**FMR Fitting Manual**

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* **Contents:**
  + Part I. Single Peak Fitting
  + Part II. Double Peak Fitting
  + Part III. Fit Kittel and Gilbert Damping

# **Part I. Single Peak Fitting**

***MATLAB files for Lorentzian Fitting:***

|  |  |
| --- | --- |
| main | Single\_Lorentz\_main.m |
| fit-function | Single\_Lorentz.m |
| model function with single peak Lorentzian | Single\_Lorentz\_fun.m |
| name sorting in natural order | sort\_nat.m |

Check latest version at Github: <https://github.com/YCHEN-NYU/SingleLorentz.git>

**Input data format**

* Input data name format:

\*\_(frequency)MHz.dat (e. g. para\_10000MHz.dat)

* Data Format

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Column#** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|  | Index |  |  |  |  |  |  |
| Column# | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|  |  |  |  |  |  |  |  |

**Output format**

* Output file format (\*.txt):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Column#** | **1** | **2** | **3** | **4** | **5** |
|  | f(GHz) |  |  |  |  |

* Output figure format

\*.png with the input data file names (e. g. para\_1000MHz.png)

**Fitting Procedures**

1. Open Single\_Lorentz\_main.m

Set destination folder, outputname (fitting parameters storage), & indices of input data

*e. g. Set indexH = 2, indexS12real =7, indexS12imag = 8*



1. Read all data files formatting as \*MHz.dat & sort them in **natural order**



e. g. sort data files in natural order



1. Set starting and ending indices of data files for the fitting loop



1. Get microwave frequency from filenames



1. Load data into x(nx1 real) and y (nx1 complex). Then Call Single\_Lorentz function to fit data



1. Click on the **LEFT** and **RIGHT** of the fitting area inside the top image or bottom image. (this would eliminate unwanted features in the figure)[no need to worry about y-axis]



1. Click on the **LEFT**, **RIGHT** & **Peak** of the figure



1. After that we would have correct fitting as shown below.



1. **Return to the command window**, *type ‘y’ or ‘Y’ to fit the next data file*. Otherwise if the fitting doesn’t work properly**,** *type any character other than ‘y’ or ‘Y’ to re-fit current data file*. *(click on the LEFT, RIGHT and Peak would give the program a set of starting parameters, correctly set the starting parameters are important for least-square fitting of multiple parameters.)*



1. Continue to fit all data until the ending message was sent inside the command windows.
2. Check output files and figures for reliability. Remove bad data points if necessary.

# **Part II: Double Peak Fitting**

MATLAB codes for Lorentzian Fitting:

|  |  |
| --- | --- |
| main | Double\_Lorentz\_main.m |
| fit-function | Double\_Lorentz.m |
| model function with single peak Lorentzian | Double\_Lorentz\_fun.m |
| name sorting in natural order | sort\_nat.m |

Check latest version at Github: <https://github.com/YCHEN-NYU/DoubleLorentz.git>

**Input data format**

* Input data name format:

\*\_(frequency)MHz.dat (e. g. para\_10000MHz.dat)

* Data Format

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Column# | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | Index |  |  |  |  |  |  |
| Column# | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|  |  |  |  |  |  |  |  |

**Output format**

* Output file format (\*.txt):

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Data | f(GHz) |  |  |  |  |  |  |  |  |

Output figure format (\*.png) with the input data file names (e. g. para\_1000MHz.png)

**Fitting Steps**

1. Open Double\_Lorentz\_main.m

Set destination folder, outputname (fitting parameters storage), & indices of input data

*e. g. Set indexH = 2, indexS12real =7, indexS12imag = 8*



1. Read all data files formatting as \*MHz.dat & sort them in **natural order**



e. g. sort data files in natural order



1. Set starting and ending indices of data files for the fitting loop



1. Get microwave frequency from filenames



1. Load data into x(nx1 real) and y (nx1 complex). Then Call Double\_Lorentz function to fit data



1. Click on the **LEFT** and **RIGHT** of the fitting area inside the top image or bottom image. (this would eliminate unwanted features of S12)[no need to worry about the y-axis]



1. Click on the **LEFT**, **RIGHT** & **Peak** of **the 1st Peak**



1. Click on the **LEFT**, **RIGHT** & **Peak** of **the 2nd Peak**



1. After that we would have correct fitting as shown below.



1. Continue to fit all data until the ending message was sent inside the command windows.
2. Check output files and figures for reliability. Remove bad data points if necessary.

**Part III. Fit Kittel and Gilbert Damping**

(1) Extract , and with fixed g-factor

(2) Extract g-factor separately with 2 - parameters model

MATLAB codes for Lorentzian Fitting:

|  |  |
| --- | --- |
| main | fit\_Kittel\_and\_Gilbert.m |
| name sorting in natural order | sort\_nat.m |

Check latest version at Github: <https://github.com/YCHEN-NYU/fit_Kittel_and_Gilbert.git>

**Input data format**

* Input data name format: \*.txt(e. g. 21\_P2N1.txt)
* Data Format

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Column# | 1 | 2 | 3 | 4 | 5 |
|  |  |  |  |  |  |

**Output format**

* Output file format (\*.txt):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Column# | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  |  |  |  |  |  |  |  |  |

Output figure format:

a. (\*.png) with and Plot (*e. g.* 21\_P2N1.png)

b. (fH.png) with Plot

**Fitting Steps**

1. Set Destination Folder, g-factor, H interval, output file, Hmesh and thickness of layers (for legends)



1. Set Unit Conversion Constants and input data name format





1. Choose Region to be fitted by clicking on the LEFT and RIGHT of the plot



1. After Kittel Fitting on the left side, choose fitting region of the right plot to fit Gilbert Damping



1. Continue to finish all fittings & Check data & plots saved. Like those here.

