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(* read in the raw ENDF data for Uranium 235 and plot
  the cross section according to the Reich-Moore formalism *)

Clear["Global`*"];
SetDirectory["C:\\temp\\matlab\\n-ENDF-VII0.endf\\"];

EndfStream = OpenRead["n-092_U_235.endf"];
MAT = 9228;
MF = 2;
MT = 151;
searchword =
  ToString[PaddedForm[MAT, 4 - 1]] <> ToString[PaddedForm[MF, 2 - 1]] <> ToString[MT];
myline = Read[EndfStream, String];
While[myline ≠ "EndOfFile", myline = Read[EndfStream, String];
  myline = " " <> StringTake[myline, {67, 80}];
  If[Length[StringPosition[myline, searchword, 1]] > 0, Break[];]];

myline = Read[EndfStream, String];
myline = Read[EndfStream, String];
EL = ToExpression[
   StringReplace[StringTake[myline, {1, 11}], {"-" → " 10^-", "+" → " 10^+"}]];
EH = ToExpression[StringReplace[StringTake[myline, {12, 22}],
    {"-" → " 10^-", "+" → " 10^+"}]];
myline = Read[EndfStream, String];
SPI = ToExpression[
   StringReplace[StringTake[myline, {1, 11}], {"-" → " 10^-", "+" → " 10^+"}]];
AP = ToExpression[StringReplace[StringTake[myline, {12, 22}],
    {"-" → " 10^-", "+" → " 10^+"}]];
myline = Read[EndfStream, String];
AWRI = ToExpression[
   StringReplace[StringTake[myline, {1, 11}], {"-" → " 10^-", "+" → " 10^+"}]];
APL = ToExpression[StringReplace[StringTake[myline, {12, 22}],
    {"-" → " 10^-", "+" → " 10^+"}]];
L = ToExpression[StringReplace[StringTake[myline, {23, 33}],
    {"-" → " 10^-", "+" → " 10^+"}]];
NRI = ToExpression[StringReplace[StringTake[myline, {56, 66}],
    {"-" → " 10^-", "+" → " 10^+"}]];

RMoore = Table[{0, 0, 0, 0, 0, 0}, {j, NRI}];

For[j = 1, j ≤ NRI, j++, myline = Read[EndfStream, String];
  RMoore[[j]][[1]] = ToExpression[StringTake[myline, {1, 1}] <>
     StringReplace[StringTake[myline, {1 + 1, 11}], {"-" → " 10^-", "+" → " 10^+"}]];
  RMoore[[j]][[2]] = ToExpression[StringTake[myline, {12, 12}] <> StringReplace[
      StringTake[myline, {12 + 1, 22}], {"-" → " 10^-", "+" → " 10^+"}]];
RMoore[[j]][[3]] = ToExpression[StringTake[myline, {23, 23}] <> StringReplace[
      StringTake[myline, {23 + 1, 33}], {"-" → " 10^-", "+" → " 10^+"}]];
RMoore[[j]][[4]] = ToExpression[StringTake[myline, {34, 34}] <> StringReplace[
      StringTake[myline, {34 + 1, 44}], {"-" → " 10^-", "+" → " 10^+"}]];
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RMoore[[j]][[5]] = ToExpression[StringTake[myline, {45, 45}] <> StringReplace[
      StringTake[myline, {45 + 1, 55}], {"-" → " 10^-", "+" → " 10^+"}]];
RMoore[[j]][[6]] = ToExpression[StringTake[myline, {56, 56}] <> StringReplace[
      StringTake[myline, {56 + 1, 66}], {"-" → " 10^-", "+" → " 10^+"}]];];

mn = 939.565560 × 10^6;
hbar = 6.582119 × 10^-16;
cspeed = 299 792 458;

kn[x_] := Sqrt[2 * mn * Abs[x] / (cspeed * cspeed * hbar * hbar)] * AWRI / (AWRI + 1);
P0[x_] := AP * kn[x] * 10^-14;
gJ[x_, y_] := (2 * x + 1) / (2 * (2 * y + 1));
phi0[x_] := AP * kn[x] * 10^-14;

