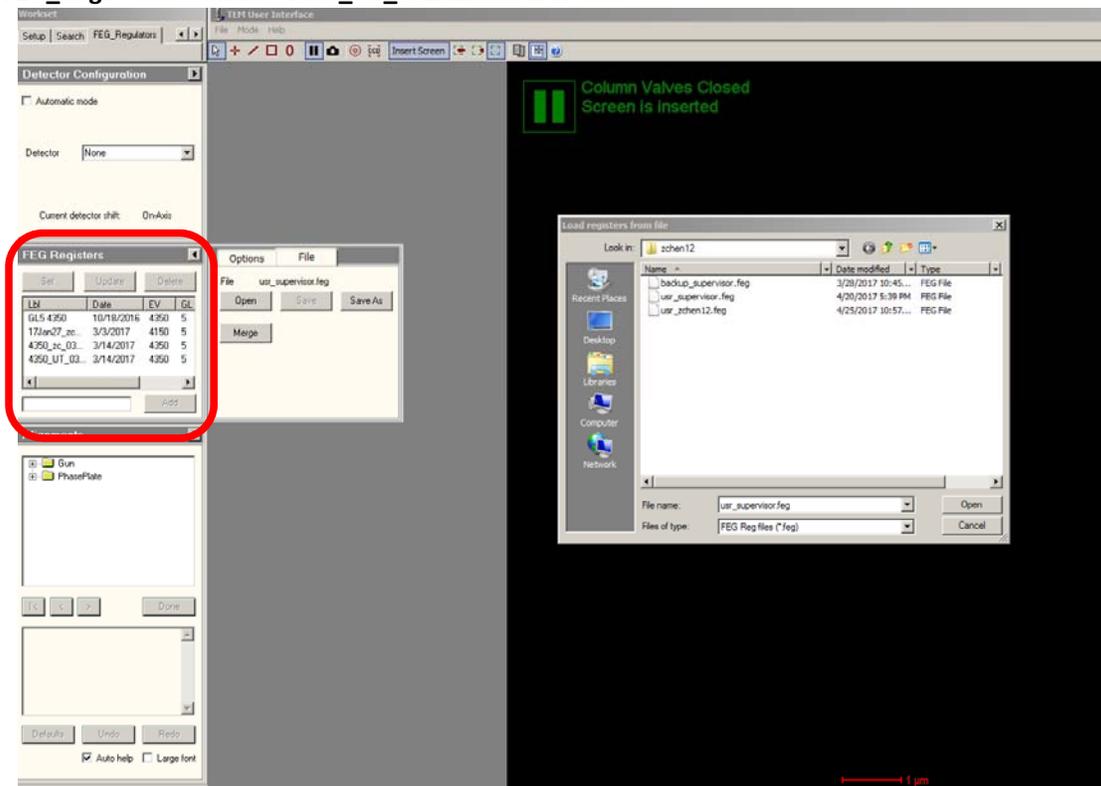## 9 – FEG_Registers

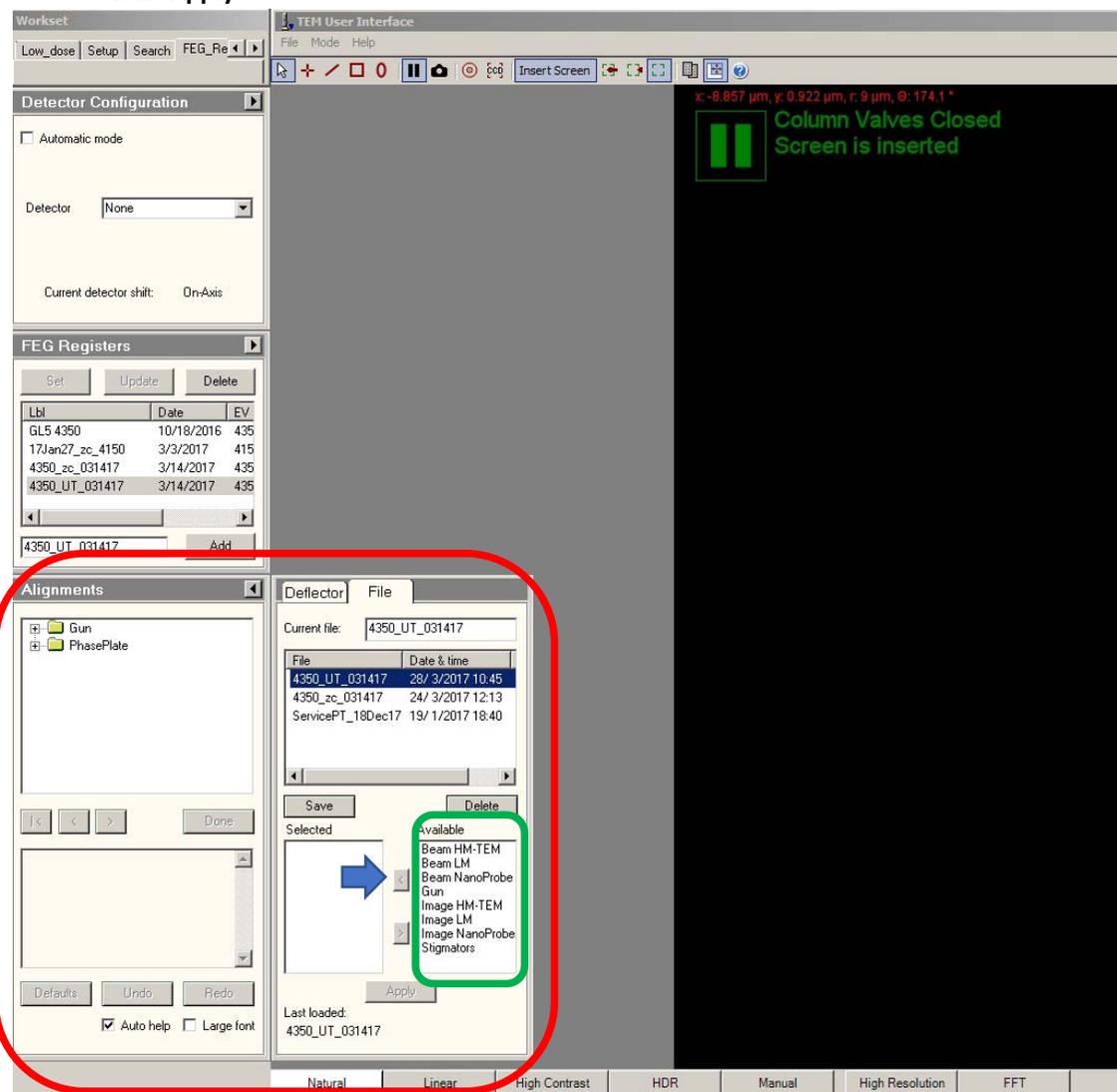**FEG_Registers -> select "4350_UT_0314…" -> click "Set"**

Note: the file navigator window on the right shows the location of the FEG_Registers configuration files. To open it, click flap-out -> "File" -> "Open".
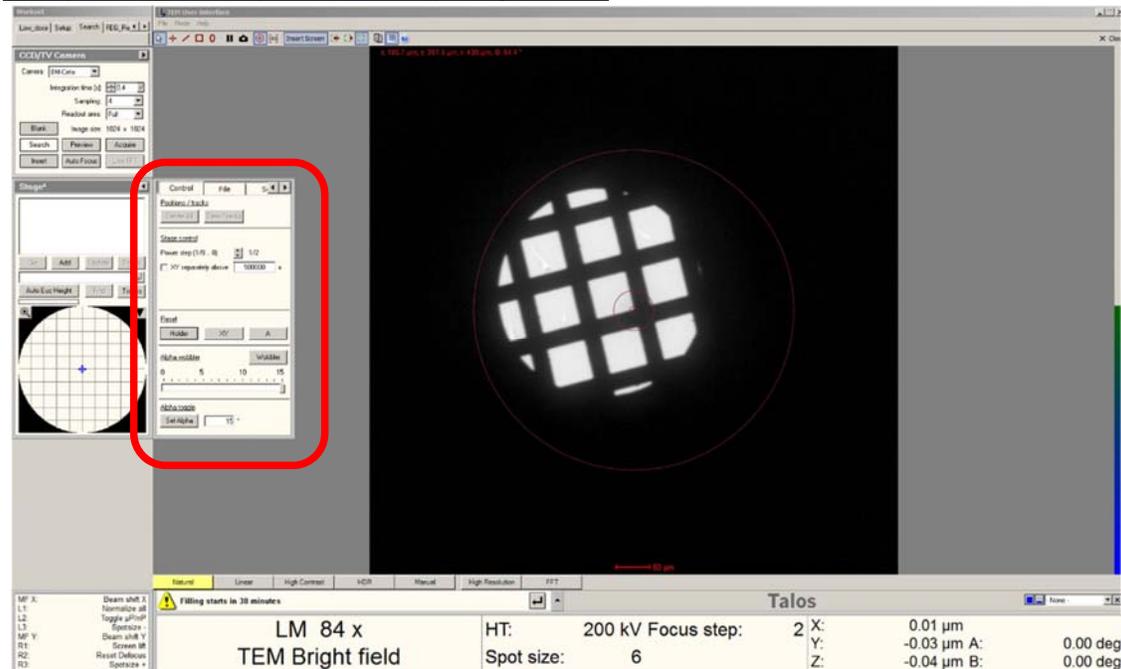
9 – FEG_Registers

FEG_Registers -> click "Alignments" -> flap-out -> click "File" -> select "4350_UT_031417…"

