Stars and Planets Problem Set I

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Exercise I.1 Sun's efficiency

Exercise I.2 Color-Magnitude diagram

(a)

I choose the "hipparcos-bright.txt" dataset to draw the color-magnitude diagram Fig.1. The star that has the greatest parallax is highlighted with a blue dot and the brightest one with a red dot.

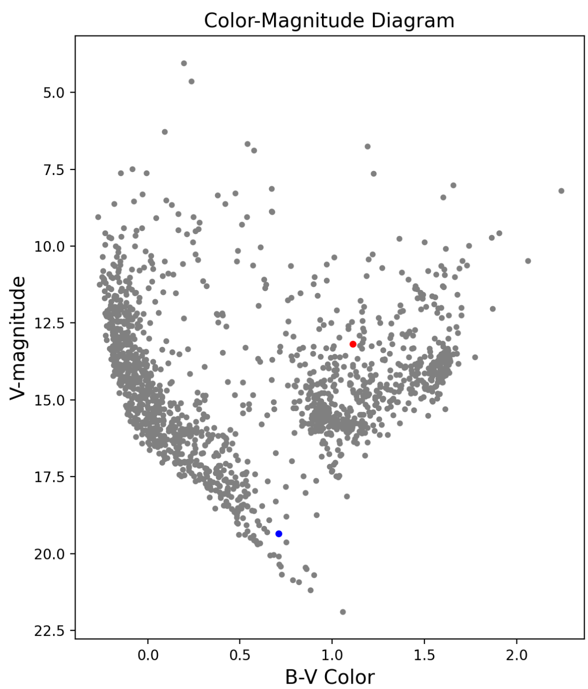

Figure 1: The color-magnitude diagram of "hipparcos-bright.txt"

(b)

That's because for a specific star the apparent and the absolute differ only by a constant.

$$m - M = 5\log_{10}(\frac{d}{10pc}) \tag{1}$$

The $B - V$ color index is defined as the subtraction of magnitudes at the B and V bands, so the constant cancels out.

(c)

According to the Wien's displacement law:

$$\lambda_{\max} = \frac{0.2898 \text{ cm K}}{T} \tag{2}$$

the lower the effective temperature T_{eff}, the more radiation in the "visual" band (V) and the less radiation in the "blue" band (B). Therefore, the star has larger magnitude in the "blue" band (B) and smaller magnitude in the "visual" band (V), and their subtraction $B-V$ color is higher. That's why stars of higher $B-V$ have lower T_{eff}.

(d)

The "hipparcos-bright" sample doesn't contain white dwarfs. The main sequence stars and the RGB stars are labeled as blue and orange respectively in the Fig.2. I only does a rough classification of these two groups of stars.

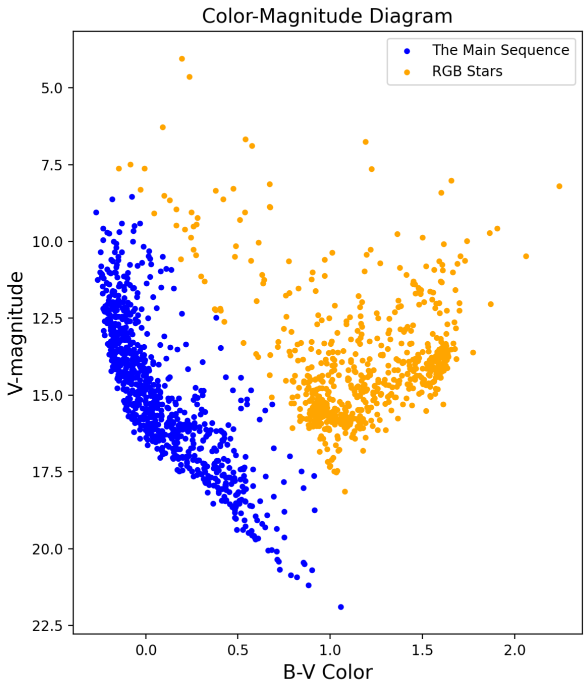

Figure 2: The color-magnitude diagram with classification

(e)