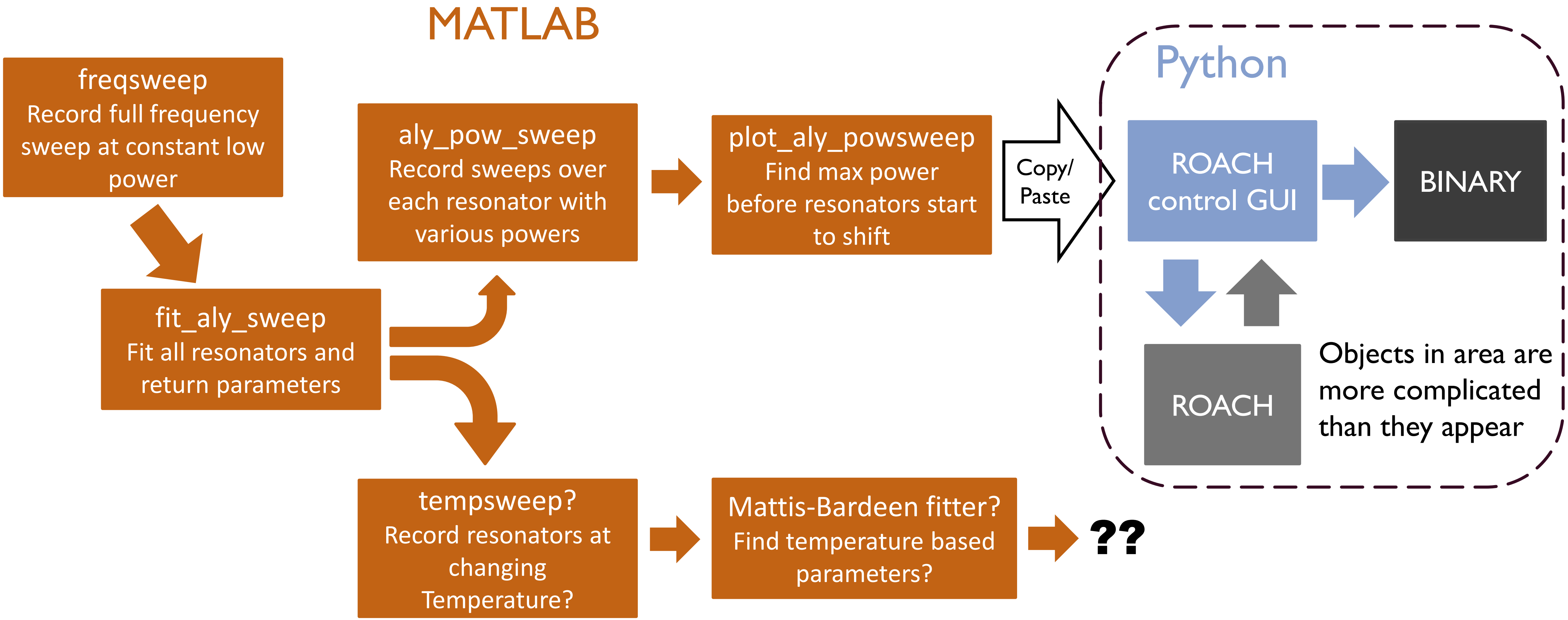
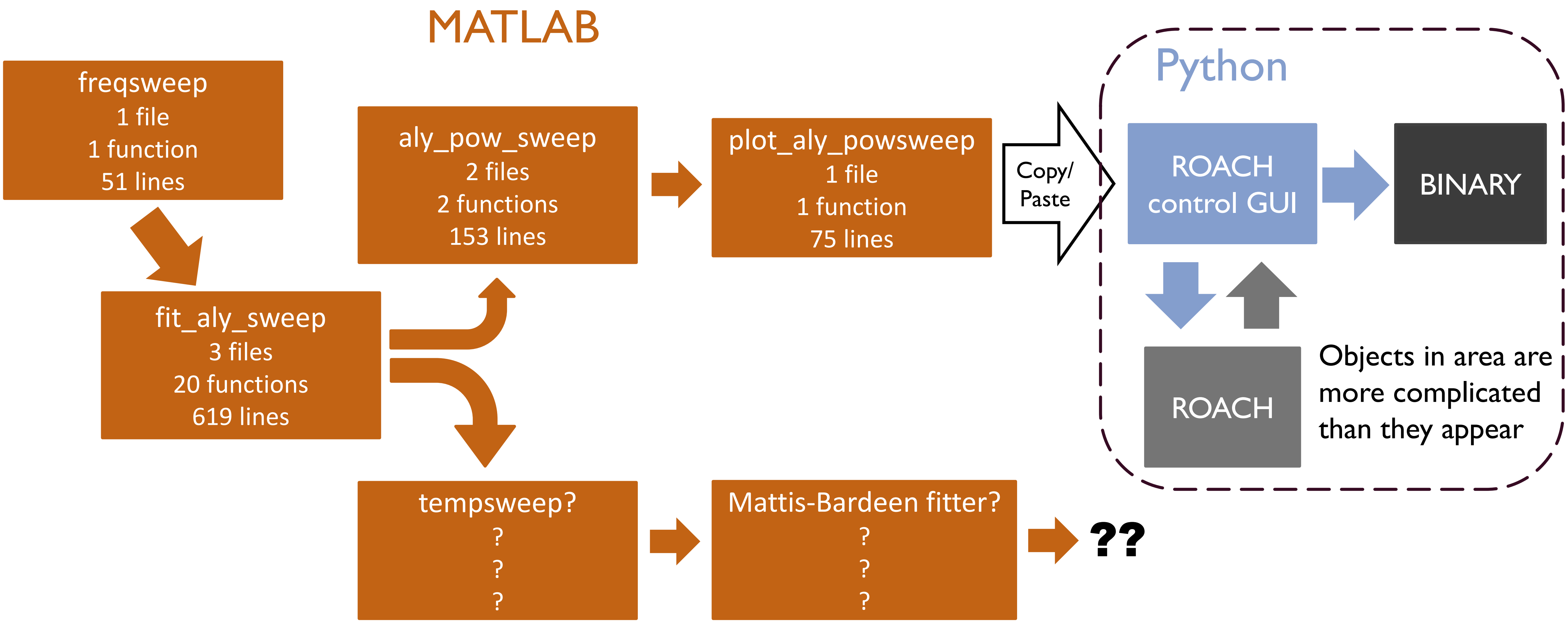
MKID READOUT UPDATE

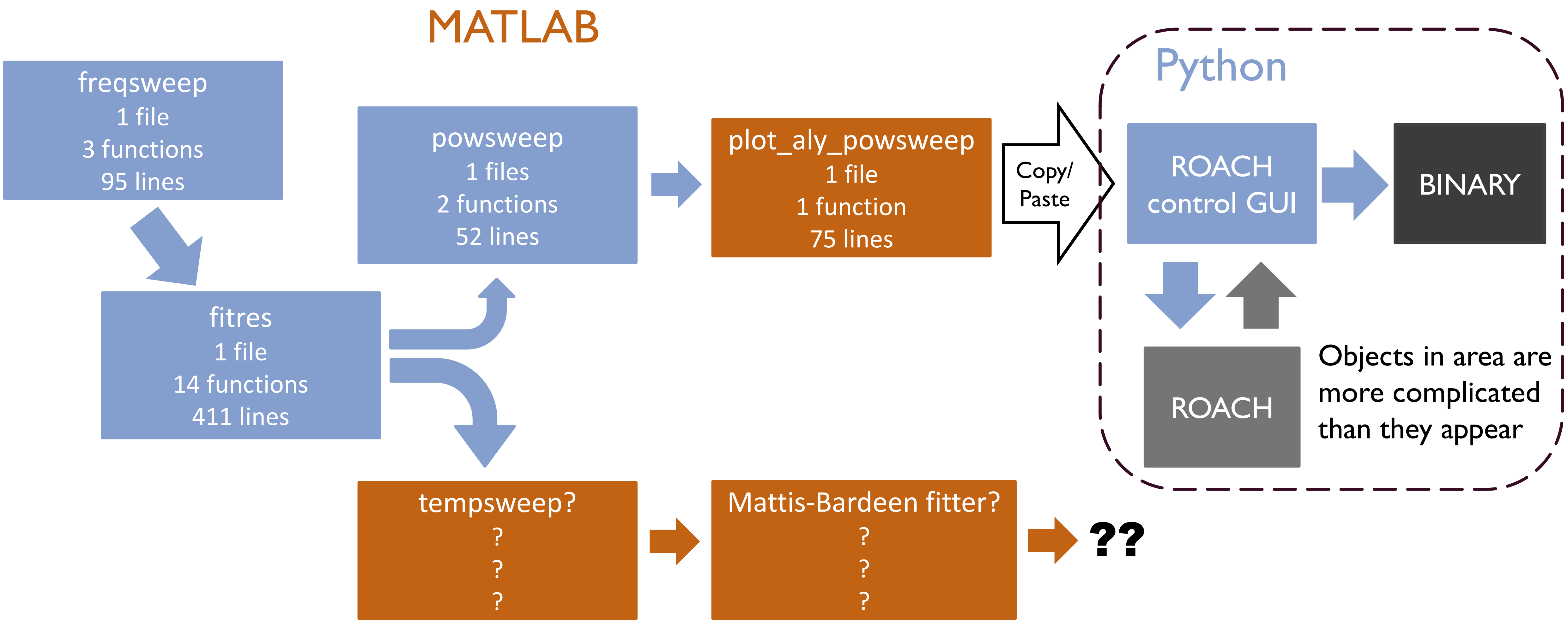
OLD SETUP


MATLAB
freqsweep
Record full frequency sweep at constant low power
fit_aly_sweep
Fit all resonators and return parameters
aly_pow_sweep
Record sweeps over each resonator with various powers
plot_aly_powsweep
Find max power before resonators start to shift
Copy/ Paste
tempsweep?
Record resonators at changing Temperature?
Mattis-Bardeen fitter?
Find temperature based parameters?
??
Python
ROACH control GUI
BINARY
ROACH
Objects in area are more complicated than they appear

OLD SETUP


MATLAB
freqsweep
1 file
1 function
51 lines
aly_pow_sweep
2 files
2 functions
153 lines
plot_aly_powsweep
1 file
1 function
75 lines
Copy/ Paste
Python
ROACH control GUI
BINARY
ROACH
Objects in area are more complicated than they appear
fit_aly_sweep
3 files
20 functions
619 lines
tempsweep?
?
?
?
Mattis-Bardeen fitter?
?
?
?
??

