

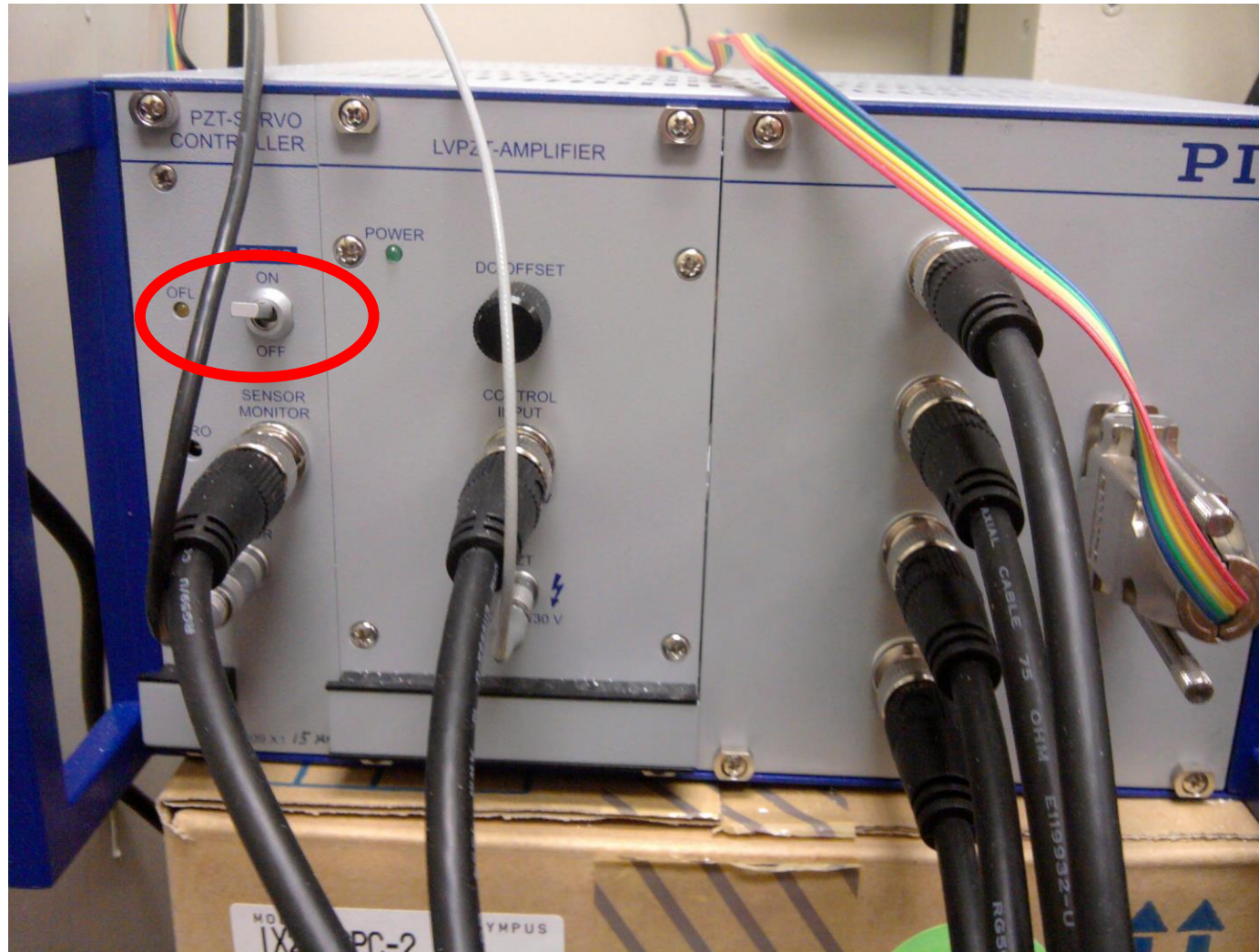
Manual for Home-build AFM

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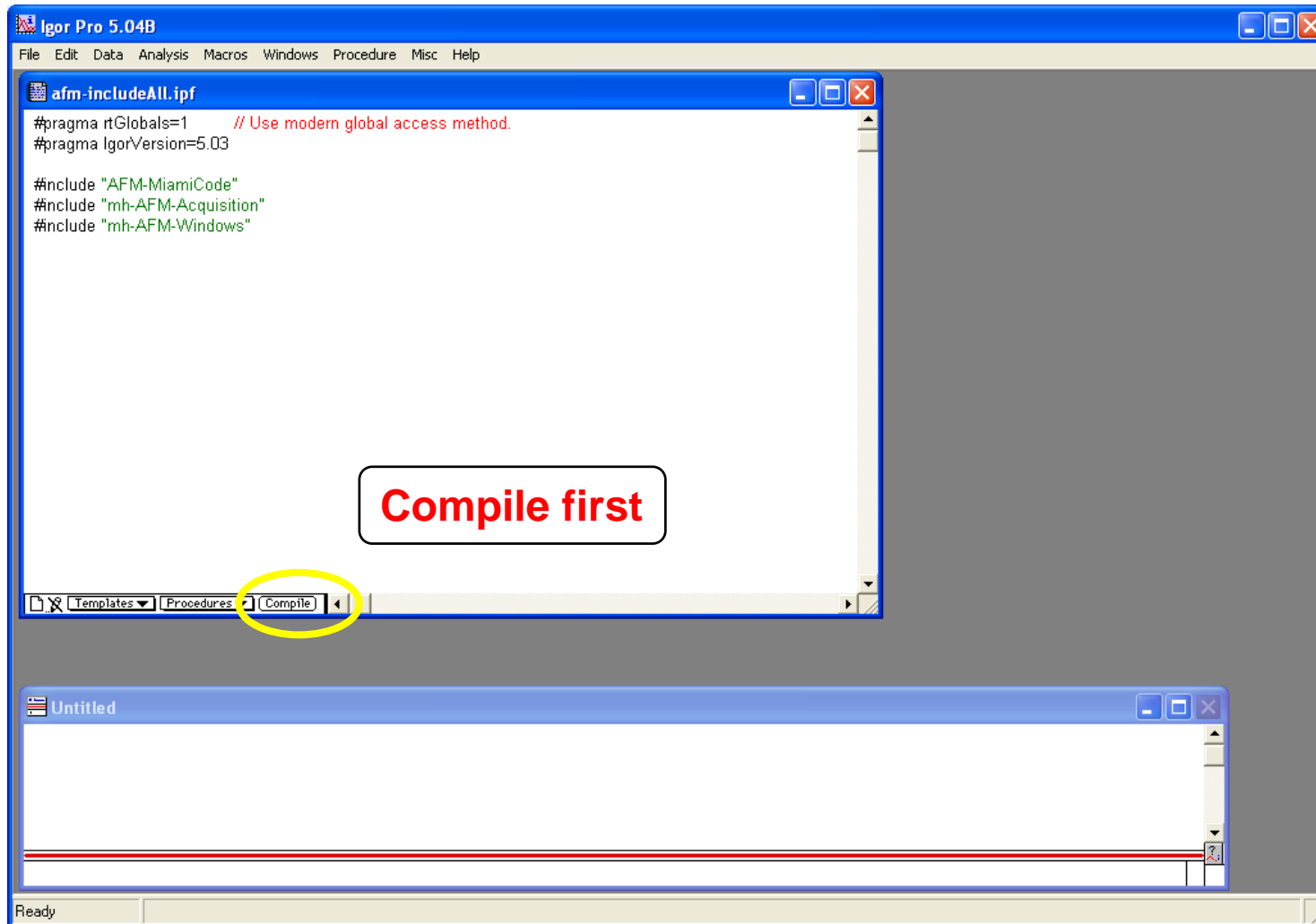
Procedure

- Step 1: Turn on AFM controller; run Igor (afm-includeAll).
- Step 2: **Calibration**
- Step 3: Pulling Experiment

Step 1 – Turn on AFM Controller



Step 1 – Run Igor (afm-includeAll)



Click **Compile**;
Go to **Macros -> Init**

Step 2 - Calibration