- Highlight all items on the bottom right corner window (green box) by click on top item, then hold the "SHIFT" key and click on the item at the bottom;
- click on the "left arrow" icon (blue arrow) so that same set of items show up on the window to the left;
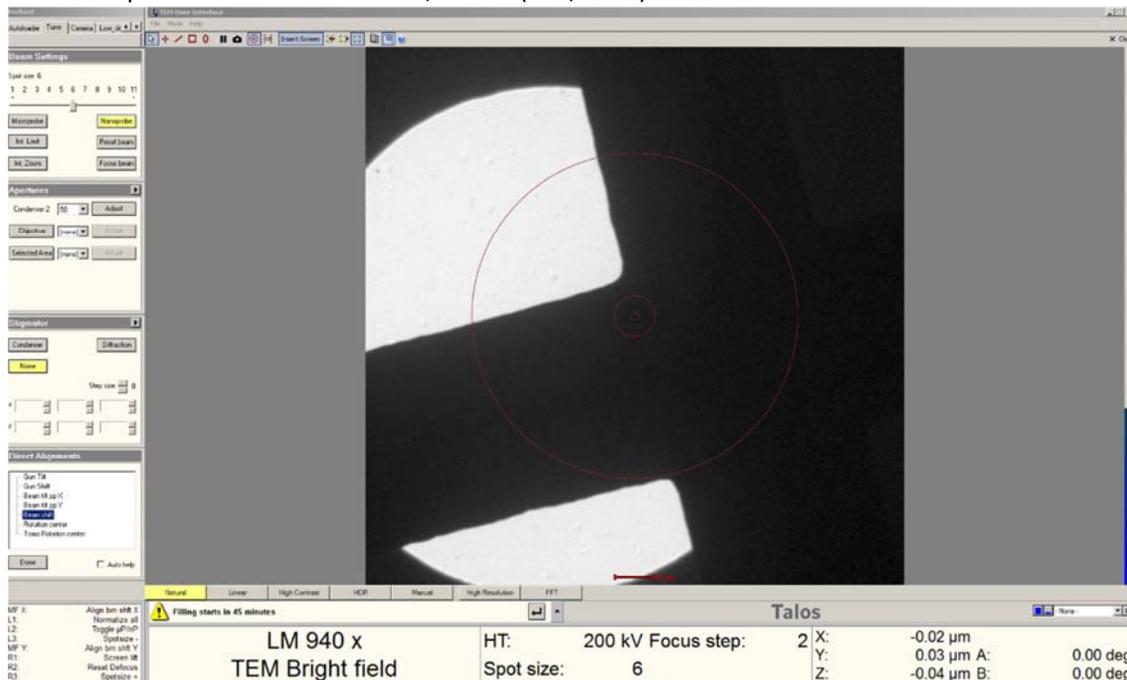- Click "Apply".

14 – Eucentric Height/Focus

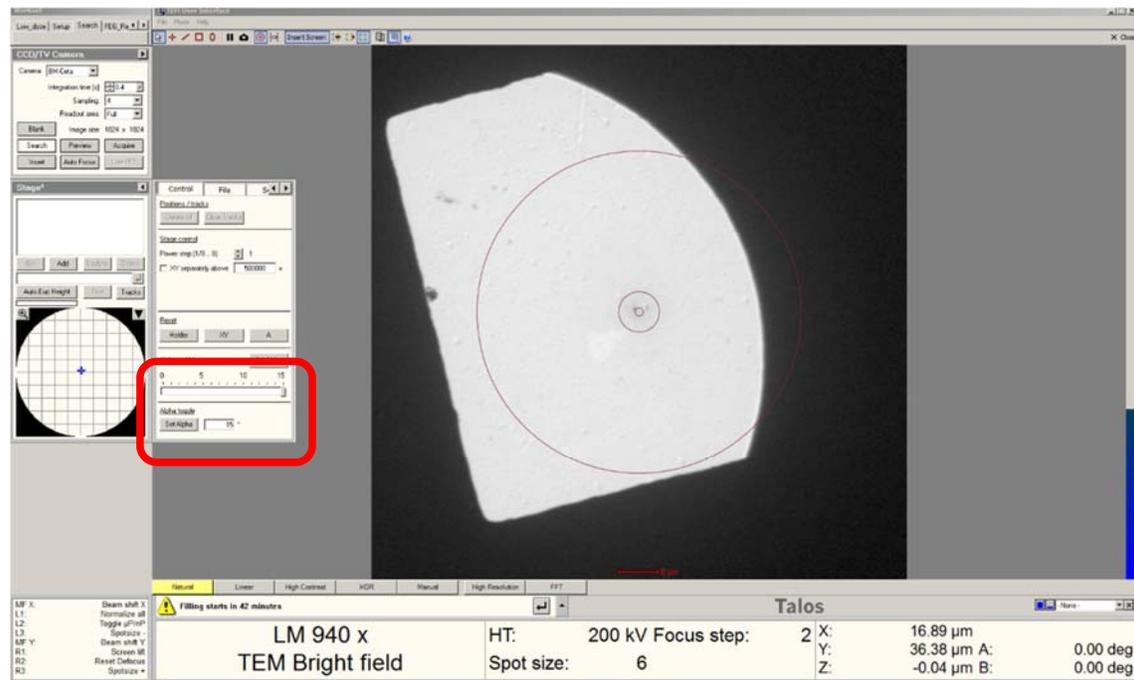**Reset/home "holder" (back to center), set spotsize=5**

14. Find the Eucentric Height: (press the Eucentric Focus button afterwards)
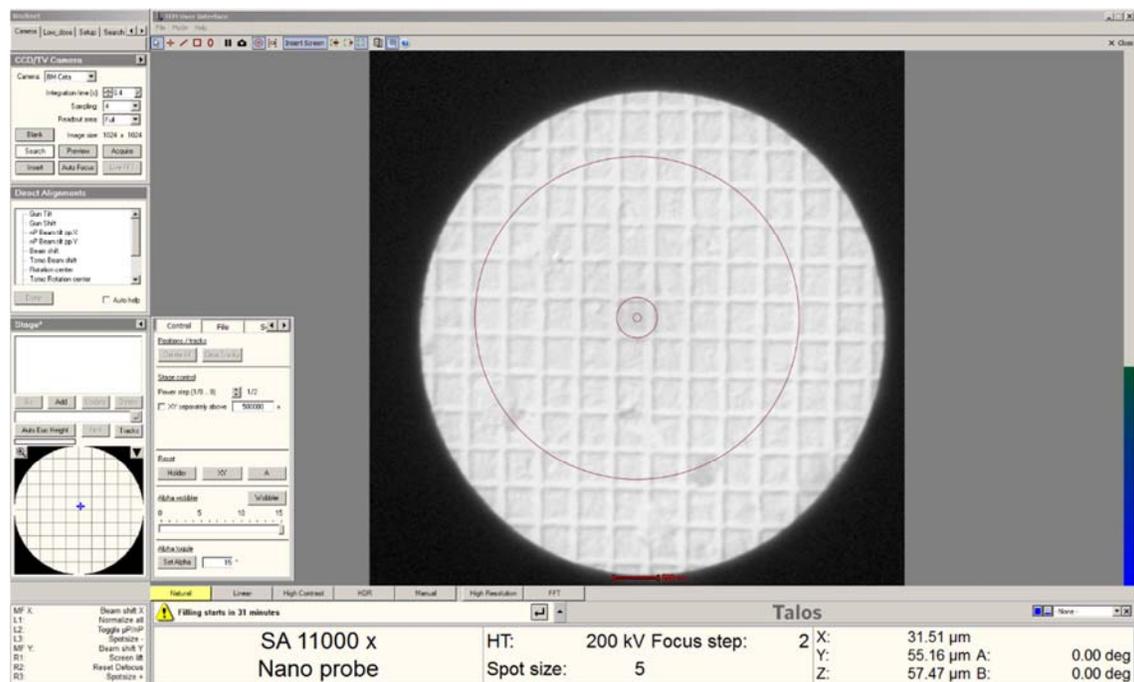
- Set magnification to 1,000x;
- Center beam by "Direct alignment" -> Beam Shift -> MFX/Y -> click "Done" when finished;
- Make sure alpha = 0 (not 15 degrees), find an obvious feature with joystick;
- Stage -> Control -> set α = 15° -> Set alpha;
- Use "Z axis" button (press and hold) to move feature back to center (horizontal only);
- Repeat with a second feature, a third (fine/small) if needed.

14 – Eucentric Height/Focus
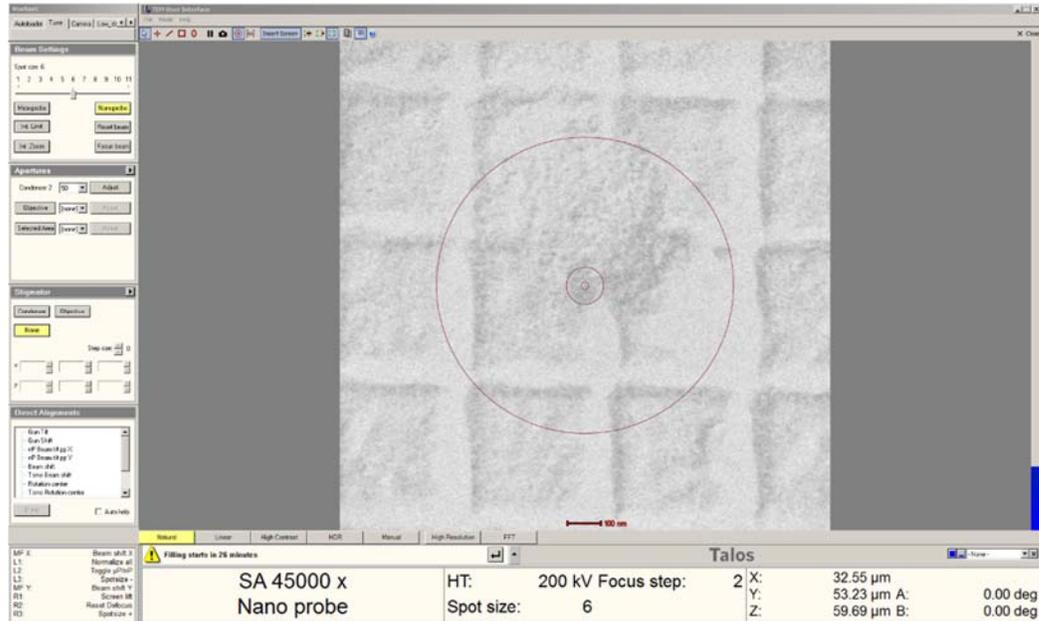

- **Repeat the process at 11,000x magnification.**

!!! Press "Eucentric Focus" on right control panel !!!