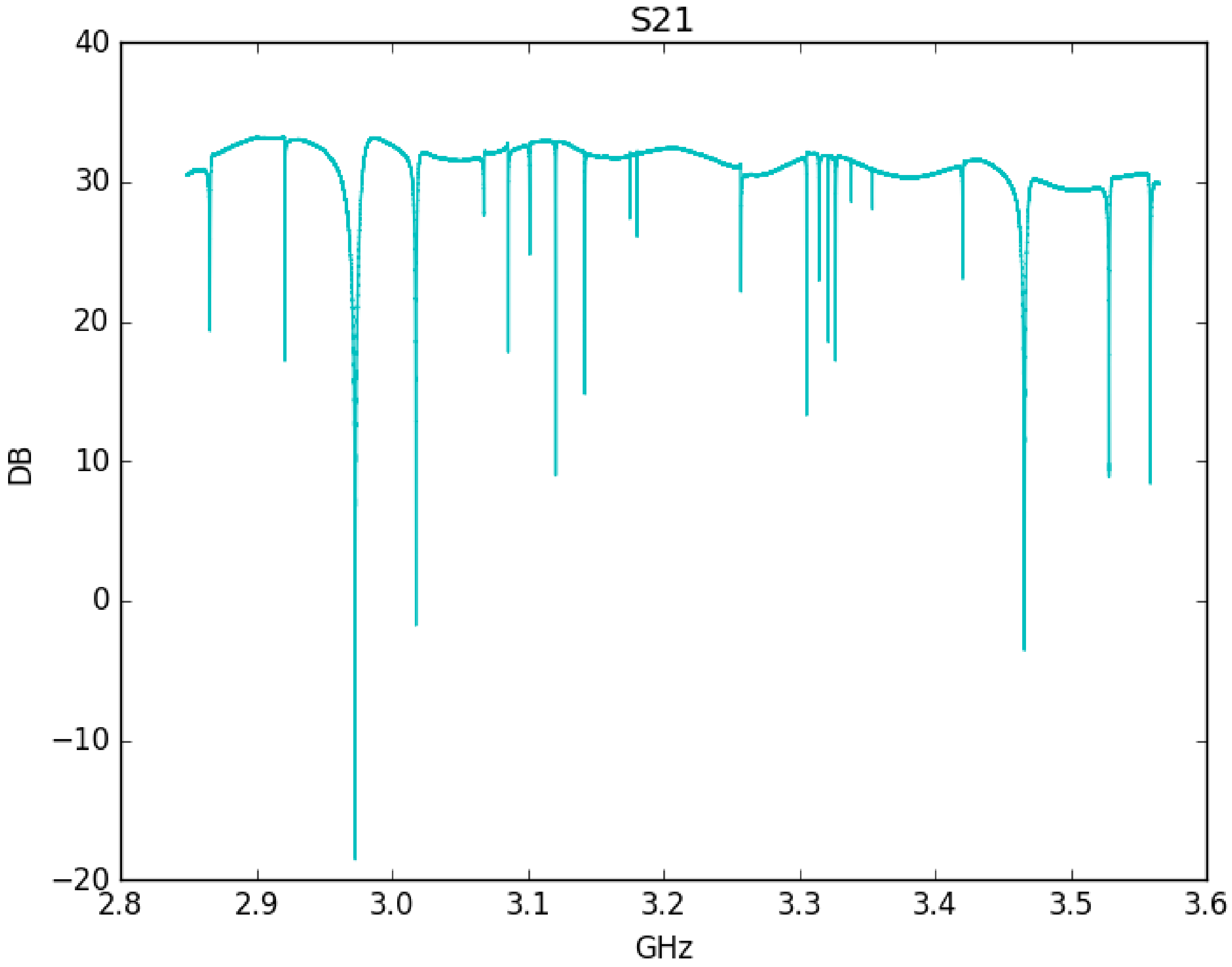
TRANSITIONAL SETUP



- freqsweep + fit_aly_sweep + aly_pow_sweep = 6 files 23 functions 823 lines
- freqsweep + fitres + powsweep = 3 files 19 functions 558 lines
- Translating the programs is helping me understand how to use them

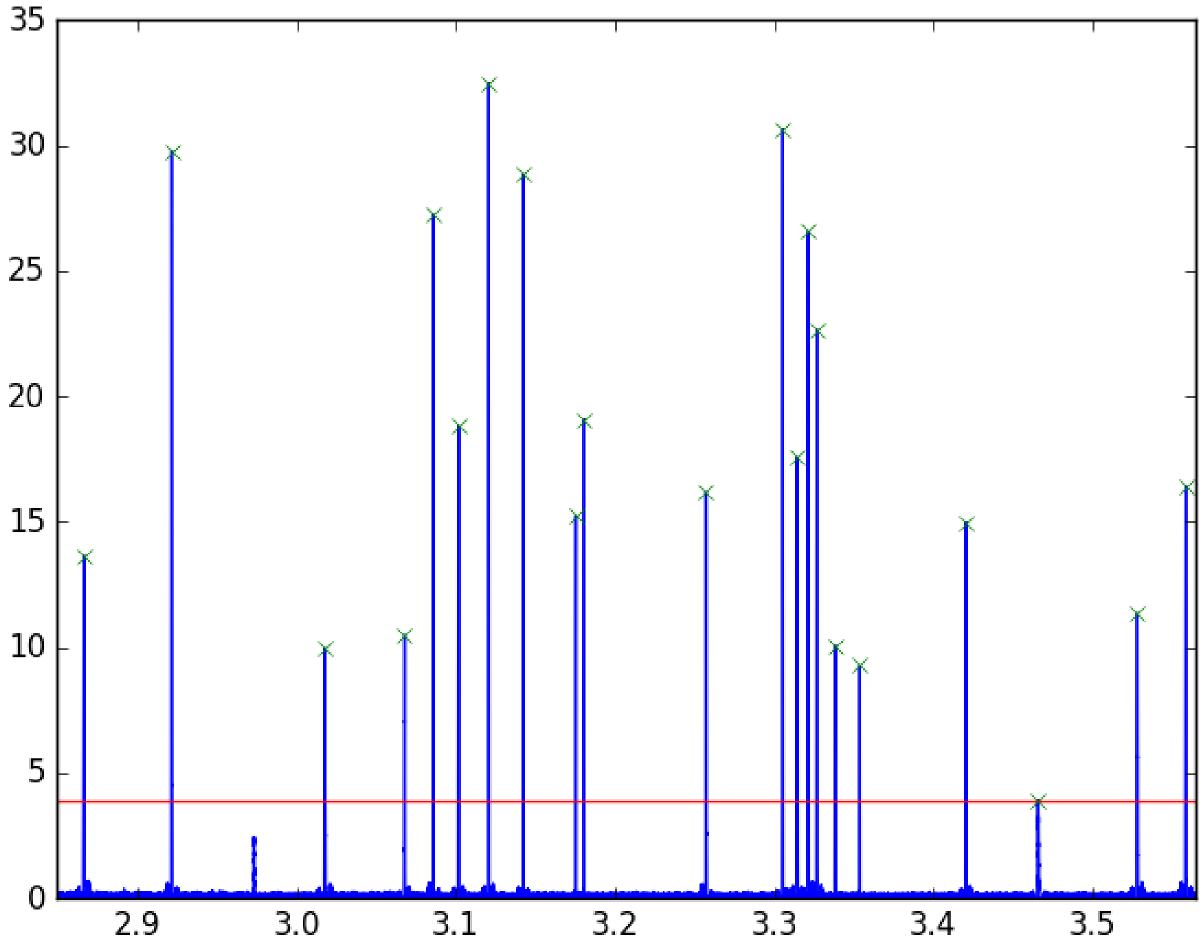
FREQSWEEP

- Call freqsweep to take a sweep over all frequencies and all channels (S11, S12, S21, S22)
- Data saved to an hdf5 file
- Example on the right is old data, taken by a similar program, with an actual mkid (replotted using freqsweep)



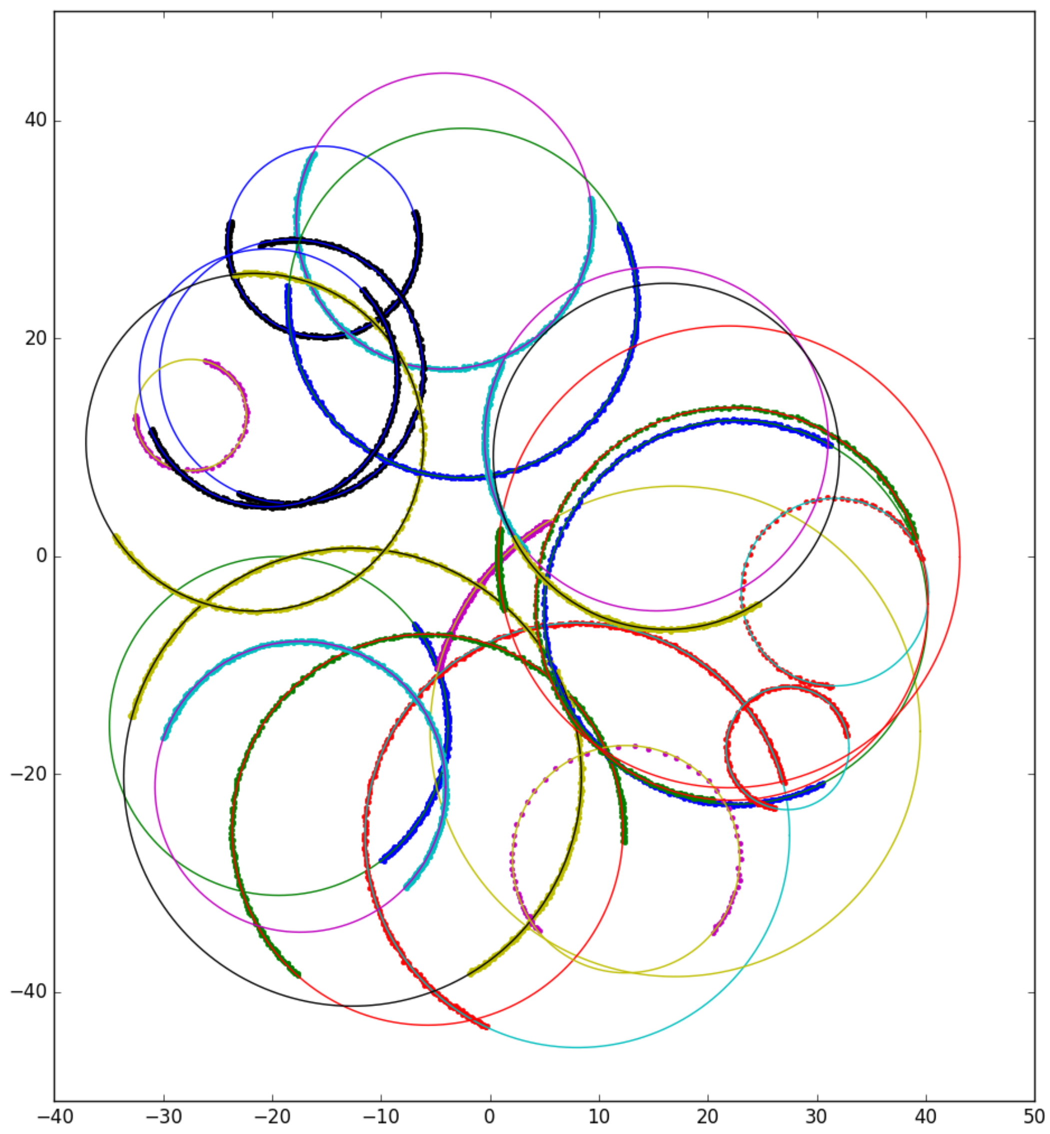
FITRES

- Call fitres to find each resonator's f0, Q, and Qc parameters
- Uses filters and absolute values to find likely resonator points