- **Before Calibration:**
- Mount the holder to the AFM piezo properly.
- Align the laser, to make the laser shot into the photodetector.
- Keep the holder far from the dish surface when doing the sample scan.

Step 2 – Calibration: Sample Scan

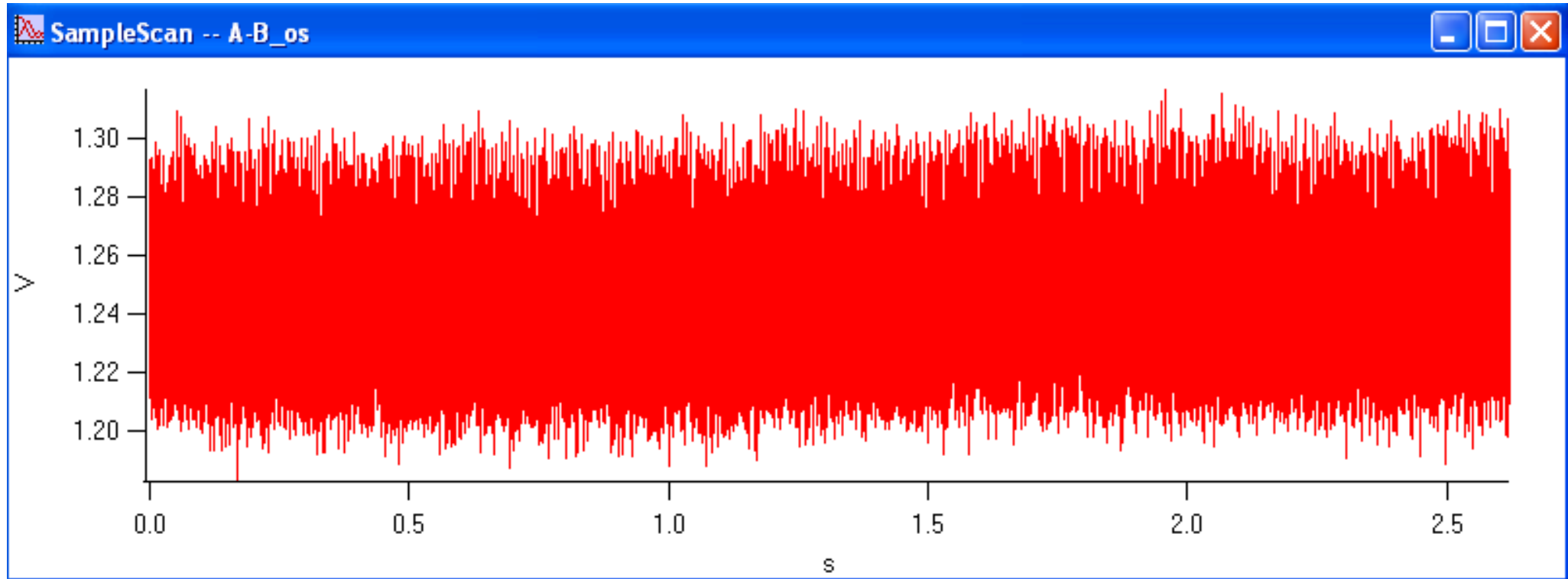


Sample Scan Parameters:

Range: 1.024 V (default)
Change to a higher value when necessary, for example, when using a smaller cantilever.

