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**Fitting**

***Create a Session***

**Click “File”**

|  |
| --- |
| **Then click “New session”.** |

|  |
| --- |
| **A session page named “Untitled” will show up.** |

***Launch application in a session***

|  |
| --- |
| **Two applications are available for us to launch. We first launch the “Default application” to perform fitting.** |

**After clicking the “Default application”, we can see the following interface.**

|  |
| --- |
|  |

***Load hdf5 file***

**Click “Select Folder”**

|  |
| --- |
| **Click “Select a data directory”**  **Select a folder (not a file) that contains the data in hdf5 format.** |

|  |
| --- |
| **Click the drop-down menu to display all available hdf5 files.**  **Pick the hdf5 file that contains the data you want to fit.** |

***Power selection***

|  |
| --- |
| **Select an arbitrary power to begin fitting.**  **Click the drop-down menu to display all the powers in the selected hdf5 file.** |

**“S21 Fit” page shows four plots:**

1. **mag(S21) vs f**
2. **arg(S21) vs f**
3. **Re(S21) vs f**
4. **Im(S21) vs f**

**The two boxes allow the user to enter the lower bound and upper bound separately for each parameter. After entering the value, be sure either to press *Enter* on the keyboard, or click the “confirm” button.**

**The user can tune the parameter value and see how the fit curve change in real time by dragging this handle.**

**These four buttons are for performing single fitting operation with respect to one of the four quantities: mag(S21), arg(S21), Re(S21), Im(S21).**

|  |
| --- |
| **“Fit” page shows the optimal value of the parameters found by the fitting algorithm,** |

**“Circle Fit” page shows the plot of Im(S21) vs Re(S21)**

***Discard data points***

**The “Config” page contains other data-related setting. “DISCARD\_LEFT” allows the user discard data point on the left side (lower frequency side) of the data, and similarly for “DISCARD\_RIGHT”.**

|  |
| --- |
|  |

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| --- |
| **“Q vs Power” page shows Qe, Qi, and Qtot vs power. Note that the plot is empty initially, you need to click at least one time on any of the four fitting buttons to see the curves.** |

***Fitting***

|  |
| --- |
| **Both “%\_std” and “SSE” can be used as indicator to indicate the fitting quality. Definition of SSE is given in Appendix.**  **Begin fitting by iteratively clicking these four buttons several times.** |

***Switch to other power***

|  |
| --- |
| **After finishing fitting for one power, move on to the next power. Note that the fitting results obtained in the previous powers will not get lost, you can go back to see it at any given time.** |

***Create a second session page***

**After fitting all powers, you may check the “Q vs Power” plot.**

|  |
| --- |
| **Create a new session to fit the next range of powers in another hdf5 file.** |

***Rename the session page***

**You may rename the tab label for each session. To rename a session page label, first switch to the page and right-click on its label, then click “Rename”.**

|  |
| --- |
| **Enter the new name, then press *Enter* or click “ok”.**  **Continue finishing fitting for all the powers in this hdf5 file.** |

***Save fitting results***

**After finishing fitting for all ranges of power, we next plot “Overall Q vs Power”. First we need to save the fitting results for all sessions. From “File”, click “Save session data”.**

|  |
| --- |
| **Click “Save”.**  **Select the folder to save fitting results. The saved fitting results will be in “.json” format.** |

**Plot overall Q vs power**

***Launch “Plot Q vs Power” application***

|  |
| --- |
| **Click “Launch”**  **Then click “Plot Q vs Power application”.** |

***Select multiple saved fitting results to plot overall Q vs power***

|  |
| --- |
| **Click “Select Folder”.**  **Select the folder where we saved our fitting results.**  **Click “Select directory…”** |

**All saved “.json” files will be displayed**

|  |
| --- |
| **The overall Q vs power plot will appear.**  **Click “plot”.**  **Only check those “.json” files that are needed.** |

**Appendix**

***Function definitions***

|  |  |
| --- | --- |
|  | |
| **Re(S21)** | |
|  | |
| **Im(S21)** | |
|  |  |
| **arg(S21)** | **mag(S21)** |
|  | |
| **Sum of squared normalized error** | |

**Reference**

**[1]** Kurtis Lee Geerlings. *Improving Coherence of Superconducting Qubits and Resonators*. p.199, equation A.18.

**[2]** D. Zoepfl, P. R. Muppalla, C. M. F. Schneider, et al. *Supplemental Material: Characterization of low loss microstrip resonators as a building block for circuit QED in a 3D waveguide.* p.2, equation S1.