1. The Very Large Array (VLA) is a radio interferometer consisting of 28 antennas. The VLA cycles between configurations, moving the antennas to cover different resolutions. These configurations are labeled A, B, C, and D.

   a. You want to use the VLA to observe emission in the L-band (1.5 GHz or 1.5×10^9 Hz) what wavelength are you observing? Are there any interesting lines in this band?

   b. In the table below, B_{max} is the maximum antenna separation for each configuration.

VLA Config	B_{max} [km]
A-array	36.4
B-array	11.1
C-array	3.4
D-array	1.03

      i. Which configuration has the highest resolution, why?

      ii. The VLA's resolution is generally diffraction limited. Use the wavelength in Part a to calculate the minimum angular scale you can observe the D-array.

   c. You're reading a paper that reports the brightness temperature of a source observed with the VLA in the L-band is 25 Kelvin. What is the intensity of the source (in units of $W/m^2/Hz/sr$ or $Joules/s/m^2/Hz/sr$)? What information do you need to determine the antenna temperature?

The Very Large Array (VLA) is a radio interferometer consisting of 28 antennas. The VLA cycles between configurations, moving the antennas to cover different resolutions. These configurations are labeled A, B, C, and D.

d. You want to use the VLA to observe emission in the L-band (1.5 GHz or $1.5\text{x}10^9$ Hz) what wavelength are you observing? Are there any interesting lines in this band?

$$\lambda = \frac{c}{f} = \frac{3e10\frac{cm}{s}}{1.5e9}s = 20 \text{ cm}$$

This is close to the HI 21 cm line

e. In the table below, B_{max} is the maximum antenna separation for each configuration.

VLA Config	B_{max} [km]
A-array	36.4
B-array	11.1
C-array	3.4
D-array	1.03

i. Which configuration has the highest resolution, why?

A-array is the highest resolution because it has the longest baseline.

ii. The VLA's resolution is generally diffraction limited. Use the wavelength in Part a to calculate the minimum angular scale you can observe the D-array.

$$\theta \sim \frac{\lambda}{D} = \frac{20\ cm}{103000\ cm} = 0.00019\ rad = \ 40\ arcseconds$$

f. You're reading a paper that reports the brightness temperature of a source observed with the VLA in the L-band is 25 Kelvin. What is the intensity of the source (in units of $W/m^2/Hz/sr$ or $Joules/s/m^2/Hz/sr$)? What information do you need to determine the antenna temperature?

$\frac{2k\nu^2}{c^2}T_B$ = (25 K*2*1.380649e-23 J/K*(1.5e9)^2)/(2.99e8 m/s)**2

= 1.7e-20 (J/s)/Hz/m2/sr or W/Hz/m2/sr

To determine the antenna temperature, you need the solid angle of the source and the solid angle of the beam

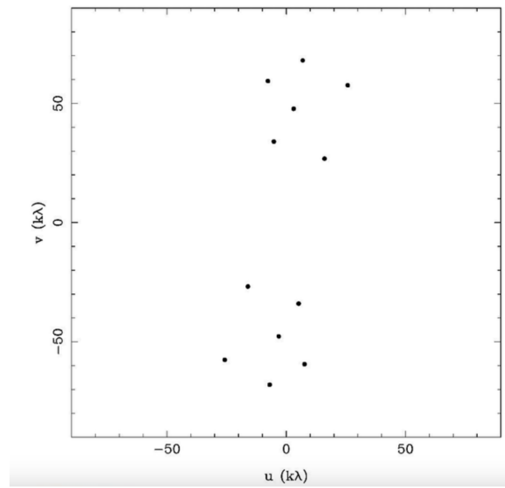
Bonus:

2. Using the VLA as an example, answer the following questions about interpreting the uv plane.
    a. How many antennas were used in this one sample?

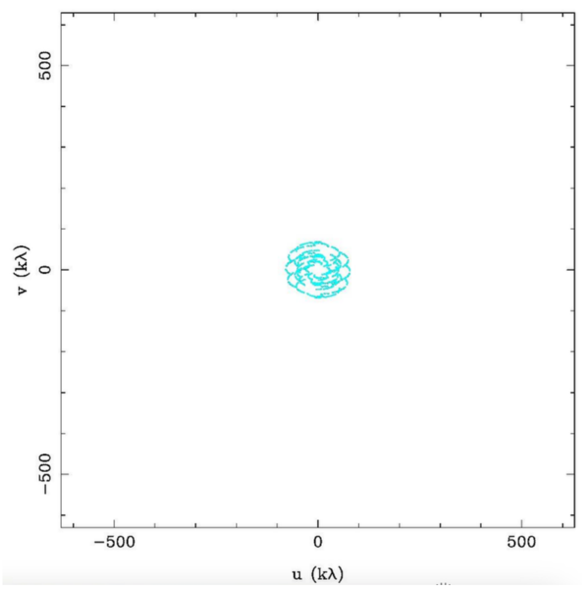
        6 combinations = n(n-1)/2

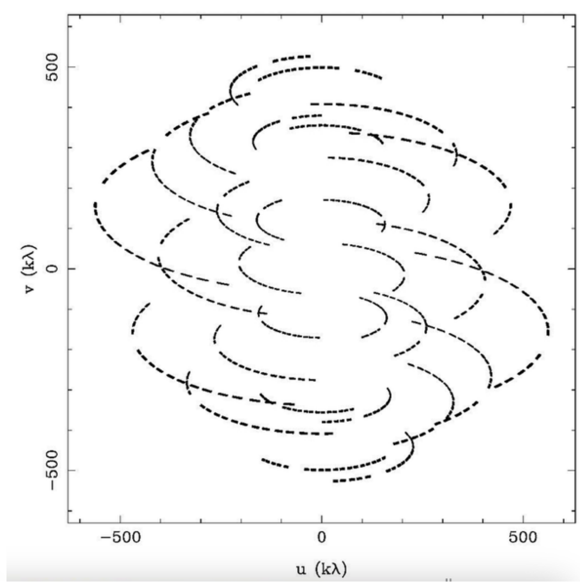
        $0 = n^2 - n - 12$

        (n+3)(n-4) so n = 4



    b. Which one of the two samplings below is the longer baseline array? Explain.





The right is the longer baseline array because of the longer u-v distances. u and v are spatial frequencies. High spatial frequencies are due to fine structure probed by long baselines.