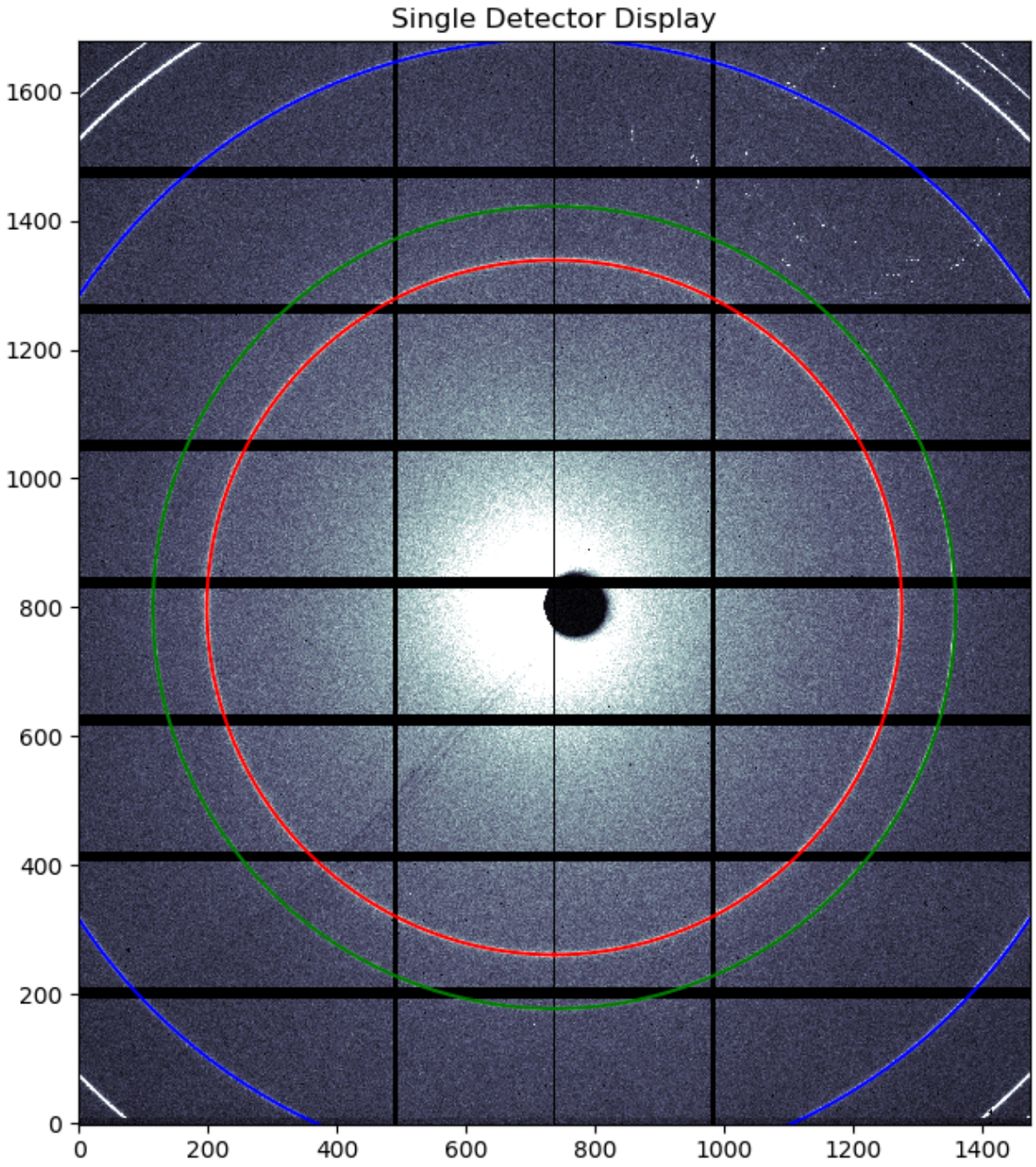
**MIDAS Integration Manual**

This manual covers 2D-integration using MIDAS.