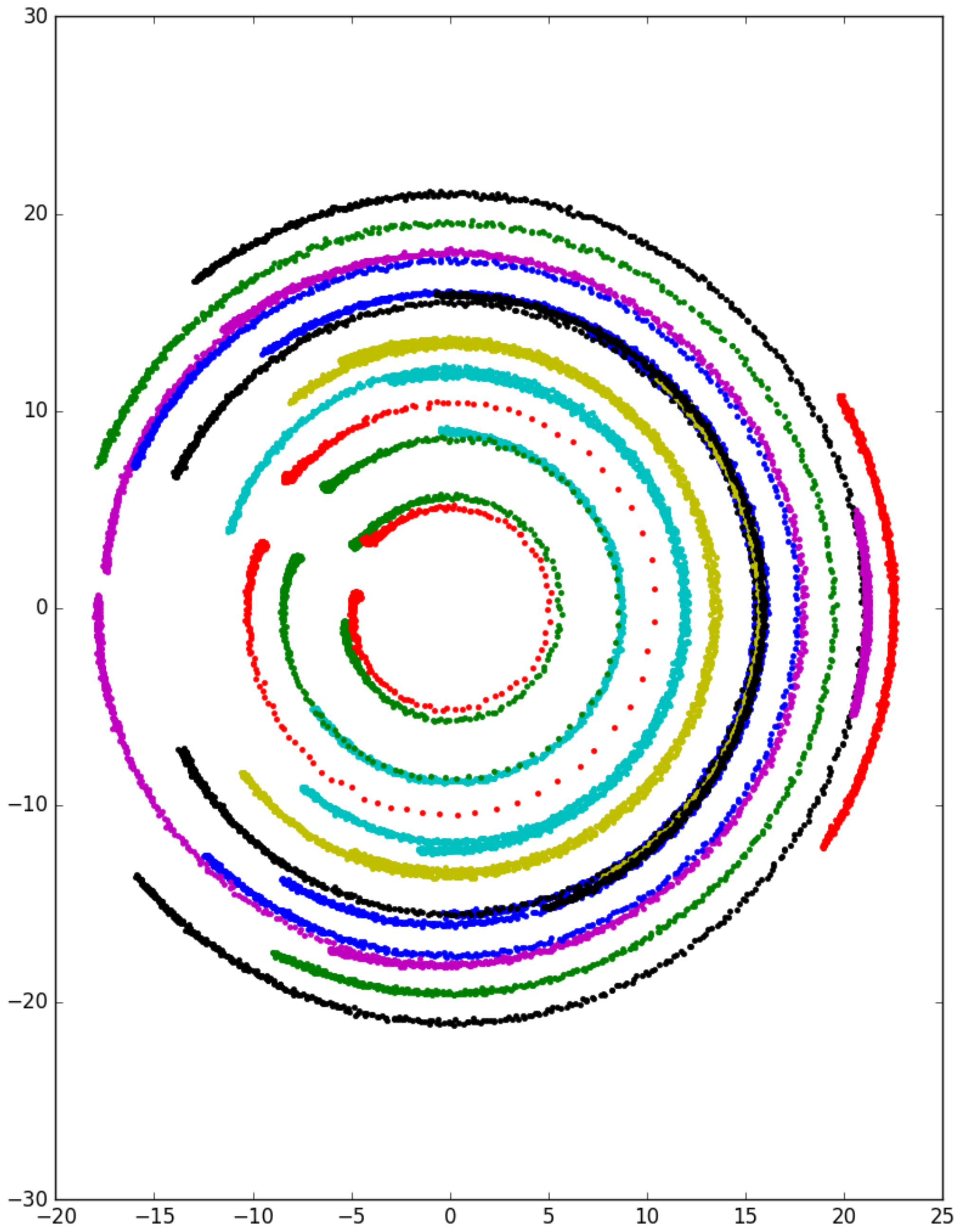
FITRES

- Cuts a window of data around each resonator and fits a circle in the complex plane



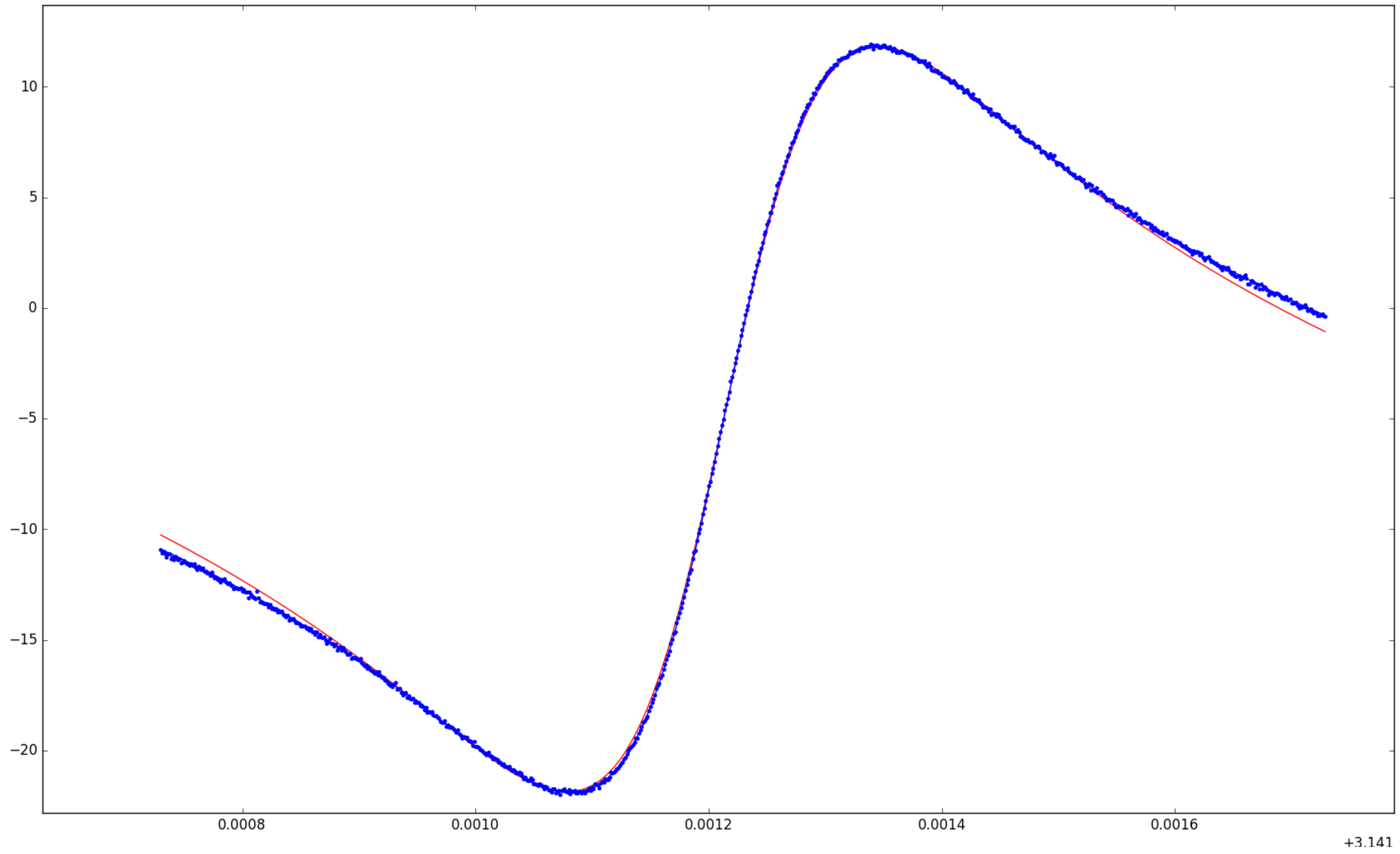
FITRES

- Use circle fit parameters to translate and rotate each resonator circle to the origin



FITRES

- Use parameter guesses from circle fit and other methods to perform a rough fit (fine red line)
- Use rough fit parameters to perform a fine fit (fine blue line)
- Old matlab program skipped the fine fit
- All data is saved back to the original hdf5 file



POWSWEEP

- Powsweep reads in the resonator locations from the file (found using fitres)
- Performs small window sweeps over each resonator for various powers
- Records data to the hdf5 file

FINDPOW

- Program I am working on now
- Reads the powsweep data and finds the maximum value each resonator can be driven at before f0 begins to shift

ABOUT THE FITTING

Jiansong's thesis

$$t_{21}(f) = ae^{-2\pi j f \tau}\left[1 - \frac{Q_r/Q_c e^{j\phi_0}}{1 + 2jQ(\frac{f-f_r}{f_r})}\right]$$

$parameters\colon a, \tau, f_r, Q, Q_c, \phi_0$

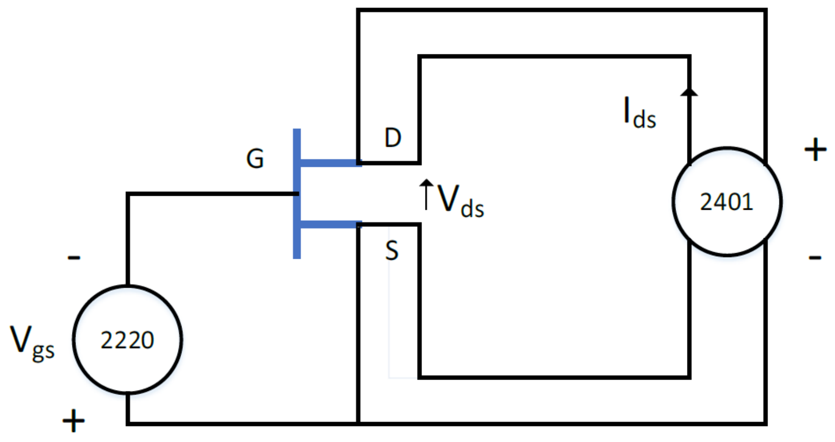
fit_aly_sweep (fine fit)

