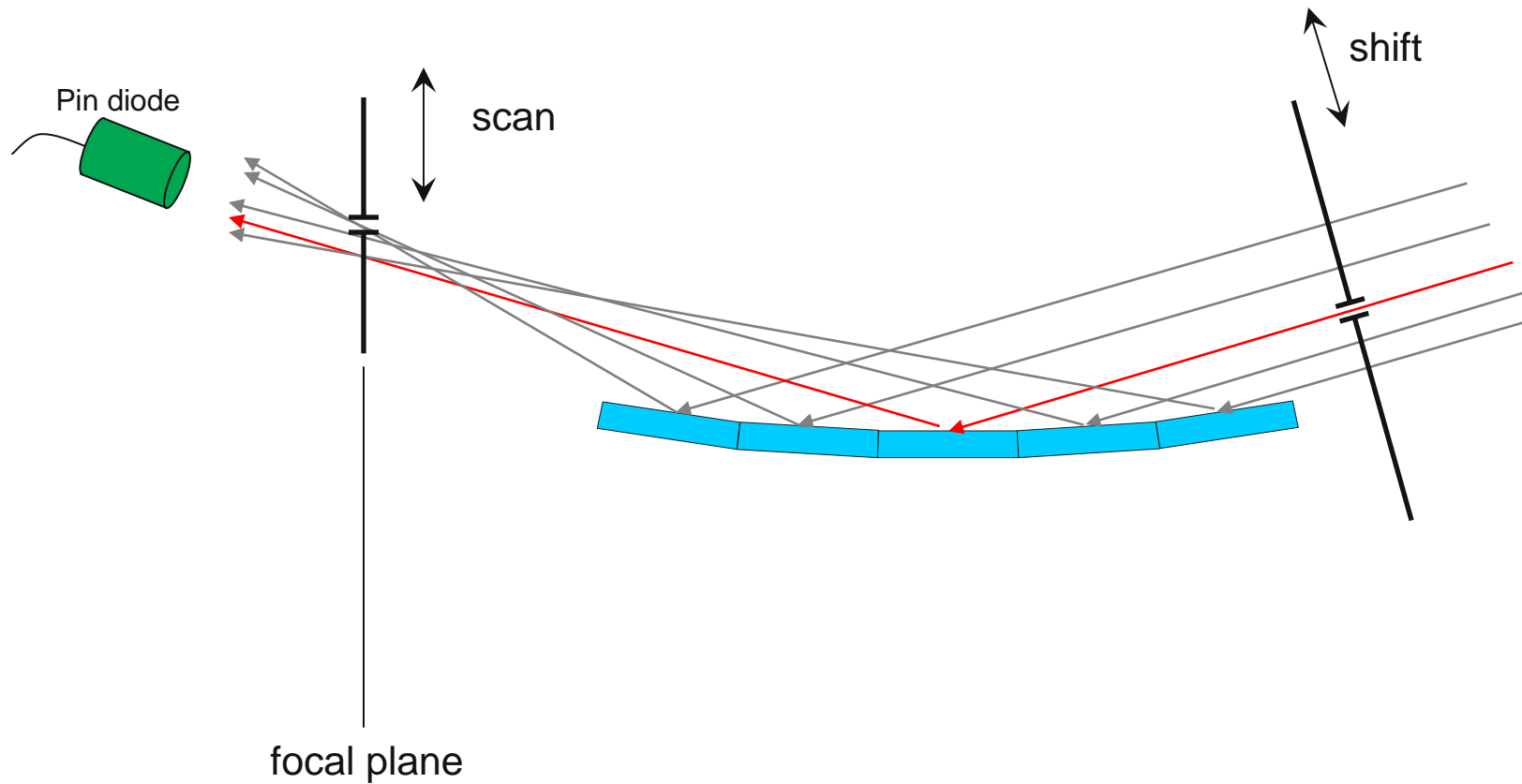
How correction matrix data is collected



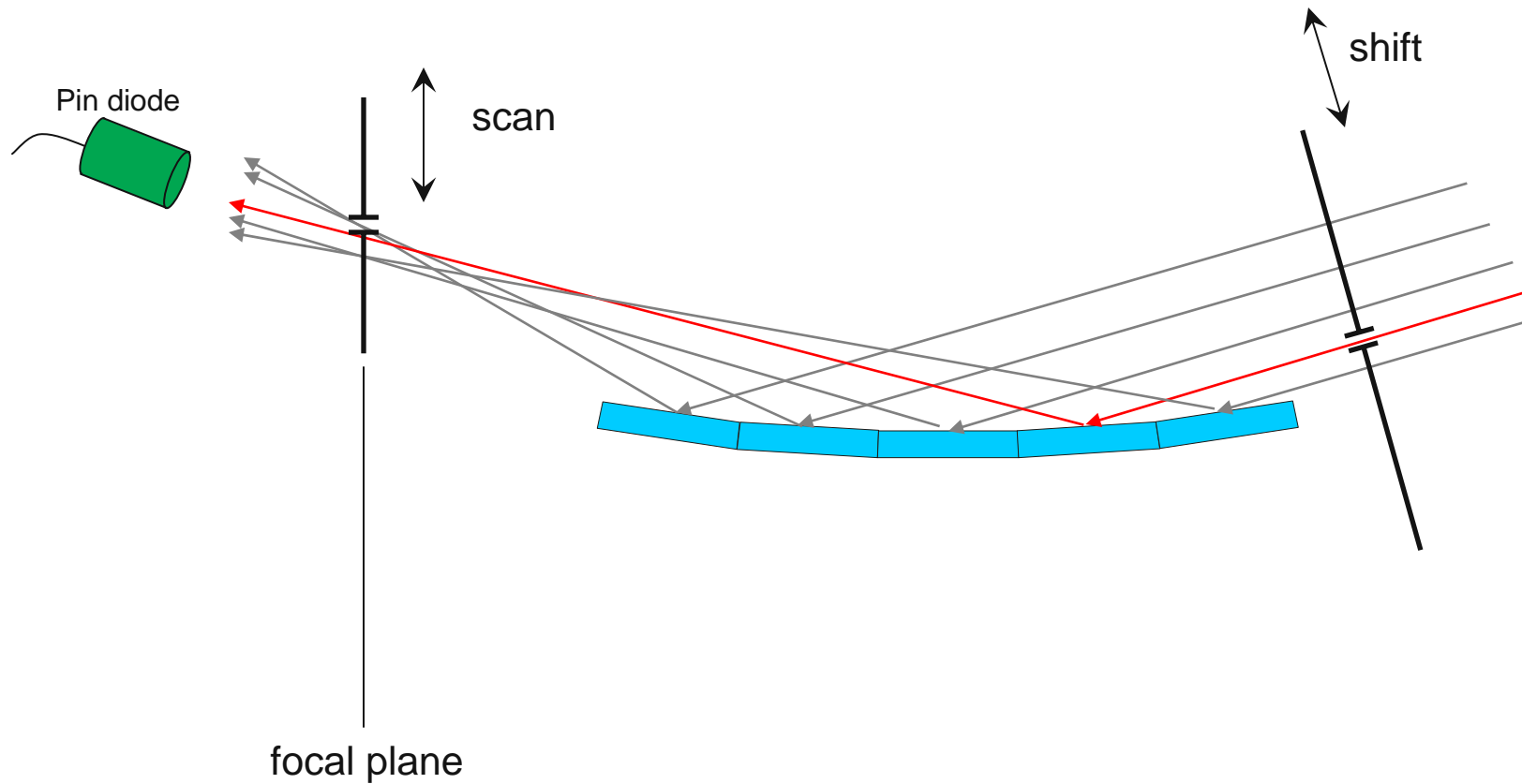
How correction matrix data is collected



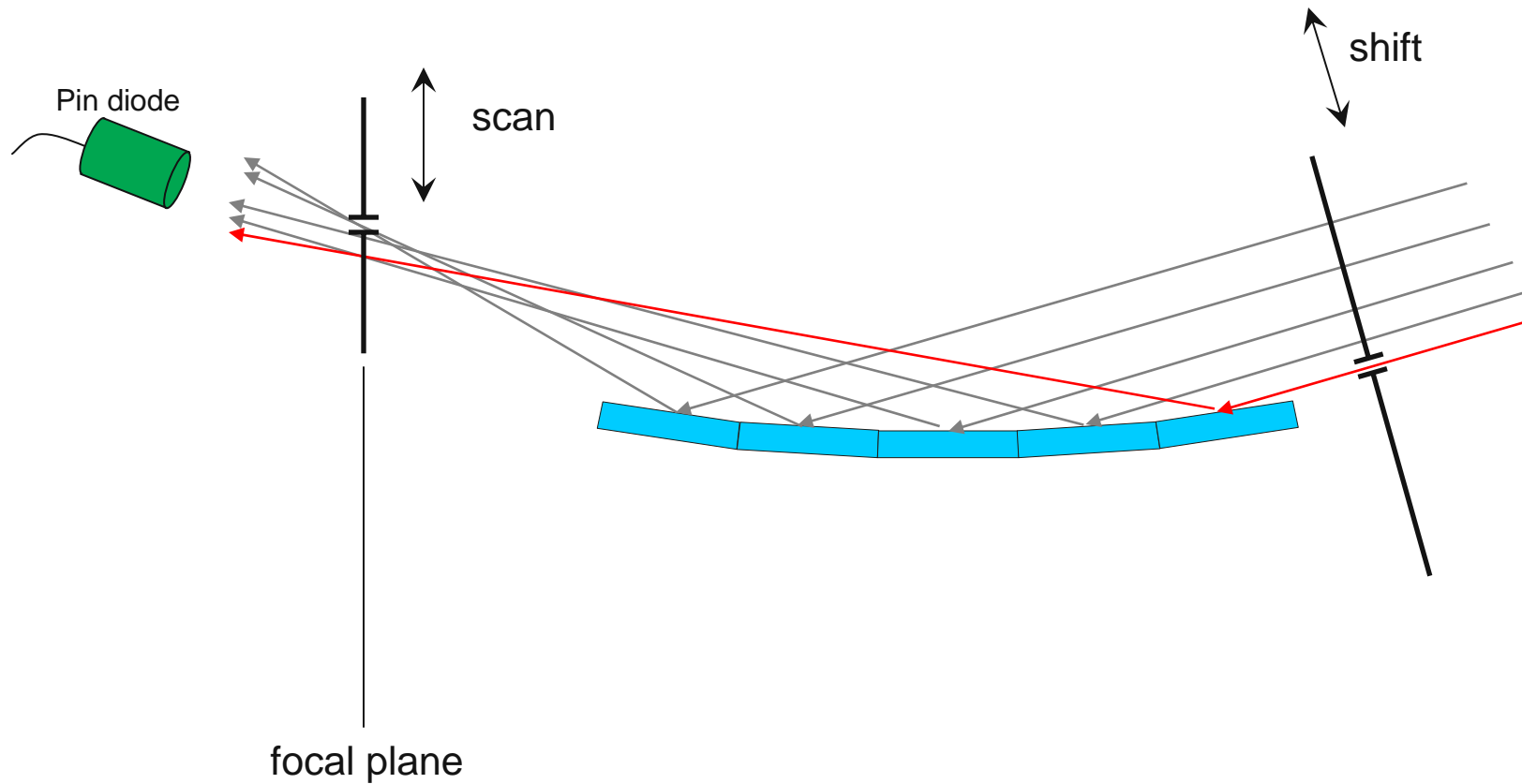
How correction matrix data is collected



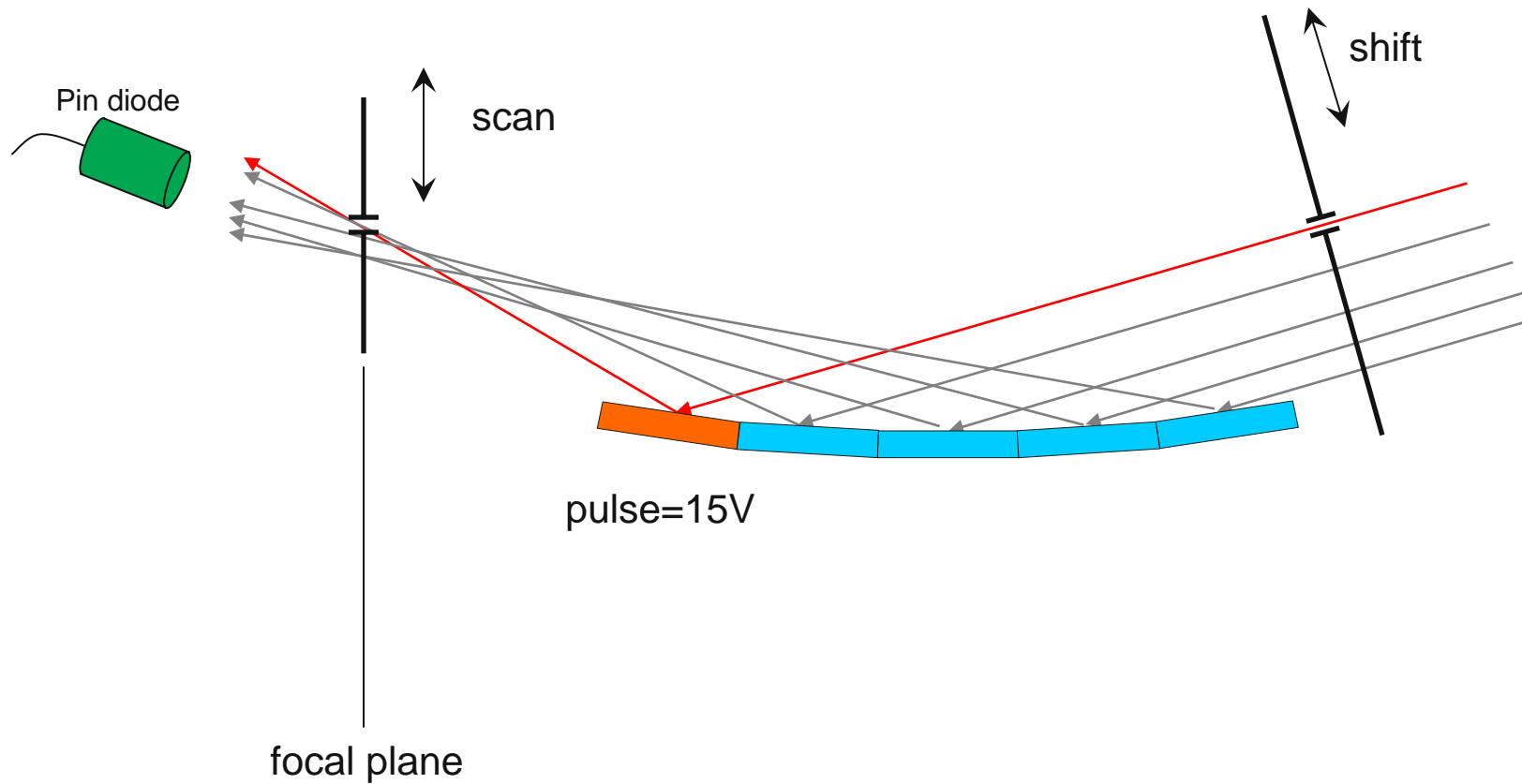
How correction matrix data is collected



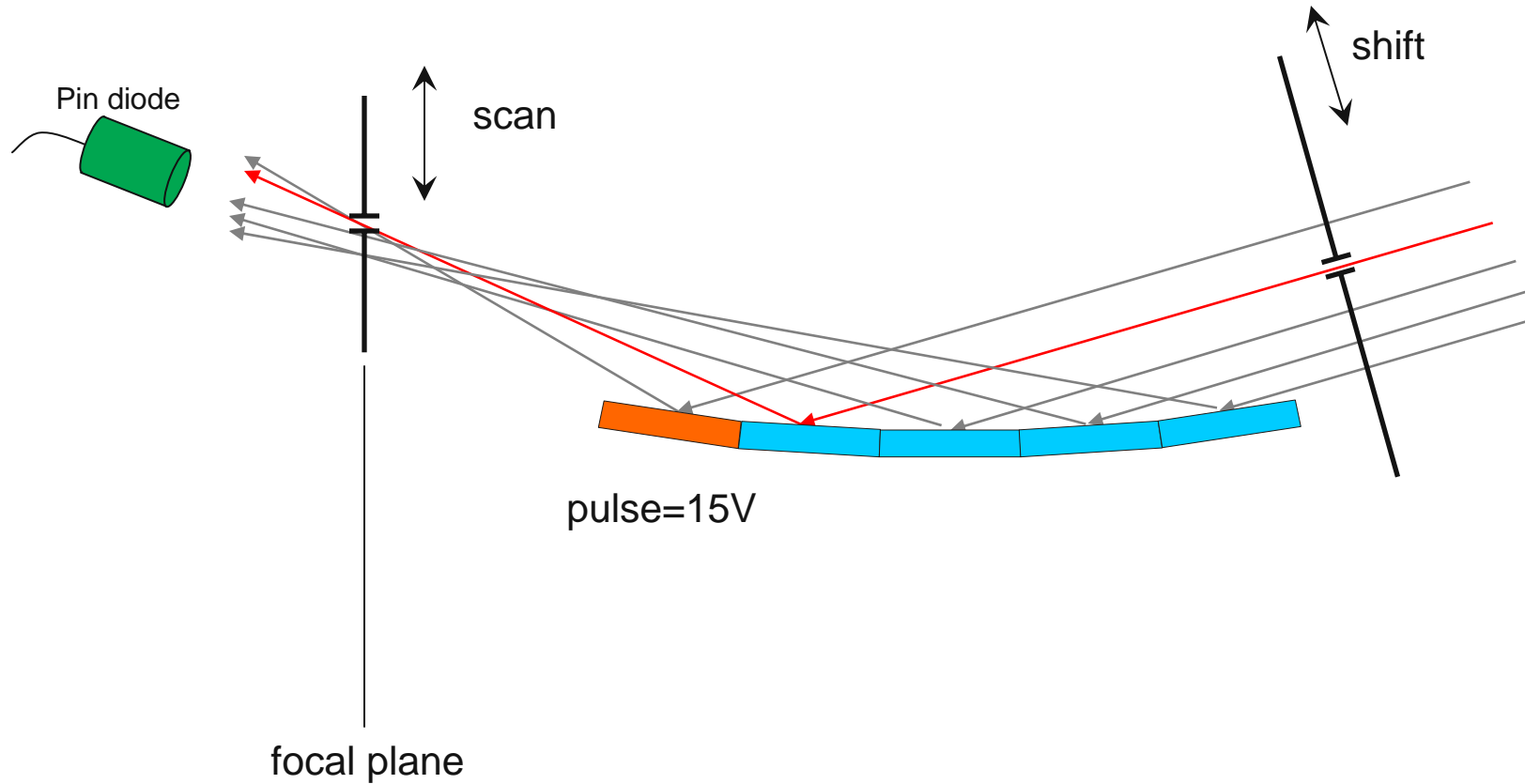
