```
In[ ]:= data = {{-2, 11, .60}, {-1.5, 11, .61}, {-1, 11, .632}, {-.5, 11, .655},
    {0, 11, .651}, {.5, 11, .652}, {1, 11, .655}, {1.5, 11, .645}, {2, 11, .60},
    {-2.5, 8.5, .60}, {-2, 8.5, .62}, {-1.5, 8.5, .640},
    {-1, 8.5, .654}, {-.5, 8.5, .662}, {0, 8.5, .668}, {.5, 8.5, .670},
    {1, 8.5, .667}, {1.5, 8.5, .657}, {2, 8.5, .64}, {2.5, 8.5, .60},
    {-3, 6, .59}, {-2.5, 6, .603}, {-2, 6, .640},
    {-1.5, 6, .654}, {-1, 6, .663}, {-.5, 6, .669}, {0, 6, .675}, {.5, 6, .678},
    {1, 6, .679}, {1.5, 6, .677}, {2, 6, .662}, {2.5, 6, .61}, {3, 6, .59},
    {-3.5, 3.5, .59}, {-3, 3.5, .60}, {-2.5, 3.5, .624}, {-2, 3.5, .642}, {-1.5, 3.5, .655},
    {-1, 3.5, .665}, {-.5, 3.5, .671}, {0, 3.5, .676}, {.5, 3.5, .678}, {1, 3.5, .680},
    {1.5, 3.5, .679}, {2, 3.5, .671}, {2.5, 3.5, .665}, {3, 3.5, .618}, {3.5, 3.5, .57},
    {-3.5, 1, .58}, {-3, 1, .612}, {-2.5, 1, .636}, {-2, 1, .649}, {-1.5, 1, .660},
    {-1, 1, .667}, {-.5, 1, .671}, {0, 1, .675}, {.5, 1, .679}, {1, 1, .682},
    {1.5, 1, .6825}, {2, 1, .682}, {2.5, 1, .671}, {3, 1, .632}, {3.5, 1, .60},
    {-3.5, -1.5, .575}, {-3, -1.5, .603}, {-2.5, -1.5, .636},
    {-2, -1.5, .651}, {-1.5, -1.5, .660}, {-1, -1.5, .663}, {-.5, -1.5, .670},
    {0, -1.5, .675}, {.5, -1.5, .680}, {1, -1.5, .683}, {1.5, -1.5, .684},
    {2, -1.5, .682}, {2.5, -1.5, .677}, {3, -1.5, .646}, {3.5, -1.5, .59},
    {-3.5, -4, .58}, {-3, -4, .608}, {-2.5, -4, .639}, {-2, -4, .646}, {-1.5, -4, .656},
    {-1, -4, .663}, {-.5, -4, .6695}, {0, -4, .675}, {.5, -4, .6795}, {1, -4, .6825},
    {1.5, -4, .682}, {2, -4, .679}, {2.5, -4, .675}, {3, -4, .645}, {3.5, -4, .62},
    {-3.5, -6.5, .58}, {-3, -6.5, .602}, {-2.5, -6.5, .628},
    {-2, -6.5, .643}, {-1.5, -6.5, .652}, {-1, -6.5, .658}, {-.5, -6.5, .661},
    {0, -6.5, .666}, {.5, -6.5, .673}, {1, -6.5, .675}, {1.5, -6.5, .676},
    {2, -6.5, .675}, {2.5, -6.5, .672}, {3, -6.5, .640}, {3.5, -6.5, .62},
    {-3.5, -9, .57}, {-3, -9, .598}, {-2.5, -9, .621}, {-2, -9, .640}, {-1.5, -9, .648},
    {-1, -9, .654}, {-.5, -9, .658}, {0, -9, .664}, {.5, -9, .668}, {1, -9, .671},
    {1.5, -9, .673}, {2, -9, .672}, {2.5, -9, .668}, {3, -9, .640}, {3.5, -9, .61},
    {-3, -11.5, .585}, {-2.5, -11.5, .611}, {-2, -11.5, .628},
    {-1.5, -11.5, .640}, {-1, -11.5, .648}, {-.5, -11.5, .655},
    {0, -11.5, .660}, {.5, -11.5, .664}, {1, -11.5, .665}, {1.5, -11.5, .664},
    {2, -11.5, .662}, {2.5, -11.5, .645}, {3, -11.5, .630},
    {-2.5, -14, .59}, {-2, -14, .618}, {-1.5, -14, .636}, {-1, -14, .644},
    {-.5, -14, .651}, {0, -14, .654}, {.5, -14, .659}, {1, -14, .662},
    {1.5, -14, .661}, {2, -14, .655}, {2.5, -14, .616}, {3, -14, .61},
    {-2, -16.5, .59}, {-1.5, -16.5, .613}, {-1, -16.5, .627},
    {-.5, -16.5, .634}, {0, -16.5, .644}, {.5, -16.5, .649}, {1, -16.5, .648},
    {1.5, -16.5, .636}, {2, -16.5, .616}, {2.5, -16.5, .60}(*,
    {-5/Sqrt[2],-25/Sqrt[2]-4,0.5},{-5/Sqrt[2],25/Sqrt[2]-4,0.5},
    {5/Sqrt[2],-25/Sqrt[2]-4,0.5},{5/Sqrt[2],25/Sqrt[2]-4,0.5},
    {-5,-4,0.5},{0,-29,0.5},{5,-4,0.5},{0,0,21,0.5} *)};

In[ ]:= data[[All, 2]] = (data[[All, 2]] + 4) / 5;
    (*w_0 = gamma*B_0*)
    (* f_0 (MHz) = 4.258 B_0 (kilogauss) *)
    data[[All, 3]] = (data[[All, 3]] + 14) / 4.258;
```

```
In[ ]:= data

In[ ]:= Show[ListContourPlot[data, Contours → 50, PlotRange → {{-5, 5}, {-5, 5}}],
         ParametricPlot[{5 Cos[t], 5 Sin[t]}, {t, 0, 2 * Pi}, PlotStyle → Black], Frame → True,
         FrameLabel → {"x (cm)", "y (cm)"}, PlotLabel → "Magnetic Field Contour Plot"]

In[ ]:= waterT2data = {{0, 9.04}, {.1, 7.44}, {.2, 6.12}, {.3, 5.04},
          {.4, 4.24}, {.5, 3.56}, {.6, 3.12}, {.7, 2.68}, {.8, 2.28}, {.9, 2.00}};

In[ ]:= nlmWater = NonlinearModelFit[waterT2data, a * Exp[-t / T2], {a, T2}, t]

In[ ]:= nlmWater["ParameterTable"]

In[ ]:= Plot[nlmWater[x], {x, 0, 1}]

In[ ]:= h2o = {{0, 9.79}, {.02, 9.65}, {.04, 9.64}, {.06, 9.45},
          {.08, 9.41}, {.10, 9.29}, {.12, 9.24}, {.14, 9.13}, {.16, 9.17},
          {.18, 9.01}, {.2, 8.95}, {.22, 8.88}, {.24, 8.81}, {.26, 8.73}, {.28, 8.61},
          {.30, 8.57}, {.32, 8.52}, {.34, 8.45}, {.36, 8.36}, {.38, 8.25}};

In[ ]:= NonlinearModelFit[h2o, a * Exp[-t / T2], {a, T2}, t]["ParameterTable"]

In[ ]:= h2opt2 = {{0, 9.63}, {.02, 9.59}, {.04, 9.47}, {.06, 9.43},
          {.08, 9.34}, {.10, 9.19}, {.12, 9.15}, {.14, 9.11}, {.16, 9.11},
          {.18, 8.99}, {.2, 8.84}, {.22, 8.79}, {.24, 8.71}, {.26, 8.66}, {.28, 8.52},
          {.30, 8.50}, {.32, 8.39}, {.34, 8.34}, {.36, 8.25}, {.38, 8.15}};

In[ ]:= h2opt2fit = NonlinearModelFit[h2opt2, a * Exp[-t / T2], {a, T2}, t]
        h2opt2fit["ParameterTable"]

In[ ]:= Plot[h2opt2fit[t], {t, 0, 3}]

In[ ]:= h2oNoMorePlease =
          {{0, 9.56}, {.01, 9.55}, {.02, 9.51}, {.03, 9.47}, {.04, 9.45}, {.05, 9.41}, {.06, 9.35},
           {.07, 9.32}, {.08, 9.27}, {.09, 9.23}, {.10, 9.24}, {.11, 9.15}, {.12, 9.17}, {.13, 9.14},
           {.14, 9.09}, {.15, 9.05}, {.16, 9.03}, {.17, 9.04}, {.18, 8.99}, {.19, 8.90}};

In[ ]:= NonlinearModelFit[h2oNoMorePlease, a * Exp[-t / T2], {a, T2}, t]["ParameterTable"]

In[ ]:= h2oNoMorePlease2 =
