Exercise 2 — adding waves -- due Mon. Oct 26

Draw/write on these slides.
Save as PDF.
Upload to http://www.bioinfo.rpi.edu/bystrc/courses/bcbp4870/homework.html

part 1

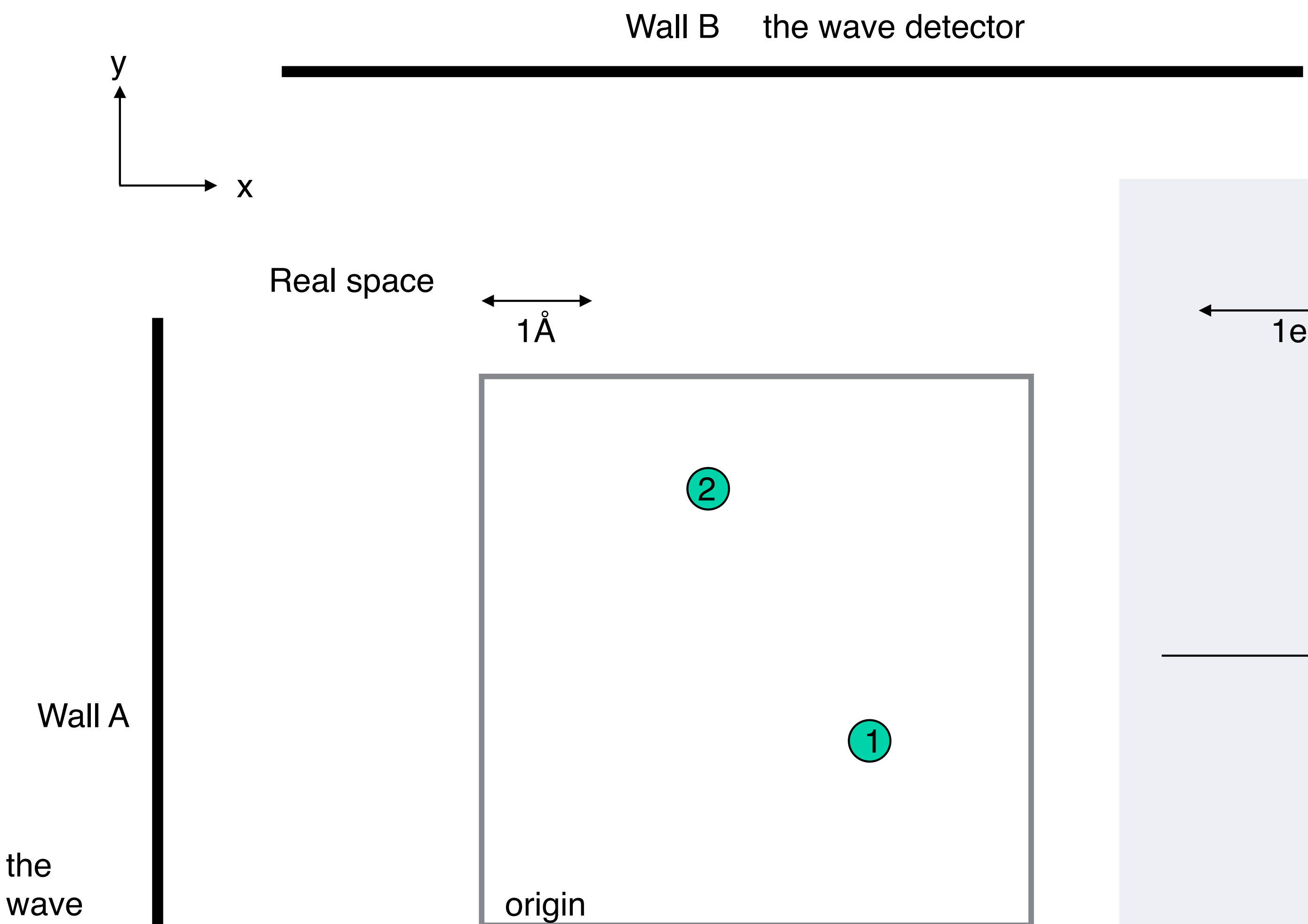
(1) Look at the setup on the next page, a square unit cell of width 5.00Å, with 2 hydrogen atoms in it. Xrays come in from the left, scatter at $2\theta=90°$.

(2) Measure the distance traveled from Wall A to Atom 1 (r_1) to Wall B, traveling along beam direction $\mathbf{s}_0= (1, 0, 0)$ and scattered wave $\mathbf{s}= (0, 1, 0)$, respectively. Divide by the wavelength. Multiply by 2π (or 360) to get the phase in radians (or degrees).

