Co-ordinate Systems Exercise – DARA 2021

Question (1) below is a "pen and paper" exercise (does not require a computer).

1) Complete the following Table, for observers at various latitudes on the surface of the earth. N.B. This exercise does not require complicated calculations or use of Python code. You may find Fig. 1 useful in visualising the horizon co-ordinate system in relation to the equatorial co-ordinate system. Th right hand side of the figure shows the relationship between the local horizon co-ordinate system (altitude and azimuth) and the equatorial co-ordinate system (Right Ascension and Declination). You may find making a pen and paper sketch helps when attempting the more complex latitude = 30 degree and latitude = 60 degree cases.

Observer's Latitude	Altitude of North Celestial Pole	Altitude of South Celestial Pole	Altitude of highest part of Celestial Equator (Az=0)	Declination of North horizon	Declination of South horizon	Declination of Zenith
0 (Ecuador)						
30 (Caribbean)						
60 (Canada)						
90 (North Pole)						

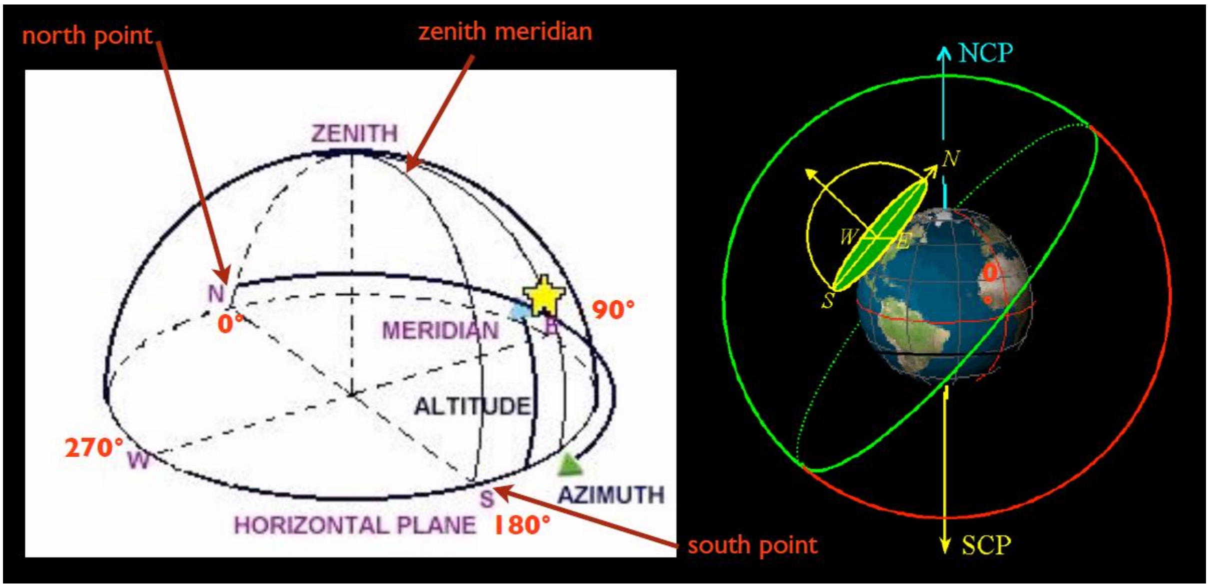

Fig.1. (Left) The horizon based co-ordinate system. (Right) The superposition of a local horizon based co-ordinate system on the surface of the earth.

The following two problems require the use of the accompanying IPython Notebook, which you should have installed on your computer. Read through the examples first and then write your own code (based on the examples) to solve the two problems below.

(2) The Crab Nebula (Tau A) is the brightest radio source in the sky and has RA = 05h 34m 32s and Dec = +22° 00′ 52'' in J2000 epoch co-ordinates.

- Create a SkyCoord object for TauA, in a similar way as was for Orion A above.

Now use this object to find the galactic co-ordinates TauA.

(3) An observer would like to observe TauA from the Onsala 20 m telescope in Sweden (lat 57.395773N, lon 11.926377E).

- Use astropy to create a suitable location object for Onsala.

The observer would like observe TauA at 00:30 local time.

- Use astropy.time to create a suitable Time object to represent this local time.

Now use the AltAz function to calculate the altitude and elevation (in degrees) of TauA at the observing time.

Is the object observable (i.e. above the horizon)?

Note, with these techniques we can do more sophisticated things like plot the altitude of TauA as a function of time. Astropy also has many other features – calculating Local Sidereal Time, Hour Angles, angular separation of objects on the sky etc. etc. Be sure to read the documentation on the internet.