          {{0, 8.88}, {.01, 8.85}, {.02, 8.81}, {.03, 8.82}, {.04, 8.78}, {.05, 8.73}, {.06, 8.70},
           {.07, 8.66}, {.08, 8.64}, {.09, 8.56}, {.10, 8.52}, {.11, 8.54}, {.12, 8.48}, {.13, 8.45},
           {.14, 8.42}, {.15, 8.38}, {.16, 8.36}, {.17, 8.33}, {.18, 8.30}, {.19, 8.24}};

In[ ]:= waterT2Fit = NonlinearModelFit[h2oNoMorePlease2, a * Exp[-t / T2], {a, T2}, t]
        waterT2Fit["ParameterTable"]

In[ ]:= h2oNoMorePlease3 =
          {{0, 10.10}, {.01, 9.99}, {.02, 10.01}, {.03, 9.93}, {.04, 9.93}, {.05, 9.87}, {.06, 9.88},
           {.07, 9.81}, {.08, 9.78}, {.09, 9.72}, {.10, 9.68}, {.11, 9.66}, {.12, 9.61}, {.13, 9.56},
           {.14, 9.57}, {.15, 9.49}, {.16, 9.46}, {.17, 9.41}, {.18, 9.39}, {.19, 9.34}};

In[ ]:= NonlinearModelFit[h2oNoMorePlease3, a * Exp[-t / T2], {a, T2}, t]["ParameterTable"]
```

```
In[ ]:= eaData = {{0, 5.74}, {.01, 5.69}, {.02, 5.70}, {.03, 5.64},
          {.04, 5.63}, {.05, 5.60}, {.06, 5.61}, {.07, 5.58}, {.08, 5.56},
          {.09, 5.53}, {.10, 5.51}, {.11, 5.55}, {.12, 5.50}, {.13, 5.48}, {.14, 5.44},
          {.15, 5.43}, {.16, 5.43}, {.17, 5.40}, {.18, 5.38}, {.19, 5.38}};

In[ ]:= NonlinearModelFit[eaData, a * Exp[-t / T2], {a, T2}, t]["ParameterTable"]

In[ ]:= isopropanolData1 =
        {{0, 9.28}, {.02, 9.11}, {0.04, 8.96}, {.06, 8.84}, {.08, 8.64}, {.10, 8.52}, {.12, 8.39},
         {.14, 8.28}, {.16, 8.11}, {.18, 7.92}, {.20, 7.80}, {.22, 7.68}, {.24, 7.55}, {.26, 7.44},
         {.28, 7.32}, {.30, 7.20}, {.32, 7.12}, {.34, 6.96}, {.36, 6.80}, {.38, 6.69}};

In[ ]:= NonlinearModelFit[isopropanolData1, a * Exp[-t / T2], {a, T2}, t]["ParameterTable"]

In[ ]:= isopropanolData2 =
        {{0, 9.07}, {.02, 8.84}, {0.04, 8.71}, {.06, 8.54}, {.08, 8.37}, {.10, 8.29}, {.12, 8.15},
         {.14, 8.01}, {.16, 7.89}, {.18, 7.72}, {.20, 7.60}, {.22, 7.51}, {.24, 7.37}, {.26, 7.25},
         {.28, 7.12}, {.30, 7.02}, {.32, 6.91}, {.34, 6.80}, {.36, 6.68}, {.38, 6.59}};

In[ ]:= isoT2Fit = NonlinearModelFit[isopropanolData2, a * Exp[-t / T2], {a, T2}, t]
        isoT2Fit["ParameterTable"]

In[ ]:= isopropanolData3 =
        {{0, 8.86}, {.02, 8.64}, {0.04, 8.41}, {.06, 8.21}, {.08, 8.09}, {.10, 8.00}, {.12, 7.84},
         {.14, 7.85}, {.16, 7.56}, {.18, 7.57}, {.20, 7.40}, {.22, 7.28}, {.24, 7.16}, {.26, 7.00},
         {.28, 6.93}, {.30, 6.80}, {.32, 6.67}, {.34, 6.60}, {.36, 6.49}, {.38, 6.36}};

In[ ]:= NonlinearModelFit[isopropanolData3, a * Exp[-t / T2], {a, T2}, t]["ParameterTable"]

In[ ]:= householdOil1 =
        {{0, 10.35}, {.01, 8.30}, {.02, 7.24}, {.03, 5.74}, {.04, 5.02}, {.05, 4.20}, {.06, 3.84},
         {.07, 3.46}, {.08, 3.06}, {.09, 2.76}, {.10, 2.38}, {.11, 2.16}, {.12, 2.02}};

In[ ]:= NonlinearModelFit[householdOil1, a * Exp[-t / T2], {a, {T2, .05}}, t]["ParameterTable"]

In[ ]:= mineralOil1 = {{0, 10.12}, {.004, 7.90}, {.008, 6.66},
          {.012, 5.24}, {.016, 4.60}, {.02, 3.92}, {.024, 3.48}, {.028, 3.06},
          {.032, 2.76}, {.036, 2.48}, {.040, 2.24}, {.044, 2.10}, {.048, 1.90}};

In[ ]:= mo1 = NonlinearModelFit[mineralOil1,
          a * Exp[-t / T2] + b * Exp[-t / T22], {a, {T2, .05}, {b, 2}, {T22, .05}}, t]
        mo1["ParameterTable"]

In[ ]:= gamma = 2.675 * 10^4
        n = 1
        grad = Around[2.7, 0.3]

In[ ]:= waterDiffusion1 = {{0.02, 7.96}, {.04, 7.58}, {.06, 6.86},
          {.08, 6.50}, {.10, 5.94}, {.12, 5.58}, {.14, 5.22}, {.16, 4.78}, {.18, 4.40},
          {.20, 4.18}, {.22, 3.76}, {.24, 3.58}, {.26, 3.34}, {.28, 3.10}, {.30, 2.98},
          {.32, 2.74}, {.34, 2.52}, {.36, 2.36}, {.38, 2.24}, {.40, 2.02}};

In[ ]:= T2Water = MeanAround[{Around[2.75, .07], Around[2.54, .05], Around[2.53, .05]}]
```

```
In[ ]:= T2W = T2Water["Value"]

In[ ]:= waterDiffusionFit = NonlinearModelFit[waterDiffusion1,
          a * Exp[-t * ((1 / T2W) + (gamma^2 * grad["Value"]^2 * (.02)^2 * diff / 12))],
          {{a, 8}, {diff, 0.00001}}, t]
        waterDiffusionFit["ParameterTable"]

In[ ]:= gradData = {{0, 0, 14.6660}, {0, .25, 14.6670}, {0, .5, 14.6675},
          {-.25, 0, 14.6635}, {-.25, .25, 14.6645}, {-.25, .5, 14.6650},
          {-.5, 0, 14.6605}, {-.5, .25, 14.6615}, {-.5, .5, 14.6625}}

In[ ]:= gradData[[All, 3]] = gradData[[All, 3]] / 4.258

In[ ]:= G = 2.6

In[ ]:= gradient = Around[2.6, 0.2]

In[ ]:= waterDiffusionFit = NonlinearModelFit[waterDiffusion1,
          a * Exp[-t * ((1 / T2W) + (gamma^2 * G^2 * (.02)^2 * diff / 12))],
          {{a, 8}, {diff, 0.00001}}, t]
        waterDiffusionFit["ParameterTable"]

In[ ]:= waterD = Around[0.000020072480899190 79`, 1.8950903011594005`*^-7]

In[ ]:= wDPlotShort = Thread[{waterDiffusion1[[All, 1]],
            waterDiffusion1[[All, 2]] / waterDiffusionFit["ParameterTableEntries"][[1, 1]]}];
        wDPlotLong = Thread[{h2oNoMorePlease2[[All, 1]],
            h2oNoMorePlease2[[All, 2]] / waterT2Fit["ParameterTableEntries"][[1, 1]]}];

In[ ]:= Legended[Show[ListPlot[wDPlotShort, PlotStyle → Blue],
          Plot[waterDiffusionFit[t] / waterDiffusionFit["ParameterTableEntries"][[1, 1]],
           {t, -0.33, 3}], ListPlot[wDPlotLong, PlotStyle → Red],
          Plot[waterT2Fit[t] / waterT2Fit["ParameterTableEntries"][[1, 1]],