**NOTE**: The relevant files for this manual can be downloaded from MIDAS_Manual.
**NOTE**: Steps 1-10 are needed when first running on a new experiment with new parameters.
**NOTE**: Step 9 is needed whenever BinSizes or Ranges for Eta or R are changed.

1. The first step for integration is defining parameters for the integration. These include
    a. detector dimensions (Number of Pixels, Pixel Size in microns),
    b. tilts (tx,ty,tz),
    c. BC (beam center),
    d. Lsd (Sample to detector distance),
    e. RhoD (maximum ring radius on the detector used to calibrate detector distortion),
    f. p0, p1, p2, p3 (detector distortion parameters),
    g. EtaBinSize, EtaMin, EtaMax (in degrees),
    h. RBinSize, RMin, RMax (pixels).
2. Download the contents of the MIDAS_Manual folder including the CeO2.txt file.
3. Once MIDAS has been installed using the method described at MIDAS Github, go to the folder with the downloaded files.
4. Open the file in MIDAS gui (`python ~/opt/MIDAS/gui/ff_asym.py`).
    a. Change `NrPixelsHor`, `NrPixelsVert`, `BytesPerPx` to appropriate values (1475, 1679, 4 for pilatus, 2048, 2048 and 2 for GE).
    b. Click `FirstFile` and select the file of interest.
    c. (optional)If you have a **Dark** file, click `DarkFile` and select the dark or bright frame. This will be subtracted from `FirstFile`.
    d. Click `Load Single Detector`.
    e. Click `RingsMaterial` and enter approximate values.
        **NOTE:** Select the correct pixel size (172 for pilatus, 200 for GE).
    f. Once you click `Continue`, select the rings of interest in the next step and click `Done`.
    g. You can now vary the `Lsd`, `BeamCenter` values next to `Load Single Detector` and double click `PlotRings` to get close to the observed rings. The final result should look close to the figure below.




5. Edit the **CeO2.txt** file to get the correct folder name and approximate values from the previous step. The file already contains good starting values.
6. Type the following command:

```
~/opt/MIDAS/FF_HEDM/bin/Calibrant CeO2.txt

Output:
NrTransOpt: 1
```

```
TransformationOptions: 0 No change.
0.162892 1773330.141331 110000.000000 225 5.411160 5.411160 5.411160
90.000000 90.000000 90.000000
Generating hkl's
Will go from 0 to 10 in h; 0 to 10 in k; 0 to 10 in l.
Thetas: 1.493862 1.725029
Number of planes being considered: 2.
The following rings will be excluded:
2Theta Tolerance: 0.160929
Dark file  could not be read. Making an empty array for dark.
Reading calibrant file:
/home/Desktop/analysis//CeO2_2s_phi_0deg_000014.raw, nFrames: 10 99061000
9906100, skipping first 8192 bytes.
Number of eta bins: 180.
Out of 360 slices, 360 were in the detector
Number of calls to profiler function: 488413
Time elapsed in fitting peak profiles:    15.894508 s.
Number of function calls: 2478
Lsd 1773423.049444961827
BC 736.212401741989 801.049988394769
ty -0.459486144717
tz 0.287444660752
p0 0.000392430603
p1 -0.000106371799
p2 -0.000072635025
p3 23.966532834920
MeanStrain 0.000871019580
StdStrain 0.005393648368
Time elapsed for this file:   16.014579 s.
Total time elapsed:     16.017796 s.
******************Mean Values******************
Lsd 1773423.049444961827
BC 736.212401741989 801.049988394769
ty -0.459486144717
tz 0.287444660752
p0 0.000392430603
p1 -0.000106371799
p2 -0.000072635025
p3 23.966532834920
MeanStrain 0.000871019580
StdStrain  0.005393648368
******************Copy to par******************
```

7. Please copy the Mean Values (Lsd,  BC, ty, tz, p0, p1, p2, p3) to the **CeO2.txt** file.
8. If you start far away from optimum position, you should run steps 6 and 7 multiple times until the values converge.
9. Type the following command:

```
~/opt/MIDAS/FF_HEDM/bin/DetectorMapper CeO2.txt

Output:
Creating a mapper for integration.
Number of eta bins: 180, number of R bins: 1055.
Total Number of bins 6090885
Total time elapsed:     15.999297 s.
```