Save at least 5 good sample scans.

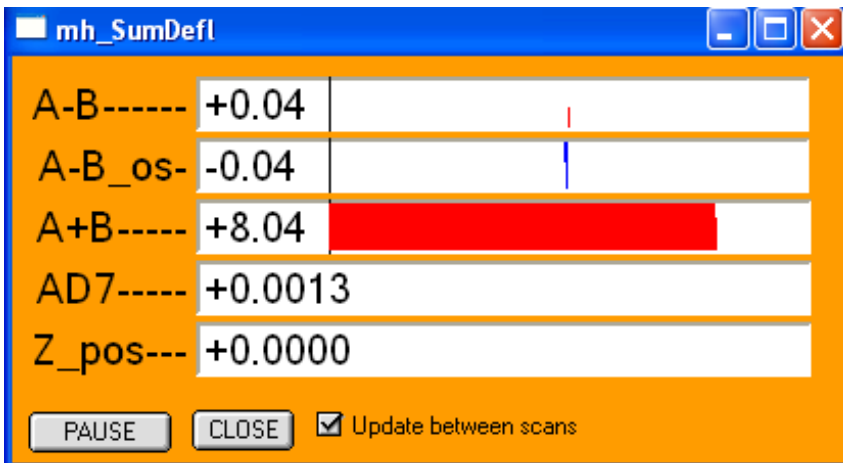
Step 2 – Calibration: Sample Scan



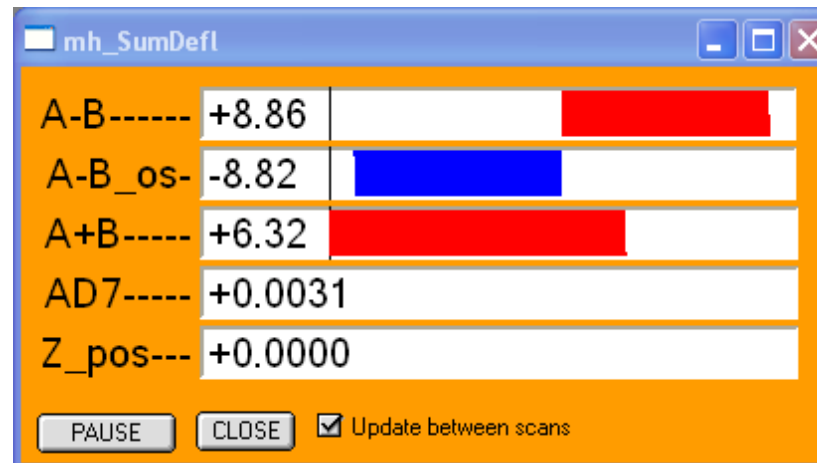
An example of good Sample Scan.

Step 2 – Calibration: Hard Scan

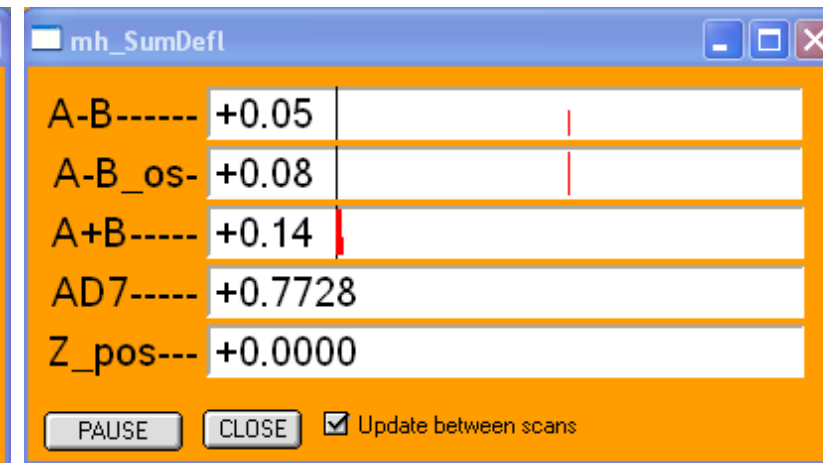
- Approach the cantilever to the dish surface first.
- Check the **sensitivity** of the reflection signal.



Beginning: cantilever is far from dish surface.



Cantilever touches dish surface. (signal jumps)



Cantilever continues to move down a little. (signal disappears) **Lift it back immediately!**

Step 2 – Calibration: Hard Scan

Menu Bar: click

DispFScanParameters.