           {t, 0, 3}, PlotStyle → Orange], PlotRange → All, Frame → True,
          FrameLabel → {"Time (s)", "Normalized Magnetization"},
          PlotLabel → "Decay with and without Diffusion H2O"], Placed[SwatchLegend[
           {Orange, Blue}, {"Diffusion Suppressed", "Fit with Diffusion"}], {0.8, 0.88}]]

In[ ]:= Legended[Show[ListPlot[wDPlotLong, PlotStyle → Red],
          Plot[waterT2Fit[t] / waterT2Fit["ParameterTableEntries"][[1, 1]],
           {t, 0, 3}, PlotStyle → Orange], PlotRange → All, Frame → True,
          FrameLabel → {"Time (s)", "Normalized Magnetization"},
          PlotLabel → "T2 Decay Water", Axes → False],
         Placed[SwatchLegend[{Red, Orange}, {"T2 Decay Data", "T2 Decay Fit"}], {0.8, 0.88}]]

In[ ]:= isoDiffusionData1 = {{.01, 5.33}, {.02, 5.42}, {.03, 5.17}, {.04, 5.25},
          {.05, 5.01}, {.06, 5.10}, {.07, 4.81}, {.08, 4.86}, {.09, 4.54}, {.10, 4.66},
          {.11, 4.37}, {.12, 4.45}, {.13, 4.25}, {.14, 4.29}, {.15, 4.01}, {.16, 4.10},
          {.17, 3.90}, {.18, 3.98}, {.19, 3.66}, {.20, 3.81}, {.21, 3.63}, {.22, 3.66},
          {.23, 3.54}, {.24, 3.48}, {.25, 3.41}, {.26, 3.43}, {.27, 3.34}, {.28, 3.27},
          {.29, 3.27}, {.30, 3.15}, {.31, 3.21}, {.32, 3.02}, {.33, 3.10}, {.34, 2.93},
          {.35, 3.00}, {.36, 2.83}, {.37, 2.94}, {.38, 2.78}, {.39, 2.82}, {.40, 2.72}};
```

```
In[ ]:= T2Iso = 1.20

In[ ]:= isoDiffusionFit = NonlinearModelFit[isoDiffusionData1,
          a * Exp[-t * ((1 / T2Iso) + (gamma^2 * G^2 * (.01)^2 * diff / 12))],
          {{a, 5}, {diff, 0.00001}}, t]
        isoDiffusionFit["ParameterTable"]

In[ ]:= Show[ListPlot[isoDiffusionData1], Plot[isoDiffusionFit[t], {t, 0, 2}]]

In[ ]:= houseOilDiffData =
          {{.002, 8.44}, {.004, 8.08}, {.01, 7.14}, {.02, 5.88}, {.03, 4.88}, {.04, 4.08},
           {.05, 3.38}, {.06, 2.84}, {.07, 2.46}, {.08, 2.10}, {.09, 1.82}, {.10, 1.58}};

In[ ]:= houseOilT2 = .066

In[ ]:= houseOilDiffusionFit = NonlinearModelFit[houseOilDiffData,
           a * Exp[((-t / houseOilT2) - (gamma^2 * G^2 * (t^3 * diff / 12)))],
           {{a, 8}, {diff, .0000001}}, t]["ParameterTable"]

In[ ]:= Show[ListPlot[householdOil1], ListPlot[houseOilDiffData, PlotStyle → Red]]

In[ ]:= mineralOilDiffData =
          {{.002, 8.50}, {.004, 7.50}, {.006, 6.74}, {.008, 6.06}, {.010, 5.48}, {.012, 5.00},
           {.014, 4.62}, {.016, 4.24}, {.018, 3.90}, {.020, 3.64}, {.022, 3.40}, {.024, 3.20},
           {.026, 2.98}, {.028, 2.82}, {.030, 2.64}, {.04, 2.02}, {.05, 1.58}, {.06, 1.22}};

In[ ]:= minOilT2 = .025

In[ ]:= mineralOilDiffusionFit = NonlinearModelFit[mineralOilDiffData,
           a * Exp[((-t / minOilT2) - (gamma^2 * G^2 * (t^3 * diff / 12)))],
           {{a, 8}, {diff, .00001}}, t]["ParameterTable"]

In[ ]:= Show[ListPlot[mineralOilDiffData, PlotStyle → Red], ListPlot[mineralOil1]]

In[ ]:= mineralOil2 = {{.0005, 9.82}, {.001, 9.56}, {.0015, 9.22}, {.002, 9.00}, {.0025, 8.70},
           {.003, 8.48}, {.0035, 8.18}, {.004, 8.02}, {.0045, 7.76}, {.005, 7.52}, {.0055, 7.38},
           {.006, 7.12}, {.0065, 6.98}, {.007, 6.76}, {.0075, 6.66}, {.008, 6.44}, {.0085, 6.34},
           {.009, 6.20}, {.0095, 6.02}, {.01, 5.84}, {.0105, 5.76}, {.011, 5.62}, {.0115, 5.52},
           {.0120, 5.40}, {.0125, 5.30}, {.0130, 5.18}, {.0135, 5.06}, {.0140, 4.96}, {.0145, 4.86},
           {.0150, 4.78}, {.0155, 4.68}, {.0160, 4.58}, {.0165, 4.50}, {.0170, 4.42}, {.0175, 4.34},
           {.0180, 4.27}, {.0185, 4.17}, {.0190, 4.15}, {.0195, 4.05}, {.0200, 3.99},
           {.0205, 3.95}, {.0210, 3.89}, {.0215, 3.81}, {.0220, 3.74}, {.0225, 3.69},
           {.0230, 3.62}, {.0235, 3.55}, {.0240, 3.54}, {.0245, 3.48}, {.0250, 3.40},
           {.0255, 3.36}, {.0260, 3.31}, {.0265, 3.28}, {.0270, 3.26}, {.0275, 3.17},
           {.0280, 3.13}, {.0285, 3.07}, {.0290, 3.06}, {.0295, 3.00}, {.0300, 2.96},
           {.0305, 2.92}, {.0310, 2.88}, {.0315, 2.83}, {.0320, 2.79}, {.0325, 2.80},
           {.0330, 2.74}, {.0335, 2.70}, {.0340, 2.70}, {.0345, 2.64}, {.0350, 2.60},
           {.0355, 2.58}, {.0360, 2.59}, {.0365, 2.51}, {.0370, 2.48}, {.0375, 2.45}};
```

```
In[ ]:= mo2 = NonlinearModelFit[mineralOil2, a * Exp[-t / T2] + b * Exp[-t / T22],
          {{a, 11}, {T2, 0.01}, {b, 2}, {T22, .001}}, t, MaxIterations → 500]
        mo2["ParameterTable"]
        mo2["RSquared"]

In[ ]:= mo2BadFit = NonlinearModelFit[mineralOil2,
          a * Exp[-t / T2], {{a, 11}, {T2, 0.01}}, t, MaxIterations → 500]
        mo2BadFit["ParameterTable"]
        mo2BadFit["RSquared"]

In[ ]:= Legended[Show[Plot[mo2[t], {t, 0, .04}, PlotStyle → Blue],
          Plot[mo2BadFit[t], {t, 0, 0.04}, PlotStyle → {Dashed, Red}], ListPlot[mineralOil2],
          PlotRange → All, Frame → True, FrameLabel → {"Time (s)", "Voltage"},
          PlotLabel → "Mineral Oil T2 Decay", Axes → False],
         Placed[SwatchLegend[{Blue, Red}, {"Biexponential Fit", "Exponential Fit"}], {0.8, 0.88}]]

In[ ]:= ListLogPlot[mineralOil2]

In[ ]:= mineralOil3 = {{0.001, 9.37}, {0.002, 8.93}, {0.003, 8.28}, {0.004, 7.90}, {0.005, 7.44},
          {0.006, 7.09}, {0.007, 6.65}, {0.008, 6.41}, {0.009, 6.08}, {0.01, 5.84}, {0.011, 5.53},
