PHD QUALIFY EXAMINATION —GALACTIC AND EXTRAGALACTIC ASTROPHYSICS

September, 2000

(1) (15 points)
Calculate the order of magnitude of the Sunyaev-Zel'dovich effect for a typical cluster of galaxy.

(2) (20 points)
What is the *apparent bolometric magnitude* of a galaxy at redshift z with an absolute bolometric luminosity $L_{\rm bol}$ in a flat universe?

(3) (15 points)
What is the horizon and flatness problems?

(4) (15 points)
What is "superluminal motion" that has been observed in the vicinity of some active galactic nuclei? Derive the two criteria (*velocity of ejected material* and the *ejecting angle to the line-of-sight*) with diagrams and equations for this phenomenon to be observed.

(5) (15 points)
Assuming the mass-to-light ratio has the same value for all spirals, and assuming that all spirals have the same surface brightness, derive the Tully-Fisher relation $L = CV_{\rm max}^4$.

(6) (20 points)
What is a"Luminosity Function"? What is the mathematical form of the "Schechter Function"? Plot a diagram showing the shape of the luminosity function of galaxies in a cluster (including cD galaxies), mark the X and Y axes properly, and briefly explain the diagram.