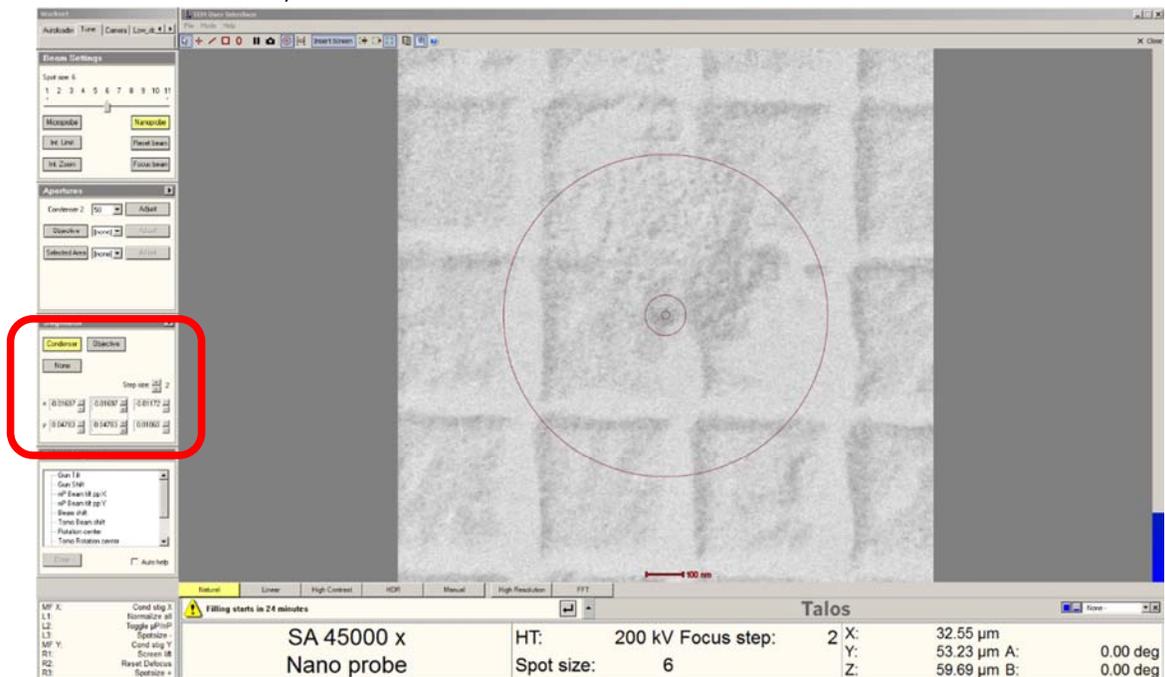## 15 – Center Condenser 2 Aperture (check C2 Stigmator)

Set Spot Size 6, Nano Probe, SA=45,000x, C2=50
- Center beam
  - Dial, only counter-clockwise, with Intensity dial/knob, to cross-over (minimum size);
  - Beam shift -> center with MFX/MFY dials/knob -> Done;
  - **To enlarge, only dial clockwise with Intensity Dial/knob.**

Check C2 Stigmatism
- No adjustment needed here, just copy and paste here;
- Click on Stigmator -> Condenser:
  - First column should be around x: -0.01697 y: 0.04783);
  - Right click copy;
  - Right click on second column and paste (should notice change of shape, more round).
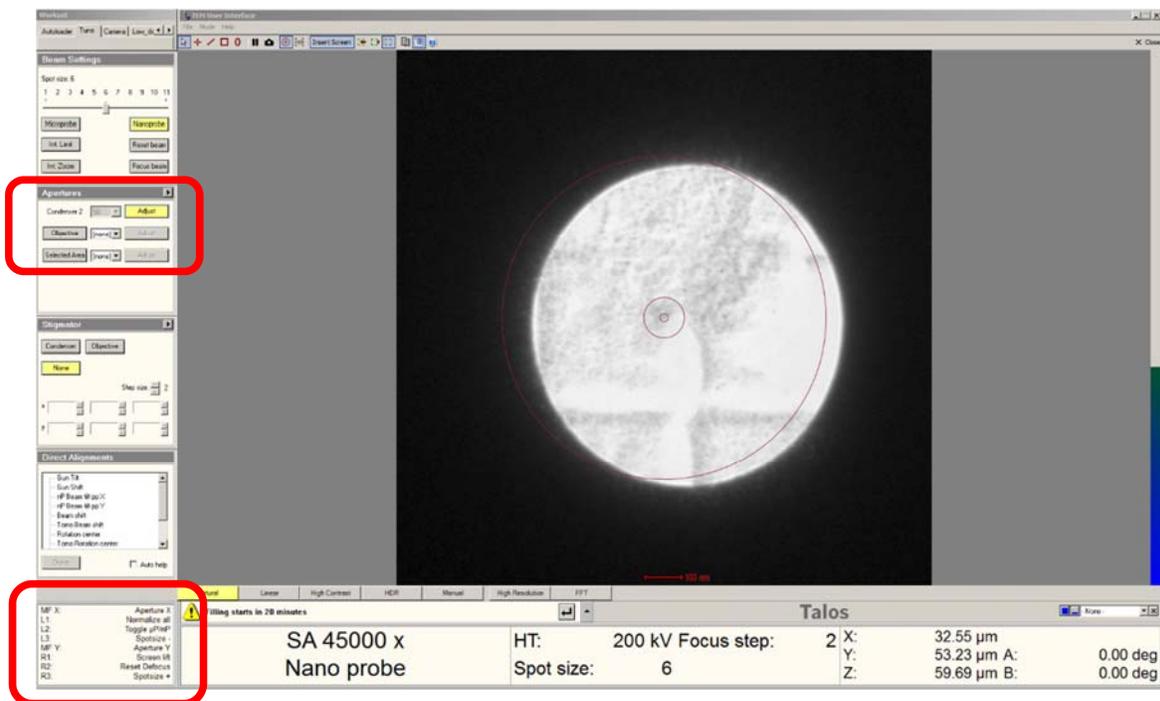
15 – Center Condenser 2 Aperture (check C2 Stigmator)

Center C2 Aperture

- Condense to cross-over with Intensity dial/knob, Center beam again;
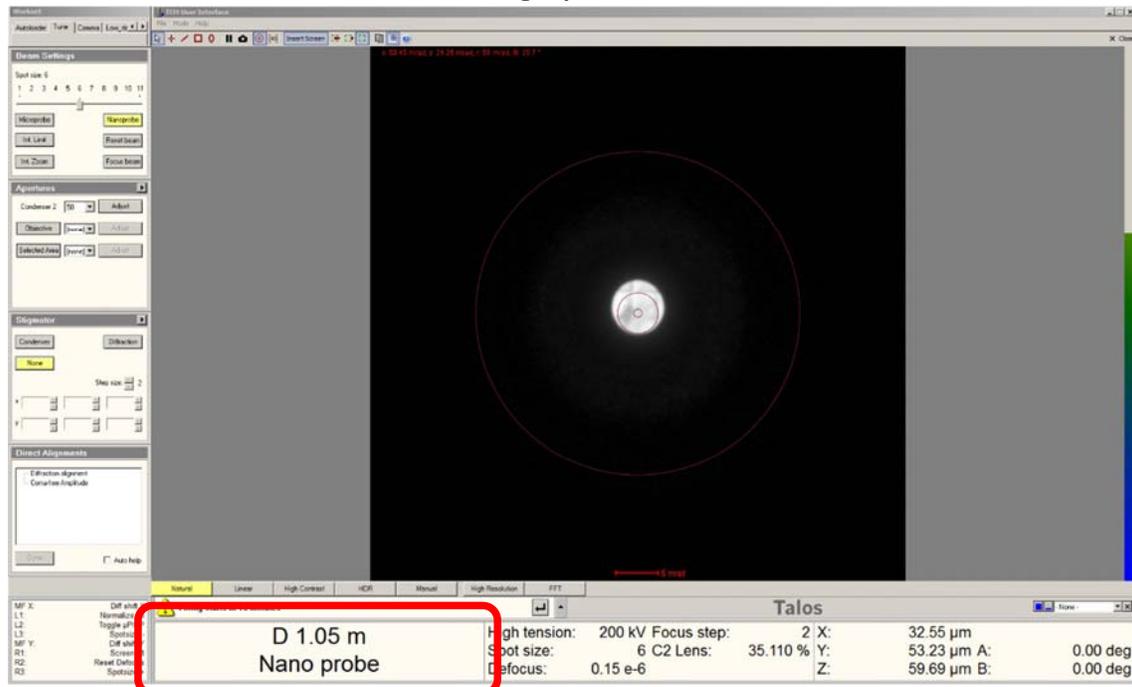- Spread beam to outer ring (**clock-wise!!!**);

- Click "Apertures" -> [Condensor 2]) Adjust (in red box);
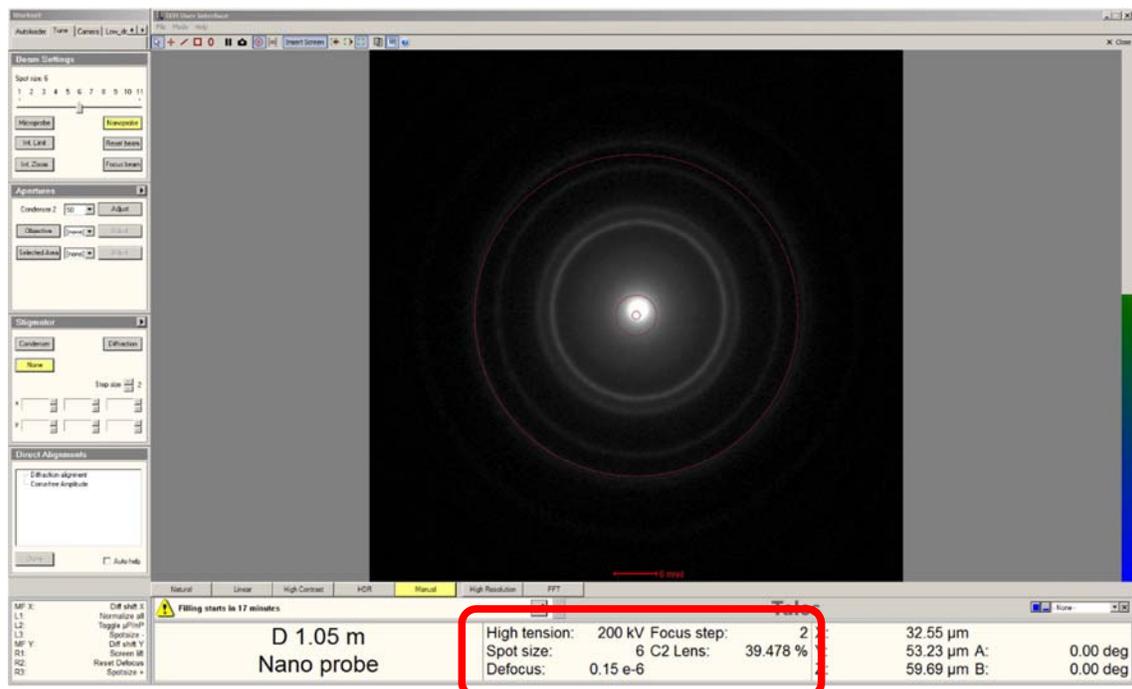- Use MFX/MFY dial/knob to adjust Aperture X/Y back to center.