          {0.012, 5.30}, {0.013, 5.07}, {0.014, 4.89}, {0.015, 4.69}, {0.016, 4.53},
          {0.017, 4.33}, {0.018, 4.20}, {0.019, 4.09}, {0.02, 3.96}, {0.021, 3.81}, {0.022, 3.64},
          {0.023, 3.56}, {0.024, 3.41}, {0.025, 3.30}, {0.026, 3.21}, {0.027, 3.13},
          {0.028, 3.12}, {0.029, 2.92}, {0.03, 2.88}, {0.031, 2.77}, {0.032, 2.73}, {0.033, 2.65},
          {0.034, 2.60}, {0.035, 2.53}, {0.036, 2.49}, {0.037, 2.41}, {0.038, 2.36},
          {0.039, 2.33}, {0.04, 2.21}, {0.041, 2.17}, {0.042, 2.16}, {0.043, 2.13}, {0.044, 2.05},
          {0.045, 2.00}, {0.046, 1.96}, {0.047, 1.93}, {0.048, 1.90}, {0.049, 1.89},
          {0.05, 1.81}, {0.051, 1.77}, {0.052, 1.73}, {0.053, 1.73}, {0.054, 1.69},
          {0.055, 1.65}, {0.056, 1.65}, {0.057, 1.54}, {0.058, 1.53}, {0.059, 1.49},
          {0.06, 1.49}, {0.061, 1.49}, {0.062, 1.45}, {0.063, 1.36}, {0.064, 1.33},
          {0.065, 1.33}, {0.066, 1.33}, {0.067, 1.25}, {0.068, 1.26}, {0.069, 1.25},
          {0.07, 1.25}, {0.071, 1.17}, {0.072, 1.15}, {0.073, 1.13}, {0.074, 1.09},
          {0.075, 1.07}, {0.076, 1.00}, {0.077, 1.05}, {0.078, 1.05}, {0.079, 1.00}, {0.08, .93},
          {0.081, .94}, {0.082, .89}, {0.083, .93}, {0.084, .93}, {0.085, .85}, {0.086, .84},
          {0.087, .81}, {0.088, .77}, {0.089, .88}, {0.09, .75}, {0.091, .77}, {0.092, .73},
          {0.093, .73}, {0.094, .77}, {0.095, .77}, {0.096, .65}, {0.097, .65}, {.098, .68}};

In[ ]:= mo3 = NonlinearModelFit[mineralOil3,
          a * Exp[-t / T2v1] + b * Exp[-t / T2v2], {{a, 5}, {T2v1, 0.01}, {b, 4}, {T2v2, .01}}, t]
        mo3["ParameterTable"]
        mo3["RSquared"]
```

```
In[ ]:= minOilT2WithErr = MeanAround[
          {Around[mo2["ParameterTableEntries"][[4, 1]], mo2["ParameterTableEntries"][[4, 2]]],
           Around[mo1["ParameterTableEntries"][[2, 1]], mo1["ParameterTableEntries"][[2, 2]]],
           Around[mo3["ParameterTableEntries"][[2, 1]], mo3["ParameterTableEntries"][[2, 2]]]}]

        minOilT22WithErr = MeanAround[
          {Around[mo2["ParameterTableEntries"][[2, 1]], mo2["ParameterTableEntries"][[2, 2]]],
           Around[mo1["ParameterTableEntries"][[4, 1]], mo1["ParameterTableEntries"][[4, 2]]],
           Around[mo3["ParameterTableEntries"][[4, 1]], mo3["ParameterTableEntries"][[4, 2]]]}]

In[ ]:= minOilT2 = minOilT2WithErr["Value"];
        minOilT22 = minOilT22WithErr["Value"];

In[ ]:= Show[ListPlot[mineralOil3], Plot[mo3[t], {t, -0.05, .15}, PlotStyle → Red]]

In[ ]:= ListLogPlot[mineralOil3]

In[ ]:= mineralOilDiffData2 = {{.0002, 10.06}, {.001, 9.26}, {.002, 8.62}, {.003, 8.10},
          {.004, 7.62}, {.005, 7.22}, {.006, 6.82}, {.007, 6.46}, {.008, 6.14}, {.009, 5.86},
          {.010, 5.58}, {.011, 5.34}, {.012, 5.08}, {.013, 4.86}, {.014, 4.70}, {.015, 4.50},
          {.016, 4.30}, {.017, 4.16}, {.018, 3.98}, {.019, 3.86}, {.020, 3.72}};

In[ ]:= mineralOilDiffusionFit2 = NonlinearModelFit[mineralOilDiffData2,
          a * Exp[((-t / minOilT2) - (gamma^2 * G^2 * (t^3 * diff / 12)))] +
           b * Exp[(- (t / minOilT22) - (gamma^2 * G^2 * (t^3 * diff / 12)))],
          {{a, 10}, {diff, .000001}, {b, 10}}, t]
        mineralOilDiffusionFit2["ParameterTable"]

In[ ]:= Show[ListPlot[mineralOil2], ListPlot[mineralOilDiffData2, PlotStyle → Red]]

In[ ]:= mineralOilDiffData3 = {{.004, 7.84}, {.008, 6.32}, {.012, 5.28}, {.016, 4.46},
          {.020, 3.80}, {.024, 3.38}, {.028, 3.04}, {.032, 2.66}, {.036, 2.40},
          {.040, 2.22}, {.044, 2.00}, {.048, 1.86}, {.052, 1.68}, {.056, 1.58},
          {.060, 1.46}, {.064, 1.34}, {.068, 1.26}, {.072, 1.10}, {.076, 1.02},
          {.080, .94}, {.084, .90}, {.088, .74}, {.092, .78}, {.096, .64}, {.100, .66}};

In[ ]:= mineralOilDiffusionFit3 = NonlinearModelFit[mineralOilDiffData3,
          a * Exp[((-t / minOilT2) - (gamma^2 * G^2 * (t^3 * diff / 12)))] +
           b * Exp[((-t / minOilT22) - (gamma^2 * G^2 * (t^3 * diff / 12)))],
          {{a, 10}, {diff, .1}, b}, t]
        mineralOilDiffusionFit3["ParameterTable"]
        mineralOilDiffusionFit3["RSquared"]

In[ ]:= ListLogPlot[mineralOilDiffData]

In[ ]:= Show[Plot[mineralOilDiffusionFit3[t], {t, 0, .1}, PlotRange → All],
         ListPlot[mineralOilDiffData3]]
```

```
In[ ]:= mineralOilDiffData4 = {{.0002, 9.88}, {.0004, 9.70}, {.001, 9.22}, {.002, 8.61},
    {.003, 8.12}, {.004, 7.66}, {.005, 7.25}, {.006, 6.87}, {.007, 6.50}, {.008, 6.21},
    {.009, 5.91}, {.010, 5.64}, {.011, 5.38}, {.012, 5.16}, {.013, 4.94}, {.014, 4.73},
    {.015, 4.54}, {.016, 4.37}, {.017, 4.20}, {.018, 4.06}, {.019, 3.93}, {.020, 3.78},
    {.021, 3.64}, {.022, 3.52}, {.023, 3.40}, {.024, 3.29}, {.025, 3.18}, {.026, 3.08},
    {.027, 2.99}, {.028, 2.91}, {.029, 2.83}, {.030, 2.74}, {.031, 2.68}, {.032, 2.59},
    {.033, 2.52}, {.034, 2.46}, {.036, 2.31}, {.038, 2.19}, {.040, 2.10}, {.042, 1.98},
    {.044, 1.89}, {.046, 1.79}, {.048, 1.71}, {.050, 1.63}, {.055, 1.45}, {.060, 1.28},
    {.065, 1.13}, {.070, 1.00}, {.080, 0.77}, {.090, 0.59}, {.100, 0.46}};

In[ ]:= mineralOilDiffusionFit4 = NonlinearModelFit[mineralOilDiffData4,
   a * Exp[((-t / minOilT2) - (gamma^2 * G^2 * (t^3 * diff / 12)))] +