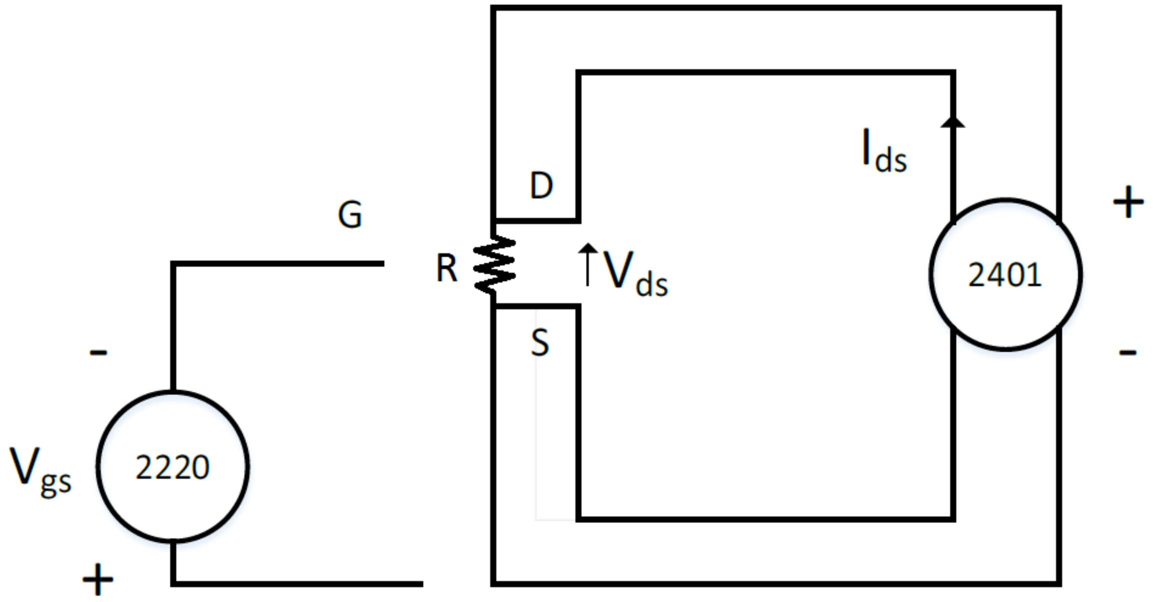
$$z = e^{2\pi i(f-f_1)\tau}\left[zinf + \frac{zd}{1 + 2iQ\left(\frac{f-f_0}{f_0}\right)}\right]$$

$parameters\colon zinf, zd, \tau, f_0, Q,$

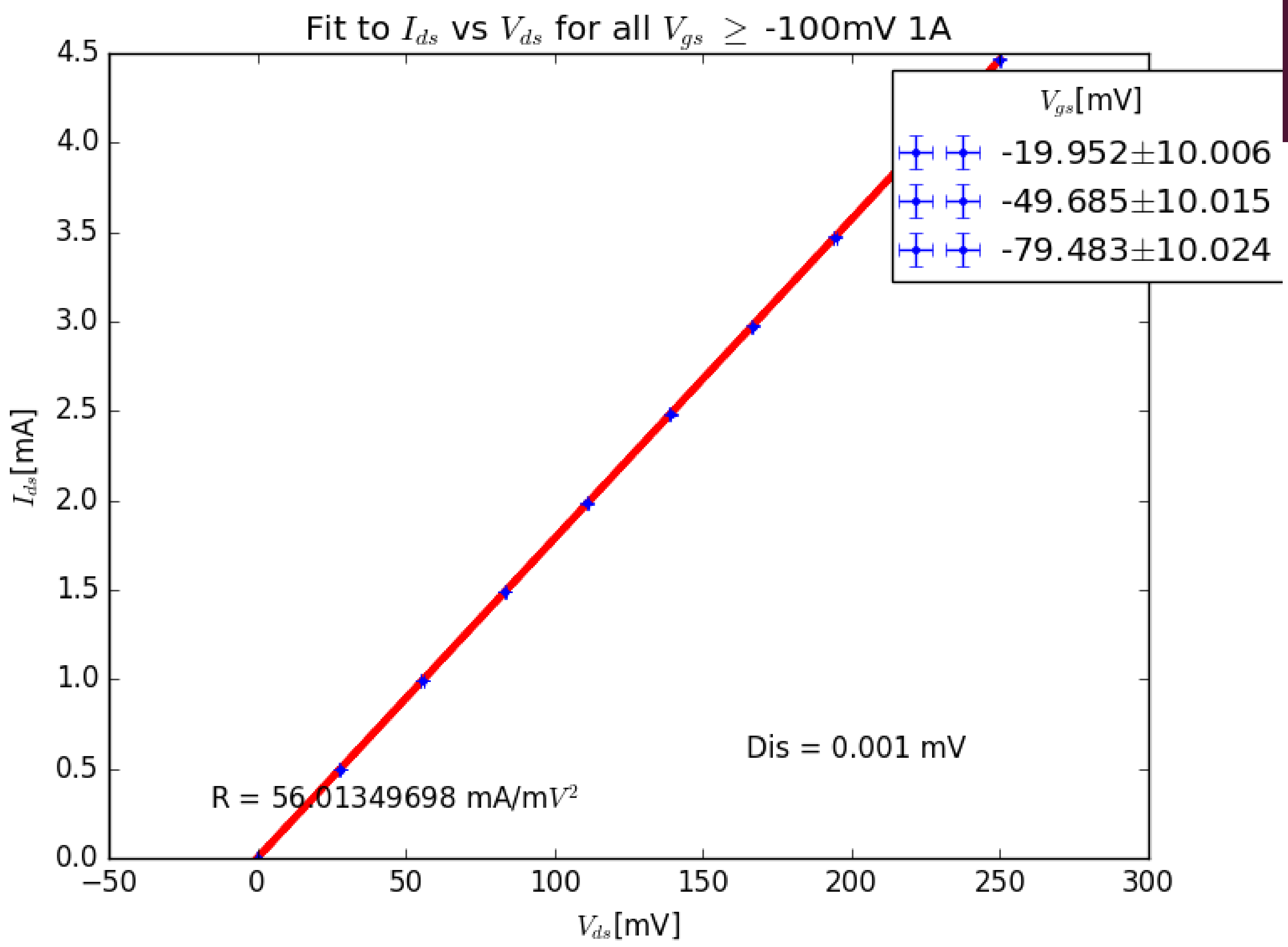
HEMT TESTING SETUP

- Soldered 6 resistors of different values to 6 different channels on the tester board (at least 1 per HEMT)
- Resistors were connected to drain supply/return(Ids) and drains sense+/-(Vds), but not gate supply/return(Vgs)
- Connected the tester board to the 100-way cable and 25-way cable (so that each channel was connected as it would be when testing HEMTs)
- Did not close the box or cool down
- Took data using my version of the LabVIEW program

