June 3rd, 2015 Update

Jack Matteucci

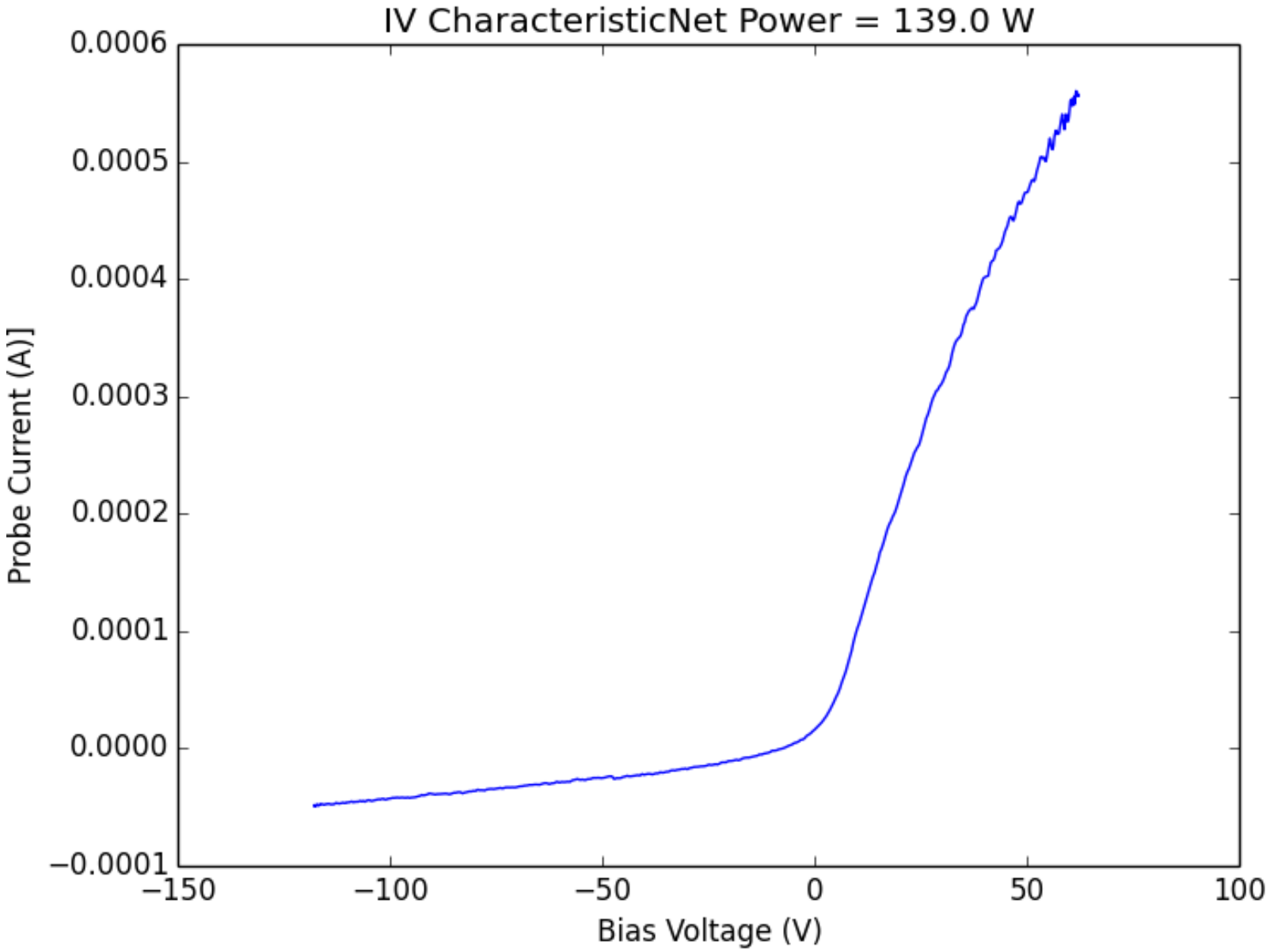
Run 5/27

- MC Pressure Scans:
  - ER at 0.325 mTorr, MC from 0.22 to .70 mTorr
  - ER at 0.530 mTorr, MC from 0.43 to 1.36 mTorr
    - Net Power at 100 W for pressure scans
- Net Power Scan
  - 8 W to 160 W
    - ER at 0.350 mTorr, MC at 0.64 mTorr

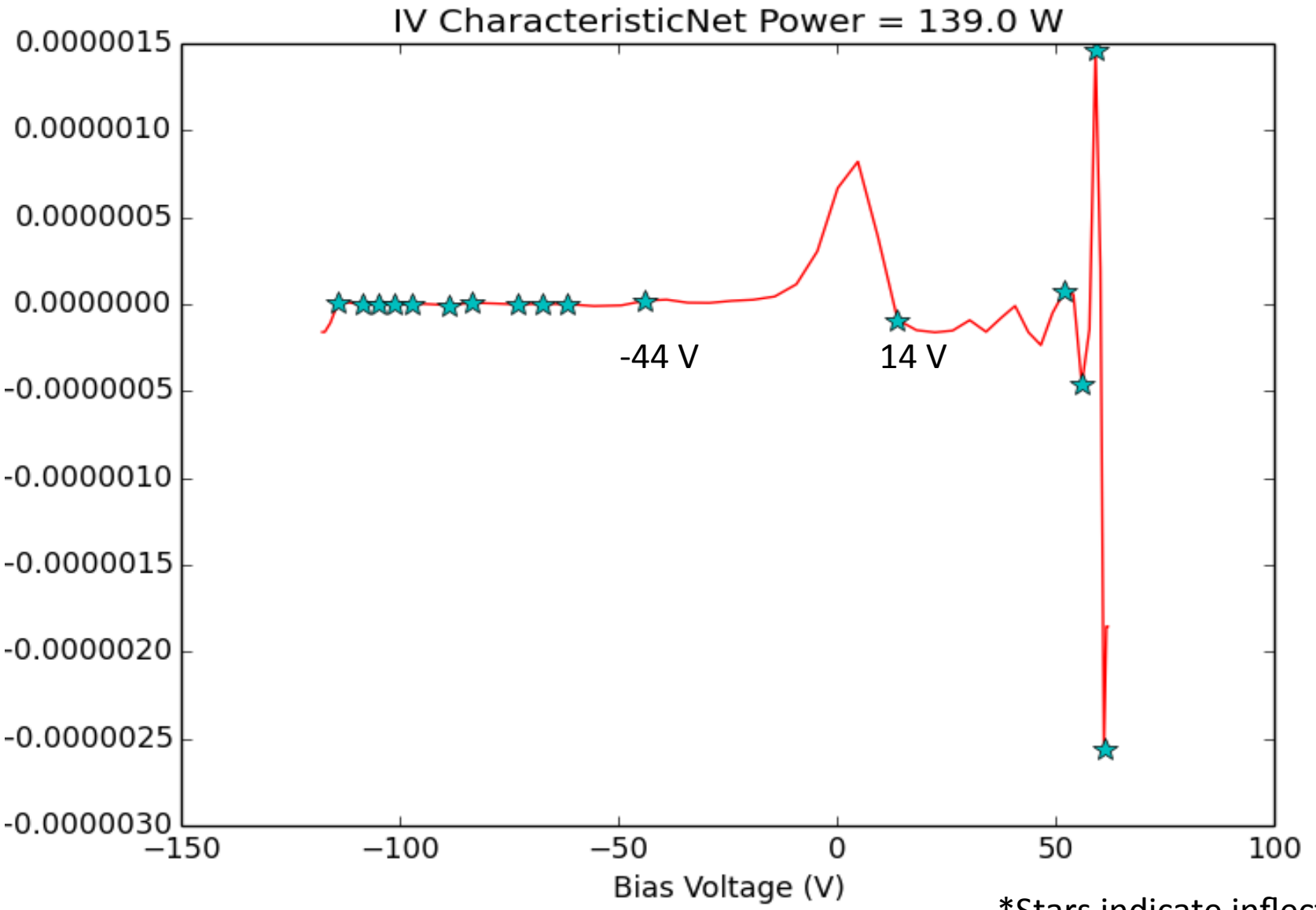
  For all scans, Main Mag = 92A, Nozzle = 300 A

Conditions:

- MC pressure: 0.69 mTorr
- ER pressure: 0.354 mTorr
- Satellite: 1.6 e-5 Torr
- Net Power: 139 W, pforward: 170W, prefl: 31 W
- 27 MHz helicon power
- R = 0.0 cm
- Bias from ~-120 V to ~65 V
- Nozzle 300 A, Main 92 A

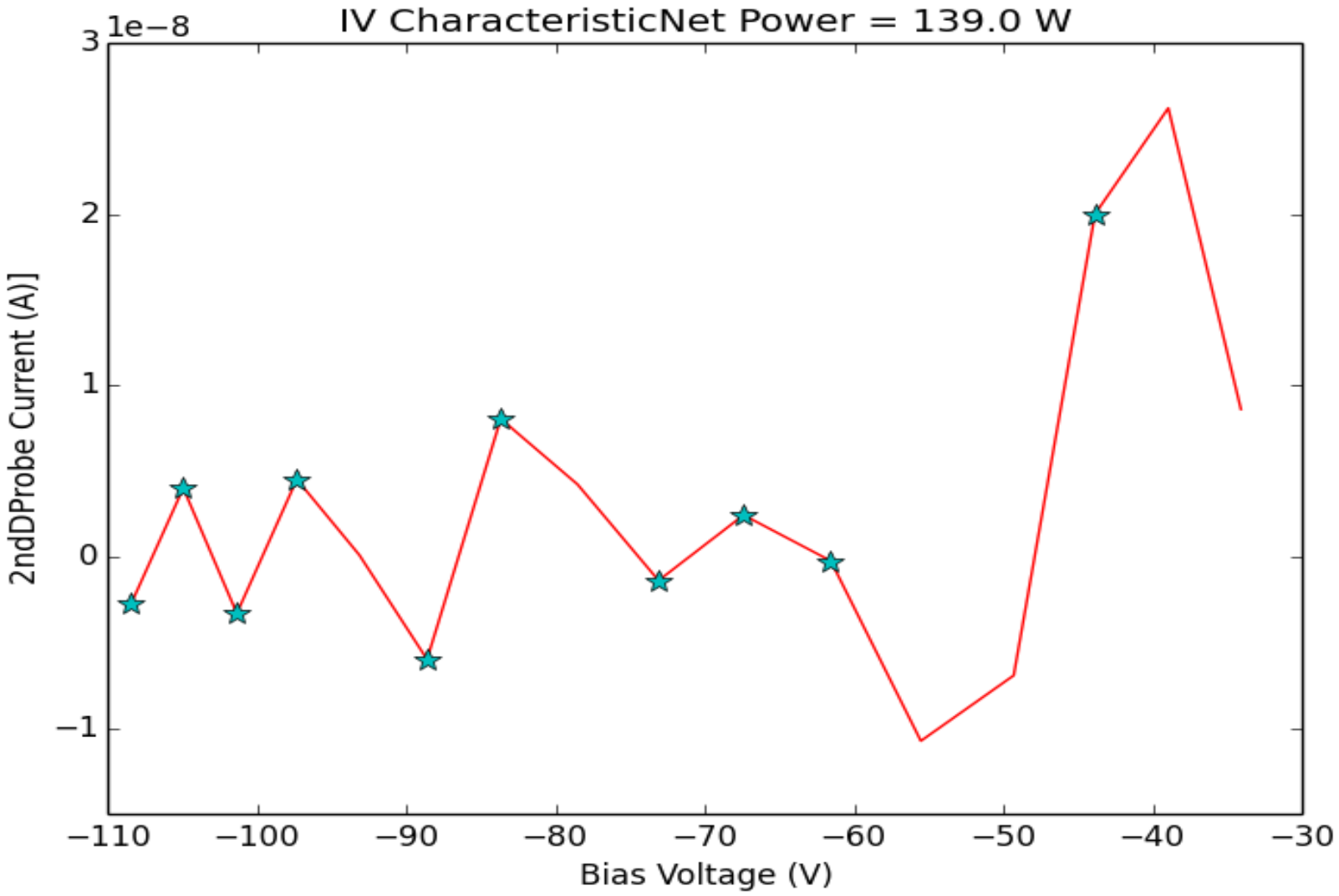

IV CharacteristicNet Power = 139.0 W
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
−0.0001
Probe Current (A)]
−150
−100
−50
0
50
100
Bias Voltage (V)

