

Integrate 2-photon Lineshape over Doppler Distribution

$$\text{transProb}[\omega_{1_}, \omega_{2_}, v_] = \sum_{fDPrime=fMinFin}^{fMaxFin} \sum_{f=fMinGnd}^{fMaxGnd} \left(\left(\frac{(\gamma_{Fin} + \gamma_T)^2}{4} / \left(\left(2\pi v_{GndToFin}[f, fDPrime] - \omega_1 \left(1 + \frac{v}{c} \right) - \omega_2 \left(1 - \frac{v}{c} \right) \right)^2 + \frac{(\gamma_{Fin} + \gamma_T)^2}{4} \right) \right) \right. \\ \left. \frac{1}{2f+1} \sum_{m=-f}^f \sum_{mDPrime=-fDPrime}^{fDPrime} \text{Abs} \left[\sum_{fPrime=fMinInt}^{fMaxInt} \sum_{mPrime=-fPrime}^{fPrime} \left(\frac{\gamma_{Int} + \gamma_T}{2} / \left(\frac{i(\gamma_{Int} + \gamma_T)}{2} + \left(\omega_1 \left(1 + \frac{v}{c} \right) - 2\pi v_{GndToInt}[f, fPrime] \right) \right) \right) \right. \right. \\ \left. \left. d_{GndToInt}_{f, fPrime, m, mPrime} d_{IntToFin}_{fPrime, fDPrime, mPrime, mDPrime} \right] \right]^2 \Bigg);$$

$$\text{fnToIntegrate}[fR_ , v_] = \sum_{n1=1}^{\text{Length}[n1List]} \sum_{n2=1}^{\text{Length}[n2List]} \text{dopplerDist}[v] \\ \text{transProb}[\omega_L[n1List[[n1]], fR], \omega_L[n2List[[n2]], fR], v];$$

```
vIntSpec[fRep_?NumericQ] := NIntegrate[fnToIntegrate[fRep, v], {v, -60 000, 60 000},
  MinRecursion -> 3, MaxRecursion -> 10, AccuracyGoal -> 4, PrecisionGoal -> 2];
```

Calculation

```
δf = 1;
fr = fRepMin;
fRepList = {};
(*Form the fRepList*)
While [fr < fRepMax,
  {fRepList = Append[fRepList, fr];
  fr += δf;}]

(*Export["C:\\RbDFCS\\Rb87_5D52.txt", totalSpec, "Table"];*)
tt = AbsoluteTime[];
(*distribute NIntegrate among CPU cores*)
specList = ParallelTry[vIntSpec, fRepList, Length[fRepList]];
ttd = AbsoluteTime[] - tt;
Print["Execution time = ", ttd]
fRepList = fRepList - Min[fRepList];
totalSpec = Table[{fRepList[[t]], Chop[specList[[t]]]}, {t, 1, Length[specList]};
ListPlot[totalSpec, PlotRange -> All, Joined -> True]
```

Execution time = 188.4960083