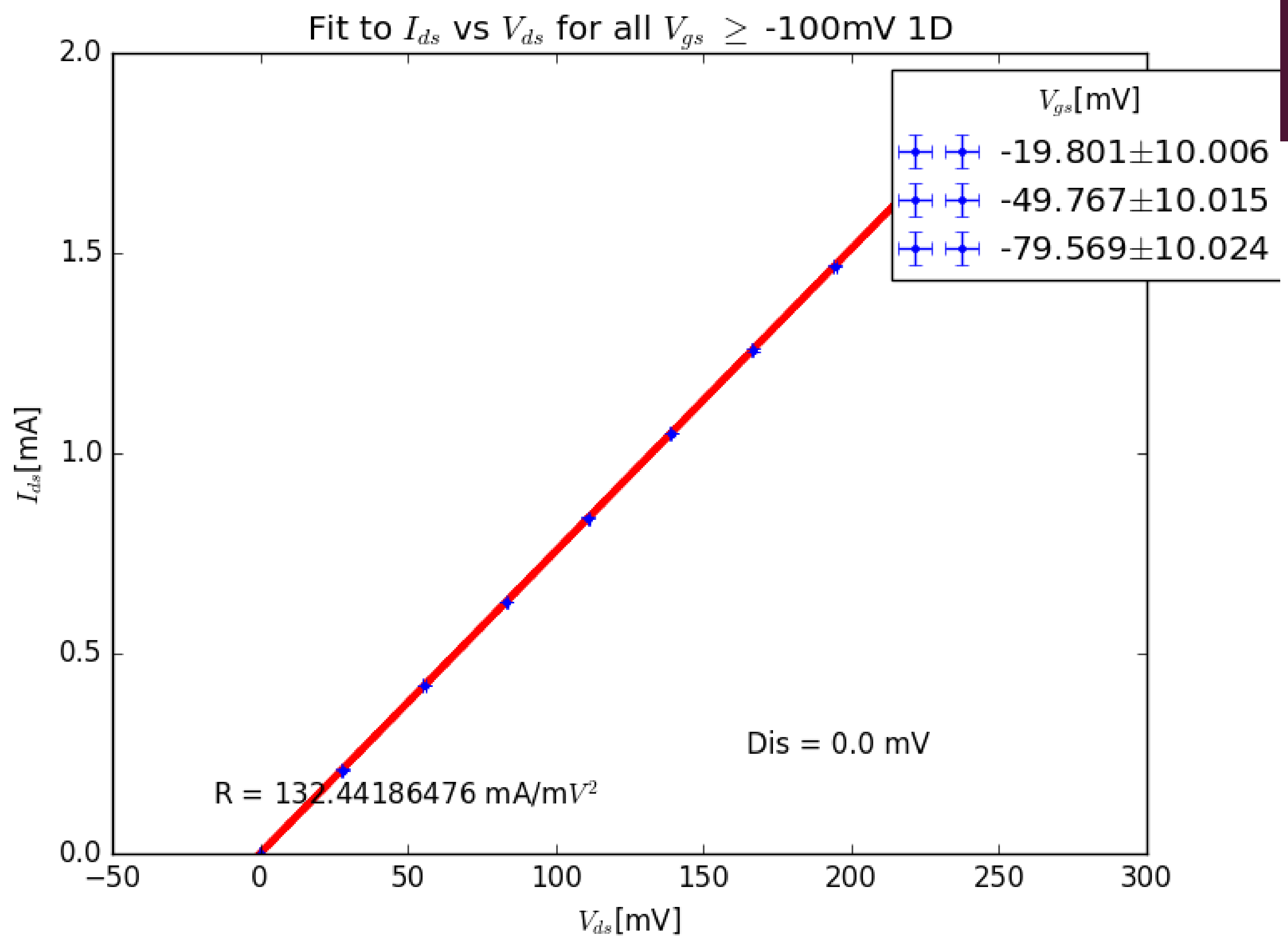




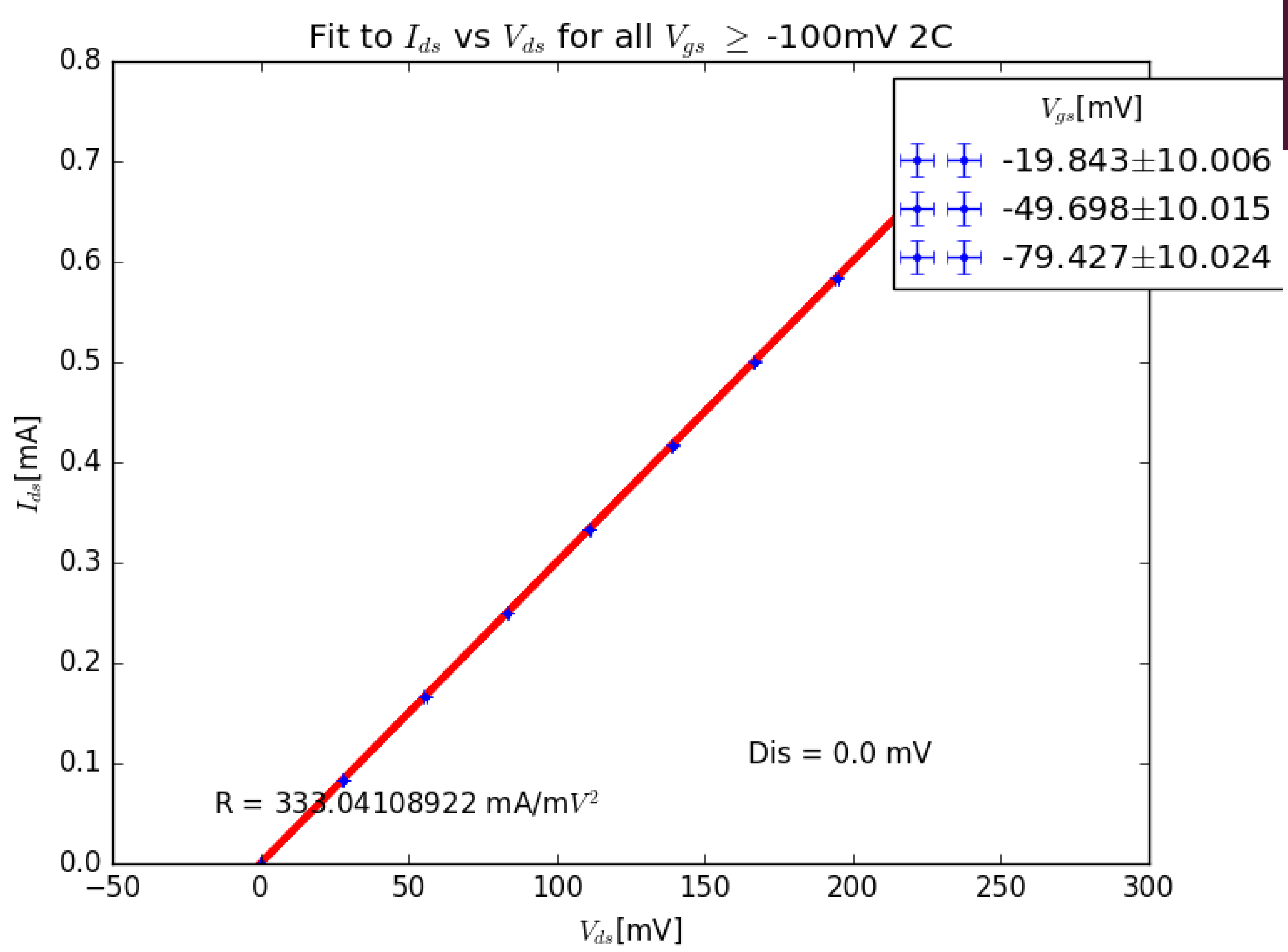
CHANNEL 1A
56Ω



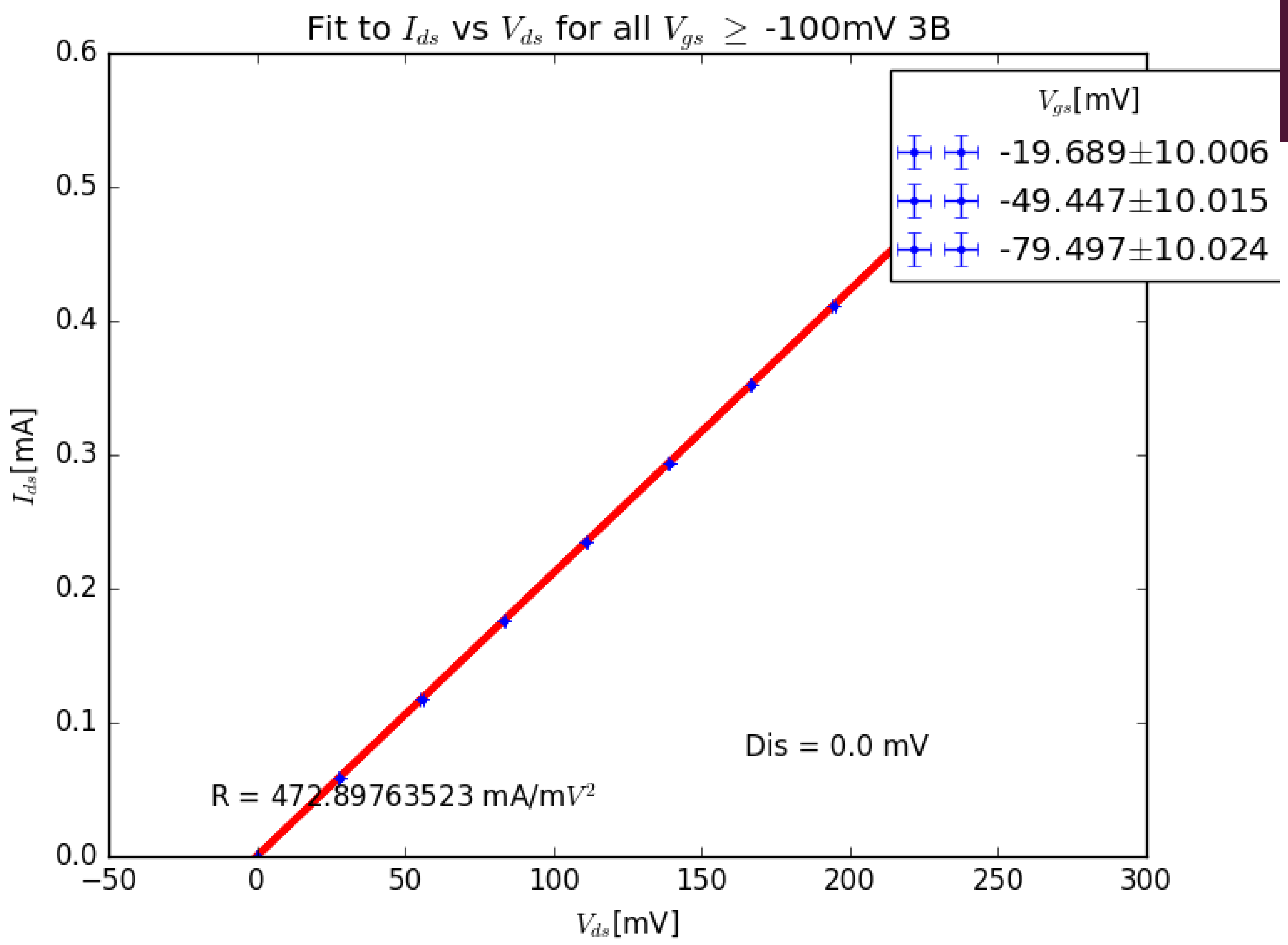
CHANNEL 1D 133Ω



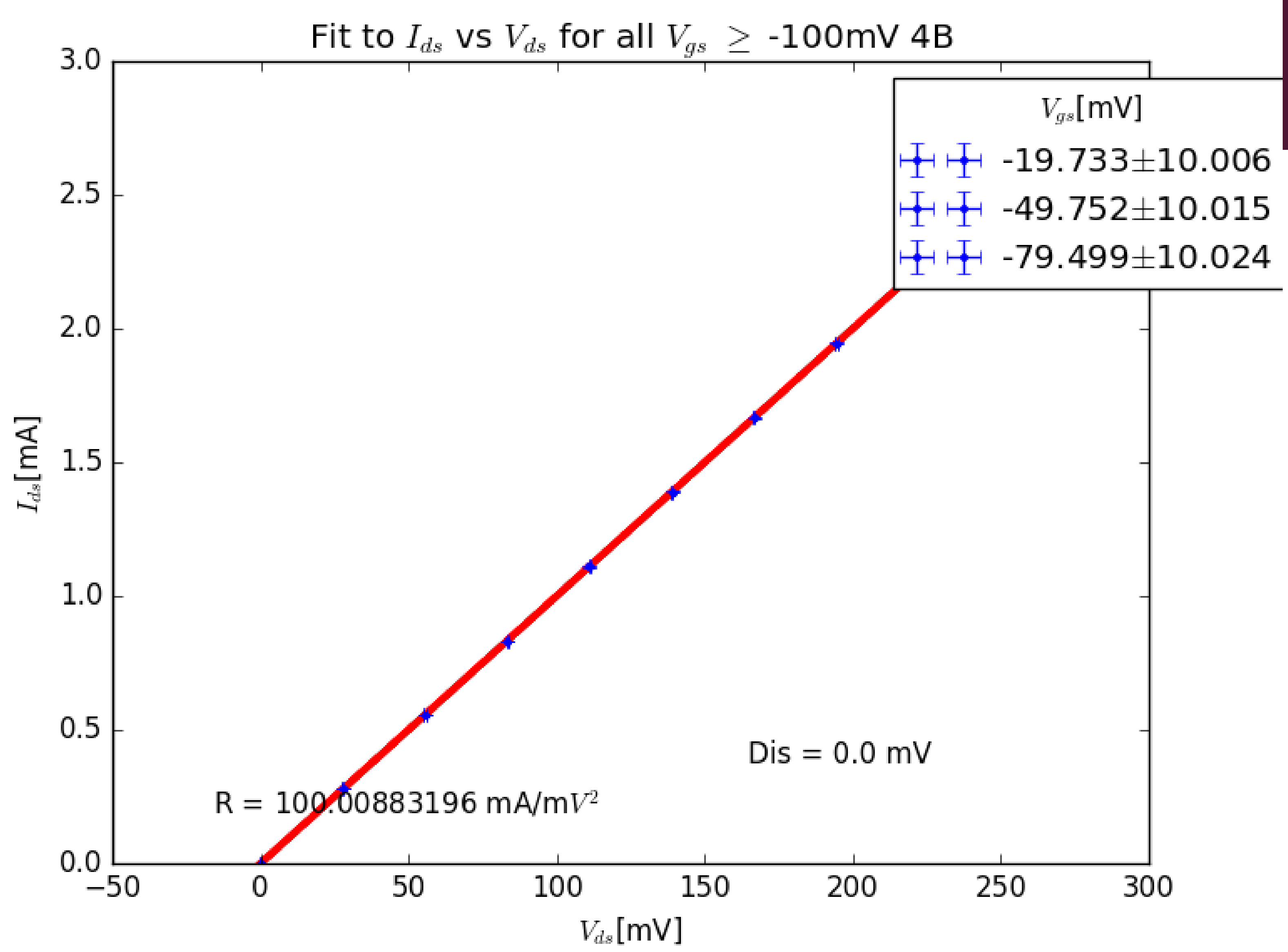
CHANNEL 2C 333Ω



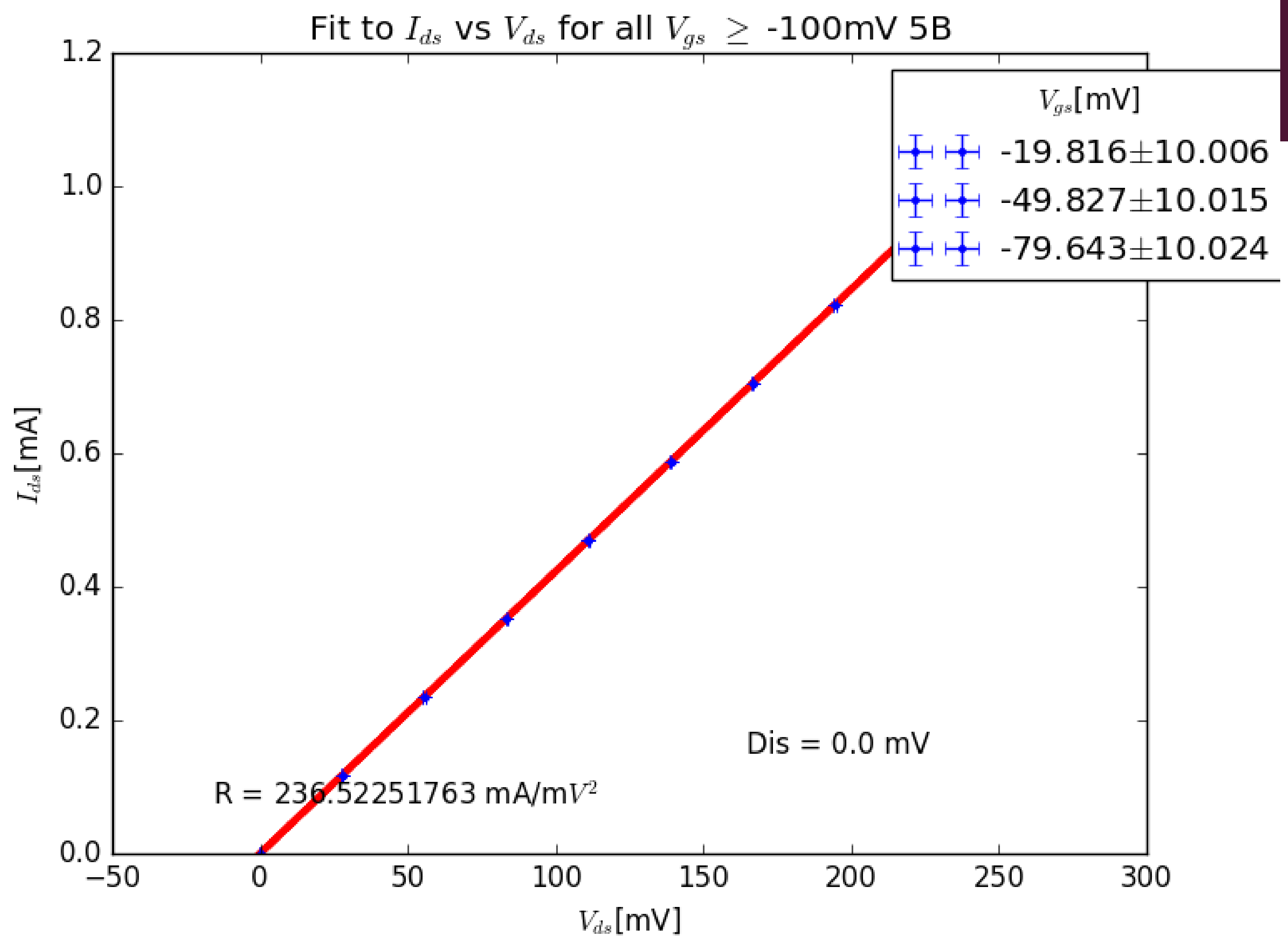
CHANNEL 3B 473Ω



CHANNEL 4B 100Ω

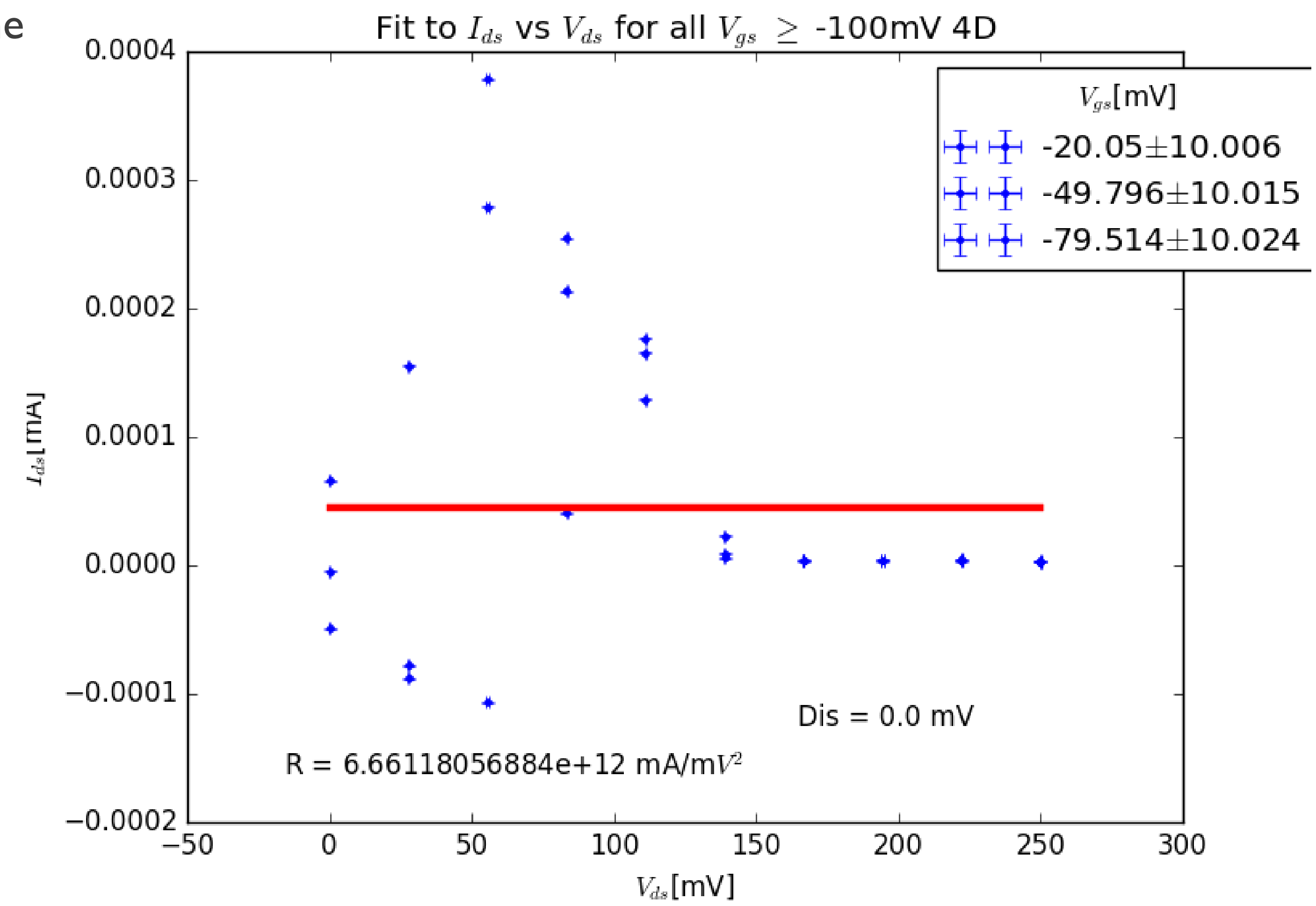


CHANNEL 5B
237Ω



HOORAY FOR OHM'S LAW

