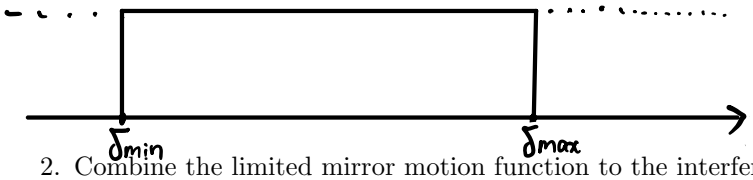
Upload your finished worksheet as a single pdf file on moodle before the next class session in order to get participation credit.
Try to keep your books closed. Discuss with your fellow students to come to an answer.
Show your work.

Name:_____

1. Even with an ideal broadband source, the available frequencies in an FTIR spectrometer are limited by the mirror motion. Think and sketch: how would you add the mirror motion into the FTIR formalism.

Mirror movement has limitations, it cannot go to infinite far.
We can add a box function representing lower & upper limit.

$$V(\delta) = \text{StepFunc}\left(\frac{\delta_{max} - \delta_{min}}{2} - |\delta - \frac{\delta_{min} + \delta_{max}}{2}|\right)$$



2. Combine the limited mirror motion function to the interferogram function.

Measured: $V(\delta)\ A(\delta)$

Spectrum: $FT^{-1}\{V(\delta) \cdot A(\delta)\}$

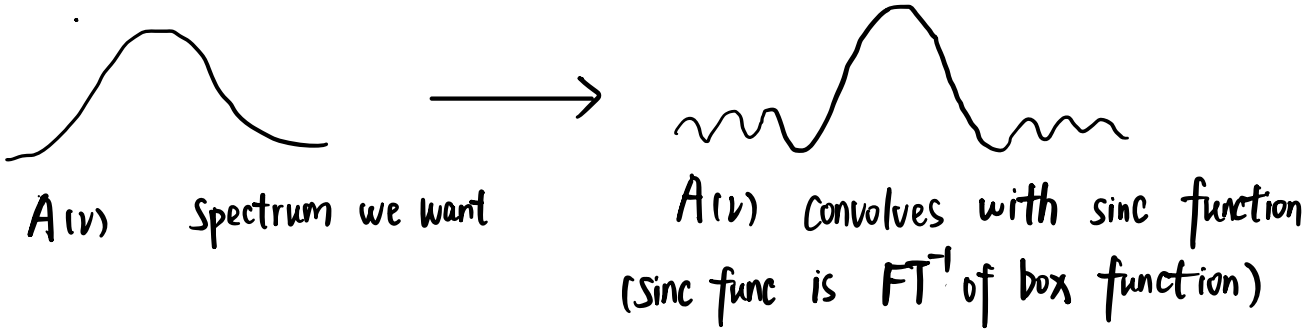
$V(\delta)$ is the box function

$A(\delta)$ is ideal interferogarm with δ goes from $-\infty$ to $+\infty$

3. Remember the convolution theorem for Fourier Transforms. What is the impact of the limited mirror motion onto the line shapes?

$$FT^{-1}\{V(\delta) \cdot A(\delta)\} = FT^{-1}\{V(\delta)\} * FT^{-1}\{A(\delta)\} = \text{sinc}(\nu) * A(\nu)$$

product convolution



4. For your Master thesis work you need to pre-screen many samples with a resolution of 0.5 cm^{-1}. What is your choice of spectrometer? What are the requirements for your spectrometer?

Movable Distance: $\frac{1}{2} \cdot \frac{1}{0.5\,cm^{-1}} = 1\,cm$.

At least the Michelson Spectrometer needs 1cm of movable distance.

5. Now your advisor proposes a project to build an FTIR spectrometer with a resolution better than 0.01 cm^{-1}. Should you take on the challenge? Where do you see problems?

Least Movable Distance: $\frac{1}{2} \cdot \frac{1}{0.01\,cm^{-1}} = 50\,cm$

50 cm is a long distance, it's hard to move the mirror by half a meter without losing alignment.

The End.