RMatrixM11[x_, NRJ_] := Sign[RMoore[[NRJ]][[3]]] *
   Sqrt[0.5 * Abs[RMoore[[NRJ]][[3]]] / P0[RMoore[[NRJ]][[1]]]] *
   Sign[RMoore[[NRJ]][[3]]] *
   Sqrt[0.5 * Abs[RMoore[[NRJ]][[3]]] / P0[RMoore[[NRJ]][[1]]]] /
    (RMoore[[NRJ]][[1]] - x - 0.5 * i * RMoore[[NRJ]][[4]] / 1);
RMatrixM12[x_, NRJ_] := Sign[RMoore[[NRJ]][[3]]] *
   Sqrt[0.5 * Abs[RMoore[[NRJ]][[3]]] / P0[RMoore[[NRJ]][[1]]]] *
   Sign[RMoore[[NRJ]][[5]]] * Sqrt[0.5 * Abs[RMoore[[NRJ]][[5]]] / 1] /
    (RMoore[[NRJ]][[1]] - x - 0.5 * i * RMoore[[NRJ]][[4]] / 1);
RMatrixM13[x_, NRJ_] := Sign[RMoore[[NRJ]][[3]]] *
   Sqrt[0.5 * Abs[RMoore[[NRJ]][[3]]] / P0[RMoore[[NRJ]][[1]]]] *
   Sign[RMoore[[NRJ]][[6]]] * Sqrt[0.5 * Abs[RMoore[[NRJ]][[6]]] / 1] /
    (RMoore[[NRJ]][[1]] - x - 0.5 * i * RMoore[[NRJ]][[4]] / 1);

RMatrixM21[x_, NRJ_] := RMatrixM12[x, NRJ];
RMatrixM22[x_, NRJ_] :=
  Sign[RMoore[[NRJ]][[5]]] * Sqrt[0.5 * Abs[RMoore[[NRJ]][[5]]] / 1] *
   Sign[RMoore[[NRJ]][[5]]] * Sqrt[0.5 * Abs[RMoore[[NRJ]][[5]]] / 1] /
    (RMoore[[NRJ]][[1]] - x - 0.5 * i * RMoore[[NRJ]][[4]] / 1);
RMatrixM23[x_, NRJ_] := Sign[RMoore[[NRJ]][[5]]] *
   Sqrt[0.5 * Abs[RMoore[[NRJ]][[5]]] / 1] *
   Sign[RMoore[[NRJ]][[6]]] * Sqrt[0.5 * Abs[RMoore[[NRJ]][[6]]] / 1] /
    (RMoore[[NRJ]][[1]] - x - 0.5 * i * RMoore[[NRJ]][[4]] / 1);

RMatrixM31[x_, NRJ_] := RMatrixM13[x, NRJ];
RMatrixM32[x_, NRJ_] := RMatrixM23[x, NRJ];
RMatrixM33[x_, NRJ_] :=
  Sign[RMoore[[NRJ]][[6]]] * Sqrt[0.5 * Abs[RMoore[[NRJ]][[6]]] / 1] *
   Sign[RMoore[[NRJ]][[6]]] * Sqrt[0.5 * Abs[RMoore[[NRJ]][[6]]] / 1] /
    (RMoore[[NRJ]][[1]] - x - 0.5 * i * RMoore[[NRJ]][[4]] / 1);

RMatrix[x_, NRJ_] := {{RMatrixM11[x, NRJ], RMatrixM12[x, NRJ], RMatrixM13[x, NRJ]},
   {RMatrixM21[x, NRJ], RMatrixM22[x, NRJ], RMatrixM33[x, NRJ]},
   {RMatrixM31[x, NRJ], RMatrixM32[x, NRJ], RMatrixM33[x, NRJ]}};
```

```
TablJ3 = {};
TablJ4 = {};
For[j = 1, j ≤ NRI, j++,
  If[RMoore[[j]][[2]] == 3.0, AppendTo[TablJ3, j], AppendTo[TablJ4, j]]];

RSMatrixJ3[x_] := Sum[RMatrix[x, j], {j, TablJ3}];
RSMatrixJ4[x_] := Sum[RMatrix[x, j], {j, TablJ4}];

PMatrix[x_] := {{Sqrt[P0[x]], 0, 0}, {0, Sqrt[1], 0}, {0, 0, Sqrt[1]}};
LMatrix[x_] := {{1 / (i * P0[x]), 0, 0}, {0, 1 / i, 0}, {0, 0, 1 / i}};