- All other channels were open (like 4D on the right)
- Ids and Vds seem to be connected properly
- The LabVIEW program is working correctly



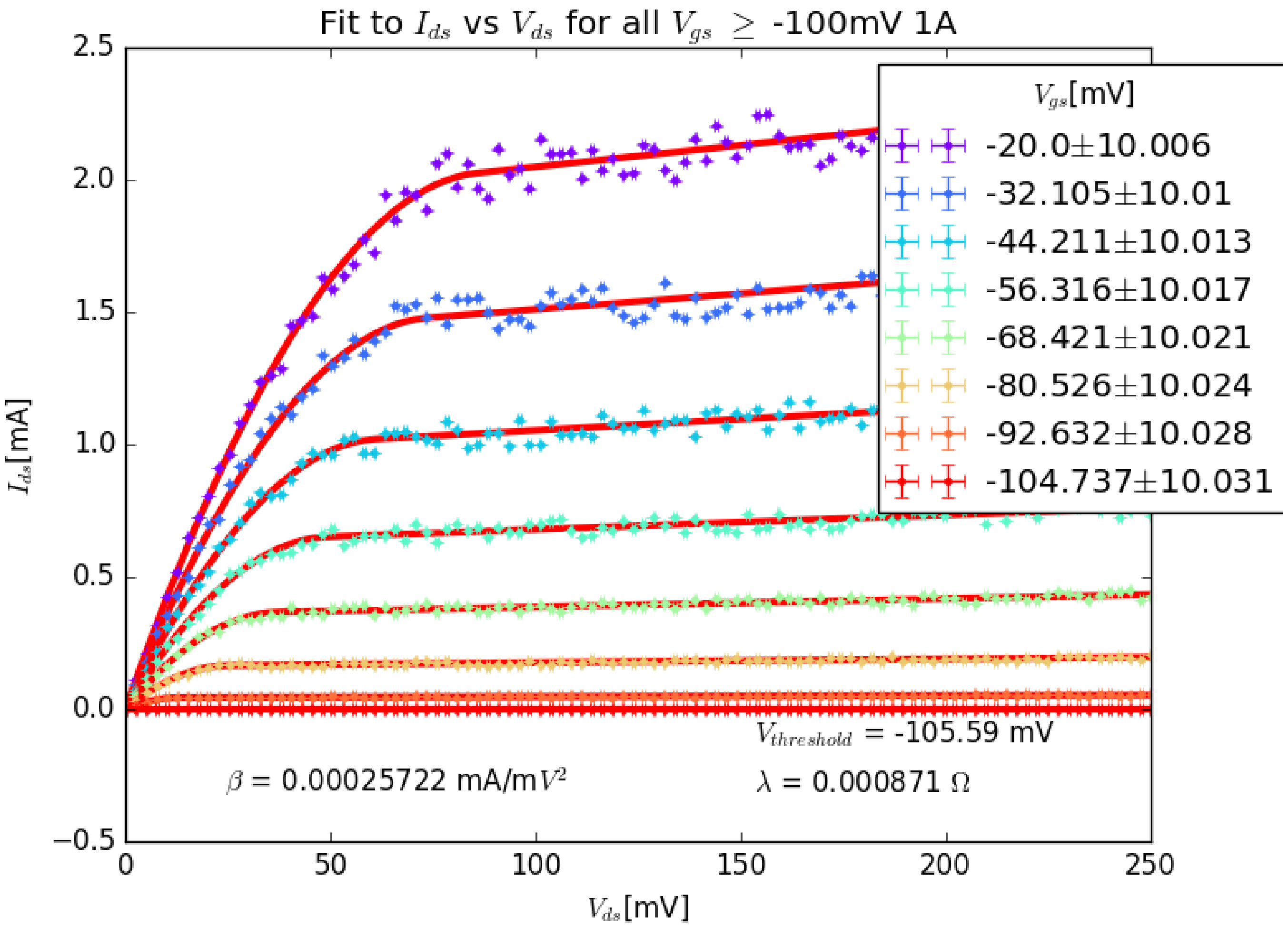
ACTUAL HEMT PLOTTING/FITTING SOFTWARE

- Want to fit to equations (mathematical model for N-channel JFET), which can be found on the Mathworks website or Delphine Boursette's presentation.