2nd derivative of Current w/ respect to V

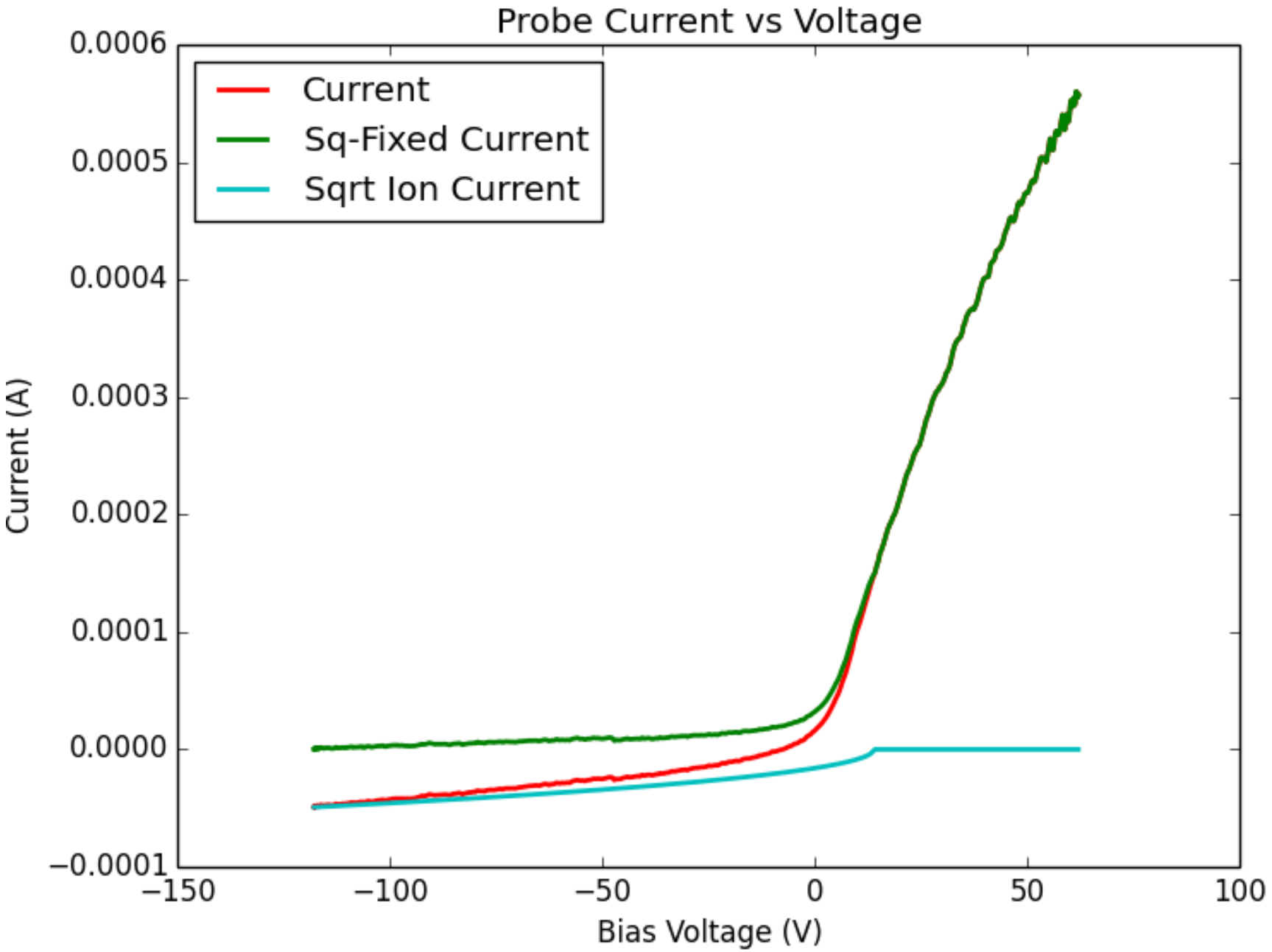


*Stars indicate inflection point

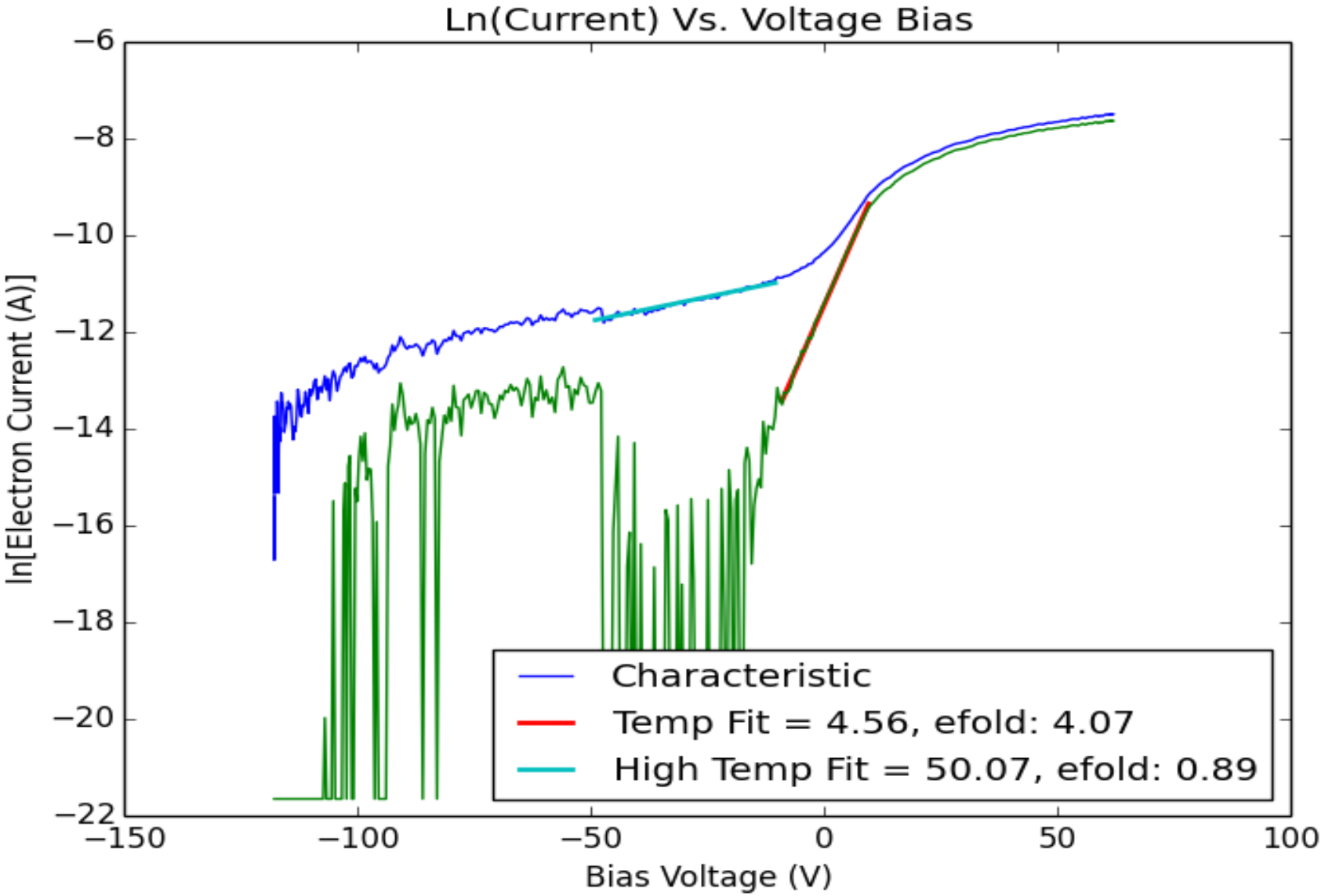
2nd derivative of Current w/ respect to V