How correction matrix data is collected



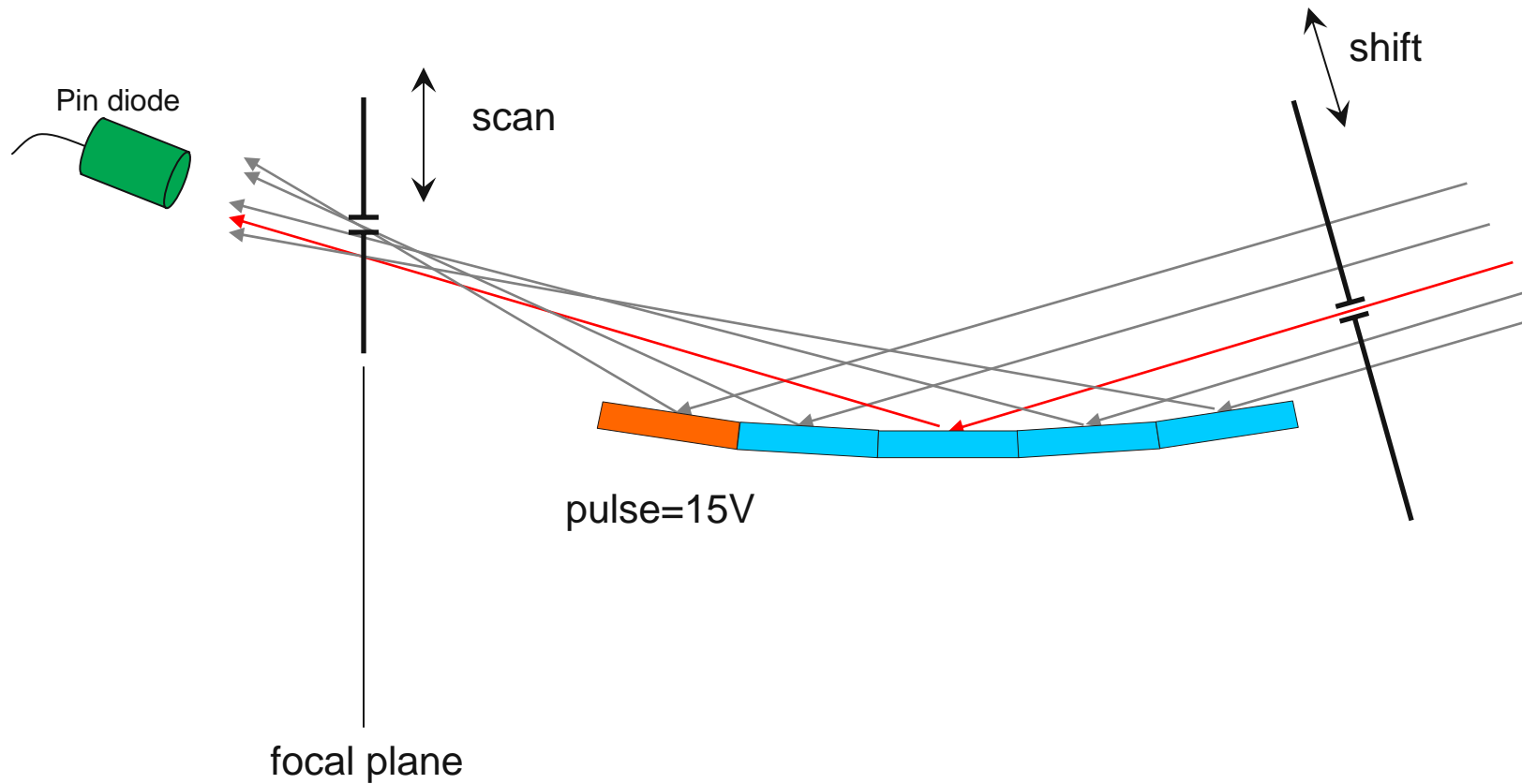
How correction matrix data is collected



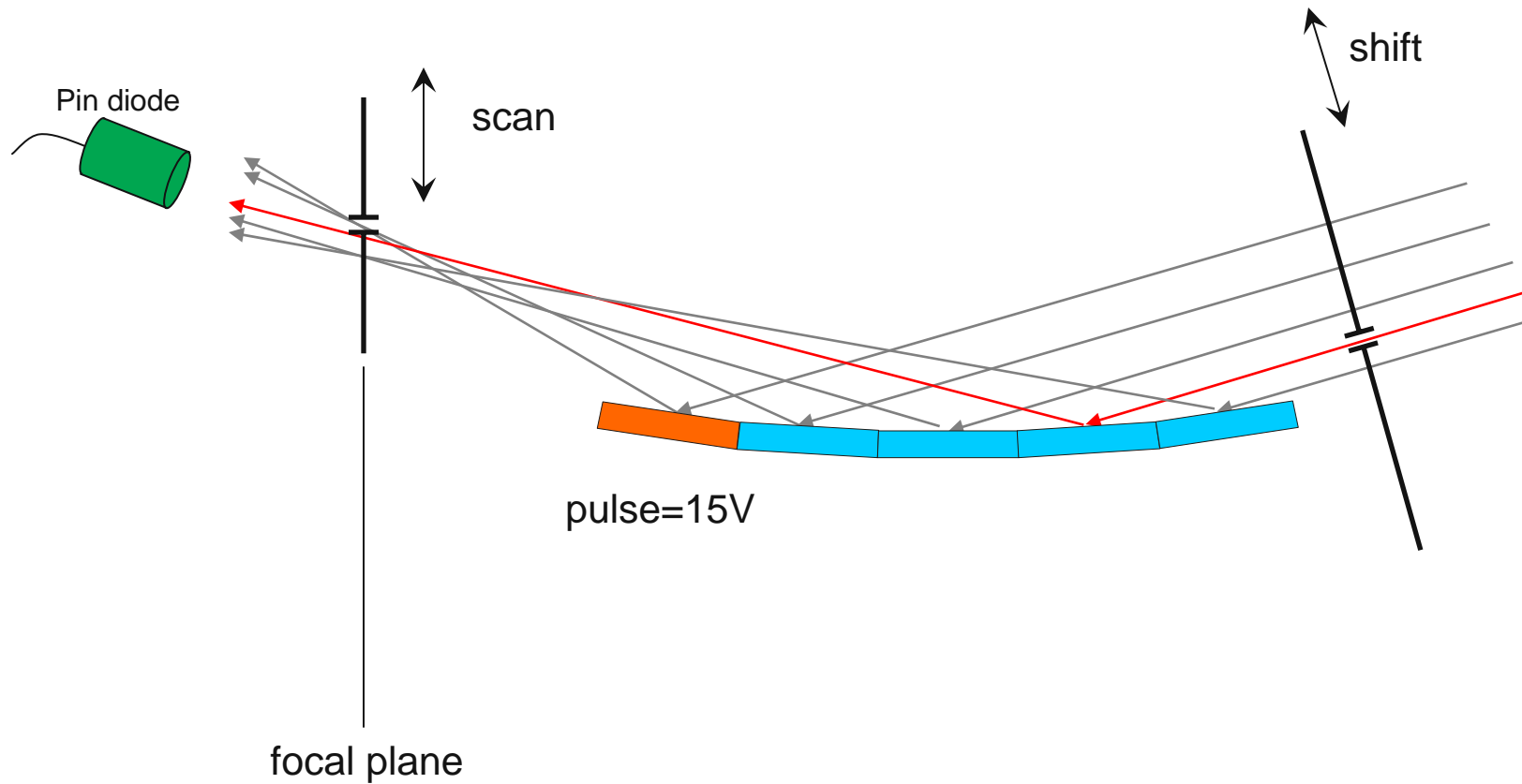
How correction matrix data is collected



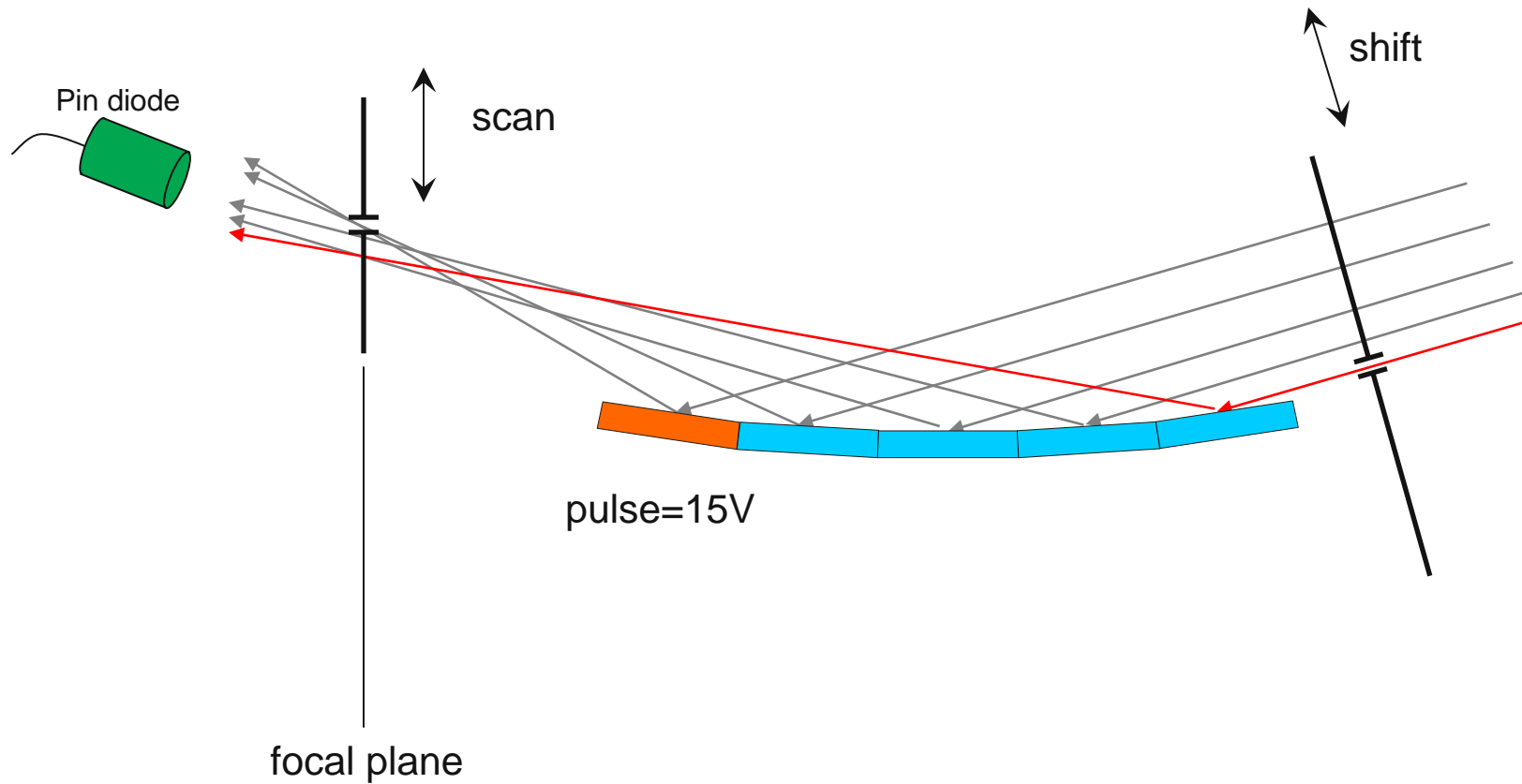
How correction matrix data is collected



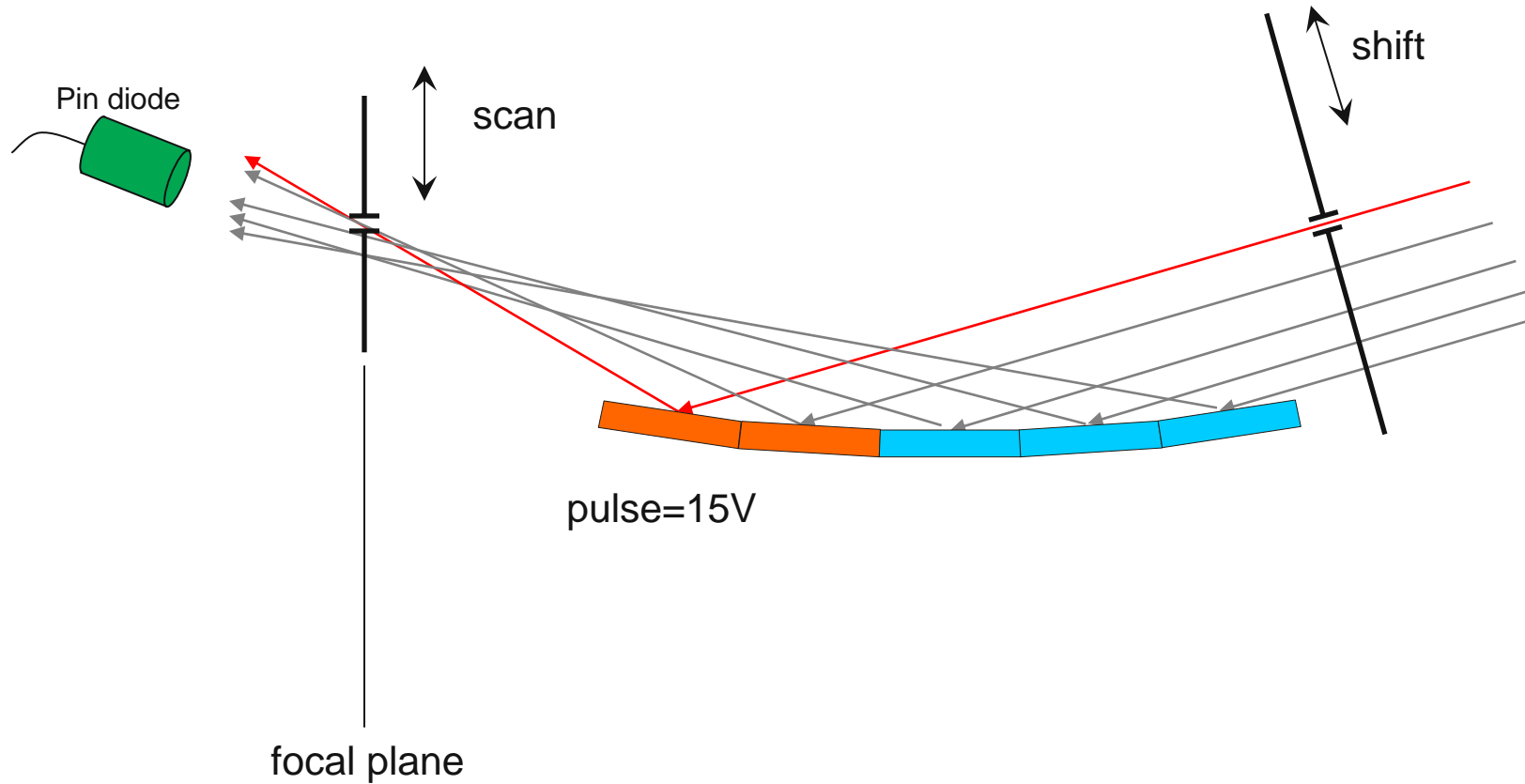
How correction matrix data is collected



