**Spatial Variation of the CMB Temperature**

The spatial variation in the temperature of the CMBR was first measured by the Wilkinson Microwave Anisotropy Probe (WMAP), and again with greater precision by the ESA Planck satellite. Astronomers can study the distribution of matter at recombination by looking at how the temperature varies from point to point in the sky. Specifically, astronomers compute a temperature fluctuation spectrum that measures the relative number of blobs of different sizes.

Using a section of the WMAP image of the CMB radiation, count the number of blobs with sizes of 1.5 cm, 1 cm, 0.5 cm, and 0.25 cm. These sizes correspond to angles on the sky of 6°, 4°, 2° and 1° (an angle of 1° is twice the diameter of the full moon). Include both lower temperature blobs (darker blue) and warmer temperature blobs (yellow, orange, red).

To keep track of what you are doing, circle the blobs as you count them.

Enter your data in the second row of the table on the next page. Work with other students with different sections of the WMAP image to fill in additional rows of the table – at least three image sections.

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| --- | --- | --- | --- | --- |
| Map Section Number | Number of  1.5 cm (6°) blobs | Number of  1 cm (4°) blobs | Number of  0.5 cm ( 2°) blobs | Number of  0.25 cm (1°) blobs |
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|  |  |  |  |  |
| Sum of blobs from map sections |  |  |  |  |



Add up the number of blobs of each size from at least three map sections, and plot the result in the chart below. You will need to add a scale on the vertical axis depending on the largest number of blobs you find.

How does the number of blobs depend on the size of the blob?