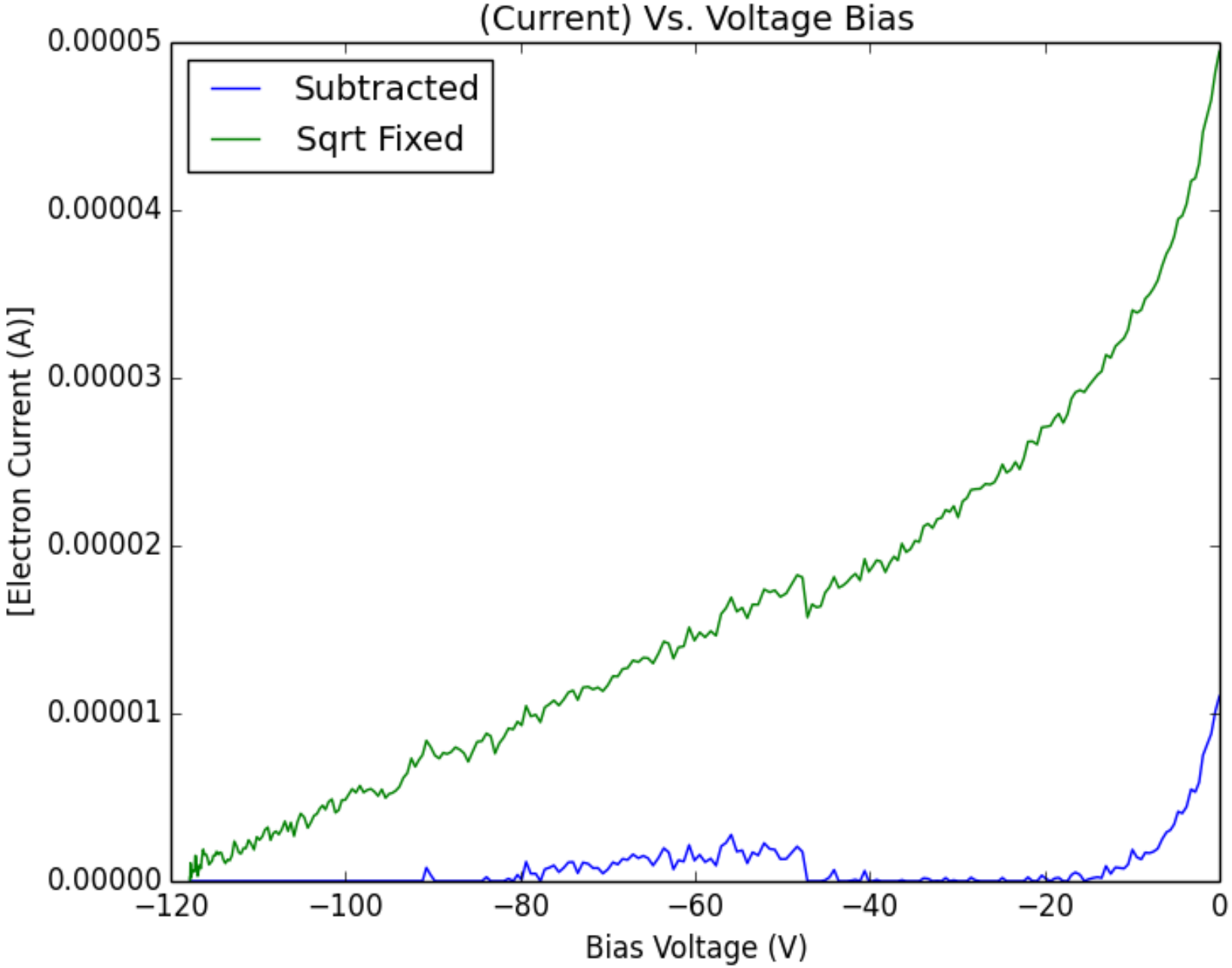


*Stars indicate inflection points

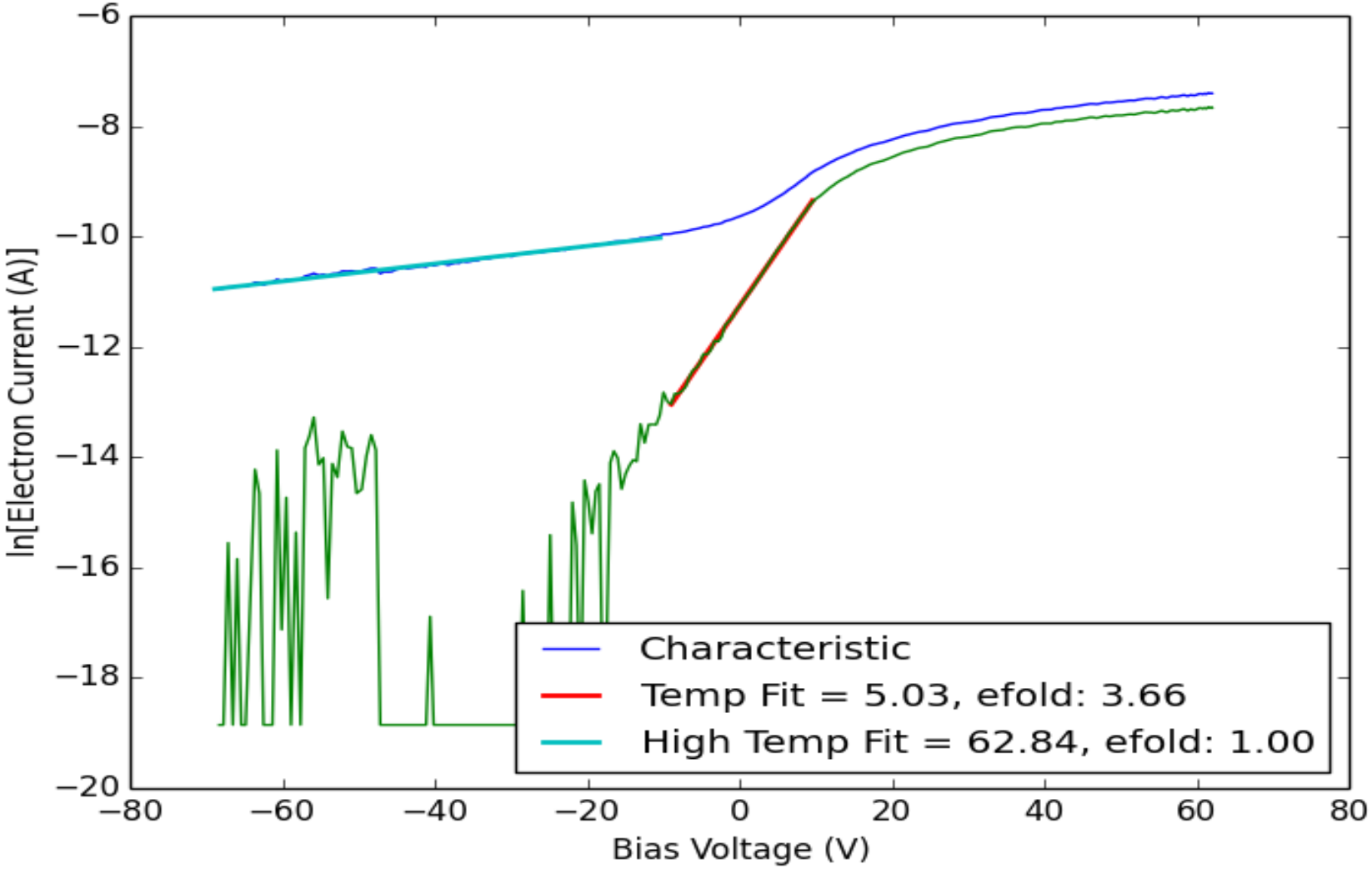

Probe Current vs Voltage
Current
Sq-Fixed Current
Sqrt Ion Current
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
−0.0001
Current (A)
−150
−100
−50
0
50
100
Bias Voltage (V)

Sqrt Ion sat approximation

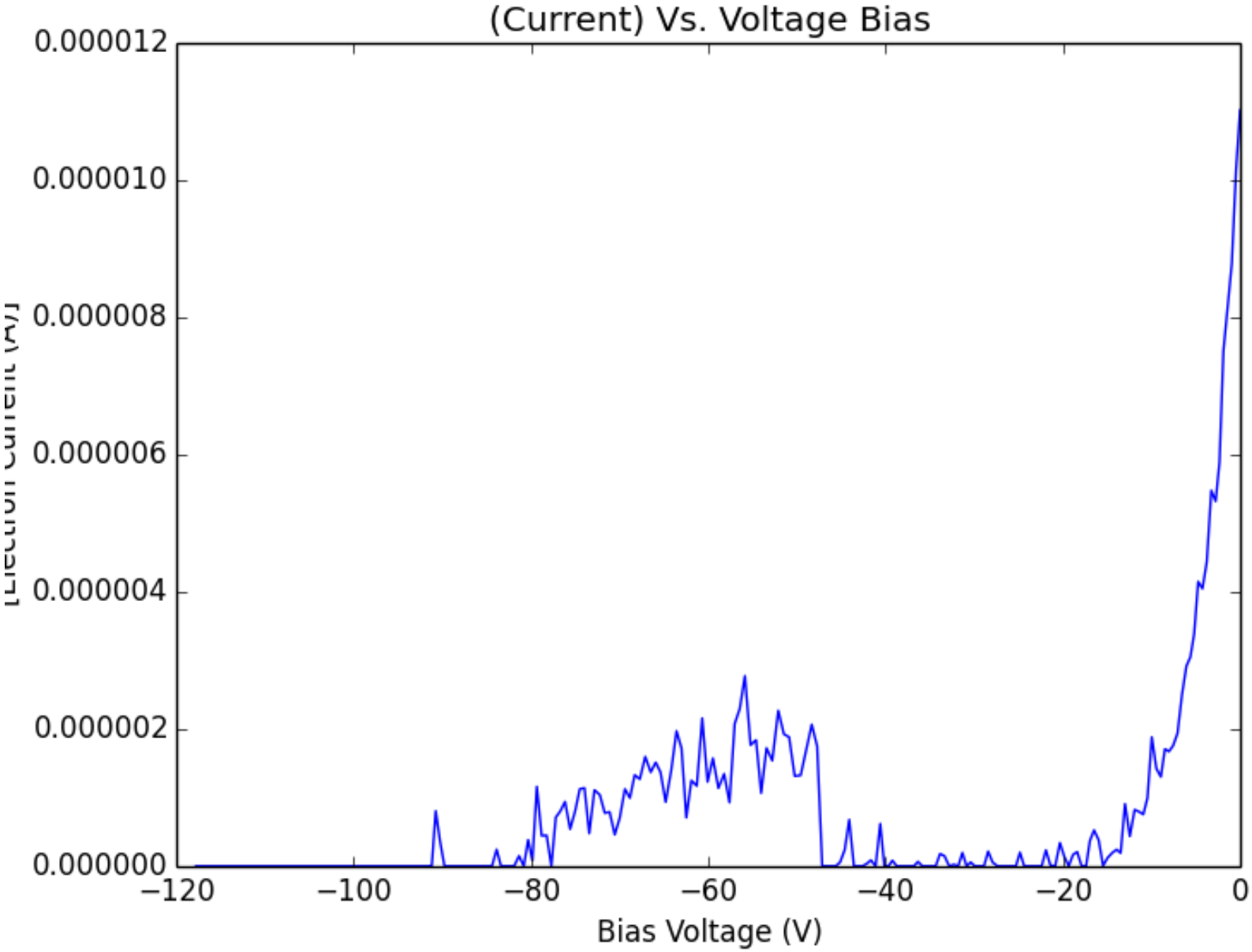



(Current) Vs. Voltage Bias
Subtracted
Sqrt Fixed
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
[Electron Current (A)]
−120
−100
−80
−60
−40
−20
0
Bias Voltage (V)