Off	$Vgs - Vt \leq 0$	$Id = 0$
Linear	$0 < Vds < Vgs - Vt$	$Id = \beta * Vds(2(Vgs - Vt) - Vds)(1 + \lambda * Vds)$
Saturation	$0 < Vgs - Vt \leq Vds$	$Id = \beta * (Vgs - Vt)^2(1 + \lambda * Vds)$

CURVEFIT 2D AND 3D

- Fake data fits using curve_fit

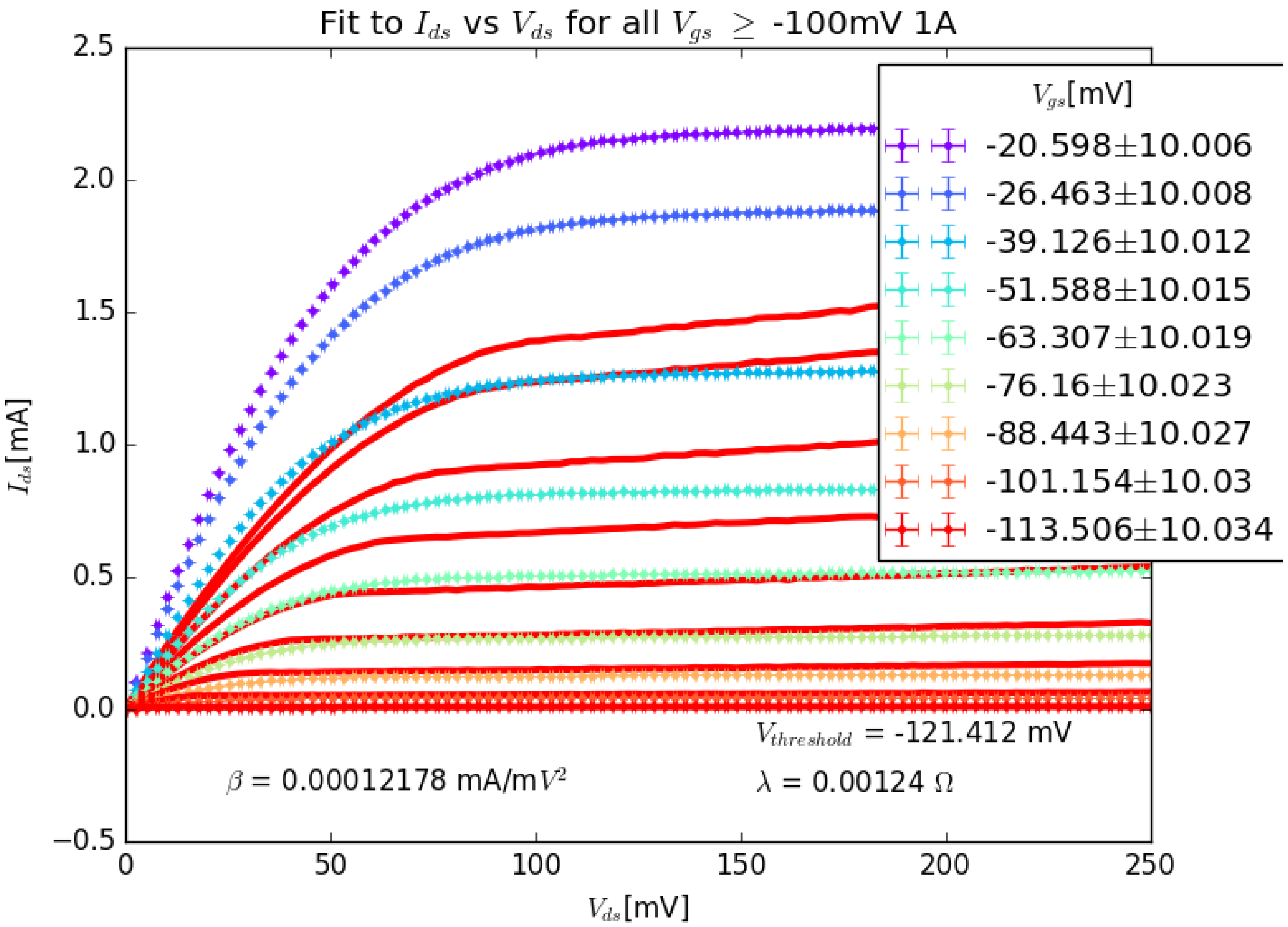


CURVEFIT 2D AND 3D

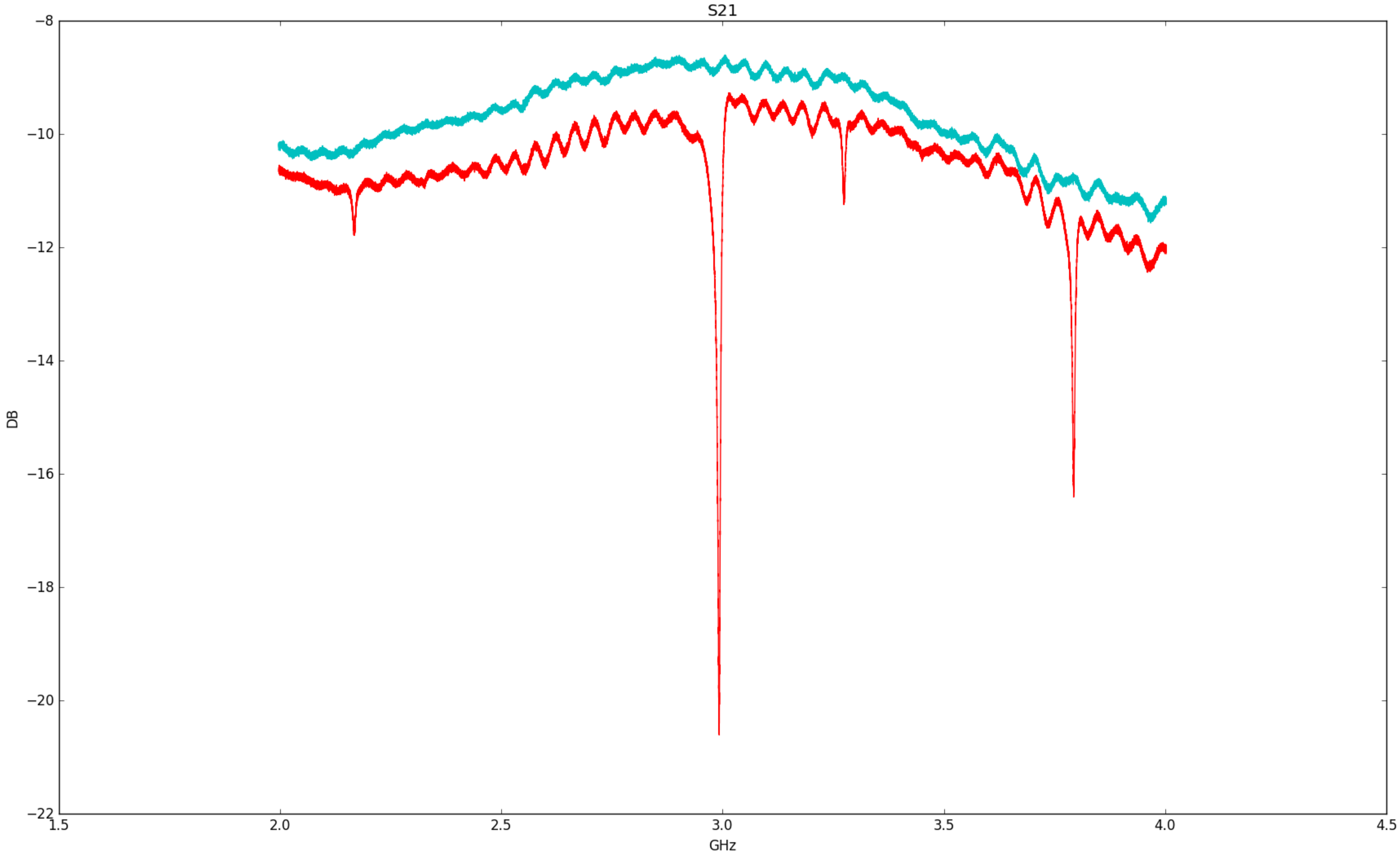
- Real data fits using curve_fit (data taken from the confluence page)
- Data dragged down by small Ids error given to points with small Ids

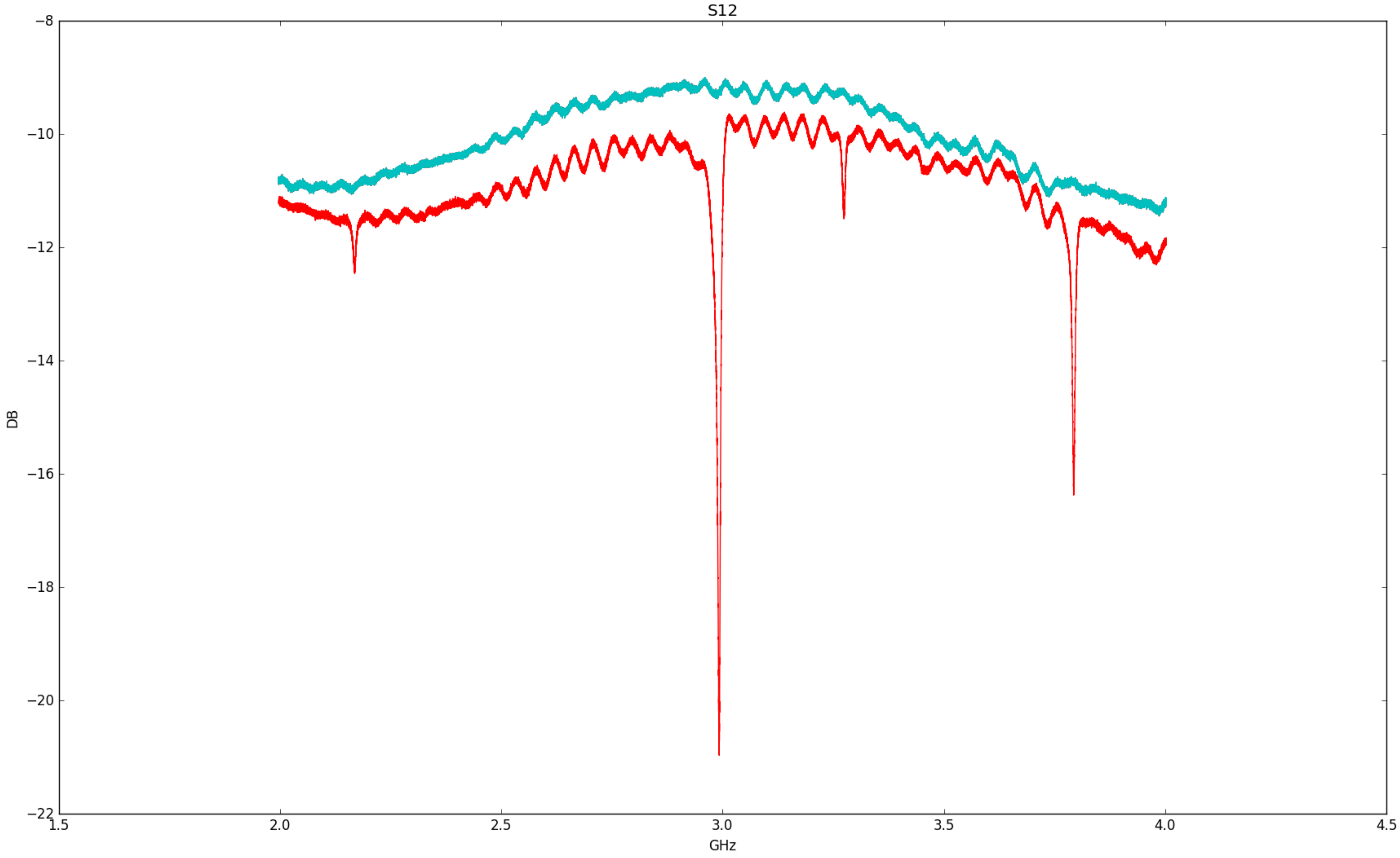
CURRENT PROGRAMMING ACCURACY (Local or Remote Sense)