    b * Exp[((-t / minOilT22) - (gamma^2 * G^2 * (t^3 * diff / 12)))],
   {{a, 10}, {diff, .0001}, b}, t]
  mineralOilDiffusionFit4["ParameterTable"]
  mineralOilDiffusionFit4["RSquared"]

In[ ]:= mineralOilDiffData5 =
   {{.0002, 9.82}, {.0004, 9.62}, {.001, 9.14}, {.002, 8.54}, {.003, 8.04}, {.004, 7.59},
    {.005, 7.19}, {.006, 6.80}, {.007, 6.45}, {.008, 6.15}, {.009, 5.85}, {.010, 5.58},
    {.011, 5.34}, {.012, 5.13}, {.013, 4.91}, {.014, 4.70}, {.015, 4.52}, {.016, 4.36},
    {.017, 4.19}, {.018, 4.03}, {.019, 3.89}, {.020, 3.75}, {.021, 3.63}, {.022, 3.51},
    {.023, 3.39}, {.024, 3.28}, {.025, 3.18}, {.026, 3.07}, {.027, 2.98}, {.028, 2.88},
    {.029, 2.82}, {.030, 2.74}, {.032, 2.58}, {.034, 2.45}, {.036, 2.33}, {.038, 2.19},
    {.040, 2.08}, {.042, 1.98}, {.044, 1.89}, {.046, 1.79}, {.048, 1.70}, {.050, 1.61},
    {.055, 1.42}, {.060, 1.23}, {.070, 0.94}, {.080, 0.70}, {.090, 0.51}, {.100, 0.38}};

In[ ]:= mineralOilDiffusionFit5 = NonlinearModelFit[mineralOilDiffData5,
   a * Exp[((-t / minOilT2) - (gamma^2 * G^2 * (t^3 * diff / 12)))] +
    b * Exp[((-t / minOilT22) - (gamma^2 * G^2 * (t^3 * diff / 12)))],
   {{a, 10}, {diff, .0001}, b}, t]
  mineralOilDiffusionFit5["ParameterTable"]
  mineralOilDiffusionFit5["RSquared"]

In[ ]:= minOilD = MeanAround[{Around[mineralOilDiffusionFit5["ParameterTableEntries"][[2, 1]],
     mineralOilDiffusionFit5["ParameterTableEntries"][[2, 2]]],
    Around[mineralOilDiffusionFit4["ParameterTableEntries"][[2, 1]],
     mineralOilDiffusionFit4["ParameterTableEntries"][[2, 2]]],
    Around[mineralOilDiffusionFit3["ParameterTableEntries"][[2, 1]],
     mineralOilDiffusionFit3["ParameterTableEntries"][[2, 2]]]}]
```

```
In[ ]:= moPlotShort = Thread[{mineralOilDiffData5[[All, 1]],
          mineralOilDiffData5[[All, 2]] / (mineralOilDiffusionFit5["ParameterTableEntries"][[1, 1]] +
             mineralOilDiffusionFit5["ParameterTableEntries"][[3, 1]])}];
        moPlotLong = Thread[{mineralOil3[[All, 1]], mineralOil3[[All, 2]] /
            (mo3["ParameterTableEntries"][[1, 1]] + mo3["ParameterTableEntries"][[3, 1]])}];
        Legended[Show[ListPlot[moPlotShort, PlotStyle → Blue, PlotRange → All],
          ListPlot[moPlotLong, PlotStyle → Red], Frame → True,
          FrameLabel → {"Time (s)", "Normalized Magnetization"},
          PlotLabel → "Decay of Magnetization of Mineral Oil with and without Diffusion"],
         Placed[SwatchLegend[{Red, Blue}, {"Diffusion Suppressed", "Data With Diffusion"}],
          {0.8, 0.88}]]

In[ ]:= sodiumData = {{.02, 7.38}, {.04, 7.24}, {.06, 7.10}, {.08, 6.87}, {.10, 6.89}, {.12, 6.64},
          {.14, 6.60}, {.16, 6.28}, {.18, 6.24}, {.20, 5.88}, {.22, 5.90}, {.24, 5.76}, {.26, 5.54},
          {.28, 5.55}, {.30, 5.32}, {.32, 5.36}, {.34, 5.16}, {.36, 5.16}, {.38, 4.96},
          {.40, 4.88}, {.42, 4.62}, {.44, 4.52}, {.46, 4.50}, {.48, 4.40}, {.50, 4.40},
          {.52, 4.30}, {.54, 4.28}, {.56, 4.10}, {.58, 4.06}, {.60, 3.88}, {.62, 3.84},
          {.64, 3.76}, {.66, 3.64}, {.68, 3.66}, {.70, 3.50}, {.72, 3.44}, {.74, 3.38},
          {.76, 3.32}, {.78, 3.34}, {.80, 3.22}, {.82, 3.16}, {.84, 3.10}, {.86, 3.10},
          {.88, 3.00}, {.90, 2.98}, {.92, 2.88}, {.94, 2.82}, {.96, 2.78}, {.98, 2.76}};

In[ ]:= ListLogPlot[sodiumData]
```

Measure D for iso multiple times

```
In[ ]:= isoDiffData = {{0.04, 5.27}, {0.08, 3.08}, {.12, 1.84}, {.16, 1.12}, {.2, .47}};

In[ ]:= T2Iso = 1.20

In[ ]:= isoDiffusionFit = NonlinearModelFit[isoDiffData,
          a * Exp[-t * ((1 / T2Iso) + (gamma^2 * G^2 * (.04)^2 * diff / 12))],
          {{a, 8}, {diff, 0.00001}}, t]
        isoDiffusionFit["ParameterTable"]

In[ ]:= wDPlotShort = Thread[{waterDiffusion1[[All, 1]],
          waterDiffusion1[[All, 2]] / waterDiffusionFit["ParameterTableEntries"][[1, 1]]}];
        wDPlotLong = Thread[{h2oNoMorePlease2[[All, 1]],
          h2oNoMorePlease2[[All, 2]] / waterT2Fit["ParameterTableEntries"][[1, 1]]}];

In[ ]:= Legended[Show[ListPlot[wDPlotShort, PlotStyle → Blue],
          Plot[waterDiffusionFit[t] / waterDiffusionFit["ParameterTableEntries"][[1, 1]],
           {t, -0.33, 3}], ListPlot[wDPlotLong, PlotStyle → Red],
          Plot[waterT2Fit[t] / waterT2Fit["ParameterTableEntries"][[1, 1]],
           {t, 0, 3}, PlotStyle → Orange], PlotRange → All,
          Frame → True, FrameLabel → {"Time (s)", "Normalized Magnetization"},
          PlotLabel → "Decay of Magnetization of H2O with and without Diffusion"],
         Placed[SwatchLegend[{Orange, Blue}, {"Diffusion Suppressed", "Fit With Diffusion"}],
          {0.8, 0.88}]]
```

```
In[•]:= isoDiffDataShort = Thread[{isoDiffData[[All, 1]],
          isoDiffData[[All, 2]] / isoDiffusionFit["ParameterTableEntries"][[1, 1]]}];
        isoDataLong = Thread[{isopropanolData2[[All, 1]],
          isopropanolData2[[All, 2]] / isoT2Fit["ParameterTableEntries"][[1, 1]]}];

In[•]:= Legended[Show[ListPlot[isoDiffDataShort, PlotStyle → Blue],
          Plot[isoDiffusionFit[t] / isoDiffusionFit["ParameterTableEntries"][[1, 1]], {t, -.132, 1}],
          ListPlot[isoDataLong, PlotStyle → Red], Plot[