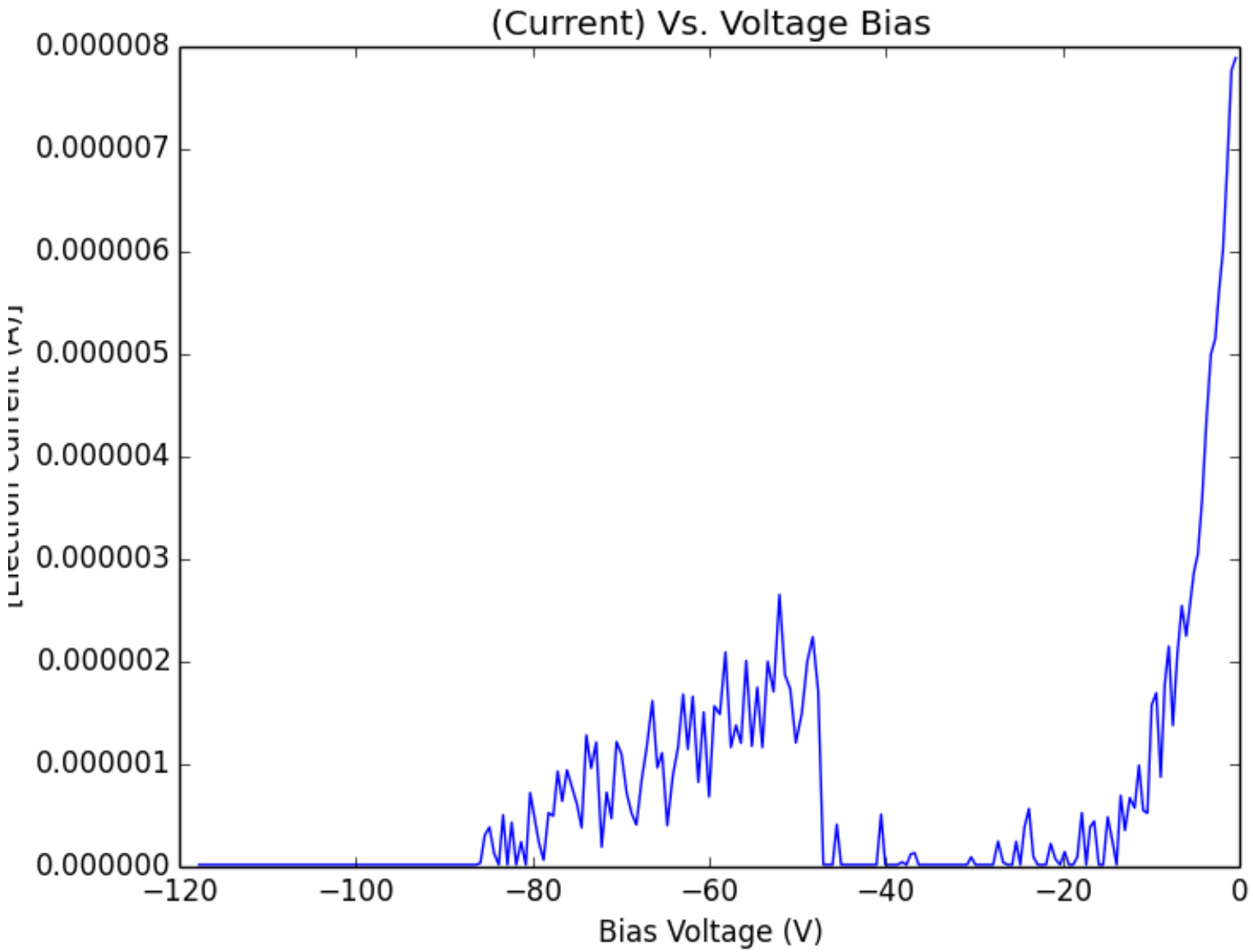
Constant Ion sat approximation



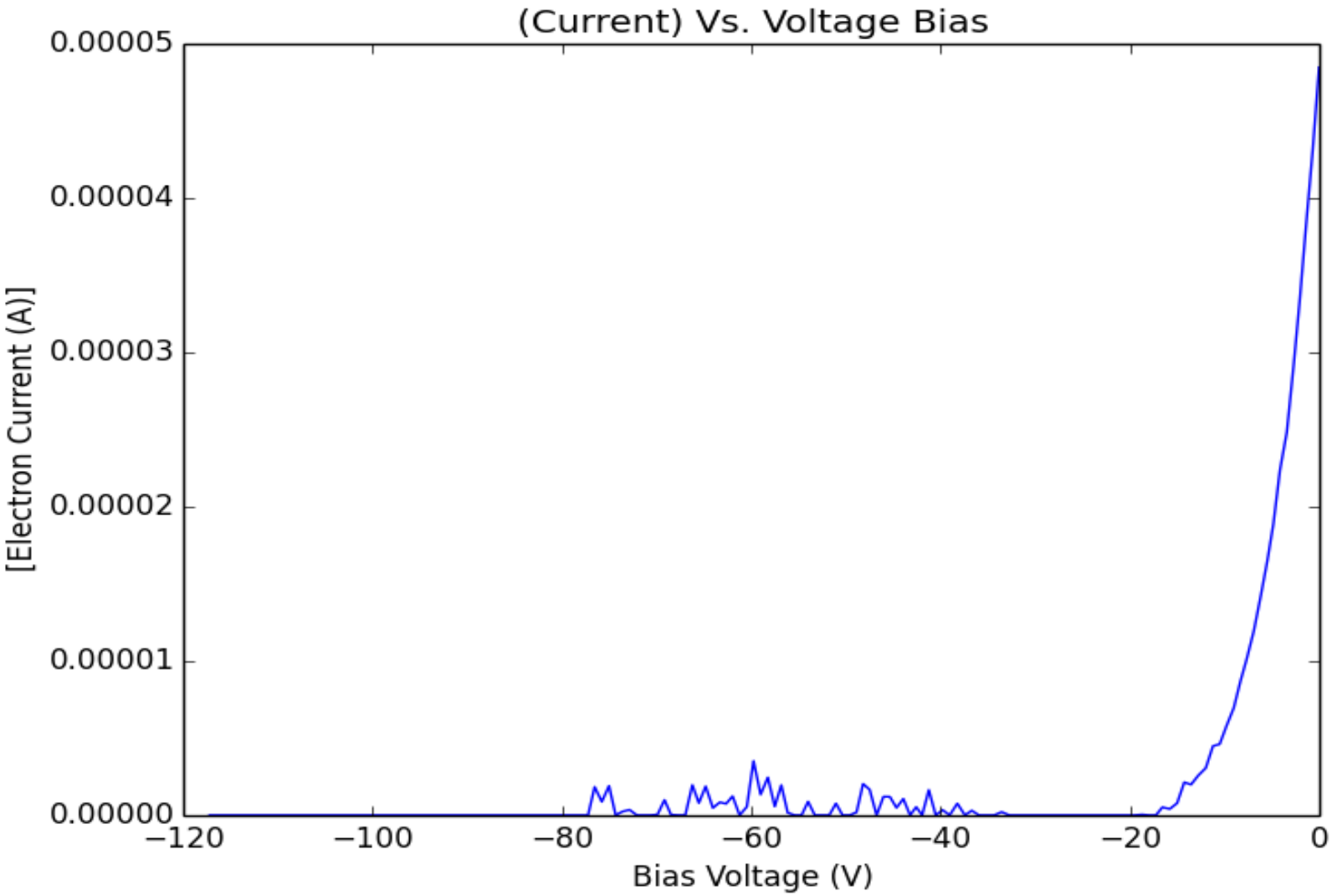
MC 0.69 mT, ER 0.354 mT, 139 W



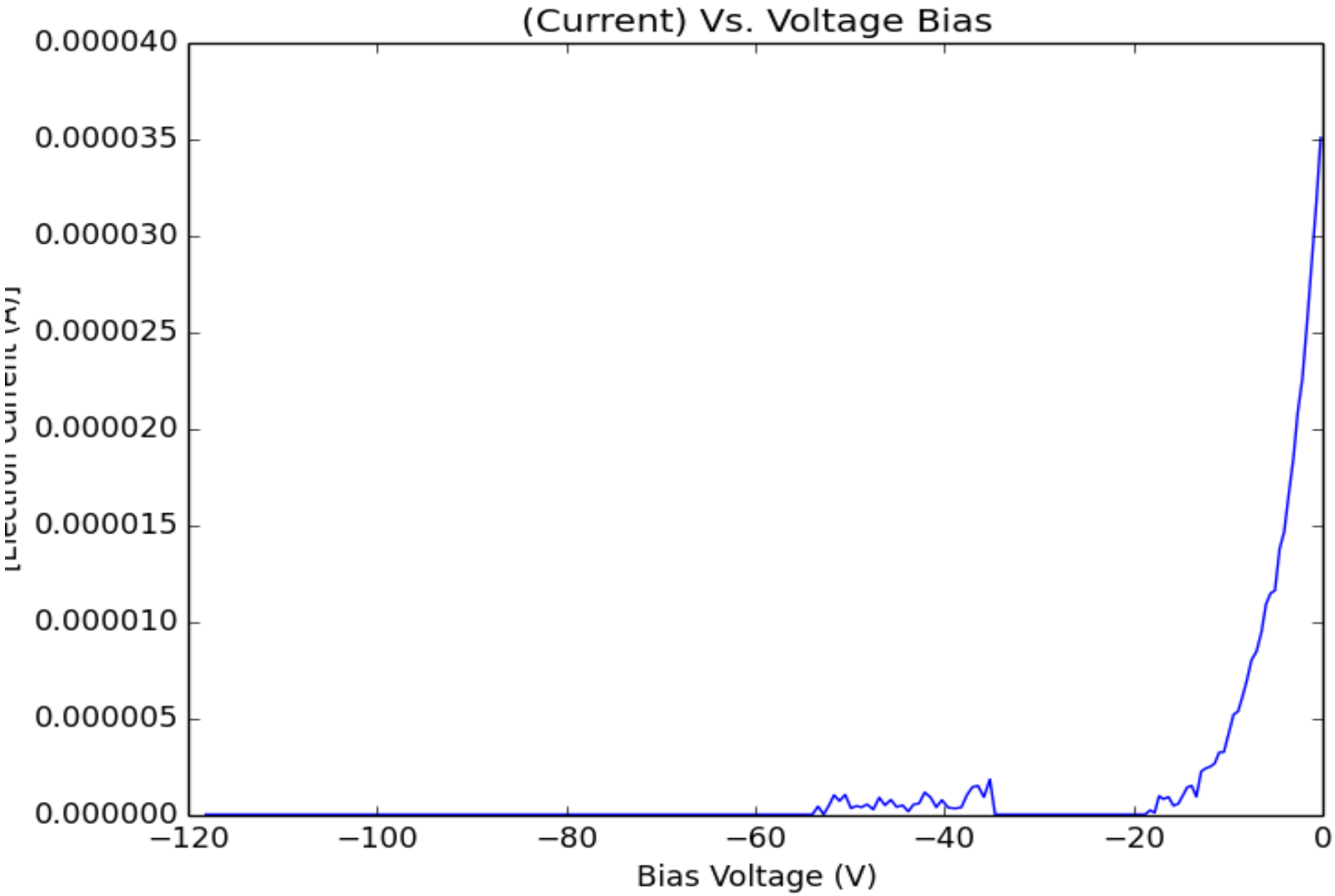
MC 0.69 mT, ER 0.354 mT, 160 W



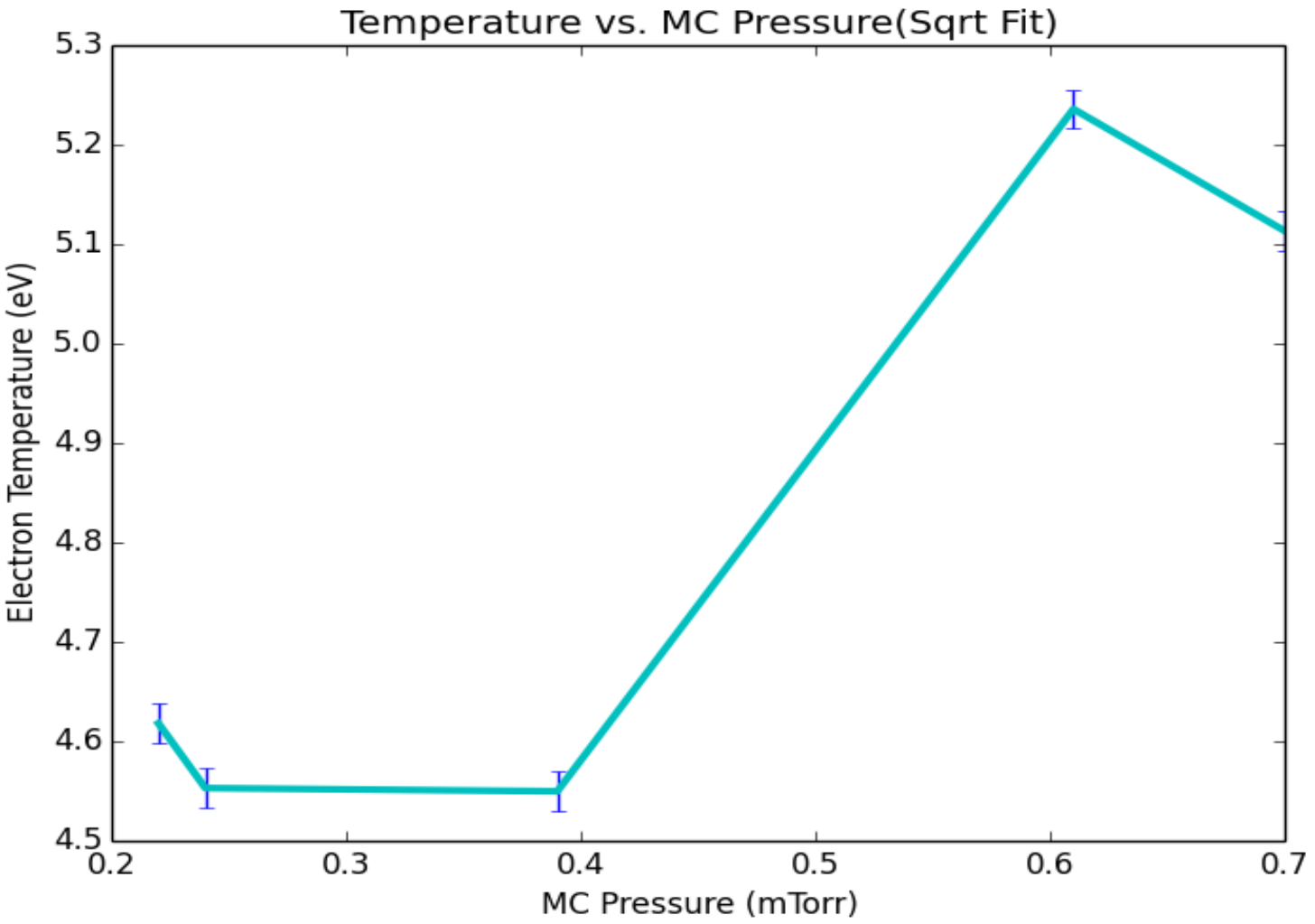
MC 0.69 mT, ER 0.354 mT, 38 W



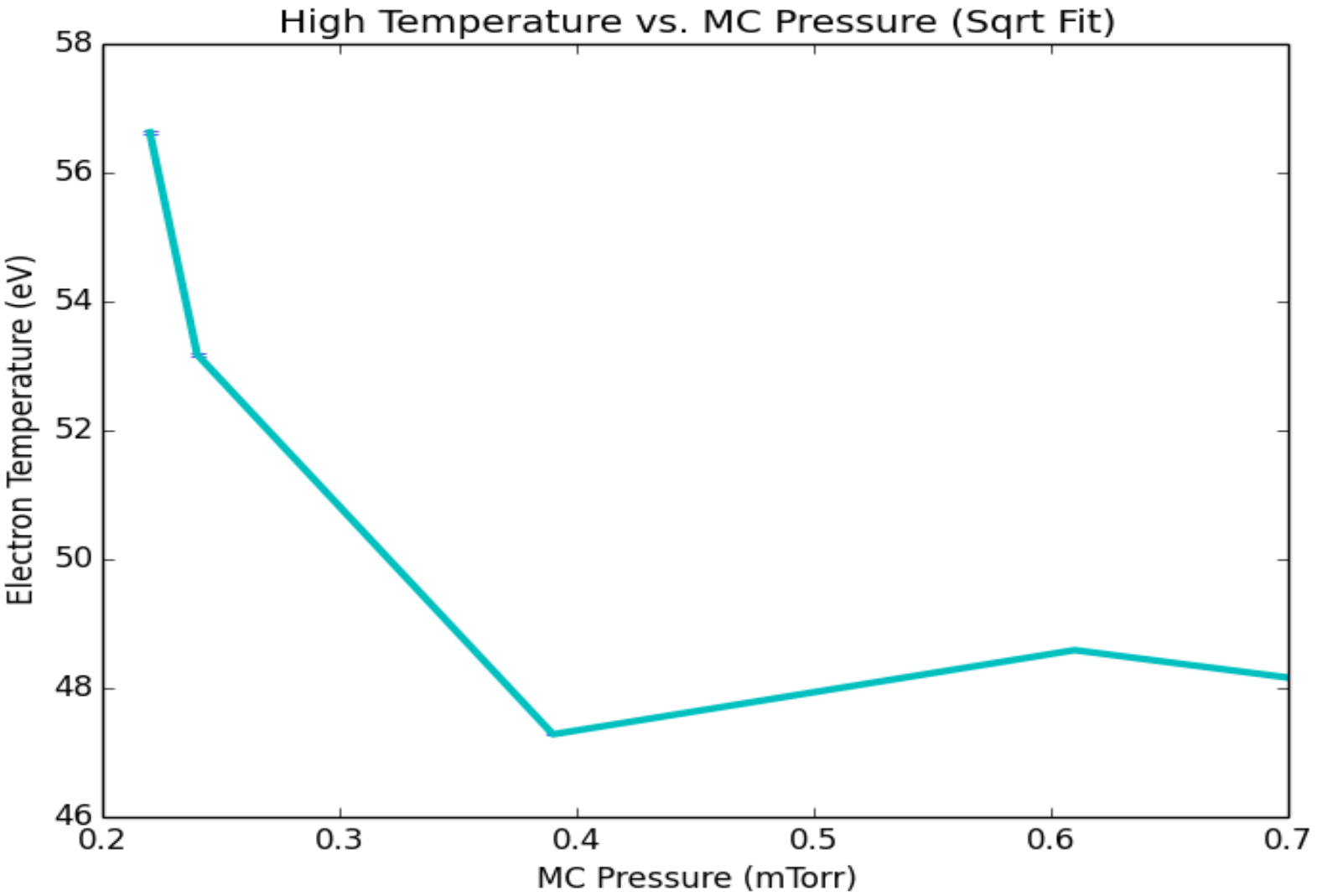
MC = 0.43mT, ER = 0.530 mT, 100 W



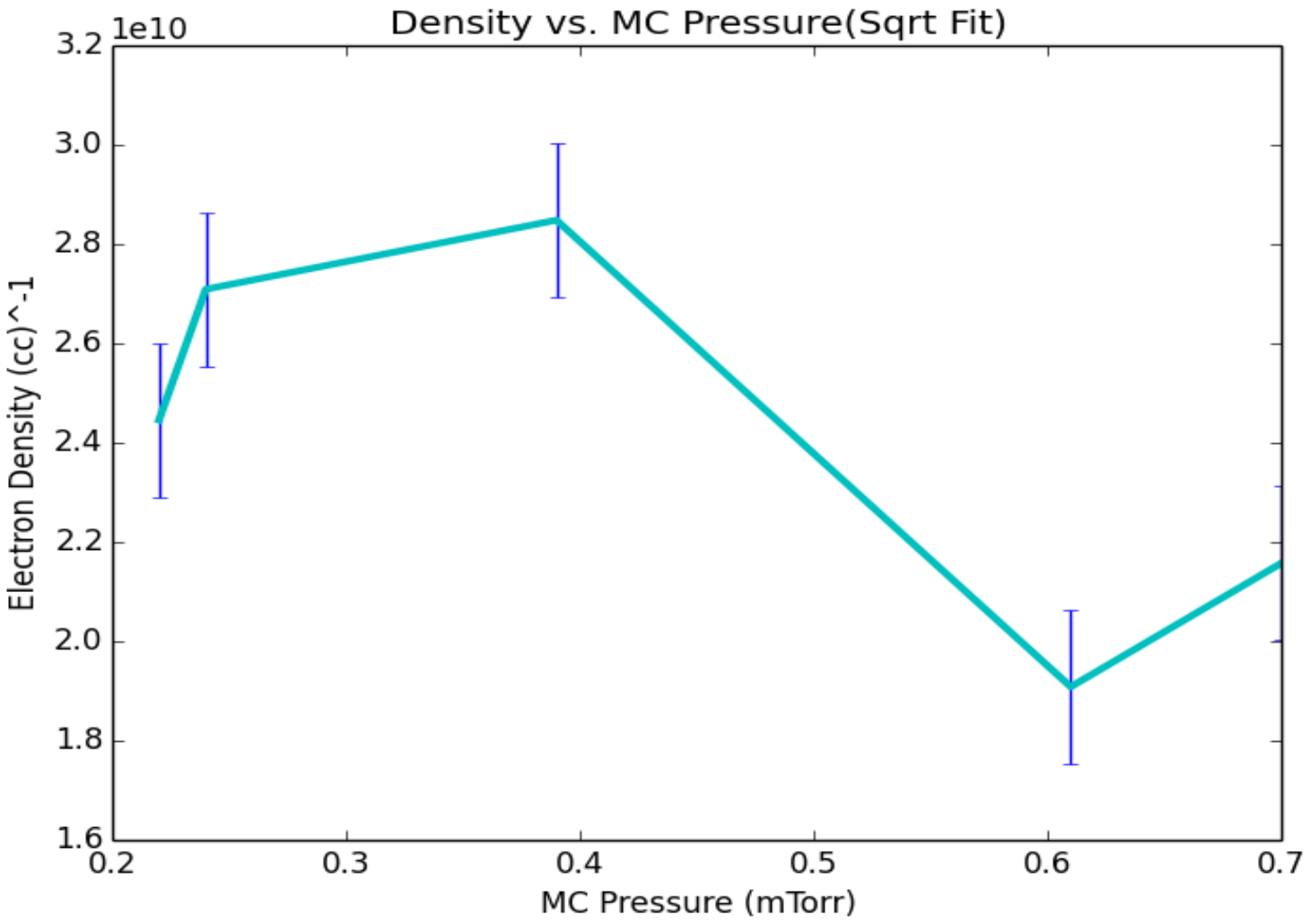
Temp: ER at 0.325 mTorr, MC from 0.22 to .70 mTorr