Dwell time: 0

Max signal (mV): -4000

Feedback ON

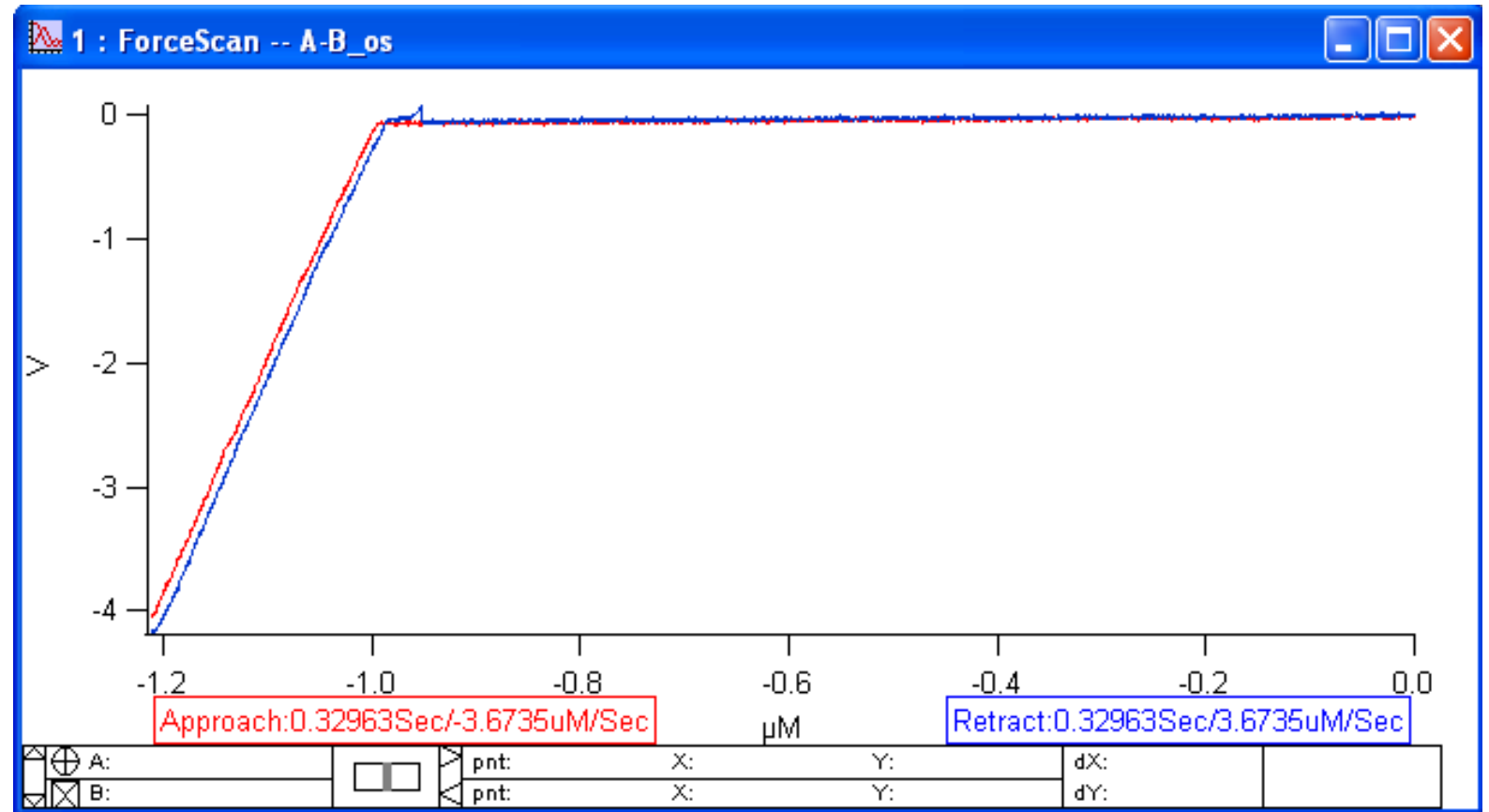
Click **DoForceScan.**

The screenshot shows the 'mh_ForceScanParameters' dialog box with the following settings highlighted in yellow:

- Scan range from (nm): 0
- Scan range to (nm): -15000
- 0V→(nm): 0
- 10V→(nm): -15046
- Bits/step : Approach: 1
- Retract: 1
- Vertical delay approach (x 1.25 uSec): 100
- Vertical delay retract (x 1.25 uSec): 100
- samp.rate [Hz] : approach: 8000
- retract: 8000
- speed [um/s] : approach: 3.76161
- retract: 3.76161
- dwell time at contact (x 1/60 Sec): 0
- Time between scans (x 1/60 Sec): 0
- Number of scans: 1
- Auto Save Data: ☐
- # of channels: ☒ 1, ☒ 2, ☐ 3
- Name: A-B_os, AD7, A+B
- Signal trigger: ☒
- Max signal (mV): -4000
- 1000, -1000
- Max indent. force [pN]: 0
- Display Data Between Scans: ☒
- Display calibrated data: ☐
- Calculate A-B-os From A=Channel #1 and B=Channel #2: ☐
- Signal Limit: ☐ Max Signal: 0
- Calibrate and save in munich style?: ☒
- Buttons: DONE, Update, Feedback ON

Step 2 – Calibration: Hard Scan

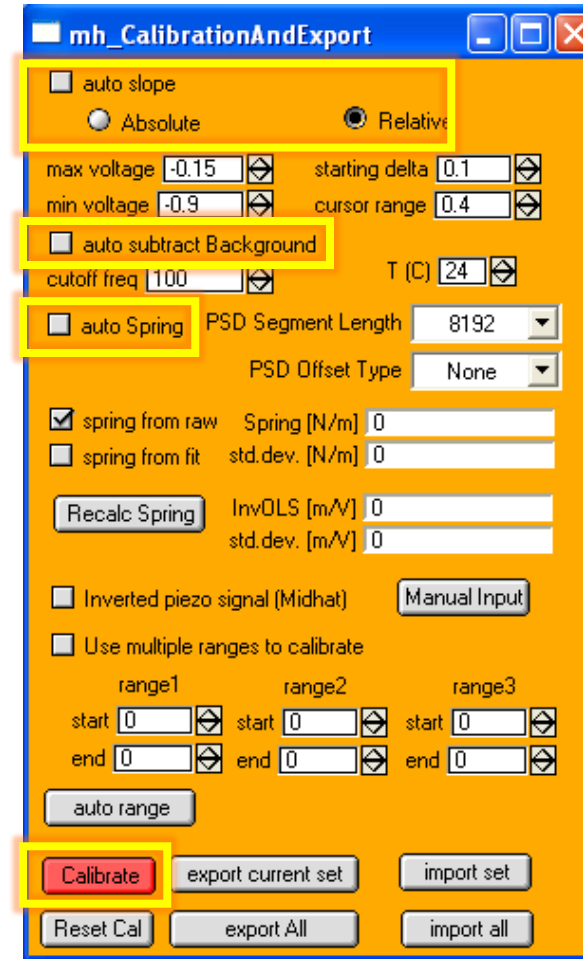
Save at least **5**
good Hard Scans.