           isoT2Fit[t] / isoT2Fit["ParameterTableEntries"][[1, 1]], {t, 0, 1}, PlotStyle → Orange],
          PlotRange → All, Frame → True, FrameLabel → {"Time (s)", "Normalized Magnetization"},
          PlotLabel → "Decay with and without Diffusion Isopropanol"], Placed[SwatchLegend[
           {Orange, Blue}, {"Diffusion Suppressed", "Fit with Diffusion"}], {0.8, 0.88}]]

In[•]:= isoDiffData = {{0.04, 4.75}, {0.08, 2.75}, {.12, 1.67}, {.16, .99}, {.2, .51}};

In[•]:= isoDiffusionFit = NonlinearModelFit[isoDiffData,
          a * Exp[-t * ((1 / T2Iso) + (gamma^2 * G^2 * (.04)^2 * diff / 12))],
          {{a, 8}, {diff, 0.00001}}, t]["ParameterTable"]

In[•]:= isoDiffData = {{0.04, 4.90}, {0.08, 2.86}, {.12, 1.63}, {.16, .90}, {.2, .47}};

In[•]:= isoDiffusionFit = NonlinearModelFit[isoDiffData,
          a * Exp[-t * ((1 / T2Iso) + (gamma^2 * G^2 * (.04)^2 * diff / 12))],
          {{a, 8}, {diff, 0.00001}}, t]["ParameterTable"]

In[•]:= houseOilData = {{.002, 8.43}, {.004, 8.46}, {.006, 7.75}, {.008, 7.70},
          {.01, 7.27}, {.012, 7.07}, {.014, 6.81}, {.016, 6.59}, {.018, 6.39},
          {.02, 6.22}, {.022, 5.96}, {.024, 5.81}, {.026, 5.54}, {.028, 5.41},
          {.03, 5.27}, {.032, 5.10}, {.034, 4.98}, {.036, 4.73}, {.038, 4.69}, {.04, 4.51},
          {.042, 4.38}, {.044, 4.30}, {.046, 4.19}, {.048, 4.06}, {.05, 3.94}, {.052, 3.83},
          {.054, 3.78}, {.056, 3.71}, {.058, 3.62}, {.06, 3.50}, {.062, 3.47}, {.064, 3.39},
          {.066, 3.30}, {.068, 3.19}, {.07, 3.10}, {.072, 3.02}, {.074, 2.94}, {.076, 2.93},
          {.078, 2.86}, {.08, 2.83}, {.082, 2.78}, {.084, 2.74}, {.086, 2.67}, {.088, 2.59},
          {.09, 2.63}, {.092, 2.51}, {.094, 2.51}, {.096, 2.42}, {.098, 2.34}};

In[•]:= houseOilFitTwoT2 = NonlinearModelFit[houseOilData,
          a * Exp[(-t / T2)] + b * Exp[(-t / T22)], {{a, 8}, {T2, .1}, {b, 2}, {T22, .2}}, t]
        houseOilFitTwoT2["ParameterTable"]
        houseOilFitSingleT2 =
         NonlinearModelFit[houseOilData, a * Exp[(-t / T2)], {{a, 8}, {T2, .1}}, t]
        houseOilFitSingleT2["ParameterTable"]

In[•]:= Legended[Show[Plot[houseOilFitSingleT2[t], {t, 0, 0.1}, PlotStyle → {Dashed, Red}],
          Plot[houseOilFitTwoT2[t], {t, 0, 0.1}, PlotStyle → Blue],
          ListPlot[houseOilData], Frame → True, FrameLabel → {"Time (s)", "Voltage"}],
         Placed[SwatchLegend[{Blue, Red}, {"Biexponential Fit", "Exponential Fit"}], {0.8, 0.88}]]
```

```
In[ ]:= houseOilData2 = {{.002, 8.43}, {.004, 8.46}, {.006, 7.75}, {.008, 7.70},
    {.01, 7.27}, {.012, 7.07}, {.014, 6.81}, {.016, 6.59}, {.018, 6.39},
    {.02, 6.22}, {.022, 5.96}, {.024, 5.81}, {.026, 5.54}, {.028, 5.41}, {.03, 5.27},
    {.032, 5.10}, {.034, 4.98}, {.036, 4.73}, {.038, 4.69}, {.04, 4.51}, {.042, 4.38},
    {.044, 4.30}, {.046, 4.19}, {.048, 4.06}, {.05, 3.94}, {.052, 3.83}, {.054, 3.78},
    {.056, 3.71}, {.058, 3.62}, {.06, 3.50}, {.062, 3.47}, {.064, 3.39}, {.066, 3.30},
    {.068, 3.19}, {.07, 3.10}, {.072, 3.02}, {.074, 2.94}, {.076, 2.93}, {.078, 2.86},
    {.08, 2.83}, {.082, 2.78}, {.084, 2.74}, {.086, 2.67}, {.088, 2.59}, {.09, 2.63},
    {.092, 2.51}, {.094, 2.51}, {.096, 2.42}, {.098, 2.42}, {.100, 2.31},
    {.110, 2.17}, {.120, 1.98}, {.130, 1.86}, {.140, 1.68}, {.150, 1.54}};

In[ ]:= houseOilFit2 = NonlinearModelFit[houseOilData2,
      a * Exp[(-t / T2)] + b * Exp[(-t / T22)], {{a, 8}, {T2, .1}, {b, 2}, {T22, .2}}, t]
    houseOilFit2["ParameterTable"]

In[ ]:= houseOilData3 = {{.002, 8.78}, {.004, 8.47}, {.006, 8.15}, {.008, 7.86},
    {.01, 7.51}, {.012, 7.31}, {.014, 7.02}, {.016, 6.79}, {.018, 6.51},
    {.02, 6.34}, {.022, 6.11}, {.024, 5.99}, {.026, 5.75}, {.028, 5.63}, {.03, 5.39},
    {.032, 5.26}, {.034, 5.15}, {.036, 4.99}, {.038, 4.78}, {.04, 4.70}, {.042, 4.63},
    {.044, 4.46}, {.046, 4.31}, {.048, 4.18}, {.05, 4.14}, {.052, 4.03}, {.054, 3.94},
    {.056, 3.83}, {.058, 3.79}, {.06, 3.71}, {.062, 3.62}, {.064, 3.55}, {.066, 3.43},
    {.068, 3.31}, {.07, 3.31}, {.072, 3.22}, {.074, 3.15}, {.076, 3.10}, {.078, 3.03},
    {.08, 2.99}, {.082, 2.87}, {.084, 2.86}, {.086, 2.79}, {.088, 2.75}, {.09, 2.75},
    {.092, 2.67}, {.094, 2.55}, {.096, 2.55}, {.098, 2.51}, {.100, 2.43},
    {.110, 2.19}, {.120, 2.03}, {.130, 1.95}, {.140, 1.75}, {.150, 1.63}};

In[ ]:= houseOilFit3 = NonlinearModelFit[houseOilData3,
      a * Exp[(-t / T2)] + b * Exp[(-t / T22)], {{a, 8}, {T2, .1}, {b, 2}, {T22, .2}}, t]
    houseOilFit3["ParameterTable"]

In[ ]:= houseOilT2v1WithErr = MeanAround[{Around[houseOilFitTwoT2["ParameterTableEntries"][[2, 1]],
       houseOilFitTwoT2["ParameterTableEntries"][[2, 2]]],
      Around[houseOilFit2["ParameterTableEntries"][[2, 1]],
       houseOilFit2["ParameterTableEntries"][[2, 2]]],
      Around[houseOilFit3["ParameterTableEntries"][[2, 1]],
       houseOilFit3["ParameterTableEntries"][[2, 2]]]}]
    houseOilT2v2WithErr = MeanAround[{Around[houseOilFitTwoT2["ParameterTableEntries"][[4, 1]],
       houseOilFitTwoT2["ParameterTableEntries"][[4, 2]]],
      Around[houseOilFit2["ParameterTableEntries"][[4, 1]],
       houseOilFit2["ParameterTableEntries"][[4, 2]]],
      Around[houseOilFit3["ParameterTableEntries"][[4, 1]],
