

```

In[156]:= ClearAll["Global`*"]
SetDirectory["/Users/lisaleemcb/ADMX/ouroboros/code/"];
(*the files in Users/baker/My Documents/data/10_9_13/TUNING
are dB files and the Q script is made for re/im files. *)
fname = "../measurements/A3.S1P";

file = Drop[Import[fname, "Table"], 12];
dataraw = file;
data = dataraw;
f = ToExpression[data[[All, 1]]];
(*S11RE=ToExpression[data[[All, 2]]];
S11IM=ToExpression[data[[All, 3]]];*)
S11dB = ToExpression[data[[All, 2]]];
S11ang = ToExpression[data[[All, 3]]];
(*S11Abs=Table[Abs[S11RE[[x]]+i S11IM[[x]]], {x, 1, Length[S11RE]}];*)
Z0 = 50;
pos = Position[S11dB, Min[S11dB]][[1, 1]];
fresinitial = f[[pos]];

(*Sparam=
Table[{{(f[[x]]-fresinitial)/fresinitial, Abs[S11RE[[x]]+j*S11IM[[x]]]^2}, {x, 1, Length[f]}}];*)
Sparam = Table[{{(f[[x]] - fresinitial)/fresinitial, 10^(S11dB[[x]] / 10.)}, {x, 1, Length[f]}}];
t = 2 δ;
model = ρ² + (d² + 2 d ρ (Cos[φ] + QL (t - t0) Sin[φ])) / (1 + QL² (t - t0)²);

vars = FindFit[Sparam, model, {{QL, 1400}, {ρ, 0.7}, {d, 0.2}, {φ, π}, {t0, 0}}, δ,
MaxIterations → 10 000, Gradient → "FiniteDifference", AccuracyGoal → 10]
pmod = Plot[model /. vars, {δ, Min[Sparam[[All, 1]]], Max[Sparam[[All, 1]]]},
PlotRange → All, Axes → False, Frame → True,
PlotPoints → 10 000, PlotStyle → Green];
Splot = ListPlot[Sparam, PlotStyle → {Red, PointSize[Small]}];

Show[pmod, Splot, PlotRange → {{Min[Sparam[[All, 1]]], Max[Sparam[[All, 1]]]}, All},
FrameLabel → {{ "|Γ|²", "" }, { "δ", "" }},
FrameStyle → Directive[Bold, 16, Medium], ImageSize → 600]
fres = fresinitial + fresinitial * vars[[5, 2]];
QL = vars[[1, 2]];
ρ = vars[[2, 2]];
d = vars[[3, 2]];
φ = vars[[4, 2]];
t0 = vars[[5, 2]];

```

$$\kappa = \left( \frac{1}{\frac{1+\rho}{d} - 1} \right);$$

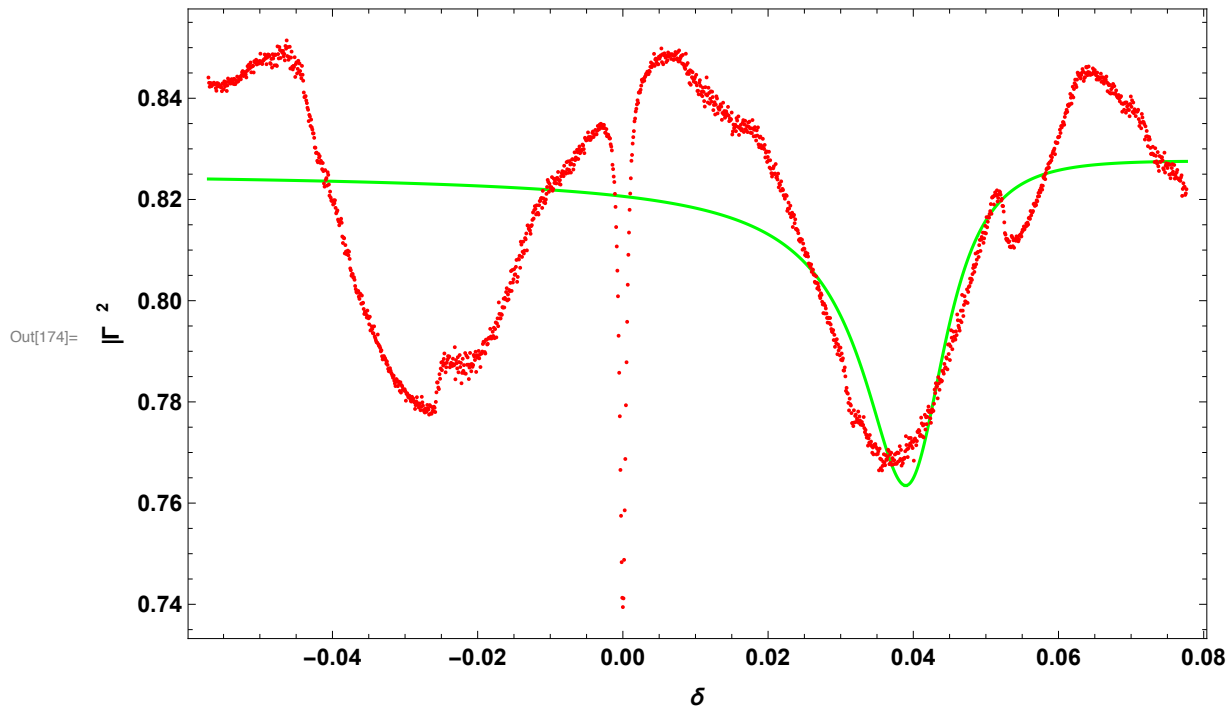
$$Q0 = \left( \frac{1}{\frac{1+\rho}{d} - 1} + 1 \right) QL;$$

```

"Q0 -> " <> ToString[Q0]
"fres[MHz] -> " <> ToString[fres]
"QL -> " <> ToString[QL]
"Coupling Coefficient -> " <> ToString[κ]