High Temp: ER at 0.325 mTorr, MC from 0.22 to .70 mTorr



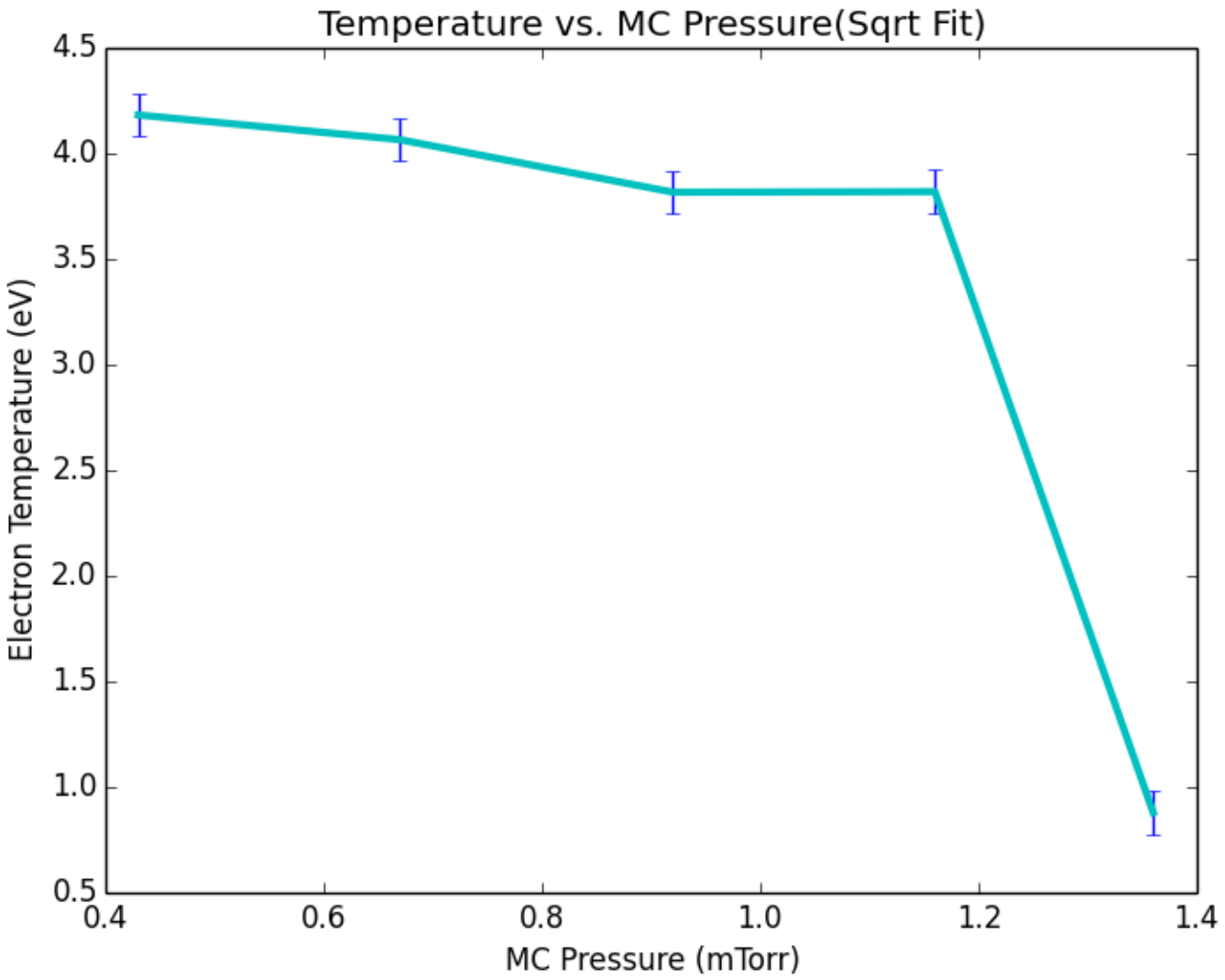
Density: ER at 0.325 mTorr, MC from 0.22 to .70 mTorr



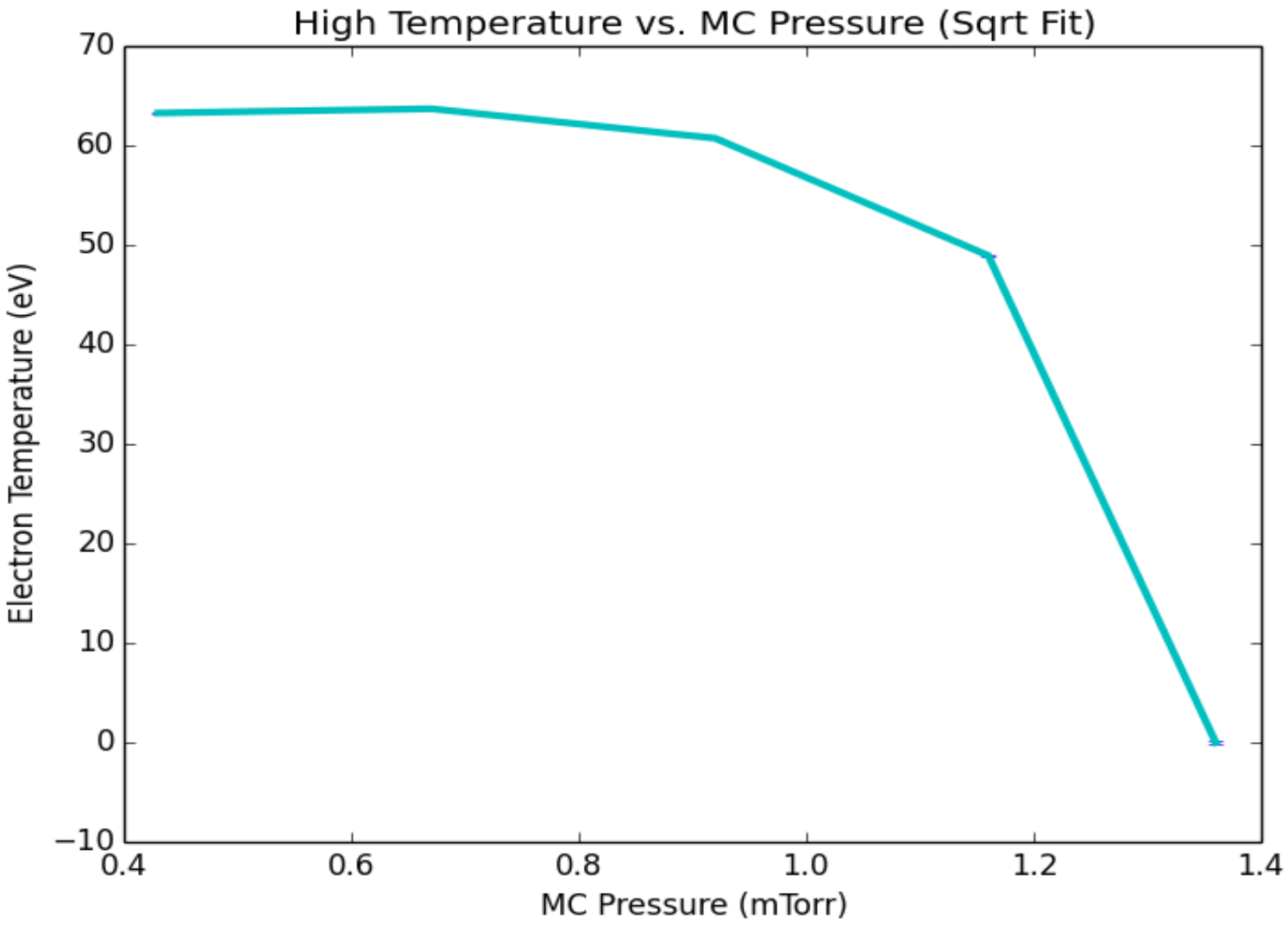
Conclusions:

- Temp shown to be constant until 0.4 mT at which point it jumps up 10% from 4.5 to 5 eV
- High temp shown to fall with MC pressure until 0.4 mT at which point it is not affected.
- Density found to depend on density although no trivial relationship.