- Click "Adjust" again when finished.

16 – Set Parallel Beam Condition

- Center beam (**To enlarge, only dial clockwise with Intensity dial/knob).**
- **Click "Diffraction Mode" button on right panel.**

- With the mouse, left click on the screen (dark area);
- Scroll middle mouse wheel button to show the rings;
- Dial the Intensity dial/knob to sharpen the rings
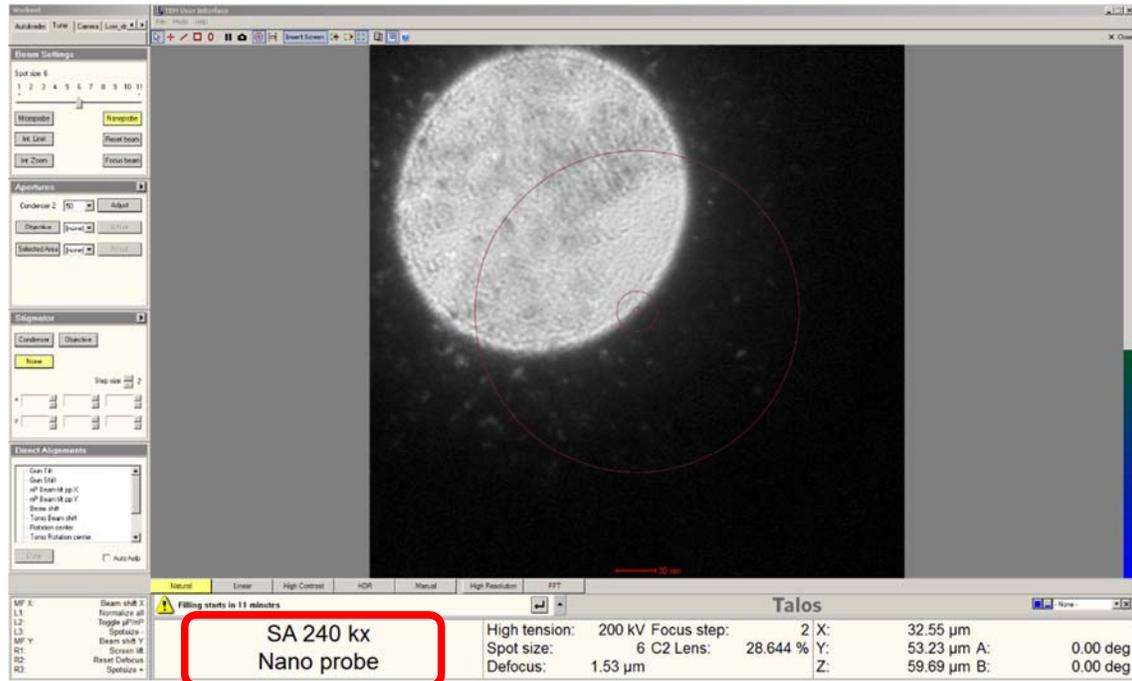 - Final values should be about 39.6% (C2);
  - Dial defocus to -0.23e-6.

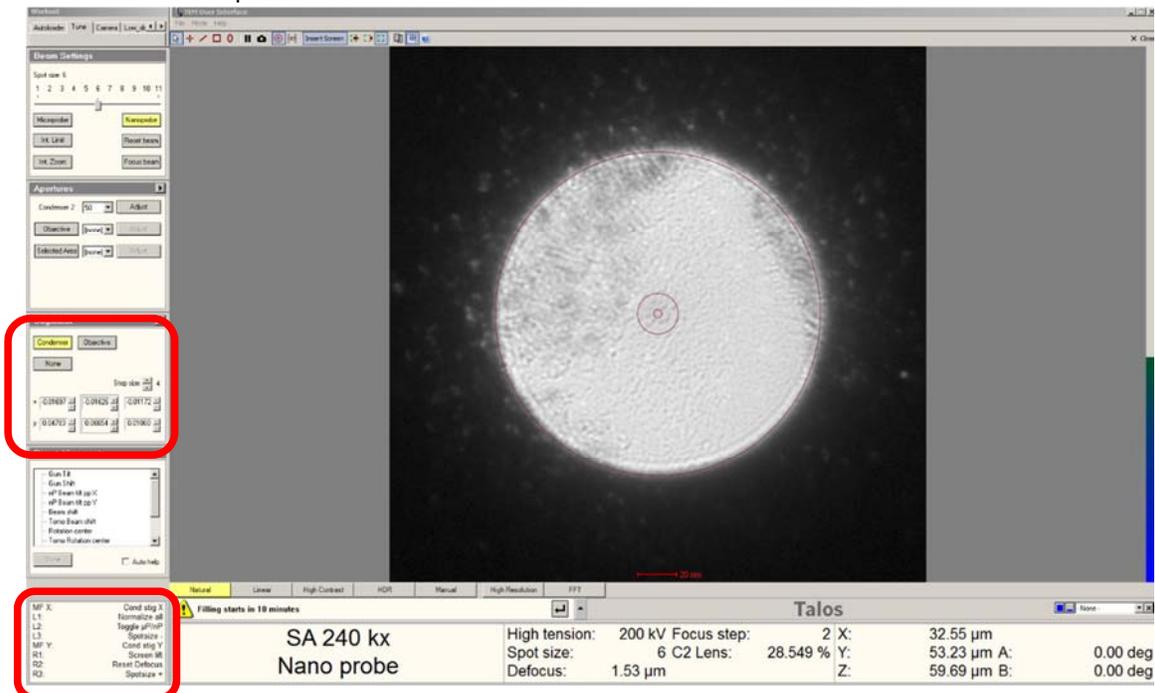- **Click "Diffraction Mode" button on right panel when finished.**

17a – Direct Alignment: Correct C2 Condenser Stigmatism

Set Spot Size 6, Nano Probe, SA=240,000x, C2=50
- Optional: Center beam (**To enlarge, only dial clockwise with Intensity dial/knob).**
- **Enlarge beam size similar to the outer red circle on screen.**

- Click on "Stigmators" -> Condenser
  - Dial MFX/MFY to adjust "Cond stig X/Y" to perfect round shape;
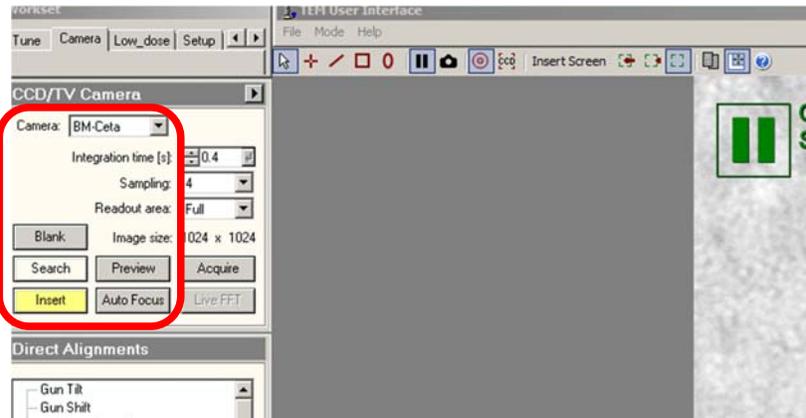 - Click "None" when finished'
  - Repeat if needed.

Quick focus: dial "Focus" to the least contrasted background (smoothest grey area, feature-less)

17b – Direct Alignment: Find True Focus

Set Spot Size 6, Nano Probe, SA=240,000x, C2=50, Beam Intensity=39.6%
- Optional: Center beam (To enlarge, only dial clockwise with Intensity dial/knob).
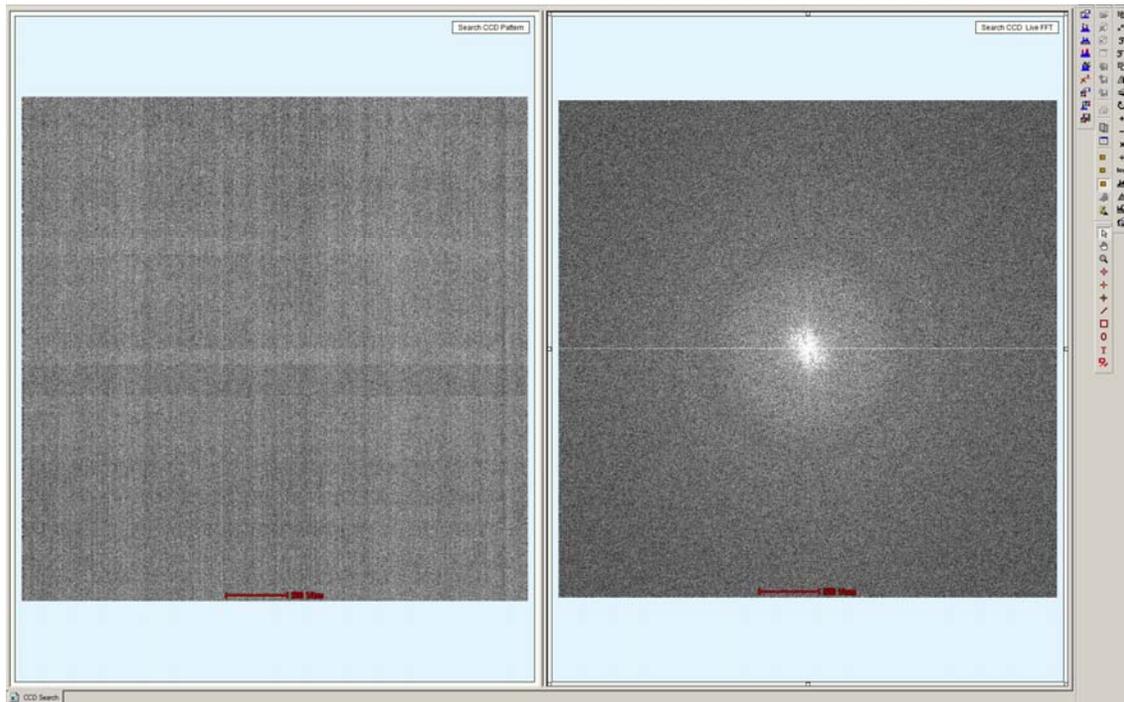- Press "**R1**" button to lift the screen (check and verify).
- **Insert BM-Ceta camera**.

