**PHYS 4270 4.0 / 5390 3.0 Astronomical Techniques**

**Assignment on Positional Astronomy**

Due: Solutions must be uploaded in PDF by Mon 18 Jan 2020 at 10 pm

In the following, take the latitude of the Allan I. Carswell Observatory (hereafter “YO”) to be: +43° 46.5’ and the longitude (W) is 79° 30.0’)

1. Find and write down the coordinates of δ Cephei for the epoch J2000 (approximately on January 1, 2000 at noon, UT). (This is among the most famous of the pulsating variable stars.)
2. What is the minimum zenith distance this star makes from YO?
3. What is this star’s zenith distance (or zenith angle) and azimuth (degrees) when its Hour Angle (HA) is −1.5 h?
4. What is the minimum declination a circumpolar star can have from YO?
5. What is the maximum declination a never-rise star can have from YO?
6. Observing from YO, the HA of δ Cephei is found to be +3.15263h
7. What is the Local Sidereal Time (LST) in hours, minutes, seconds at that moment?
8. What are the altitude and azimuth (degrees) of δ Cephei at that moment?
9. The parallax of δ Cephei is 3.77 ± 0.02 milliarcseconds (mas). What is the distance (pc) to this star and the uncertainty (pc)?
10. [Understanding this question can lead to winning bets with fellow students.]
11. Define the astronomical terms “transit” and “culmination.”
12. Briefly discuss whether these terms are the same when referring to (i) stars and (ii) solar system objects.
13. The LST is 3h 18m 14.2s at YO. A star has an RA of 22h 56m 47.1s and a Dec of +10° 21’, 44”.
14. What is the parallactic angle, *q*, of the star at that moment (decimal degrees)?
15. What is the change (in arcseconds) in RA and Dec caused by atmospheric refraction of the star at that moment for both 350 nm and 700 nm? [Hint: use equations 4.21 – 4.26]
16. The star Sirius has a (J2000) RA of 6h 45m 8.92s, Dec of -16° 42’ 58.0”, a parallax of 379.2 mas, a proper motion of μα = -0.546 arcsec/yr and μδ = -1.223 arcsec/yr.
17. What is Sirius’s distance (pc)?
18. What is the magnitude (arcsec/yr) and position angle (degrees) of its proper motion?
19. What is Sirius’s tangential velocity (km/s)?
20. Sirius has a radial velocity of −5.5 km/s. What is its total or space velocity (km/s)?
21. Using class notes, what will Sirius’ RA and Dec be in July 1, 2067 (when Canada will be 200 years old)?

Grads only:

1. Tracking refers to driving a telescope so that a celestial target remains in the centre of the field of view. Since nearly every celestial object moves along a line of constant declination during a night, tracking is simplest using an equatorial mount, i.e., using RA and Dec. In this system, the telescope is driven in in RA only. That is, Δα”/ Δ*t* = 15cos(δ)”/s Δδ/Δ*t* = 0“/s. (In practice, the software driving a large telescope will also take into consideration refraction, structural flexure, etc., when driving the telescope.)

Large telescopes have altitude-azimuth (alt-az) mounts and so have to be driven in both altitude, *h*, and azimuth, *A*. (As discussed in class, this reduces the cost of the dome, and greatly simplifies construction. It also leads to field rotation.)

Using the equations from the notes, and noting that HA(*t*) = *t*, then with

sin(*h*(*t*)) = sin(φ) sin(δ) + cos(φ) cos(δ) cos(*t*)

cos(*A*(*t*)) = [sin(δ) - sin(φ) sin(*h*(*t*))] / [cos(φ) cos(*h*(*t*))]

compute Δ*h*/Δ*t* (arcsec/s) and d*A*/Δ*t* (arcsec/s). Show all your work. [Hint: φ, δ are constant with time]