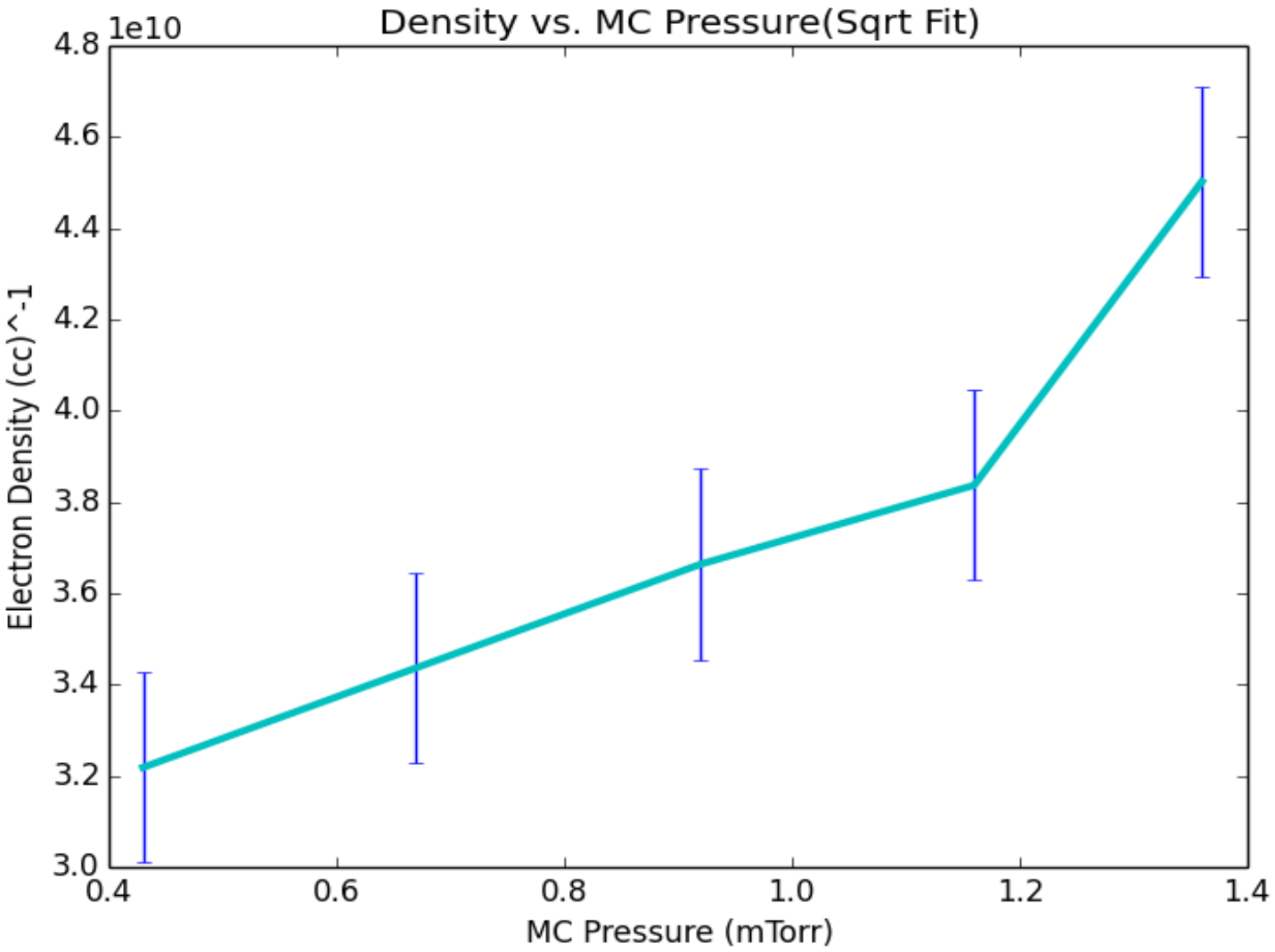
Temp: ER at 0.530 mTorr, MC from 0.43 to 1.36 mTorr



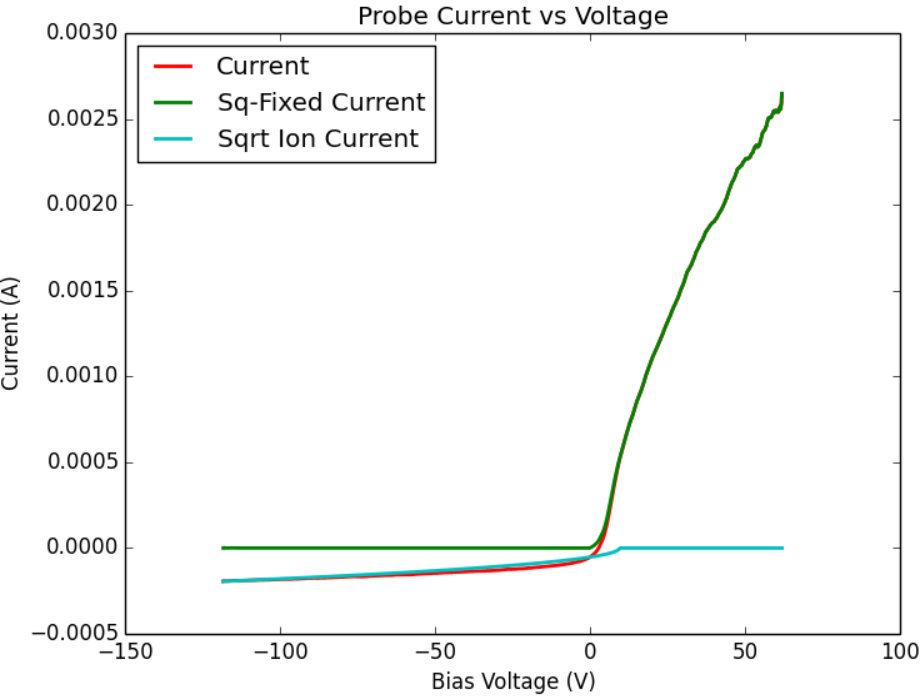
High Temp: ER at 0.530 mTorr, MC from 0.43 to 1.36 mTorr

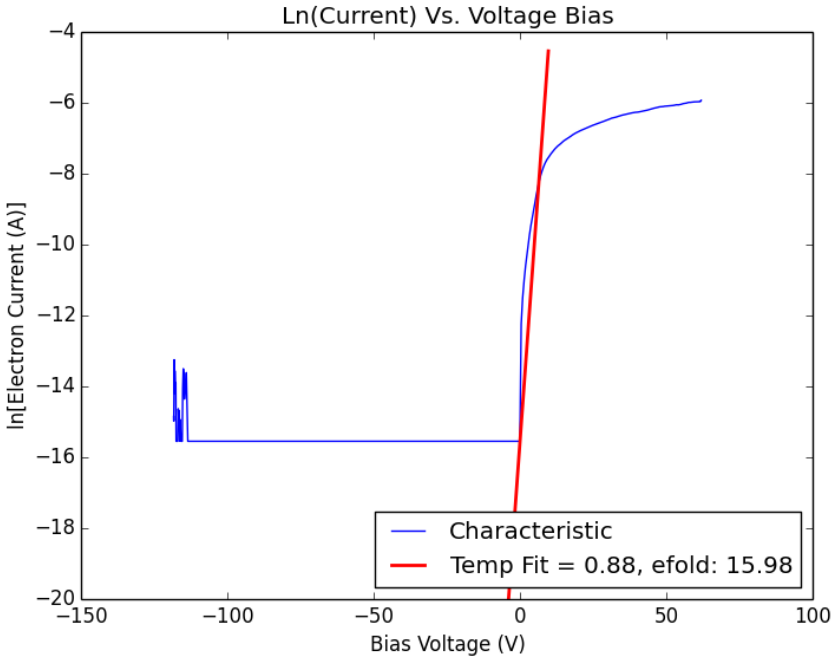


Density: ER at 0.530 mTorr, MC from 0.43 to 1.36 mTorr

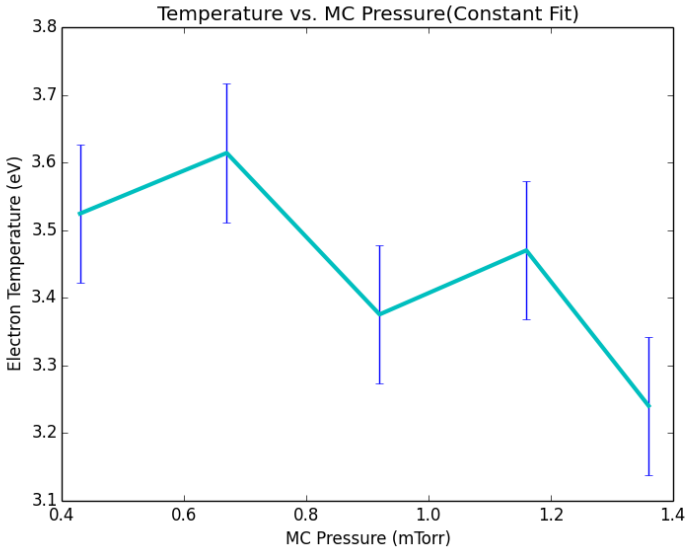


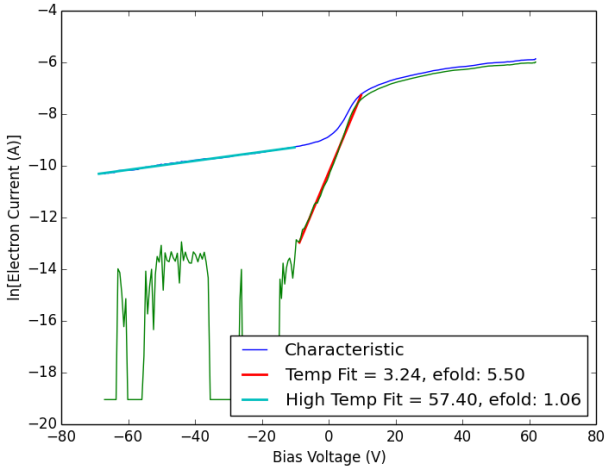
MC = 1.36 mTorr
Sqrt fit attempts:

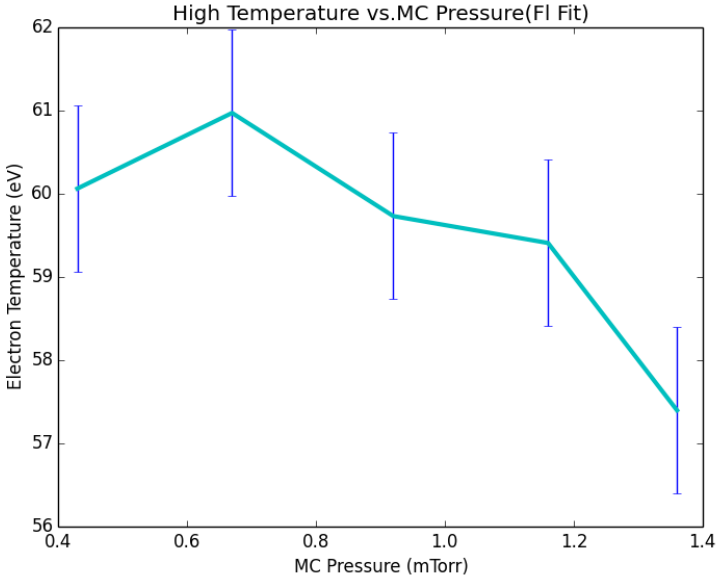


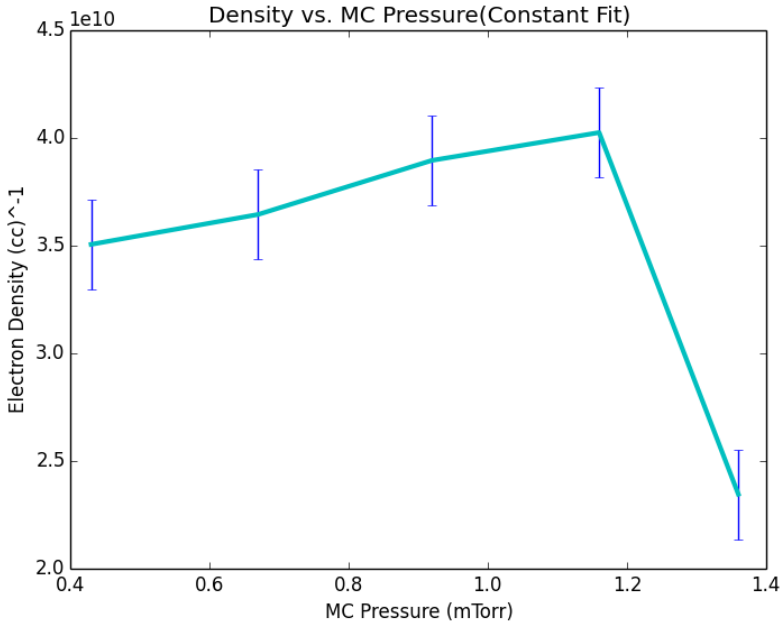


Constant Fit (MC = 1.36 mTorr)





