

Astronomy 312 - Fragile

Project 1 (assigned 1/14/16); due 2/9/16)

You may work in pairs for this project. If you do so, then you only need to turn in one solution.

The Local Standard of Rest (LSR), defined by the average motions of nearby stars, helps us to determine the Sun's peculiar motion (motion relative to the LSR). The direction of this solar motion, indicated by a position on the celestial sphere (the solar apex), can be roughly calculated by looking at the average proper motions or radial velocities of nearby stars. Since the peculiar motions of individual stars averaged over the sky should be random, any residual (leftover) motion must be due primarily to the Sun's own peculiar motion. We can find this by analyzing nearby stars such as those found in the **Bright Star Catalog**.

1. Find the approximate right ascension of the solar apex (α_A) using *proper motions* (μ).
 - (a) Sample 100 stars every 3 hours of right ascension. Plot the number of excess positive (or negative) proper motions in each 3 hr bin (remembering that μ_α is positive towards the east). There will be no excess in the direction of the solar apex or opposite it (antapex).
 - (b) After you know roughly what direction α_A is in, fine tune your search by subdividing that bin (or the 2 closest bins) into bins that are only 30 minutes of arc wide and make a new plot of excess positive (or negative) proper motions for those bins.
2. Once α_A is found, δ_A (the declination of the solar apex) can be found by sampling stars in declination in the same right ascension bins as the apex and antapex.
 - (a) Divide declination into bins of 22.5° each. Calculate the *proportion* of stars with positive proper motion ($\mu_\delta > 0$) in each declination bin. The bin that contains the solar apex (and antapex) should have about a 50-50 split of positive and negative motion.
 - (b) Now subdivide that bin (or the 2 closest bins) into bins that are 5° wide and make a new plot of the proportion of stars with positive proper motion.

Now you know the right ascension and declination of the solar apex (at least to within a few degrees). With this information, the Sun's peculiar velocity S can be approximated.

3. Find an average of the radial velocities of 50 stars near the apex. Do the same for 50 stars near the antapex. Average these (after correcting for direction) to obtain a rough estimate of S .