An example of good Hard Scan.

Step 2 – Calibration: Calculation

- Click “**Calibration & Export**”.
- **Uncheck** the followings:
 - auto slope
 - auto subtract Background
 - auto spring
- Click **Calibrate**.



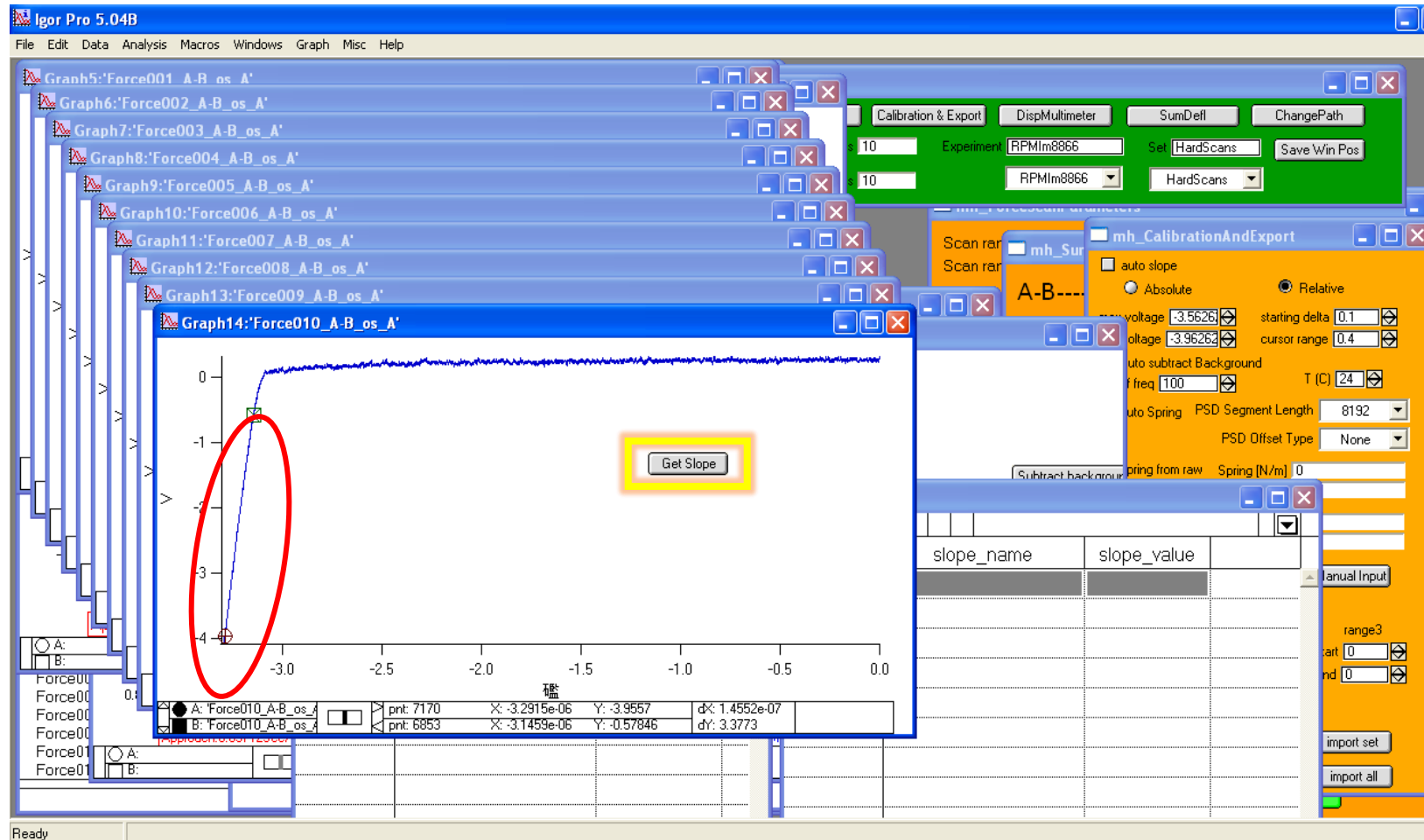
The screenshot shows the 'mh_CalibrationAndExport' dialog box. Several options are highlighted with yellow boxes:

- The 'auto slope' checkbox is unchecked, and the 'Relative' radio button is selected.
- The 'auto subtract Background' checkbox is unchecked.
- The 'auto Spring' checkbox is unchecked.
- The 'Calibrate' button at the bottom is highlighted.