       houseOilFit3["ParameterTableEntries"][[4, 2]]]}]
    houseOilT2v1 = houseOilT2v1WithErr["Value"]
    houseOilT2v2 = houseOilT2v2WithErr["Value"]
```

```
In[ ]:= houseOilDiffusionData =
          {{.002, 8.73}, {.004, 8.47}, {.006, 8.05}, {.008, 7.82}, {.010, 7.49}, {0.012, 7.33},
           {.014, 7.01}, {.016, 6.77}, {.018, 6.57}, {.020, 6.37}, {0.022, 6.09}, {.024, 5.98},
           {.026, 5.70}, {.028, 5.46}, {.030, 5.34}, {0.032, 5.21}, {.034, 5.09}, {.036, 5.01},
           {.038, 4.82}, {.040, 4.66}, {.042, 4.50}, {.044, 4.46}, {.046, 4.30}, {.048, 4.21},
           {.050, 4.13}, {0.052, 3.98}, {.054, 3.86}, {.056, 3.81}, {.058, 3.67}, {.060, 3.66},
           {0.062, 3.54}, {.064, 3.42}, {.066, 3.34}, {.068, 3.33}, {.070, 3.18},
           {0.072, 3.10}, {.074, 3.05}, {.076, 3.02}, {.078, 2.94}, {.080, 2.90},
           {.082, 2.82}, {.084, 2.78}, {.086, 2.65}, {.088, 2.74}, {.09, 2.58},
           {.092, 2.50}, {.094, 2.45}, {.096, 2.42}, {.098, 2.41}, {.100, 2.33}};

In[ ]:= houseOilDiffusionFit = NonlinearModelFit[houseOilDiffusionData,
          a * Exp[((-t / houseOilT2v1) - (gamma^2 * G^2 * (t^3 * diff / 12)))] +
           b * Exp[((-t / houseOilT2v2) - (gamma^2 * G^2 * (t^3 * diff / 12)))],
          {{a, 4}, {diff, .000001}, {b, 4}}, t]
        houseOilDiffusionFit["ParameterTable"]

In[ ]:= houseOilDiffusionData2 =
          {{0.002, 8.48}, {.004, 8.13}, {.006, 7.81}, {.008, 7.48}, {.010, 7.21}, {0.012, 6.95},
           {.014, 6.69}, {.016, 6.45}, {.018, 6.22}, {.020, 5.97}, {0.022, 5.76}, {.024, 5.54},
           {.026, 5.35}, {.028, 5.16}, {.030, 4.97}, {0.032, 4.79}, {.034, 4.61}, {.036, 4.43},
           {.038, 4.29}, {.040, 4.12}, {.042, 3.98}, {.044, 3.84}, {.046, 3.69}, {.048, 3.56},
           {.050, 3.45}, {0.052, 3.32}, {.054, 3.21}, {.056, 3.11}, {.058, 3.00}, {.060, 2.89},
           {0.062, 2.81}, {.064, 2.73}, {.066, 2.65}, {.068, 2.56}, {.070, 2.48}, {0.072, 2.42},
           {.074, 2.35}, {.076, 2.28}, {.078, 2.21}, {.080, 2.15}, {.090, 1.86}, {.100, 1.63},
           {.110, 1.40}, {.120, 1.21}, {.130, 1.02}, {.140, 0.83}, {.150, 0.70}};

In[ ]:= houseOilDiffusionFit2 = NonlinearModelFit[houseOilDiffusionData2,
          a * Exp[((-t / houseOilT2v1) - (gamma^2 * G^2 * (t^3 * diff / 12)))] +
           b * Exp[((-t / houseOilT2v2) - (gamma^2 * G^2 * (t^3 * diff / 12)))],
          {{a, 4}, {diff, .000001}, {b, 4}}, t]
        houseOilDiffusionFit2["ParameterTable"]

In[ ]:= houseOilDiffusionData3 =
          {{0.002, 8.42}, {.004, 8.09}, {.006, 7.78}, {.008, 7.46}, {.010, 7.22}, {0.012, 6.92},
           {.014, 6.70}, {.016, 6.44}, {.018, 6.20}, {.020, 6.00}, {0.022, 5.76}, {.024, 5.55},
           {.026, 5.36}, {.028, 5.15}, {.030, 4.97}, {0.032, 4.78}, {.034, 4.61}, {.036, 4.45},
           {.038, 4.27}, {.040, 4.11}, {.042, 3.95}, {.044, 3.82}, {.046, 3.69}, {.048, 3.54},
           {.050, 3.41}, {0.052, 3.32}, {.054, 3.20}, {.056, 3.08}, {.058, 3.01}, {.060, 2.89},
           {0.062, 2.80}, {.064, 2.70}, {.066, 2.64}, {.068, 2.57}, {.070, 2.47},
           {0.072, 2.41}, {.074, 2.35}, {.076, 2.29}, {.078, 2.20}, {.080, 2.15}, {.090, 1.88},
           {.100, 1.63}, {.110, 1.43}, {.120, 1.20}, {.130, 1.00}, {.140, 0.84}, {.150, 0.69},
           {.160, 0.57}, {.170, 0.46}, {.180, 0.39}, {.190, 0.32}, {.200, 0.28}};

In[ ]:= houseOilDiffusionFit3 = NonlinearModelFit[houseOilDiffusionData3,
          a * Exp[((-t / houseOilT2v1) - (gamma^2 * G^2 * (t^3 * diff / 12)))] +
           b * Exp[((-t / houseOilT2v2) - (gamma^2 * G^2 * (t^3 * diff / 12)))],
          {{a, 4}, {diff, .000001}, {b, 4}}, t]
        houseOilDiffusionFit3["ParameterTable"]
```

```
In[ ]:= hoD = MeanAround[{Around[houseOilDiffusionFit2["ParameterTableEntries"][[2, 1]],
          houseOilDiffusionFit2["ParameterTableEntries"][[2, 2]]],
         Around[houseOilDiffusionFit3["ParameterTableEntries"][[2, 1]],
          houseOilDiffusionFit3["ParameterTableEntries"][[2, 2]]]}]

In[ ]:= Legended[Show[Plot[houseOilDiffusionFit2[t] / houseOilDiffusionFit2[0], {t, 0, .2},
     PlotStyle → Blue], Plot[houseOilFit3[t] / houseOilFit3[0], {t, 0, .2}, PlotStyle → Red],
    Frame → True, FrameLabel → {"Time (s)", "Normalized Magnetization"},
    PlotLabel → "Decays with and without Diffusion 3 in 1"], Placed[SwatchLegend[
     {Red, Blue}, {"Diffusion Suppressed", "Decay with Diffusion"}], {0.8, 0.88}]]

In[ ]:= hoPlotShort = Thread[{houseOilDiffusionData3[[All, 1]],
          houseOilDiffusionData3[[All, 2]] / (houseOilDiffusionFit3["ParameterTableEntries"][[
              1, 1]] + houseOilDiffusionFit3["ParameterTableEntries"][[3, 1]])}];
    hoPlotLong = Thread[{houseOilData3[[All, 1]],
          houseOilData3[[All, 2]] / (houseOilFit3["ParameterTableEntries"][[1, 1]] +
             houseOilFit3["ParameterTableEntries"][[3, 1]])}];
    Legended[Show[ListPlot[hoPlotShort, PlotStyle → Blue, PlotRange → All],
      ListPlot[hoPlotLong, PlotStyle → Red], Frame → True,
      FrameLabel → {"Time (s)", "Normalized Magnetization"},
      PlotLabel → "Decay of Magnetization of 3 in 1 Oil with and without Diffusion"],
     Placed[SwatchLegend[{Red, Blue}, {"Diffusion Suppressed", "Data With Diffusion"}],