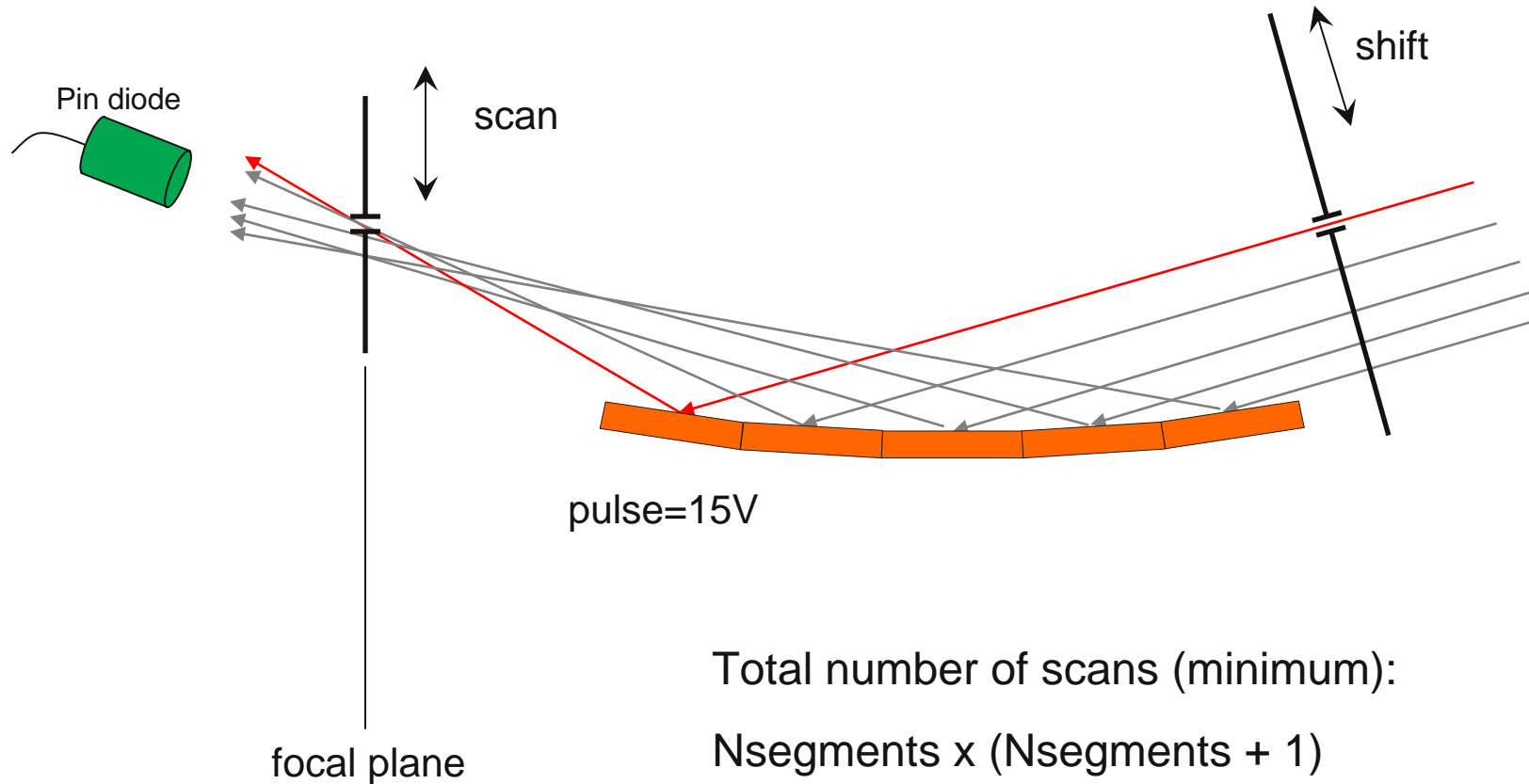
How correction matrix data is collected



How correction matrix data is collected



How correction matrix data is collected

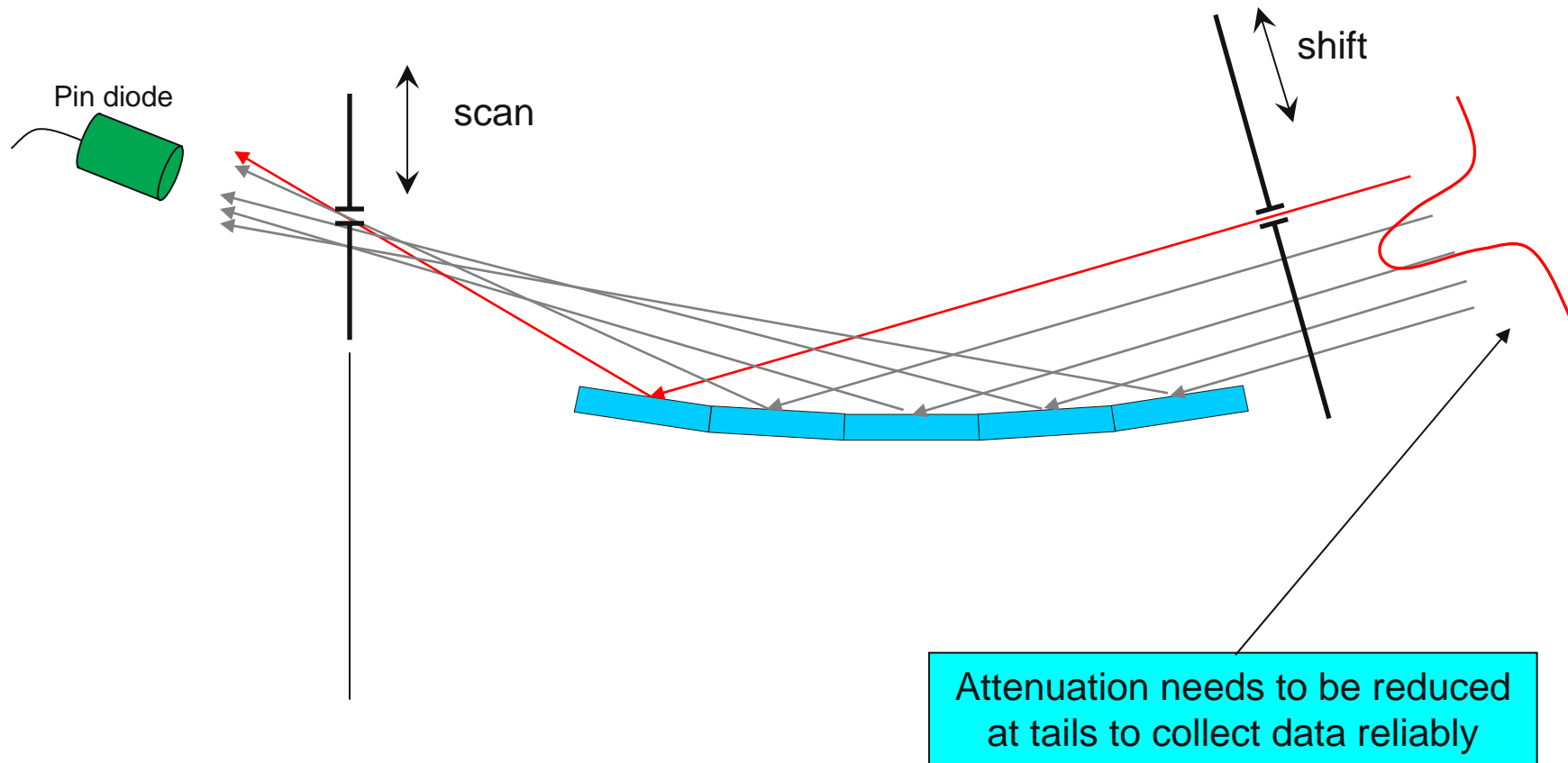


Total number of scans (minimum):

$N_{\text{segments}} \times (N_{\text{segments}} + 1)$

GMCA VFM: $16 \times 17 = 272$ (may be 2x-4x more)

How correction matrix data is collected: attenuation