Other visible settings include:

- max voltage: -0.15, min voltage: -0.9, starting delta: 0.1, cursor range: 0.4
- cutoff freq: 100, T (C): 24
- PSD Segment Length: 8192, PSD Offset Type: None
- spring from raw: checked, Spring [N/m]: 0, std.dev. [N/m]: 0
- spring from fit: unchecked
- Recalc Spring button, InvDLS [m/V]: 0, std.dev. [m/V]: 0
- Inverted piezo signal (Midhat): unchecked, Manual Input button
- Use multiple ranges to calibrate: unchecked
- range1, range2, range3: start/end values are all 0
- auto range button
- export current set, import set, export All, import all buttons

Step 2 – Calibration: Slope

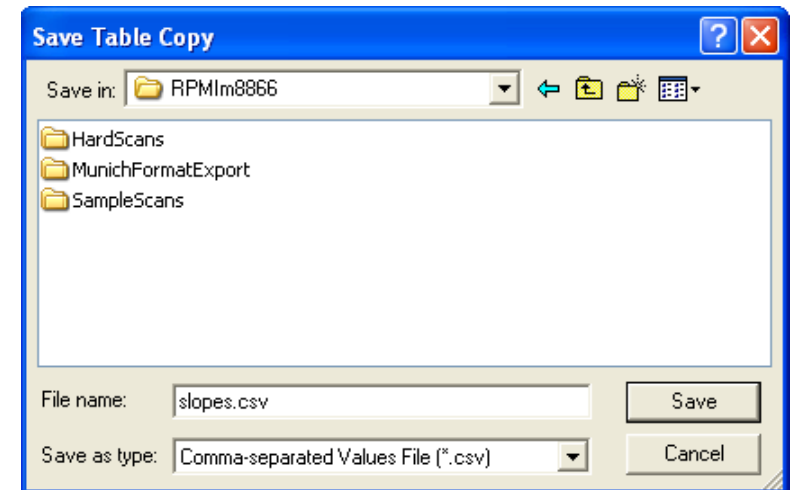
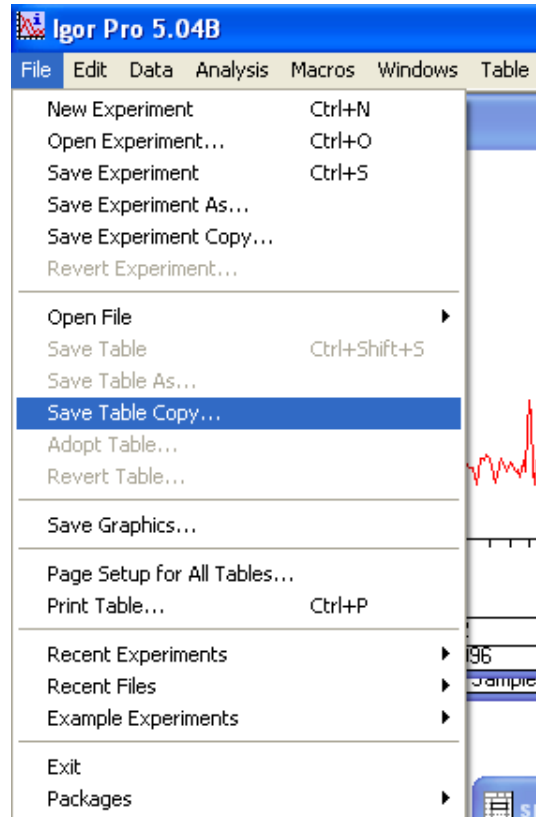


Select two points:
Linear curve
between them.

Click **“Get Slope”**.

Step 2 – Calibration: Slope

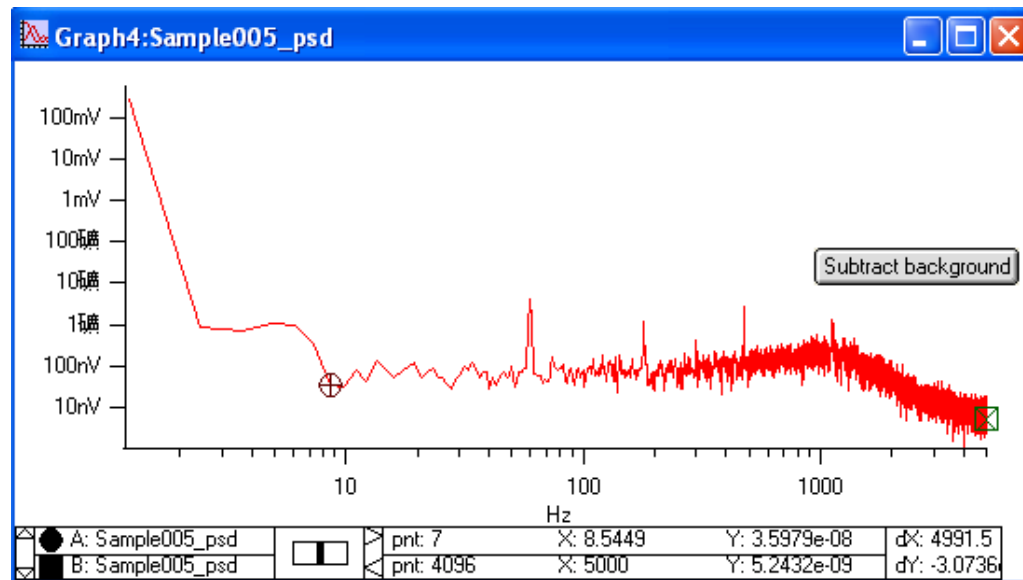
slopes		
R3C0		Force005 A-B os A
Point	slope_name	slope_value
0	Force010_A-B_os_A	4.21418e-08
1	Force007_A-B_os_A	4.10309e-08
2	Force006_A-B_os_A	4.12704e-08
3	Force005_A-B_os_A	4.12888e-08
4	Force004_A-B_os_A	4.08039e-08
5	Force003_A-B_os_A	4.12571e-08
6	Force002_A-B_os_A	4.05846e-08
7	Force001_A-B_os_A	3.99521e-08
8		



