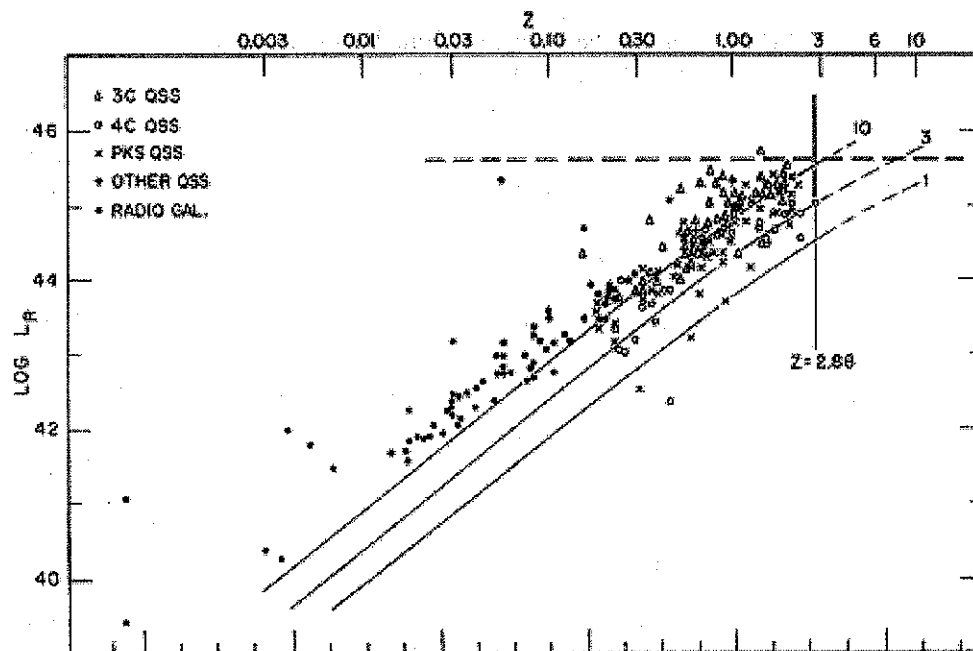


N.M.S.U. Astronomy Department: Cumulative Exam #343
25th April, 2009 – Nicole Vogt

Please start a new page for each problem, and when you are done staple the pages together in order. Be clear, state all assumptions, and do not hesitate to draw figures. You may use your calculators only as calculating machines (do not access constants other than π and e , and do not access stored formulas).

I anticipate a passing score for papers marked above 80%.

1. (a) Derive the Earth-Moon separation, if the Moon appears to shift eastward by 2.3343° at the equator over a six hour period. (8 pts)
(b) What is the name for this technique for finding distances to celestial objects? (1 pt)
(c) Who pioneered this method for estimating the distance to the Moon? (1 pt)
2. Consider stellar observations conducted with the NMSU 1-meter telescope at APO. The total number of photoelectrons collected at the CCD within the seeing-blurred image of radius R in a single exposure due to starlight is N_{str} , while the sky contribution within the same region is n_{sky} .
(a) Calculate the signal-to-noise ratio (S/N) of the photometric measurement of the star. (3 pts)
(b) Update your answer for a Keck 10-meter telescope on Mauna Kea (with good seeing), for an exposure time of the same length. (4 pts)
(c) Express the scaling of S/N with exposure time t when the star counts are much greater, or much smaller, than the sky counts. (4 pts)
(d) In each case, how much longer does the exposure time t need to be with the 1-meter telescope to match the S/N obtained with the 10-meter telescope? (4 pts)
3. (a) Five galaxies in a cluster have recessional velocities of 9700, 8600, 8200, 8500, and 10,000 km sec⁻¹. How far away is the cluster? (4 pts)
(b) Is this closer to us or further away than the Virgo cluster? (1pt)
(c) Estimate the cluster mass, in solar units, if every galaxy is projected roughly half a degree from the cluster center. (5 pts)
4. The following plot shows the distribution of power at 178 MHz for a flux-limited sample of radio galaxies, active galaxies which emit strongly at radio wavelengths (you may ignore the QSS points and the lines on the plot). You will argue that it does not rule out a traditional (passive) luminosity model for the radio galaxy population, one where there is no change in the intrinsic properties of the distribution of radio galaxies with redshift.
(a) Assume a no-evolution parent luminosity function (you may use the nearby galaxy luminosity function), and plot the number of radio galaxies as a function of luminosity qualitatively. Keep it simple, but be sure to label your axes and describe the general shape of the curve. (3 pts)
(b) Now apply an appropriate survey selection effect, and explain the absence of points in the lower right corner of the plot. (3 pts)
(c) Consider the change in the volumes sampled at low and high redshift, and explain the absence of points in the upper left corner of the plot. (3 pts)
(d) Argue that you have explained the apparent trend of L_R with redshift z . (1 pt)



Selected Physical Constants

G	$= 6.67 \times 10^{-8} \text{ cm}^3 \text{ gm}^{-1} \text{ s}^{-2}$	$M_{\odot}$	$= 1.99 \times 10^{33} \text{ gm}$
$R_{\oplus}$	$= 6,380 \text{ km}$	P_{Moon}	$= 27.322 \text{ days}$