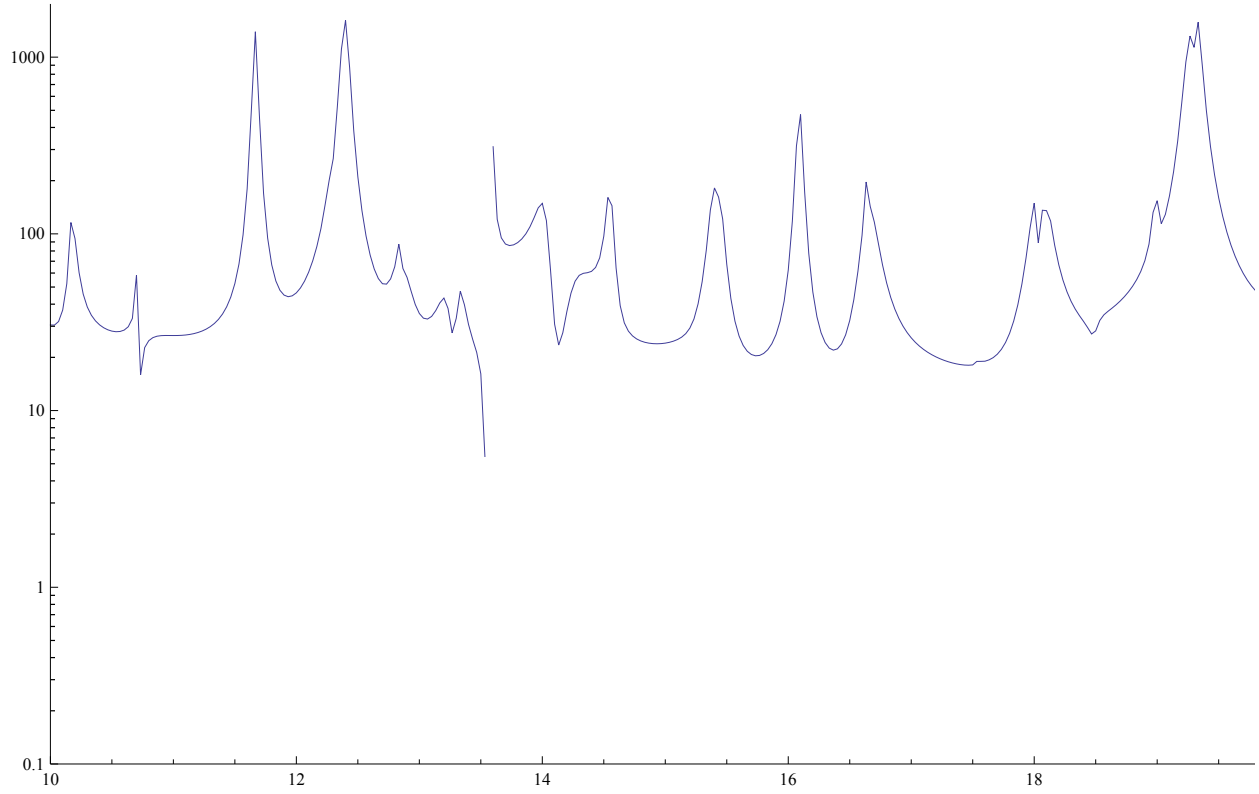
XMatrixJ3[x_] := PMatrix[x].LMatrix[x].
   Inverse[LMatrix[x] - RSMatrixJ3[x]].RSMatrixJ3[x].PMatrix[x];
XMatrixJ4[x_] := PMatrix[x].LMatrix[x].Inverse[LMatrix[x] - RSMatrixJ4[x]].
   RSMatrixJ4[x].PMatrix[x];

Xi11J3[x_] := Im[XMatrixJ3[x][[1]][[1]]];
Xr11J3[x_] := Re[XMatrixJ3[x][[1]][[1]]];