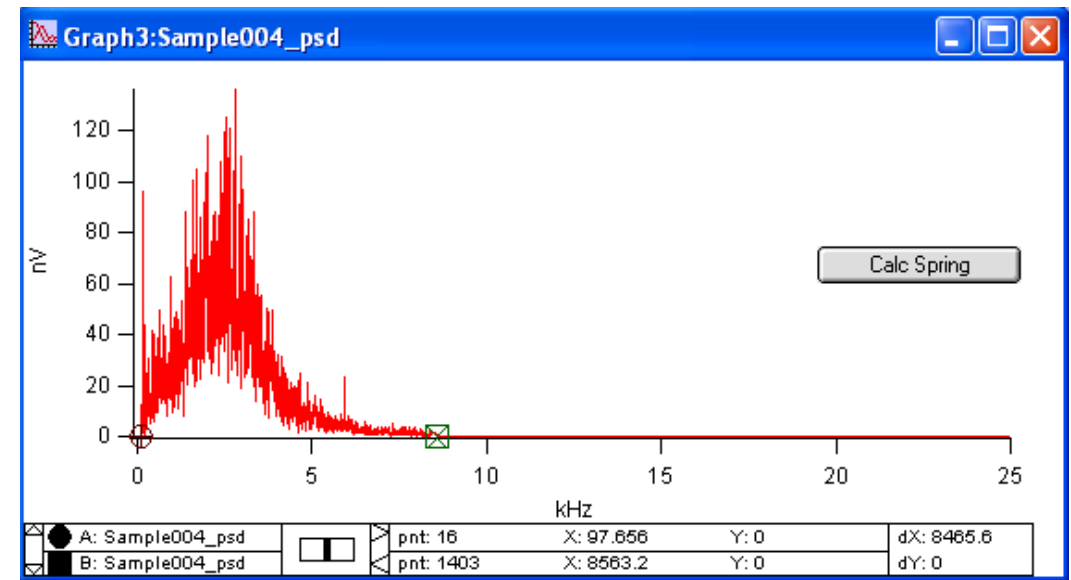
Slope Table:
Values: $\sim 5\text{E}-08$.

Save as **.csv** file.

Step 2 – Calibration: Spring

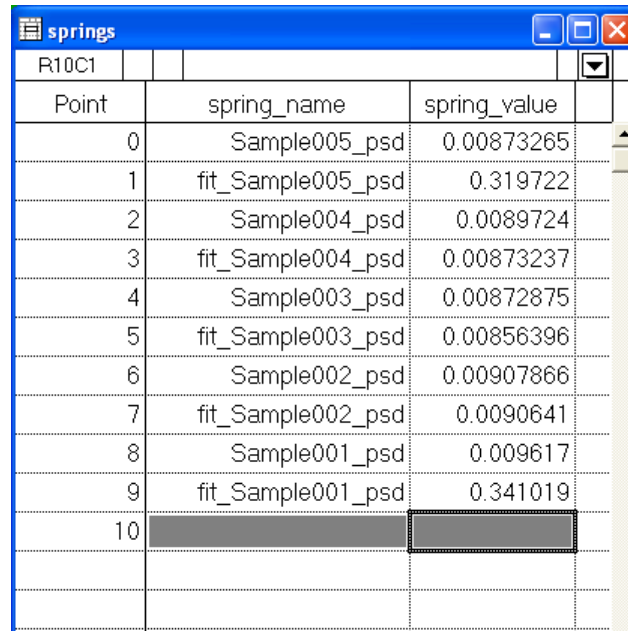


Select two points.
Click **"Subtract background"**.



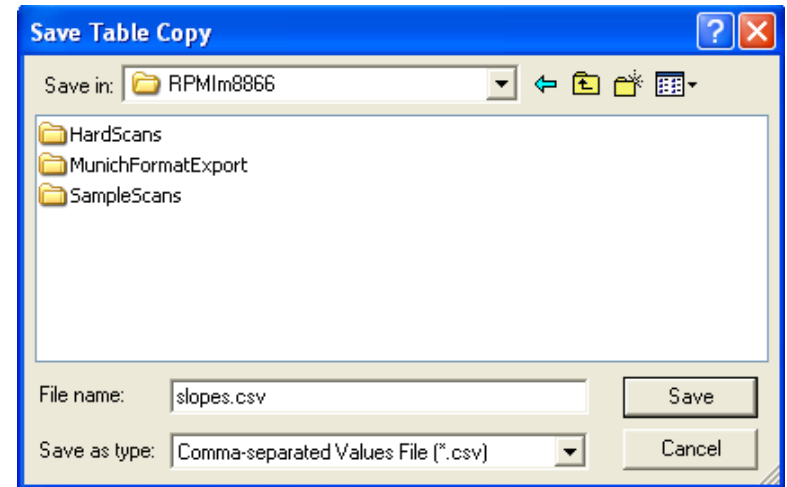
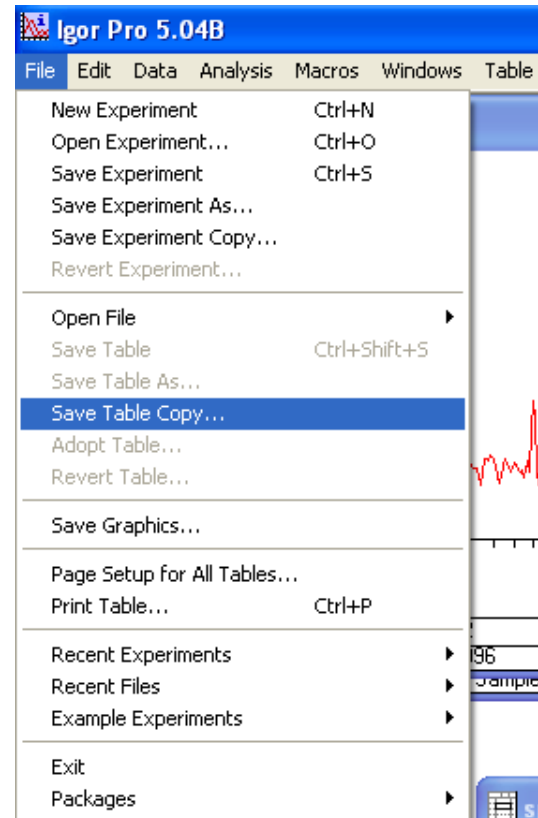
Click **"Calc Spring"**.