MODEL	RANGE	PROGRAMMING RESOLUTION	ACCURACY (1 Year)[3] 23°C ±5°C ±(% rdg. + amps)	NOISE (peak-peak) 0.1Hz – 10Hz
2400, 2410:	1.00000 µA	50 pA	0.035% + 600 pA	5 pA
ALL:	10.0000 µA	500 pA	0.033% + 2 nA	5 nA
	100.000 µA	5 nA	0.031% + 20 nA	50 nA
	1.00000 mA	50 nA	0.034% + 200 nA	500 nA
2400, 2420,2425, 2430, 2440:	10.0000 mA	500 nA	0.045% + 2 µA	50 µA
2410 Only:	20.0000 mA	500 nA	0.045% + 4 µA	200 nA
ALL:	100.000 mA	5 µA	0.066% + 20 µA	1 µA
2400, 2410:	1.00000 A[2]	50 µA	0.27% + 900 µA	100 µA
2420, 2425, 2430, 2440:	1.00000 A	50 µA	0.067% + 900 µA	50 µA
2420, 2425:	3.00000 A[2]	150 µA	0.059% + 2.7 mA	150 µA
2430:	3.00000 A[2]/ 10.00000 A[4]	500 µA	0.059% + 2.8 mA	300 µA
2440:	5.00000 A	50 µA	0.10% + 5.4 mA	500 µA

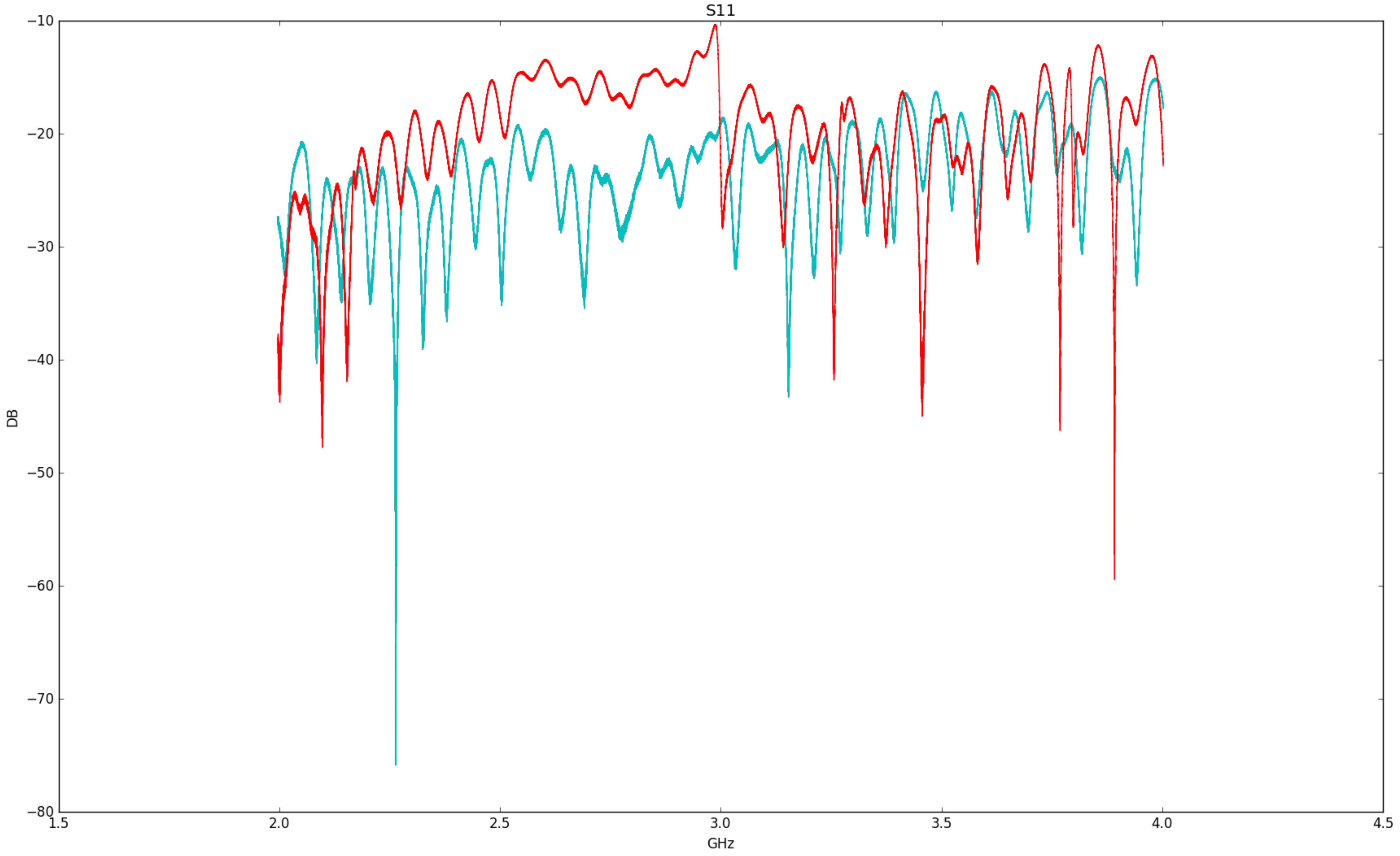


- Following slides are frequency sweeps of…
  - Two 3dB attenuators with no device (blue)
  - YY160629 with two 3dB attenuators (red)

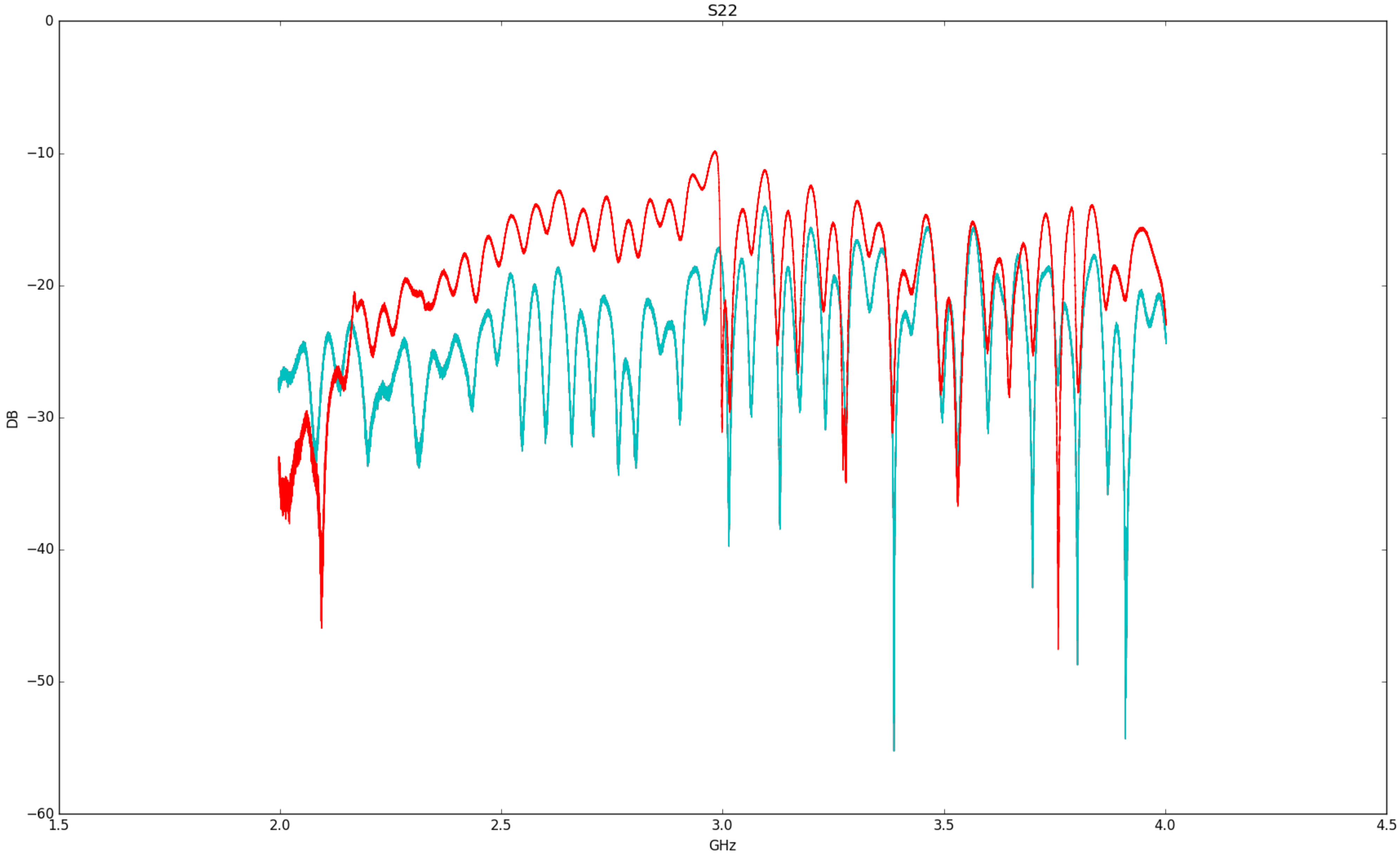

S21
−8
−10
−12
−14
−16
−18
−20
−22
DB
1.5
2.0
2.5
3.0
3.5
4.0
4.5
GHz



S12
−8
−10
−12
−14
−16
−18
−20
−22
DB
1.5
2.0
2.5
3.0
3.5
4.0
4.5
GHz



S11
DB
GHz
−10
−20
−30
−40
−50
−60
−70
−80
1.5
2.0
2.5
3.0
3.5
4.0
4.5


S22
0
−10
−20
−30
−40
−50
−60
DB
1.5
2.0
2.5
3.0
3.5
4.0
4.5
GHz