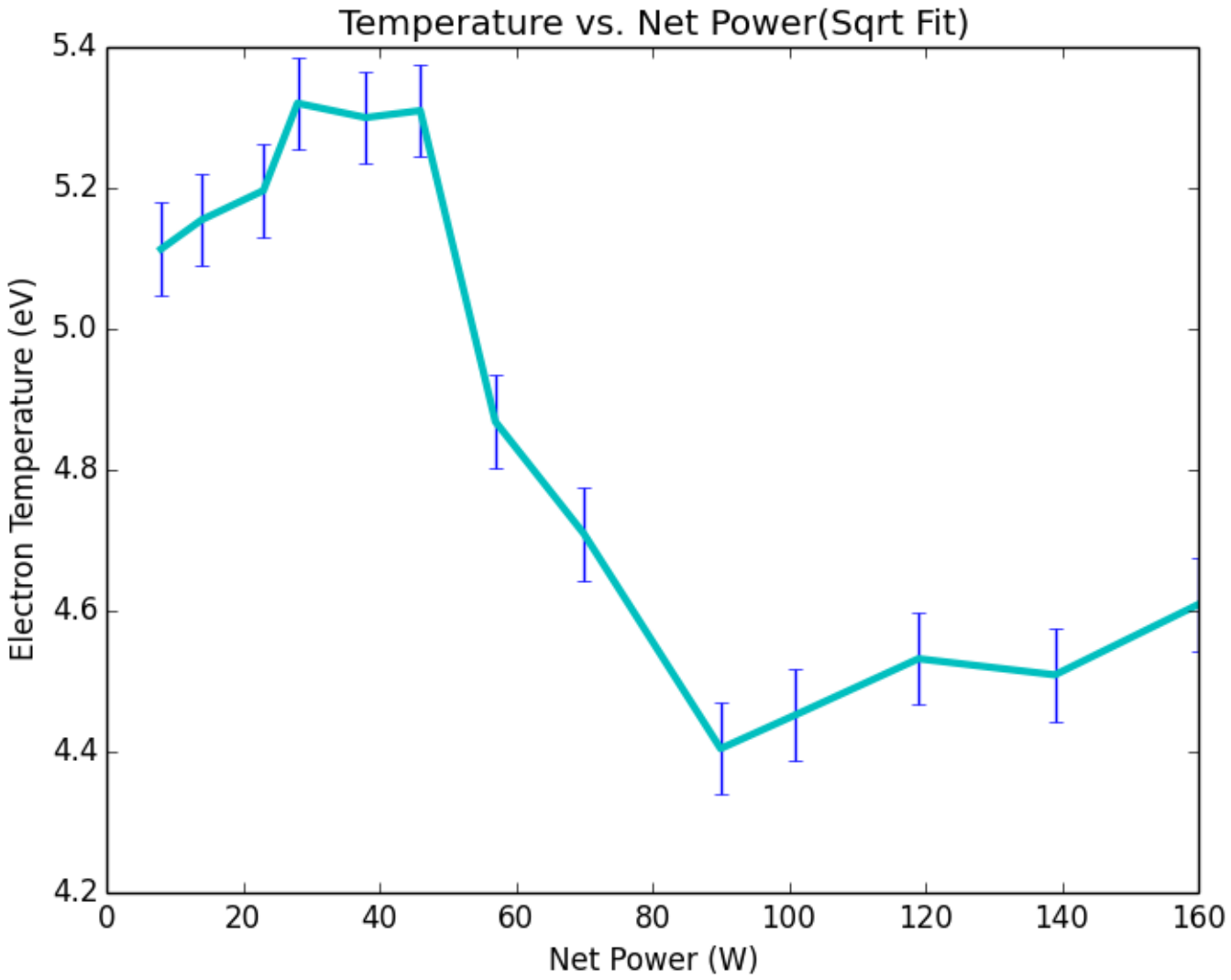




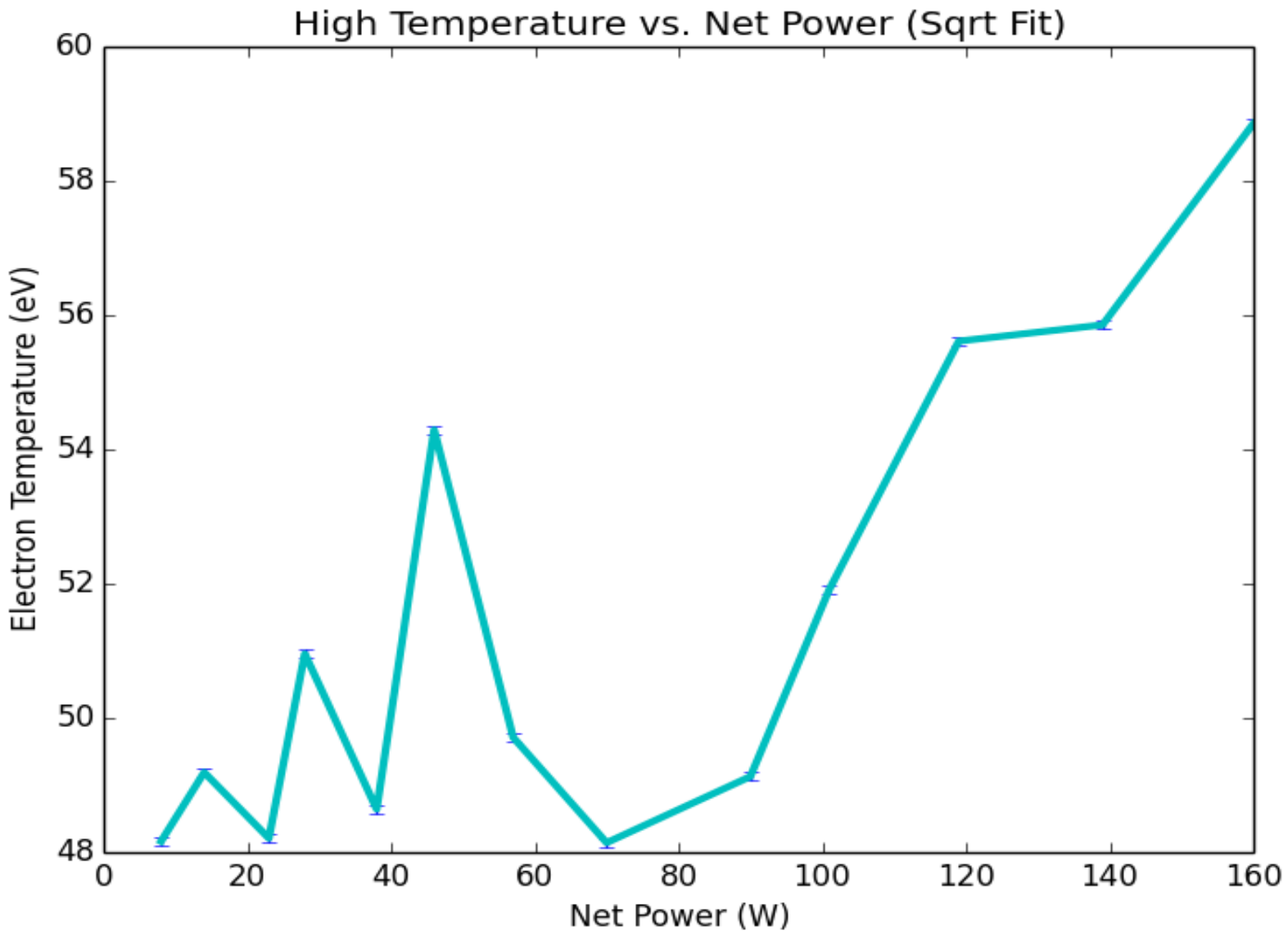
Conclusions:

- Odd drop in density after MC = 1.2 mTorr – shown to rise until this point
- High temp and temp are both shown to fall with an increase in pressure.

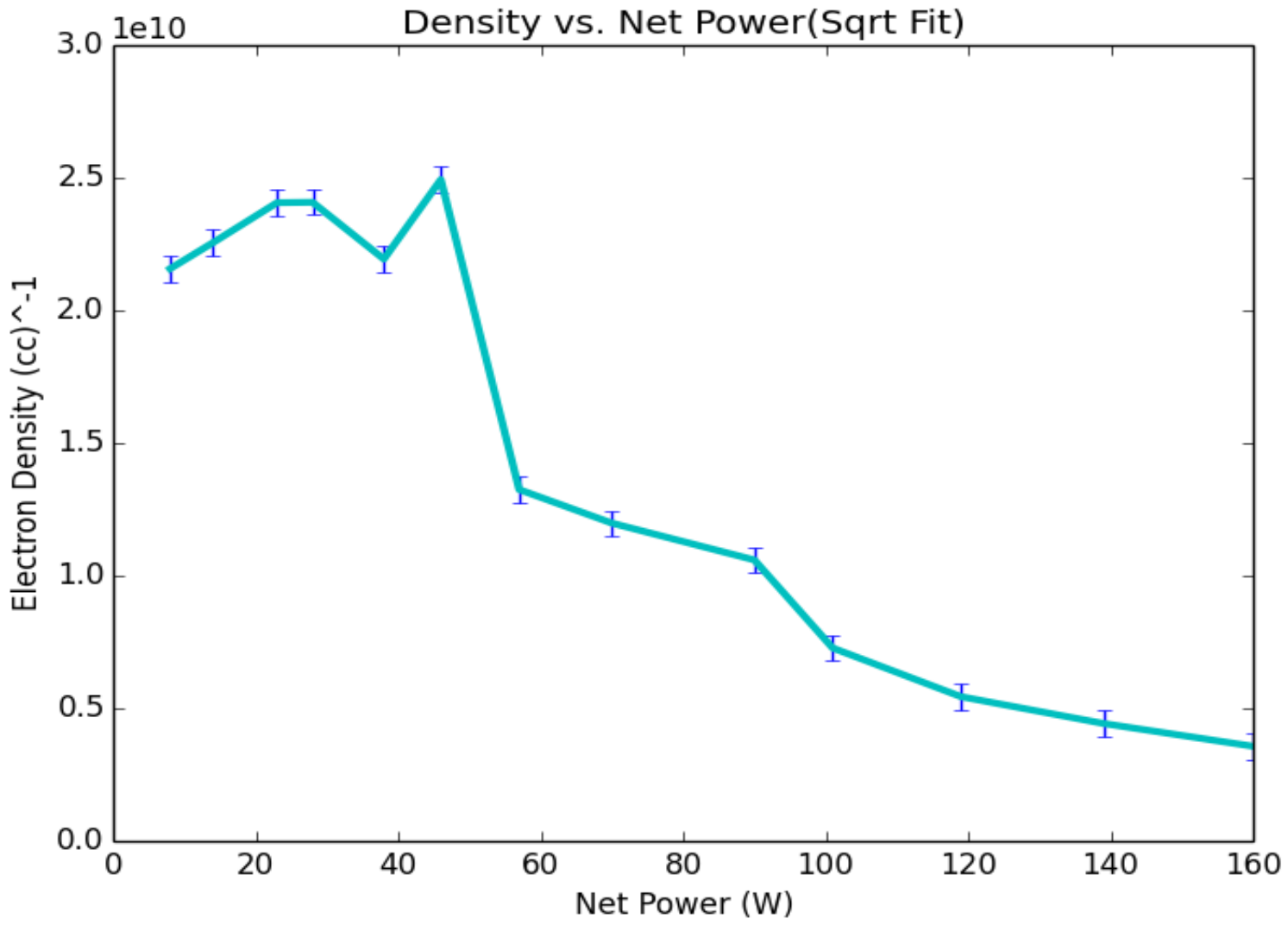
Temp:
Power scan: 8 W to 160 W, ER at 0.350 mTorr, MC at 0.64 mT