- Click "Search" -> then click "Live FFT"

17b – Direct Alignment: Find True Focus

- Dial the "**Focus**" dial/knob on right control panel:
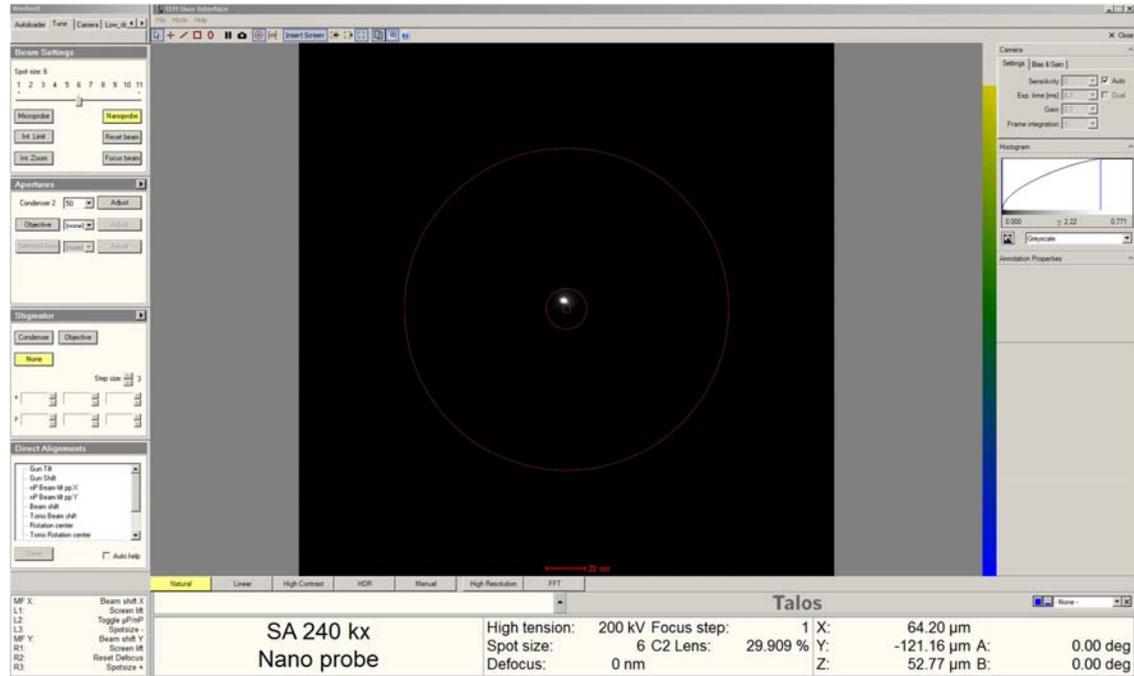 - Single Thon ring close to half the distance between center and edge (right screen);

  - Mark the Thon ring position with mouse cursor;
  - Press "**R2**" to Reset Defocus to zero;
  - Dial Focus (could be either direction) to make the Thon ring disappear then reappear at exact same position (change focus step if needed with bottom ring dial). Write down the value of Defocus here.
  - Divide the value by half (notice the plus or minus sign), dial the Focus to that value.
  - Press "**R2**" again.
- **Press "Search" to stop Ceta and finish.**

17c – Direct Alignment: PPx / PPy

Set Spot Size 6, Nano Probe, SA=240,000x, C2=50
- Optional: Center beam (To enlarge, only dial clockwise with Intensity dial/knob).
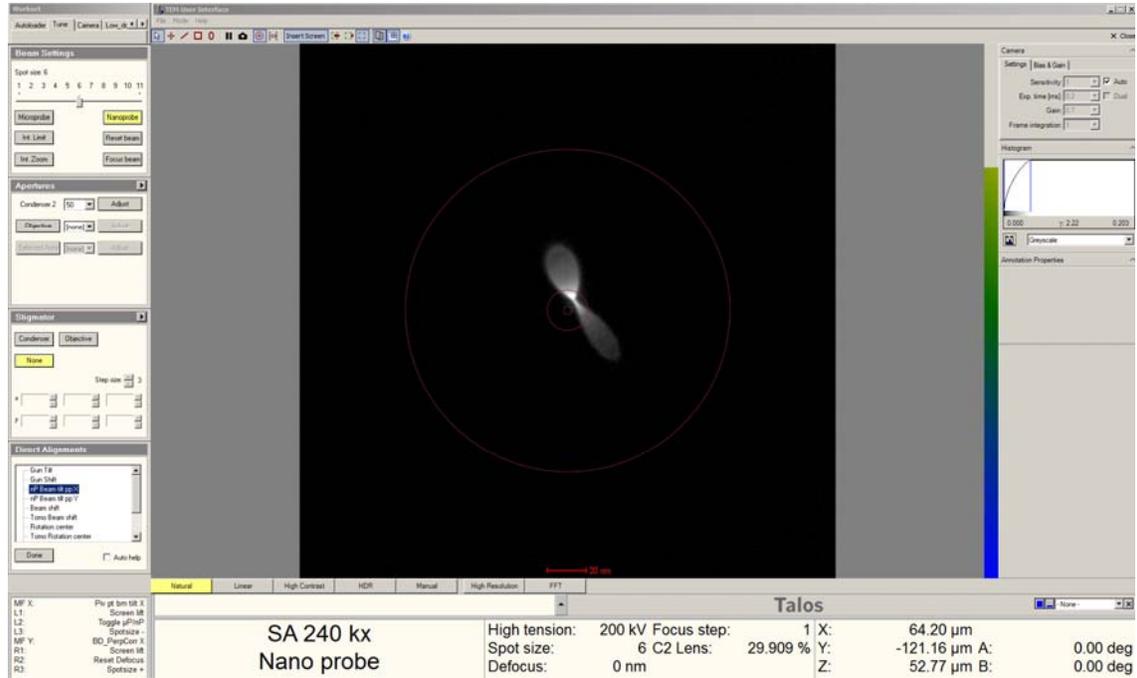- Condense beam to cross-over;
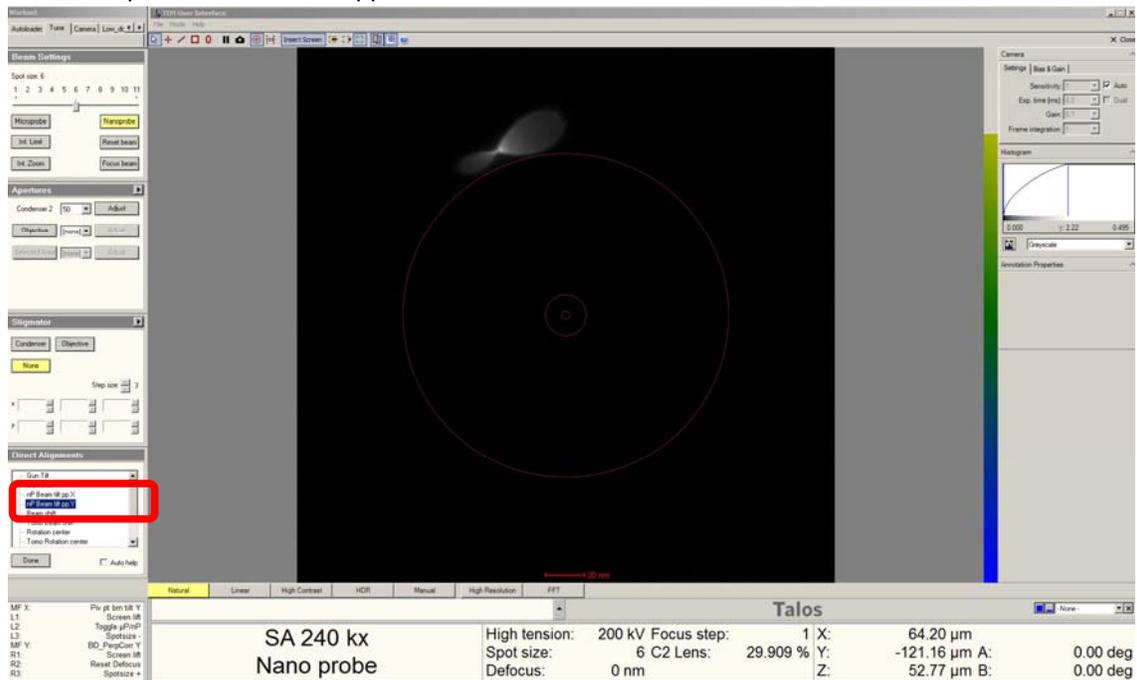

Click "Direct Alignment" -> "nP Beam pp X".