Step 2 – Calibration: Spring



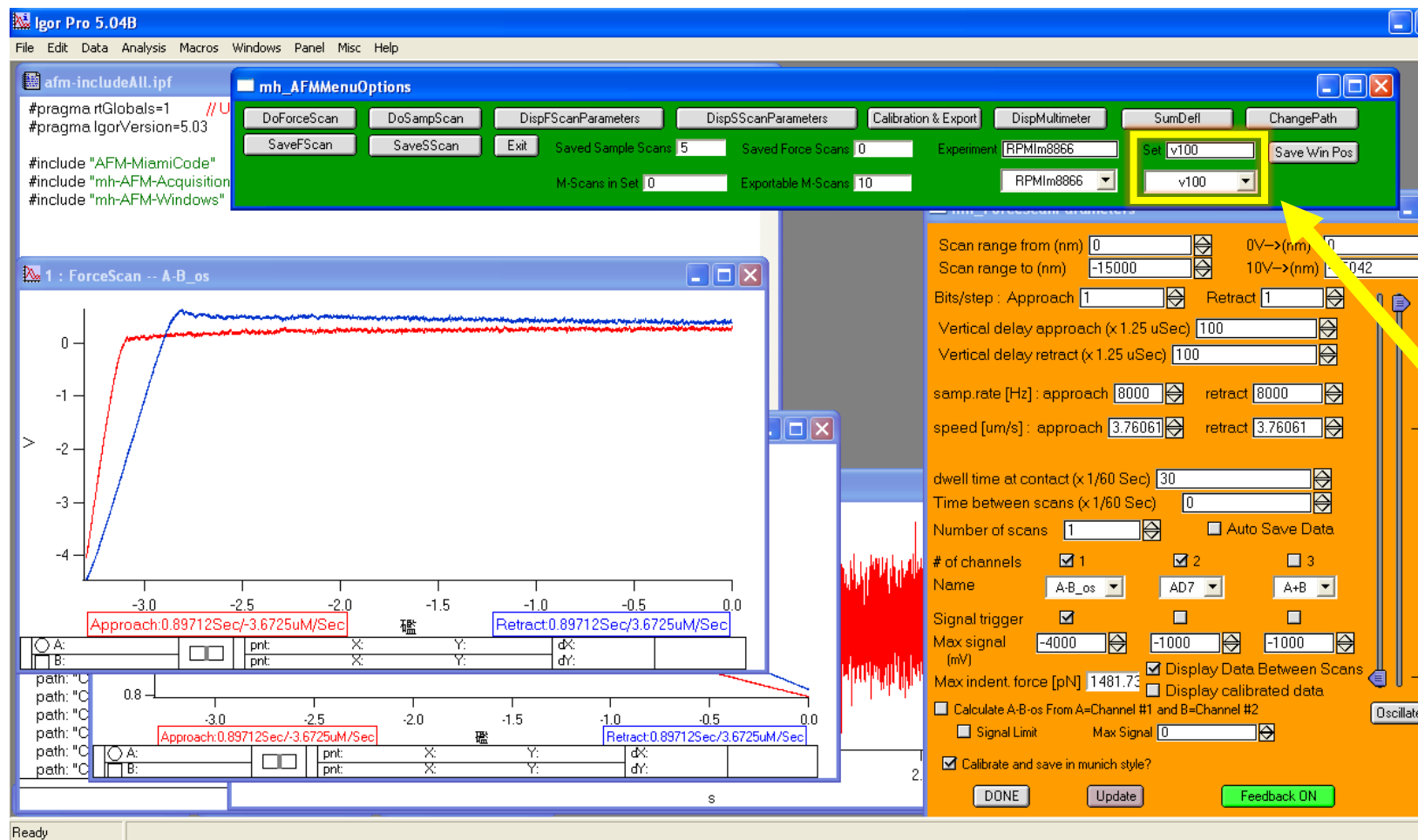
Point	spring_name	spring_value
0	Sample005_psd	0.00873265
1	fit_Sample005_psd	0.319722
2	Sample004_psd	0.0089724
3	fit_Sample004_psd	0.00873237
4	Sample003_psd	0.00872875
5	fit_Sample003_psd	0.00856396
6	Sample002_psd	0.00907866
7	fit_Sample002_psd	0.0090641
8	Sample001_psd	0.009617
9	fit_Sample001_psd	0.341019
10		

Spring Table:
Values (not fit):
~0.01 for largest
triangular cantilever.



Save as **.csv** file.

Step 3 – Pulling Experiment



Change data saving folders!

- Type the folder name, and press **Enter**.