10. This will create two files: **Map.bin** and **nMap.bin**. These are used for quick calibration later on. Steps until here are needed to be done once per experiment.
11. Type the following command to integrate one file:

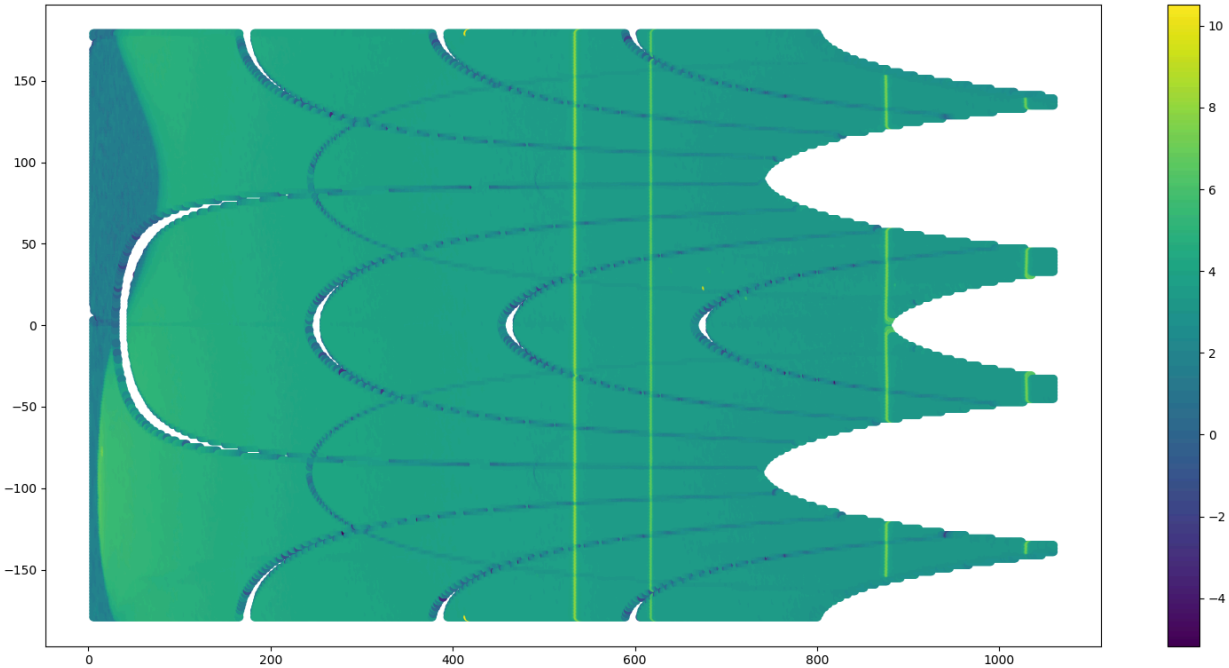
```
~/opt/MIDAS/FF_HEDM/bin/Integrator CeO2.txt CeO2_2s_phi_0deg_000014.raw

Output:
Map size in bytes: 97454160, each element size: 16, total elements:
6090885.
nMap size in bytes: 1519200, each element size: 8, total elements: 759600.
NrTransOpt: 1
TransformationOptions: 0 No change.
Number of eta bins: 180, number of R bins: 1055.
Processing frame number: 1 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Processing frame number: 2 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Processing frame number: 3 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Processing frame number: 4 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Processing frame number: 5 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Processing frame number: 6 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Processing frame number: 7 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Processing frame number: 8 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Processing frame number: 9 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Processing frame number: 10 of 10 of file CeO2_2s_phi_0deg_000014.raw.
Total time elapsed:     3.163270 s.
```

12. This will create two files for each frame: 2D cake and 1D integration. If you want to output a sum of all the frames, add the following line to the **CeO2.txt** file:

```
SumImages 1
```

13. If you plot the first frame output (log scale), it should look close to the following figure:


150
100
50
0
−50
−100
−150
0
200
400
600
800
1000
10
8
6
4
2
0
−2
−4