      {0.8, 0.88}]]
```

Mineral Oil Spectral analysis

```
In[ ]:=
    SetDirectory[NotebookDirectory[]];
    mineralOilSpectral0 = Import["mo0.csv", "CSV"];
    mineralOilSpectral0 = Drop[mineralOilSpectral0, 2];
    mineralOilSpectral1 = Import["mo1.csv", "CSV"];
    mineralOilSpectral1 = Drop[mineralOilSpectral1, 2];
    mineralOilSpectral2 = Import["mo2.csv", "CSV"];
    mineralOilSpectral2 = Drop[mineralOilSpectral2, 2];
    mineralOilSpectral3 = Import["mo3.csv", "CSV"];
    mineralOilSpectral3 = Drop[mineralOilSpectral3, 2];
    mineralOilSpectral4 = Import["mo4.csv", "CSV"];
    mineralOilSpectral4 = Drop[mineralOilSpectral4, 2];
    mineralOilSpectral5 = Import["mo5.csv", "CSV"];
    mineralOilSpectral5 = Drop[mineralOilSpectral5, 2];
    mineralOilSpectral6 = Import["mo6.csv", "CSV"];
    mineralOilSpectral6 = Drop[mineralOilSpectral6, 2];
    (*mineralOilSpectral = Thread[{mineralOilSpectral[[All,1]],mineralOilSpectral[[All,2]]}]*)
```

```
In[ ]:= mineralOilSpectral = (Abs[Fourier[mineralOilSpectral0[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral1[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral2[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral3[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral4[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral5[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral6[[All, 2]]]]^2) / 7

In[ ]:= m = (Range[Length[mineralOilSpectral]] / Length[mineralOilSpectral]) * 10^8;

In[ ]:= spectral = Thread[{m, mineralOilSpectral}];

In[ ]:= ListLogPlot[spectral, PlotRange → {All, All}]

In[ ]:= ListLogPlot[spectral, PlotRange → {{1.464 * 10^7, 1.47 * 10^7}, All}, Joined → True]

In[ ]:=

In[ ]:= mineralOilSpectral = Import["TEK00005.CSV", "CSV"];
        mineralOilSpectral = Drop[mineralOilSpectral, 16];
        mineralOilSpectral = Drop[mineralOilSpectral, -1];
        mineralOilSpectral1 = Import["TEK00006.CSV", "CSV"];
        mineralOilSpectral1 = Drop[mineralOilSpectral1, 16];
        mineralOilSpectral1 = Drop[mineralOilSpectral1, -1];
        mineralOilSpectral2 = Import["TEK00007.CSV", "CSV"];
        mineralOilSpectral2 = Drop[mineralOilSpectral2, 16];
        mineralOilSpectral2 = Drop[mineralOilSpectral2, -1];
        mineralOilSpectral3 = Import["TEK00008.CSV", "CSV"];
        mineralOilSpectral3 = Drop[mineralOilSpectral3, 16];
        mineralOilSpectral3 = Drop[mineralOilSpectral3, -1];
        mineralOilSpectral4 = Import["TEK00009.CSV", "CSV"];
        mineralOilSpectral4 = Drop[mineralOilSpectral4, 16];
        mineralOilSpectral4 = Drop[mineralOilSpectral4, -1];
        Length[mineralOilSpectral]

In[ ]:= mineralOilSpectral = (Abs[Fourier[mineralOilSpectral[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral1[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral2[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral3[[All, 2]]]]^2 +
          Abs[Fourier[mineralOilSpectral4[[All, 2]]]]^2) / 5;

In[ ]:= m = (Range[Length[mineralOilSpectral]] / Length[mineralOilSpectral]) * .5 * 10^9;

In[ ]:= spectral = Thread[{m, mineralOilSpectral}];

In[ ]:= ListLogPlot[spectral, PlotRange → {{0, .25 * 10^9}, All},
         PlotLabel → "Full-Range Discrete Fourier Transform of FID",
         Frame → True, FrameLabel → {"Frequency (Hz)", "Log Magnitude"}]

In[ ]:= ListLogPlot[spectral, PlotRange → {{1.46 * 10^7, 1.47 * 10^7}, All},
         PlotLabel → "Frequencies Near Resonance", Frame → True,
         FrameLabel → {"Frequency (Hz)", "Log Magnitude"}, Joined → True]
```

```
In[ ]:= ListLogPlot[spectral, PlotRange → {{4.38 * 10^7, 4.41 * 10^7}, {0, 0.2}},
         PlotLabel → "Frequencies Near 3rd Harmonic", Frame → True,
         FrameLabel → {"Frequency (Hz)", "Log Magnitude"}, Joined → True]

In[ ]:= leftRange = {4.3988 * 10^7, 4.3992 * 10^7}
        rightRange = {3.99998 * 10^7, 4.00005 * 10^7}

In[ ]:= ListLogPlot[spectral, PlotRange → {leftRange, {0, 0.2}},
         PlotLabel → "Frequencies Near 3rd Harmonic", Frame → True,
         FrameLabel → {"Frequency (Hz)", "Log Magnitude"}, Joined → True]

In[ ]:= ListLogPlot[spectral, PlotRange → {rightRange, {0, 0.5}},
         PlotLabel → "Frequencies Near 3rd Harmonic", Frame → True,
         FrameLabel → {"Frequency (Hz)", "Log Magnitude"}, Joined → True]

In[ ]:=
```

“Hand-Wavy” Error Propagation for D measurements

```
In[ ]:= temp = 1 / T2Water + gradient^2 * waterD * gamma^2 * .02^2 / 12
        (temp - 1 / T2Water["Value"]) / (gradient["Value"]^2 * gamma^2 * .02^2 / 12)

In[ ]:= isoT2 = Around[1.20, 0.01]
        isoD = MeanAround[{Around[2.034, .038], Around[1.937, .037], Around[1.956, .069]} * 10^-5]

In[ ]:= temp = 1 / isoT2 + gradient^2 * isoD * gamma^2 * .04^2 / 12
        (temp - 1 / isoT2["Value"]) / (gradient["Value"]^2 * gamma^2 * .04^2 / 12)

In[ ]:= temp = 1 / minOilT2WithErr + gradient^2 * minOilD * gamma^2 / 12
        (temp - 1 / minOilT2WithErr["Value"]) / (gradient["Value"]^2 * gamma^2 / 12)

In[ ]:= temp = 1 / houseOilT2v1WithErr + gradient^2 * hoD * gamma^2 / 12
        (temp - 1 / houseOilT2v1WithErr["Value"]) / (gradient["Value"]^2 * gamma^2 / 12)
```