17c – Direct Alignment: PPx / PPy
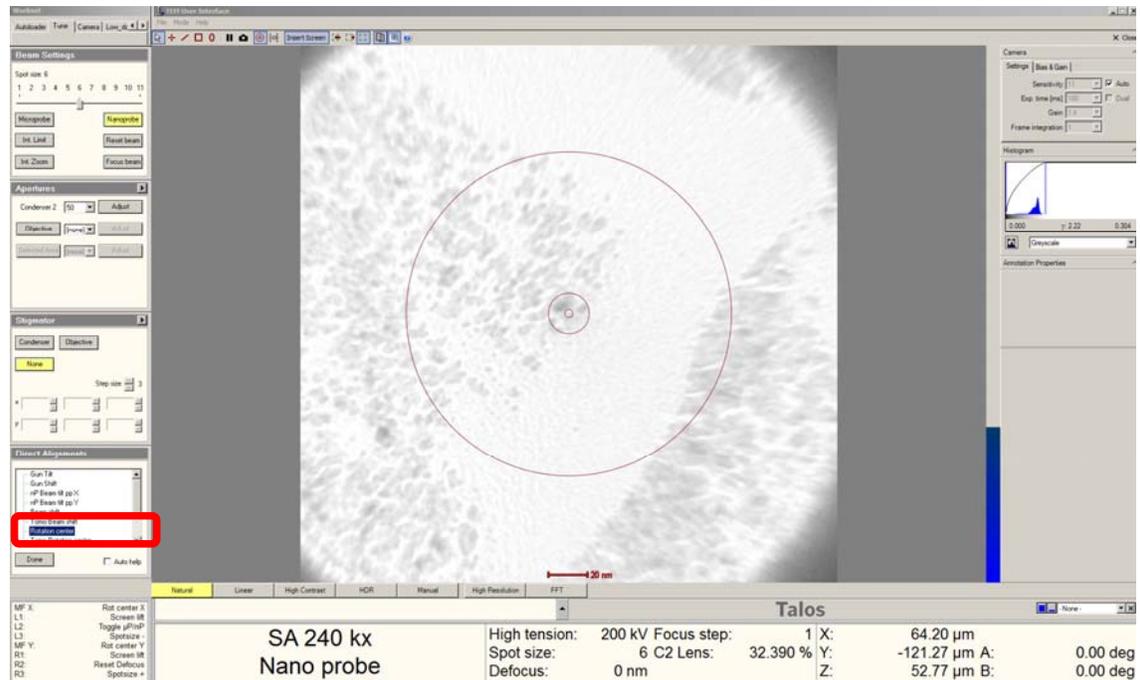
- o Use MFX/MFY to align two comets together;

- o Decrease magnification if two parts out of viewing area.
- o Click "Done" when finished.
- Repeat with "nP Beam pp Y".

17d – Direct Alignment: Rotation Center

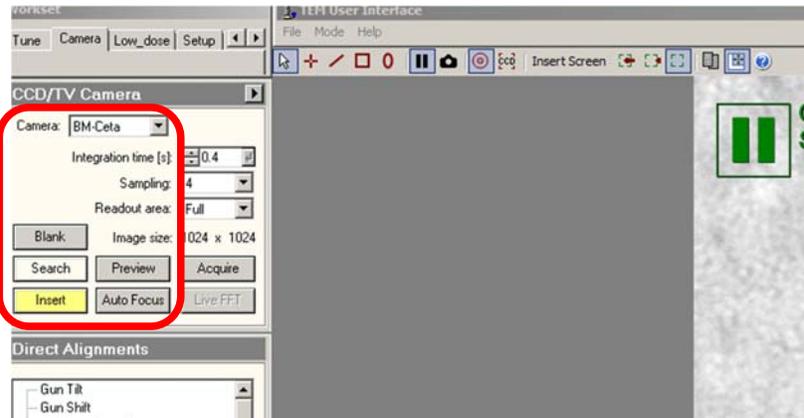**Set Spot Size 6, Nano Probe, SA=240,000x, C2=50**

- Optional: Center beam (To enlarge, only dial clockwise with Intensity dial/knob).
- Spread the beam to full screen;
- Move with the joystick to a "feature" at center.
- Click "Direct Alignment" -> "**Rotation Center**".
    - Use MFX/MFY to adjust to minimum oscillation;
    - Doesn't have to be perfect, within the center small circle okay.
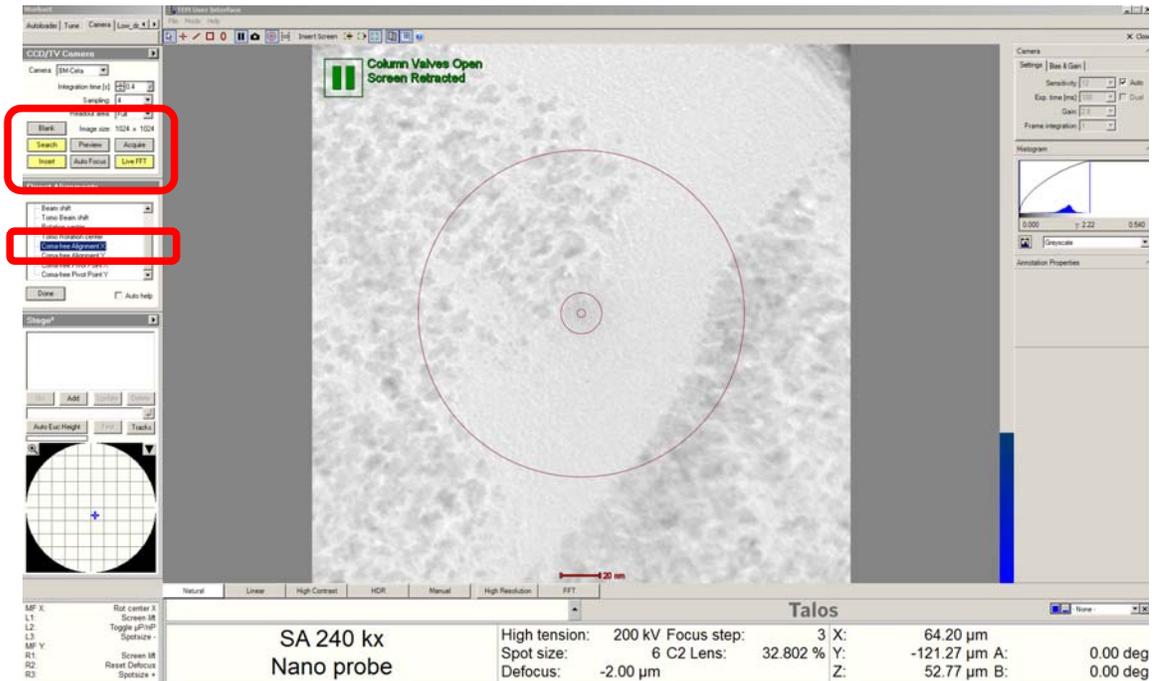   - Click "Done" when finished.

17e,f – Direct Alignment: Coma Free Alignment X/Y

Set Spot Size 6, Nano Probe, SA=240,000x, C2=50, Dial Defocus to -2.0 um

- Optional: Center beam (To enlarge, only dial clockwise with Intensity Dial).
- Press "**R1**" button to lift the screen (check and verify).
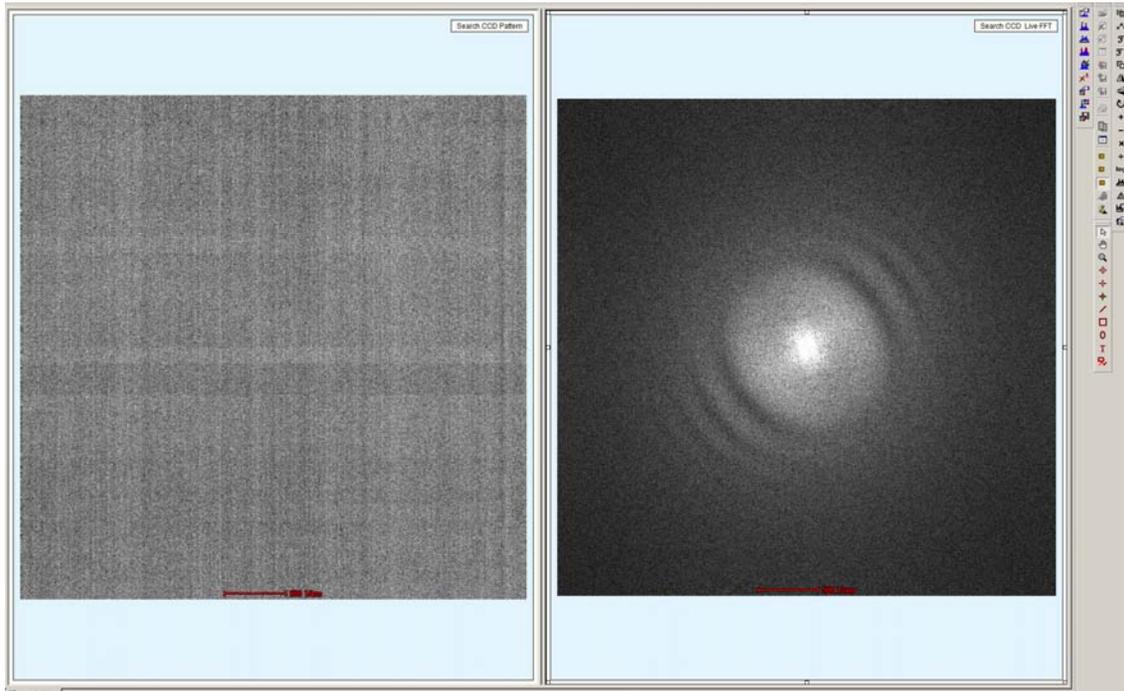- **Insert BM-Ceta camera**.

- Click "Search" -> then click "Live FFT"

- Click "Direct Alignment" -> "Coma free Alignment X";
- **Press "FINE" button TWICE before touching MFX** (no MFY needed)

17e,f – Direct Alignment: Coma Free Alignment X/Y

- Using only the MFX dial/knob, match the patterns (shown on the right monitor).
  - ○ Not necessary to be perfectly round.
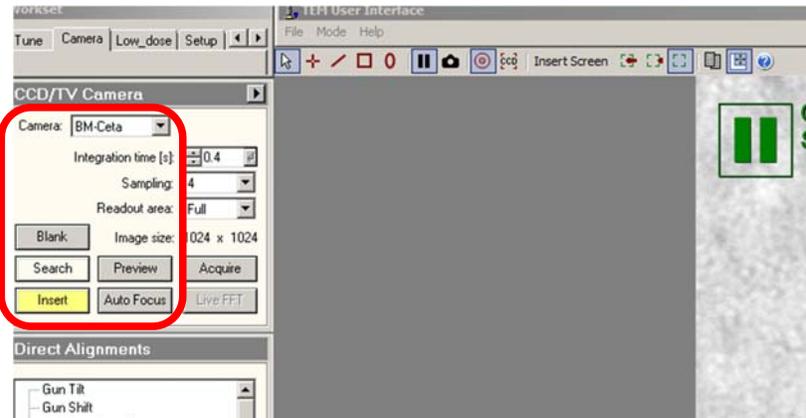 - ○ Sometimes needs to adjust Coma Free Y first.