High Temp:
Power scan: 8 W to 160 W, ER at 0.350 mTorr, MC at 0.64 mT



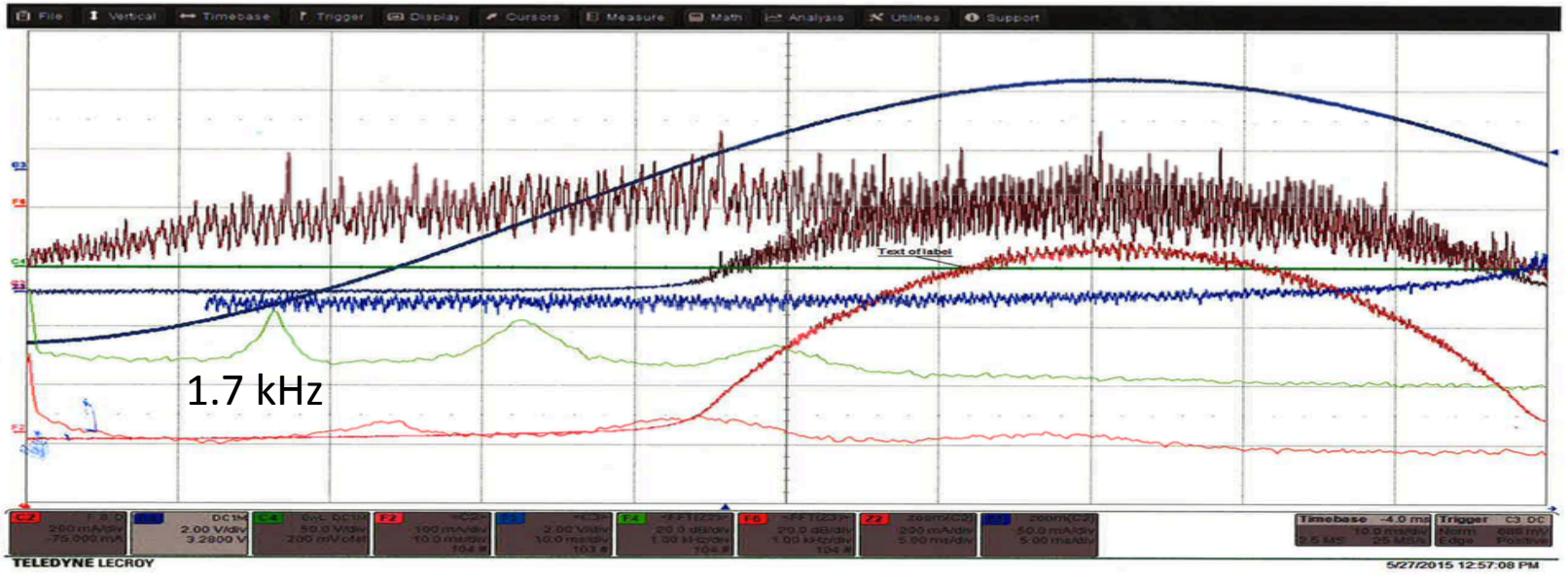
Density:
Power scan: 8 W to 160 W, ER at 0.350 mTorr, MC at 0.64 mT



Conclusions:

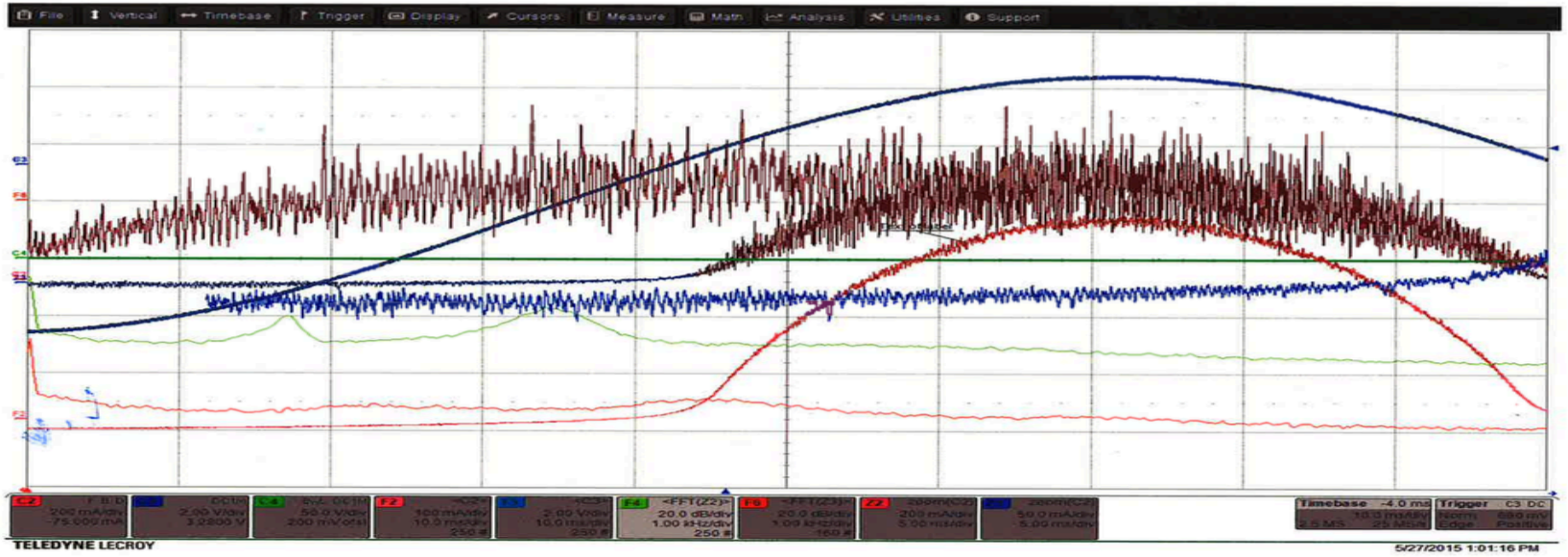
- Odd drop in density and Temp at 50 W, not observed in high temp distribution
- Temp and density rise before this drop, then fall with more power after drop (temp may begin to climb again after 100 W)
- High Temp varies by 2 eV but shows consistent trend of growing with power

E sat and I sat FFTs



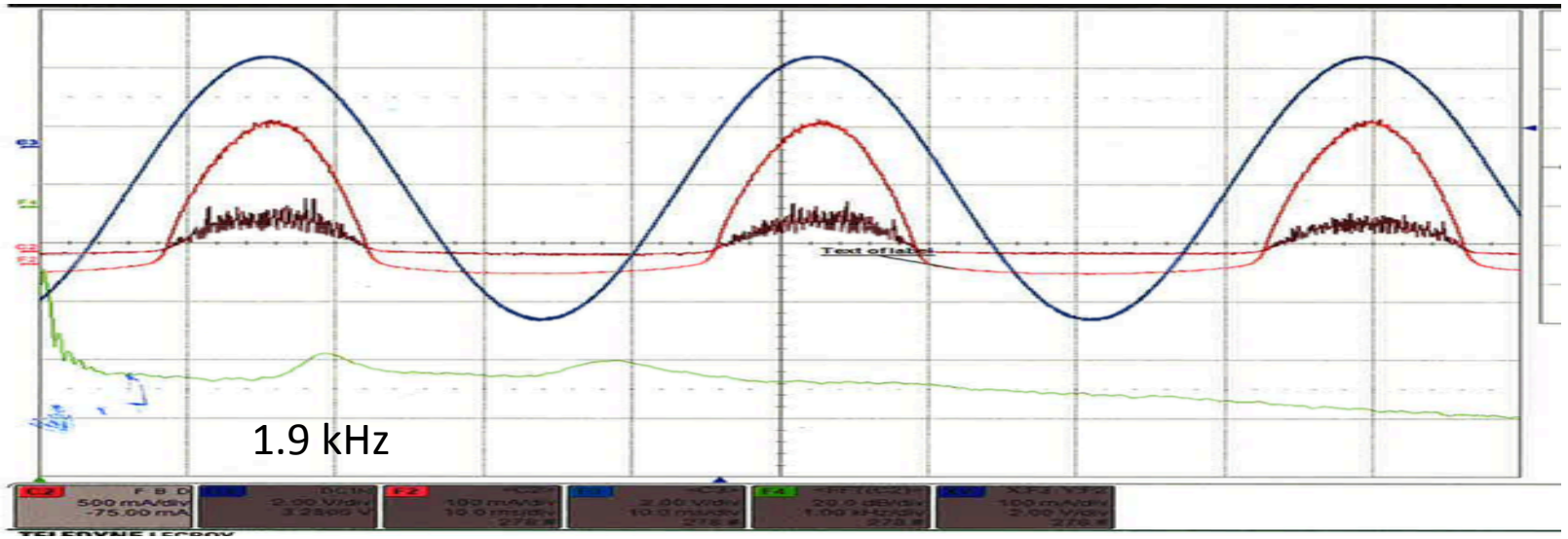
Main:
92 A

0 kHz 2 kHz 4 kHz



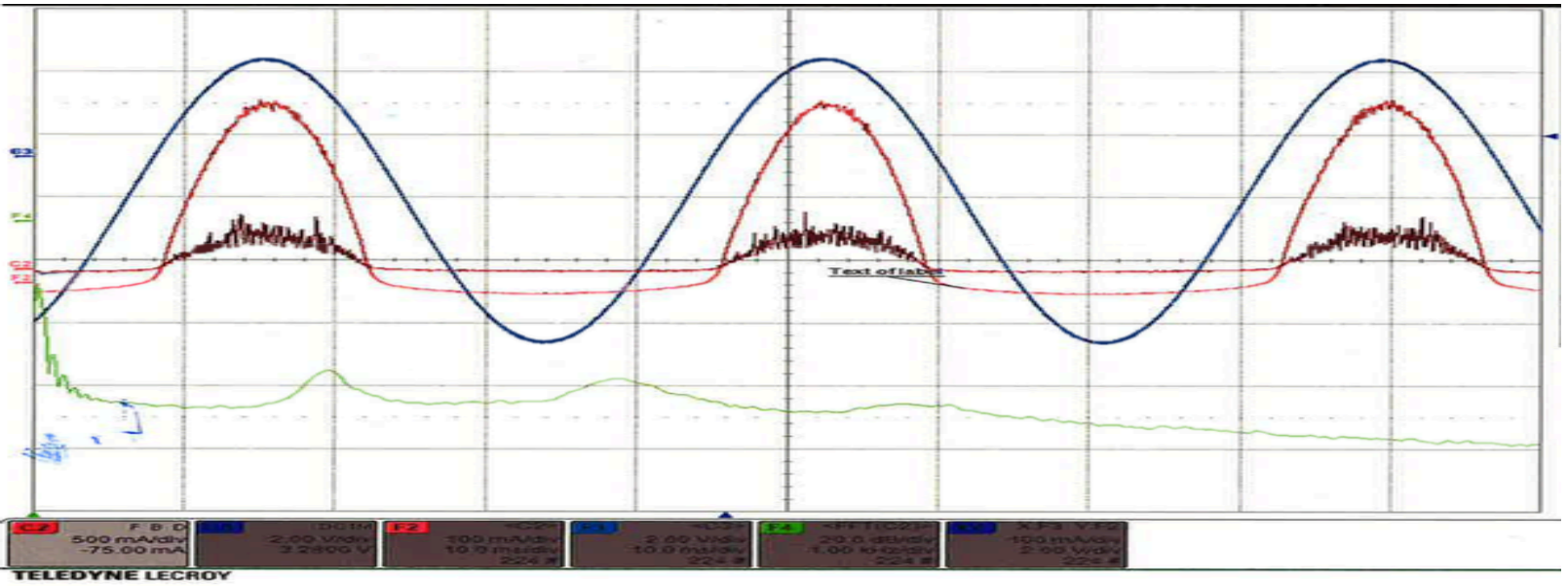
Main:
135 A

Total FFT



120 W

0 kHz 2 kHz 4 kHz



160 W

Stray Capacitance

- Measured at 257 pF
- For Sine wave, amplitude A ~ 75 V, f ~ 500 Hz
- Max(dV/dt) = 2*pi*A*f = 2.4 *10^5
- C dV/dt = I = (2.57*10^-10)*2*pi*A*f
- = 6*10^-5 amps
- Note: Ion saturation current consistently found to be 10^-5 to 10^-4 amps.
- Solution: use sawtooth wave- subtract away contribution, or real time setup probe not connected to plasma, measure signal and subtract away.

Potential Summer Projects

- Investigate sweep frequency dependence in langmuir characteristic measurements
  - If this is solely caused by stray capacitance, perform study as to how to obtain clean signal
  - Very possible (from grad lab) that not solely due to stray capacitance, could have interesting physics at play
- Create lab view program/ system to obtain time dependent langmuir characteristics