```

Out[171]= {QL → 72.804, ρ → 0.90874, d → 0.0359225, ϕ → -3.46556, t0 → 0.0802026}



Out[183]= Q<sub>0</sub> -> 74.2005

Out[184]= f<sub>res</sub>[MHz] -> 9  
2.40575 10

Out[185]= Q<sub>L</sub> -> 72.804

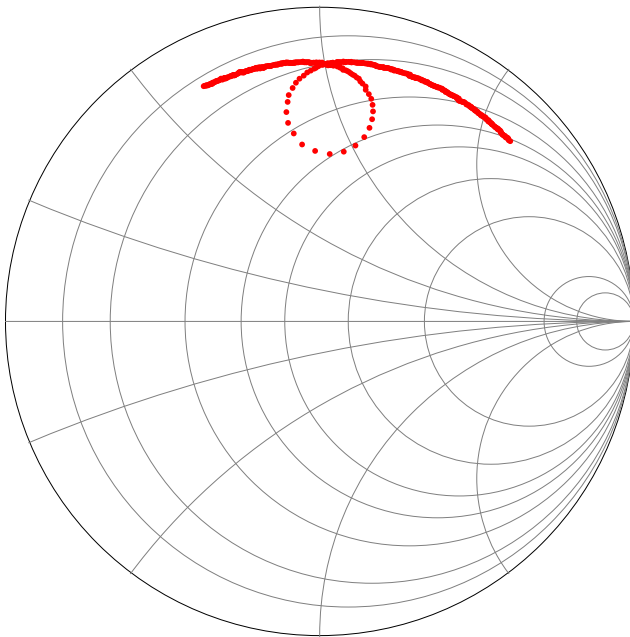
Out[186]= Coupling Coefficient -> 0.019181

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pl = ListPlot[Table[{S11RE[[a]], S11IM[[a]]}, {a, 1, Length[f]}], PlotStyle →
  {Red, Thick}, PlotRange → All, AspectRatio → Automatic, AxesOrigin → {0, 0}];

R1 = {5, 10, 20, 30, 40, 60, 100, 300, 500};
X1 = {10, -10, 100, -100, -50, 50, -25, 25};
chart = Graphics[{Circle[{0, 0}], Gray, Table[
  Circle[{1 - 1 / (1 + R1[[a]] / Z0), 0}, 1 / (1 + R1[[a]] / Z0)], {a, 1, Length[R1]}],
  Table[Circle[{1, Z0 / X1[[a]]}, Abs[Z0 / X1[[a]]]], {a, 1, Length[X1]}],
  Line[{{-1, 0}, {1, 0}}], White, Thickness[0.45],
  Circle[{0, 0}, 1.5]], PlotRange → 1.1];
Show[chart, pl]
model

```



$$\frac{0.694115 + (0.0901508 + 0.5003 (-0.992632 + 176.174 (-0.0000641145 + 2 \delta)))}{(1 + 2.11396 \times 10^6 (-0.0000641145 + 2 \delta)^2)}$$

```


$$\Gamma = \text{Abs} \left[ \text{Exp}[\text{i} (\phi - \gamma)] \left( \rho + \frac{\text{d Exp}[\text{i} \gamma]}{1 + \text{i} \text{QL t}} \right) \right]^2$$

Smithparam = Table[{S11RE[[x]], S11IM[[x]]}, {x, 1, Length[S11RE]};

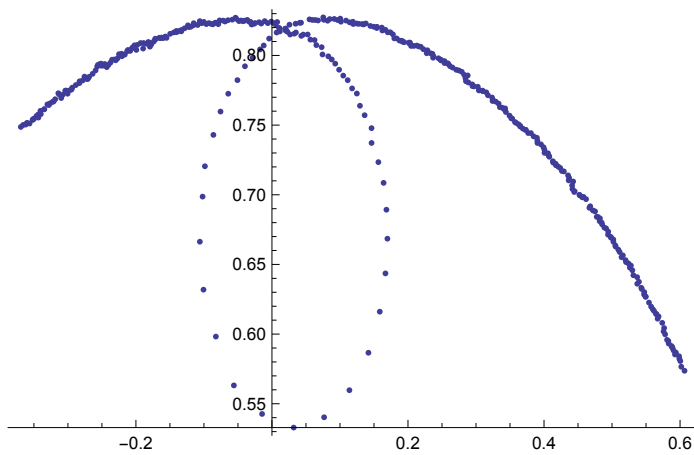
smithvar = FindFit[Smithparam,  $\Gamma$ , { $\gamma$ },  $\delta$ ]
ListPlot[Smithparam]
 $\Gamma /. \text{smithvar}$ 

```

```
Plot[( $\Gamma$ )1/2 /. smithvar, { $\delta$ , -0.8, 0.8}]
```

$$e^{2 \text{Im}[\gamma]} \text{Abs} \left[ 0.833136 + \frac{0.300251 e^{\text{i} \gamma}}{1 + (0. + 2907.89 \text{i}) \delta} \right]^2$$

```
{ $\gamma \rightarrow -0.0152443$ }
```



$$\text{Abs} \left[ 0.833136 + \frac{0.300216 - 0.00457694 \text{i}}{1 + (0. + 2907.89 \text{i}) \delta} \right]^2$$