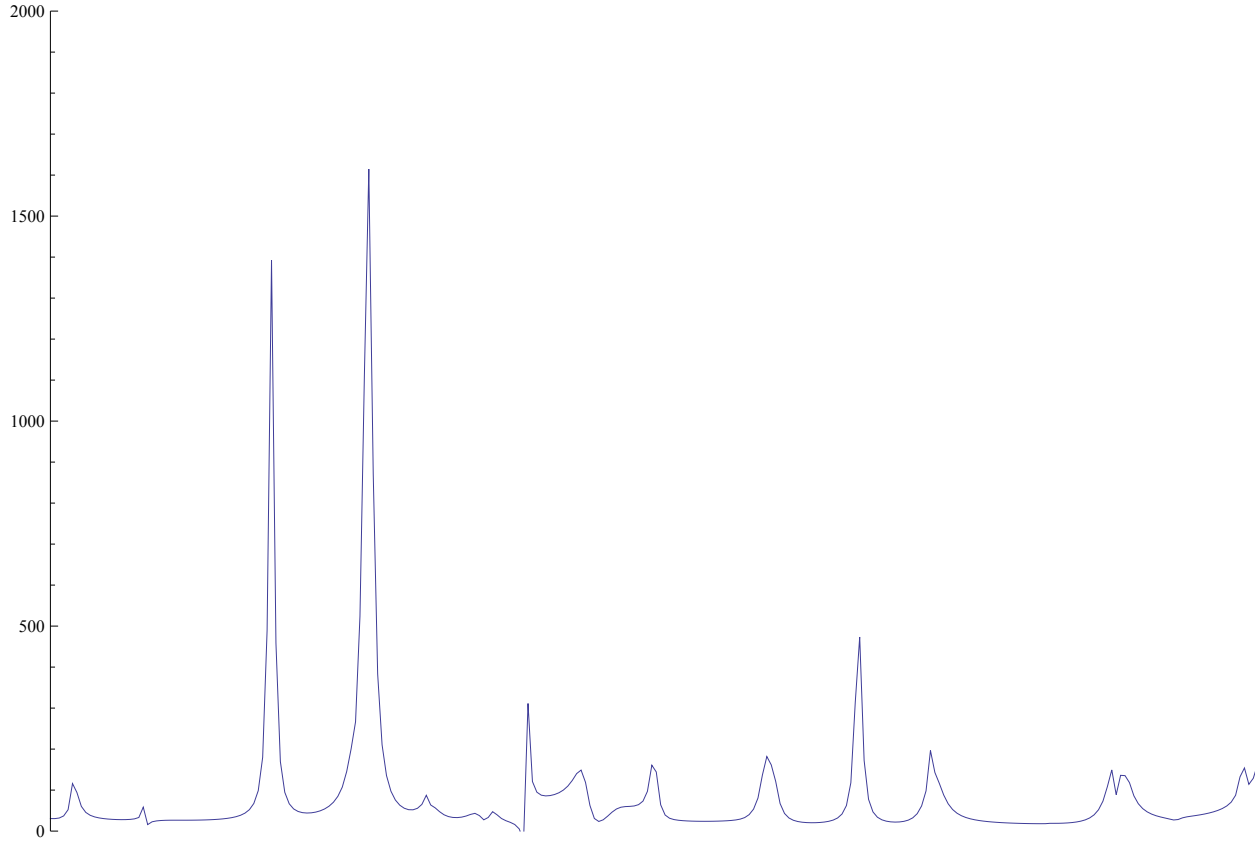
Xi11J4[x_] := Im[XMatrixJ4[x][[1]][[1]]];
Xr11J4[x_] := Re[XMatrixJ4[x][[1]][[1]]];


sigmaTJ3[x_] := (4 * π) / (kn[x] * kn[x]) * gJ[3, 3.5] * (Sin[phi0[x]] * Sin[phi0[x]] +
      Xi11J3[x] * Cos[2 * phi0[x]] - Xr11J3[x] * Sin[2 * phi0[x]]) / 10^-28;
sigmaTJ4[x_] := (4 * π) / (kn[x] * kn[x]) * gJ[4, 3.5] * (Sin[phi0[x]] * Sin[phi0[x]] +
      Xi11J4[x] * Cos[2 * phi0[x]] - Xr11J4[x] * Sin[2 * phi0[x]]) / 10^-28;
sigmaT[x_] := sigmaTJ3[x] + sigmaTJ4[x];

TablXS = {};
NK = 300;
e1 = 10;
e2 = 20;
For[j = 0, j ≤ NK, j++,
  AppendTo[TablXS, {e1 + j * (e2 - e1) / NK, sigmaT[e1 + j * (e2 - e1) / NK]}]];
ListLogPlot[TablXS, Joined → True, PlotRange → {{e1, e2}, {0.1, 2000}}]
```




```
ListPlot[TablXS, Joined → True, PlotRange → {{e1, e2}, {0.1, 2000}}]
```



```
temp = 500;
m = 1;
M = 235;
kB = 8.617343 × 10^-5;
deltaD = Sqrt[m * kB * temp / M];
ff[x_] := Interpolation[TablXS, x];
sigmaT0[x_] := Piecewise[{{ff[x], 10 < x < 20}, {0, x ≤ 10}, {0, x ≥ 20}}];
(* Plot[sigmaT0[x],{x,10,20},PlotRange→{{e1,e2},{0.1,2000}}] *)


sigmatilde[w_] := Piecewise[{{ff[w^2], w > 0}, {0, w == 0}, {-ff[w^2], w < 0}}];
sigmaTD[x_, w_] :=
  (1 / (deltaD * Sqrt[π] * x)) * w^2 * Exp[-(Sqrt[x] - w)^2 / deltaD^2] * sigmatilde[w];
sigmaTDI[x_] := NIntegrate[sigmaTD[x, w], {w, Sqrt[10], Sqrt[20]}];

TablXSD = {};
For[j = 0, j ≤ NK, j++,
  AppendTo[TablXSD, {e1 + j * (e2 - e1) / NK, sigmaTDI[e1 + j * (e2 - e1) / NK]}]];
ListPlot[TablXSD, Joined → True, PlotRange → {{e1, e2}, {0, 1000}}]
```