- Repeat with "Direct Alignment" -> "Coma free Alignment Y".
- ○ Press "Search" to stop Ceta and finish.

18 – Direct Alignment: Correct Objective Stigmatism

Set Spot Size 6, Nano Probe, SA=240,000x, C2=50
- Optional: Center beam (To enlarge, only dial clockwise with Intensity dial/knob).
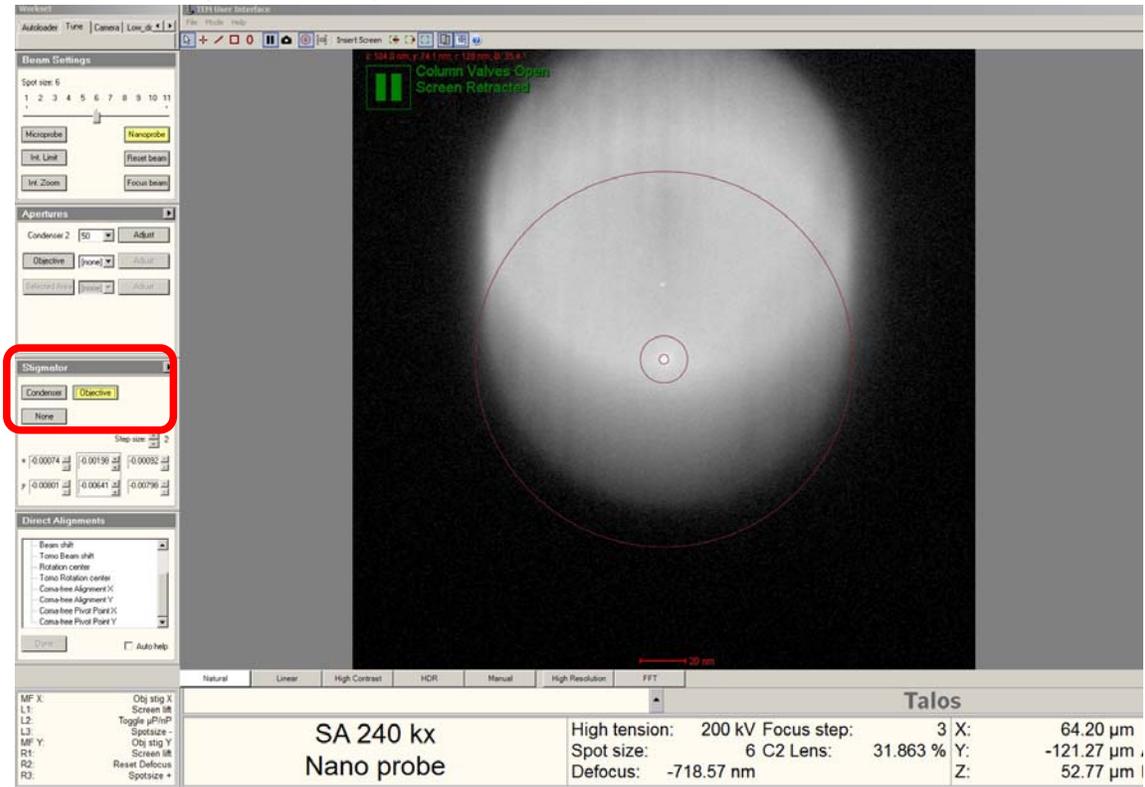- Press "**R1**" button to lift the screen (check and verify).
- **Use BM-Ceta camera**.

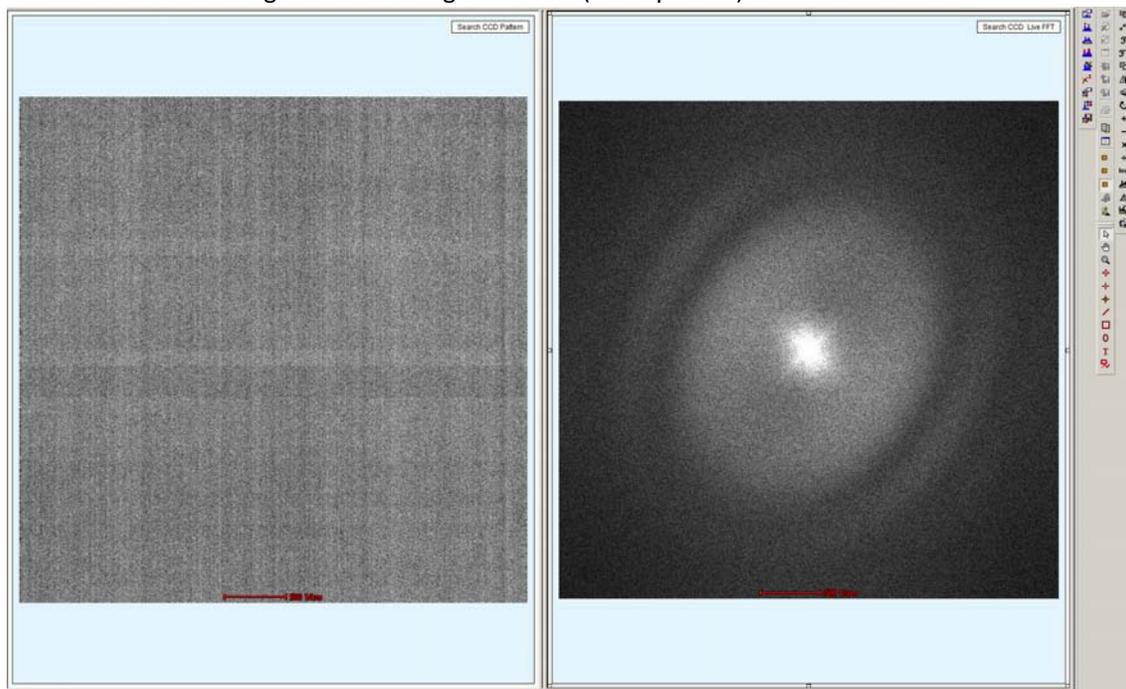- Click "Search" -> then click "Live FFT"

18 – Direct Alignment: Correct Objective Stigmatism
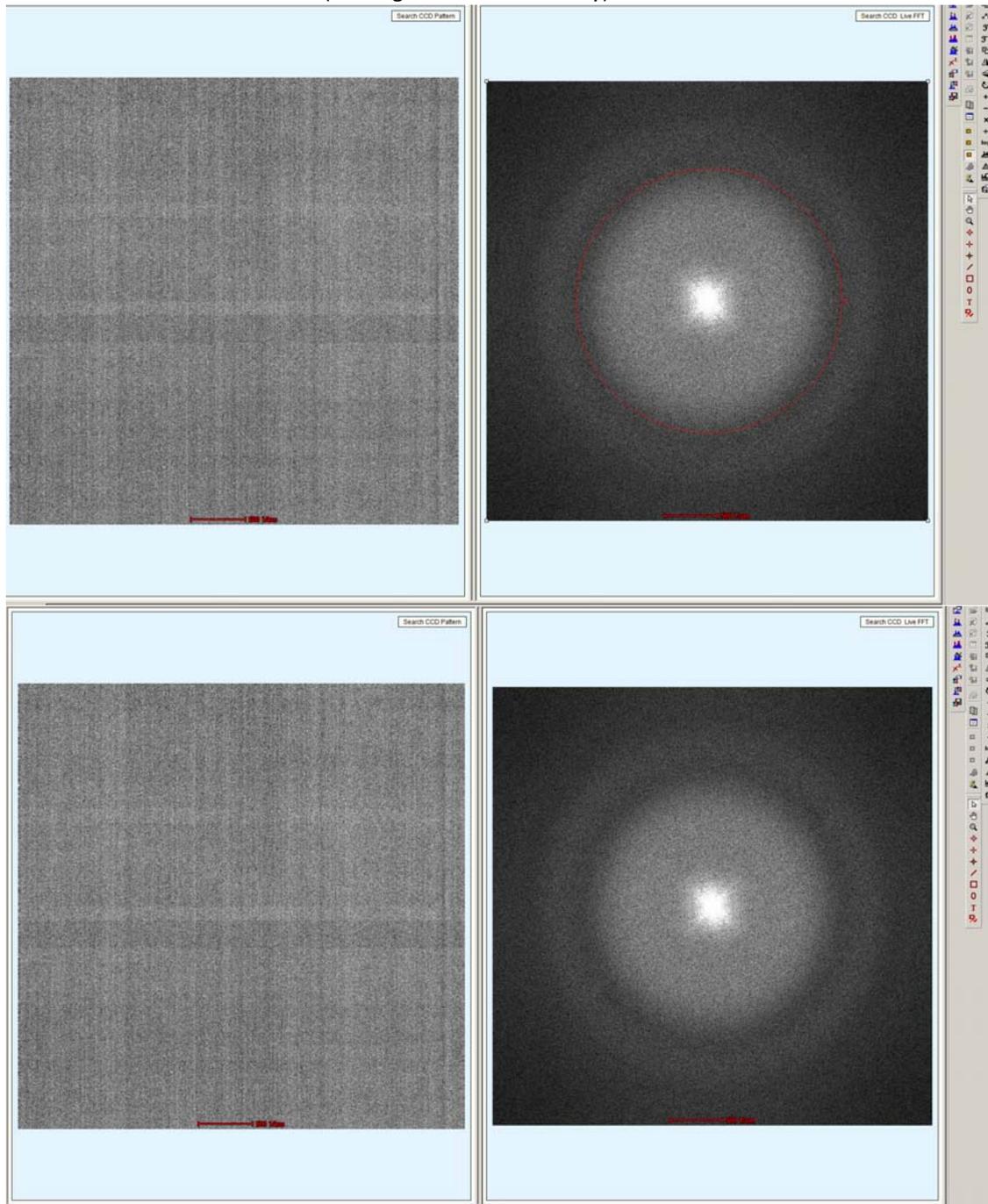
- Click "Stigmator" -> "Objective";

- Using the "**Focus**" dial/knob, make it one Thon ring.
  - Using right side monitor;
  - The larger the Thon ring the better (more precise).