GMCA implementation of correction matrix data collection

23i Mirror Focusing Matrix

Focus at sample CCD BPM

Mirror VFM HFM

Mirror angle auto

Segment sampling 2

Ignored edge beamlets 0

Mirror pulse 15. V

After-pulse delay 300 s

Scan Type ScanRec HardSync

Analyzer time/pt 0.02 s

Analyzer +/- range 0.10

Analyzer step 0.001

Struck input for I0 18

Struck input for I1 17

Struck input for I2 16

BPM counting time 1 s

Attenuation Option Use Attenuation

MEDM Option Show MEDM

Output file prefix focus

GO! **Simulate** **Cancel**

4s per scan when using HardSync on-the-fly scans. Still 2 hours per full cycle

Calls mirrorMatrix.pl, that:

- collects data (3D scans),
- builds centroid files,
- uploads centroids into SY900 correction matrix calculator (works as http client with SY900 web server),
- gets corrections from the calculator,
- applies corrected voltages to SY900 controller.

Applicability of GMCA scripts beyond GMCA

■ mirrorBimorph_PVstart.pl	OK
■ mirrorsBackup.pl	OK
■ mirrorsRestore.pl	OK
■ GUI	OK
■ mirrorMatrix.pl	Needs porting
→ filesCentroid.pl	OK
→ mirrorMatrixUpload.pl	OK
■ centerMirror.pl (<i>no focusing operations</i>)	Needs porting

mirrorMatrix.pl and centerMirror.pl use on-the-fly hardware synchronized scans that require rewriting to work with non-PMAC environment.

Applicability of GMCA scripts beyond GMCA (continued)

Mirror Matrix

30 ID Mirror Focusing Matrix

Instrument Merix Herix

Mirror VFM HFM

Mirror angle mrad

Segment sampling

Ignored edge beamlets

Mirror pulse V

After-pulse delay s

Analyzer time/pt s

Analyzer +/- range

Analyzer step

Joerger input for I1

MEDM Option Show MEDM

Output file prefix

In collaboration with **Kurt Goetze** and **Yuri Shvydko** all software was ported to work at the APS Sector 30 (HERIX/MERIX inelastic spectrometers)

Changes:

- On the fly scans were replaced with step scans based on OMS58 controllers.
- Attenuation controls removed