(3) Do the same for Atom 2 (r_2). Fill in Table 1.

(4) Add the two waves in Argand space (slide 20 of this lecture). Measure the resulting length (amplitude A) and phase (α).

Exercise 2 — copy this page and draw on it — due Mon. Oct 26



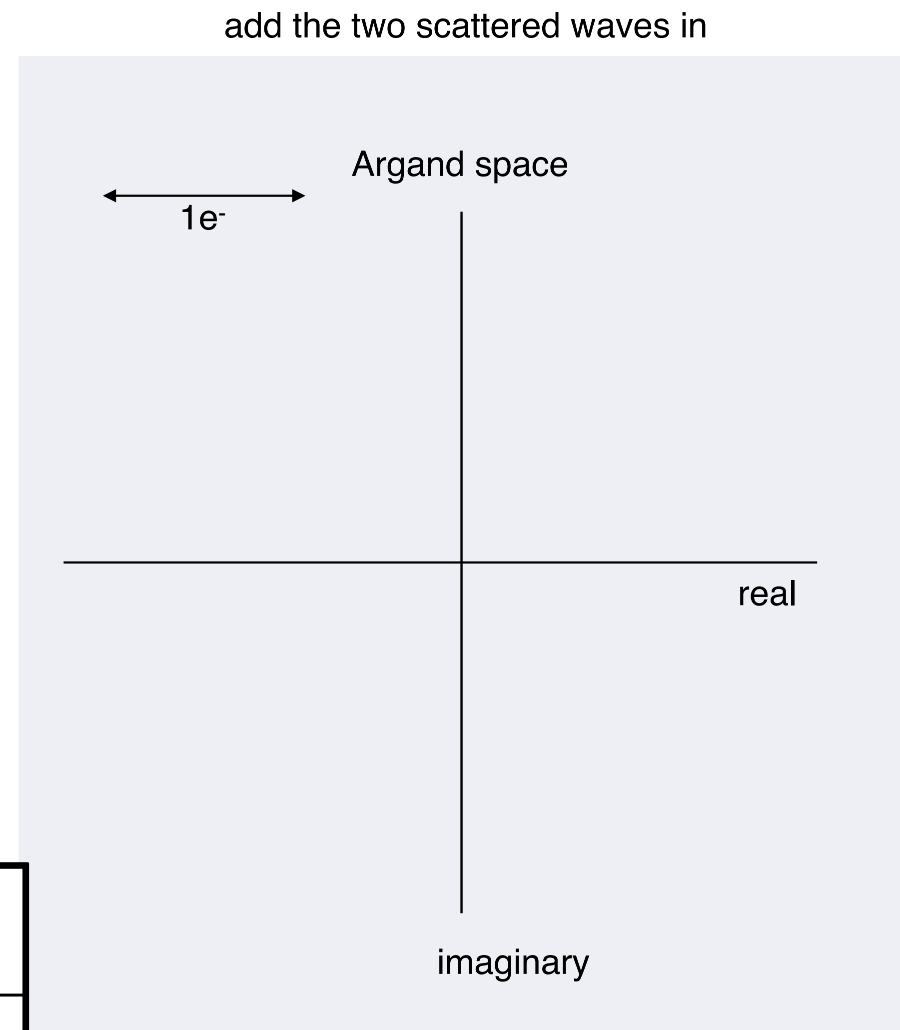


Table 1	Distance traveled	subtract origin distance traveled	phase (°) if wavelength = 1.54Å
origin			
r_1			
r_2			

Amplitude (A)	
phase (α)	

Exercise 2 — part 2

Calculate the wave sum using the Fourier transform

$$F(S) = \sum_k \varrho(r_k) e^{i2\pi S \bullet r_k}$$

$\lambda = 1.54Å$

$\mathbf{s_0} = (1, 0, 0)$

$\mathbf{s} = (0, 1, 0)$

$\mathbf{S} = (\mathbf{s} - \mathbf{s_0})/\lambda = (\ \_\_\_ \quad \_\_\_ \quad \_\_\_\ )$

Table 2	Measure Å coordinates of r_k relative to origin from previous page.	$A_k = \varrho(r_k)$	$\alpha_k = 2\pi\, S \bullet r_k$	$A_k \cos(\alpha_k)$	$i\, A_k \sin(\alpha_k)$
k=1					
k=2					

sum		
Amplitude (A) = | (imag, real) |		
phase (α) = $\tan^{-1}$(imag/real) (in degrees)		