18 – Direct Alignment: Correct Objective Stigmatism

- Using the MFX/MFY dial/knob to make the Thon ring round shape.
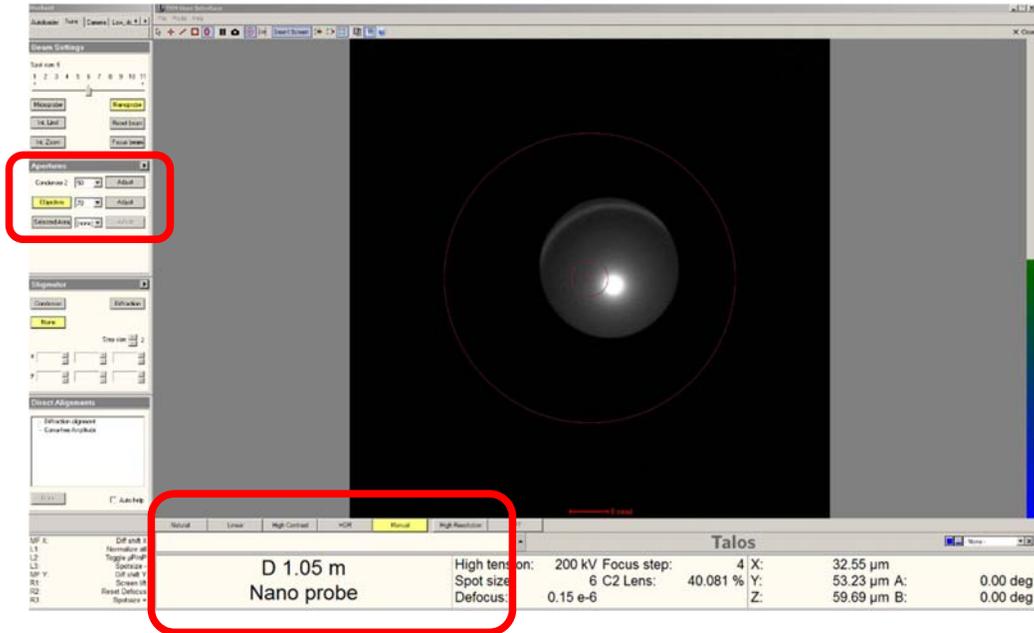   - o Can add a circle (holding down the SHIFT key) for reference.

- o Click "None" when finished.
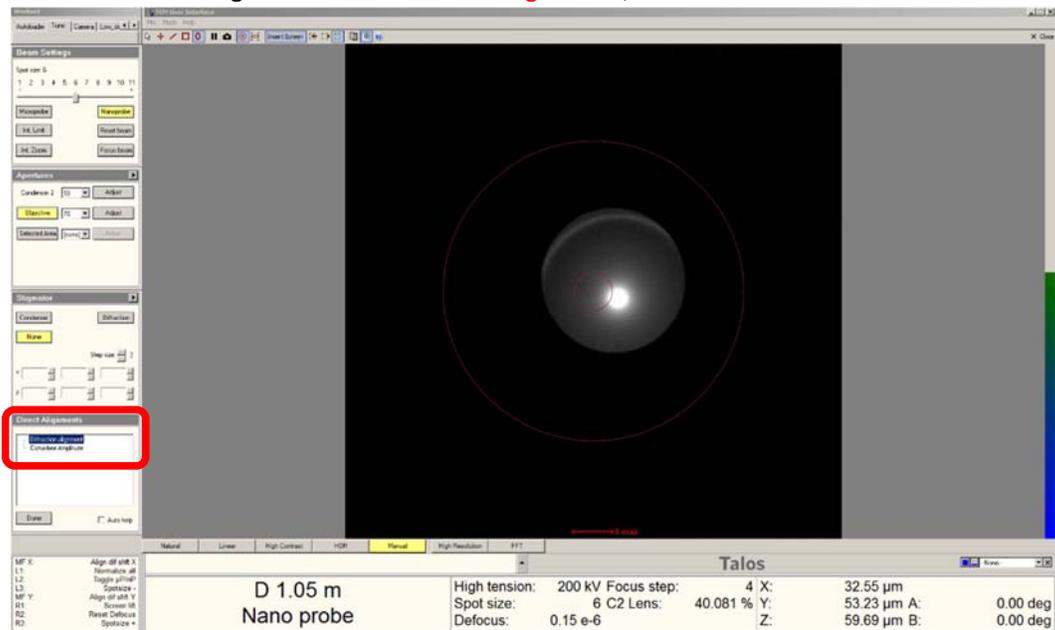- o Click "Search" to stop Ceta and finish.

19 – Direct Alignment: Center Objective Aperture

Set Spot Size 6, Nano Probe, SA=240,000x, C2=50

- Press "**R1**" button to lower the screen (check and verify).
- Optional: Center beam (To enlarge, only dial clockwise with Intensity dial/knob).
- Optional: check and center the C2 aperture (step 15).
- Press "**Diffraction Mode**" on control panel.
- Condense beam (counter clockwise) to crossover.
- Insert **Objective = 70 um (shown in red box)**.

- Click "Direct Alignment" -> "Diffraction alignment";

19 – Direct Alignment: Center Objective Aperture

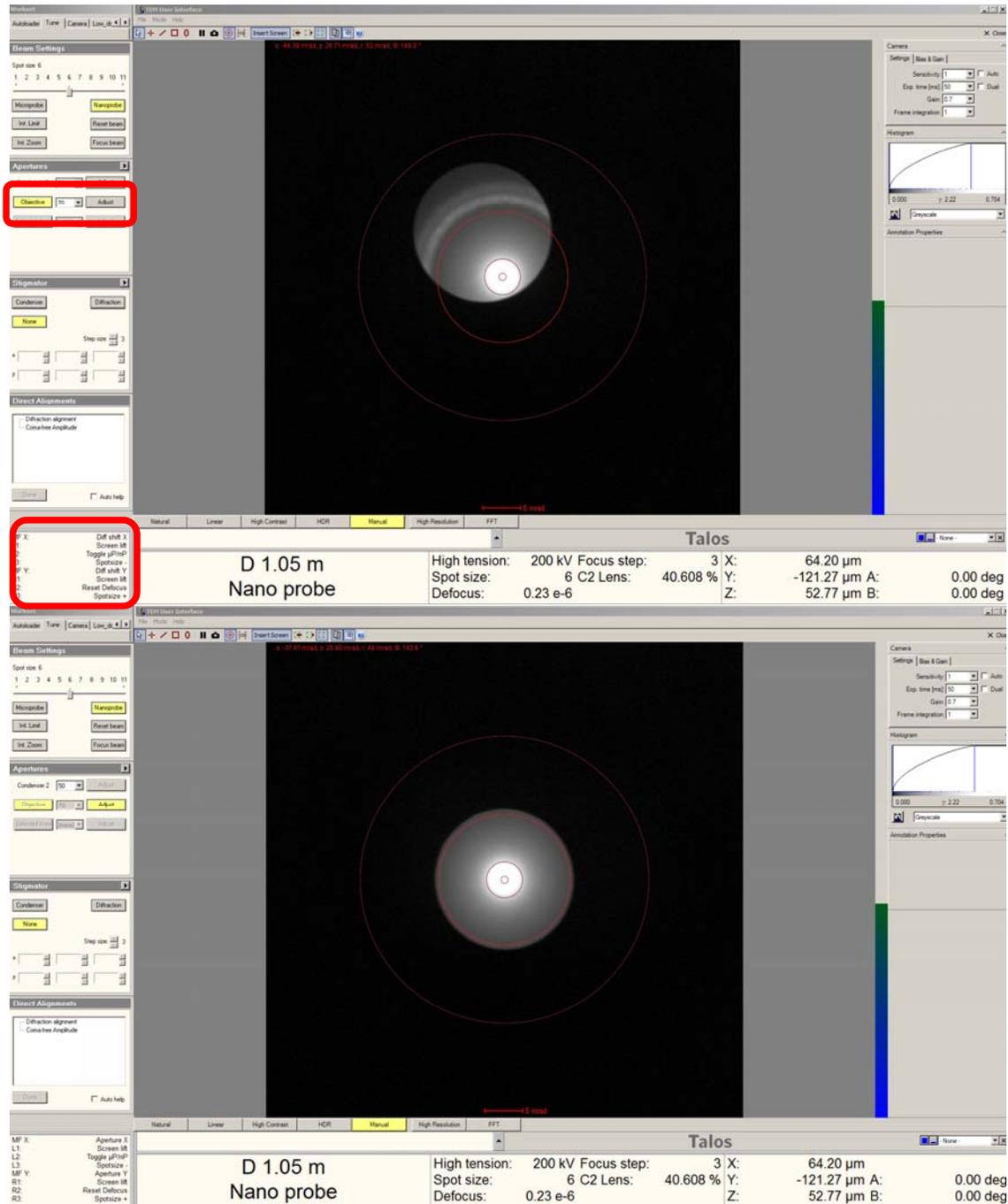- Using the MFX/MFY dial/knob to center the beam precisely.

o Press "Done" when finished.

19 – Direct Alignment: Center Objective Aperture

- Click on the display (dark area) with the left mouse button;
- Using the scroll wheel on mouse to brighten the field inside the ring.
- Insert a reference circle (by holding down the SHIFT key) similar to the size of the beam.
- Click "Apertures" -> "**Objective-Adjust**" (*not the Condensor 2-Adjust*).
- Using the MFX/MFY dial/knob to align the beam precisely to the reference circle.
  - Should be adjusting "Aperture X/Y";
  - May have to make bigger adjustment (click on "+").

- Press "Adjust" when finished.