Ultraviolet Study of the unusual high spectral index regions in the Planck HFI map

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Abstract. In this work, we present a study of regions near the Galactic plane with unusual high spectral index, $\beta \approx$ 8-9, which was calculated using PLANCK temperature maps for frequency bands at 143, 217 and 353 GHz. Usually, the radiation from Galactic plane regions in these frequency ranges is dominated by thermal dust emission with typical spectral index around $\beta \approx$1-2. It is rather challenging to study such a large region at this sub-mm frequencies with a high-frequency radio survey. Therefore, ultraviolet (FUV and NUV) observational data are used as the UV for a signpost of star formation regions. We have found that flux of UV radiation in the unusual high spectral index regions is higher than in the normal spectral index regions.

1. Introduction

A spectral index is used for studying an astronomical radiation mechanism. The spectral index of each mechanism is depended on frequencies which are used for calculating the spectral index. The spectral index in a galactic plane region are calculated by using PLANCK temperature maps at 143, 217 and 353 GHz. From the galactic spectral index map, there are some regions with the unusual high spectral index (8-9) near the Galactic plane which might be associated with high energetic mechanisms such as supernova, star formation, etc. [1]. In the star forming region, we will find very dense interstellar clouds, cloud collapsing, protostar, etc. [3]. These phenomenal can be discovered by UV observation. Therefore, we use UV as an indicator for star forming region. The UV observational data are obtained from the Galaxy Evolution Explorer (GALEX) which consists of Far UV (FUV) and Near UV (NUV). Then, we compared the UV data with the spectral index and temperature in frequency band at 143GHz for the unusual high spectral index region and the normal spectral index region.

2. Mapping spectral index and temperature

The temperature and spectral index in 2 unusual high spectral index regions was mapped where centers of these regions locate at galactic coordinate -2.7403429, -4.83478087 and -19.4563201, 10.985673945 as shown in figure 1. For comparison, we also use map of the normal spectral index region with the same condition.

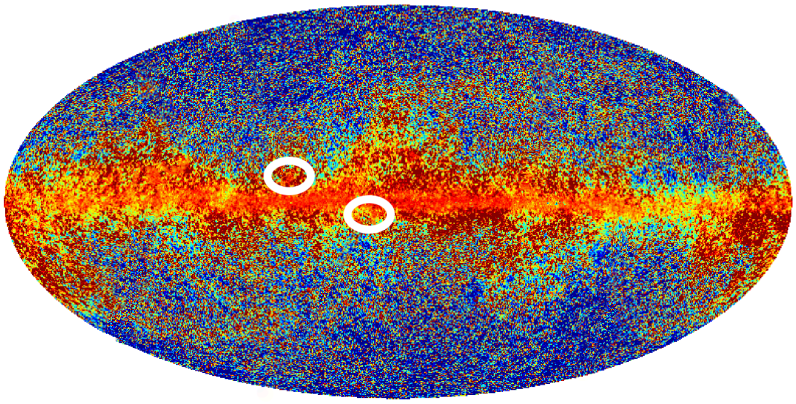

Figure 1. Show the regions with unusual high spectral index in the white circle.

3. Ultraviolet histogram

UV data from GALEX consists of index of pixel location where UV was detected and we can obtain the flux of UV in each pixel. Then, we plotted the histogram of FUV and NUV for the unusual high spectral index region and the normal spectral index region as shown in figure 2. From the figure1, we can see that the histogram of pixel numbers which represents FUV and NUV signal within wide range of UV flux (0-100 mJy), both of histograms show similar result. The flux of FUV and NUV in the unusual high spectral index region is higher than the normal spectral index region.

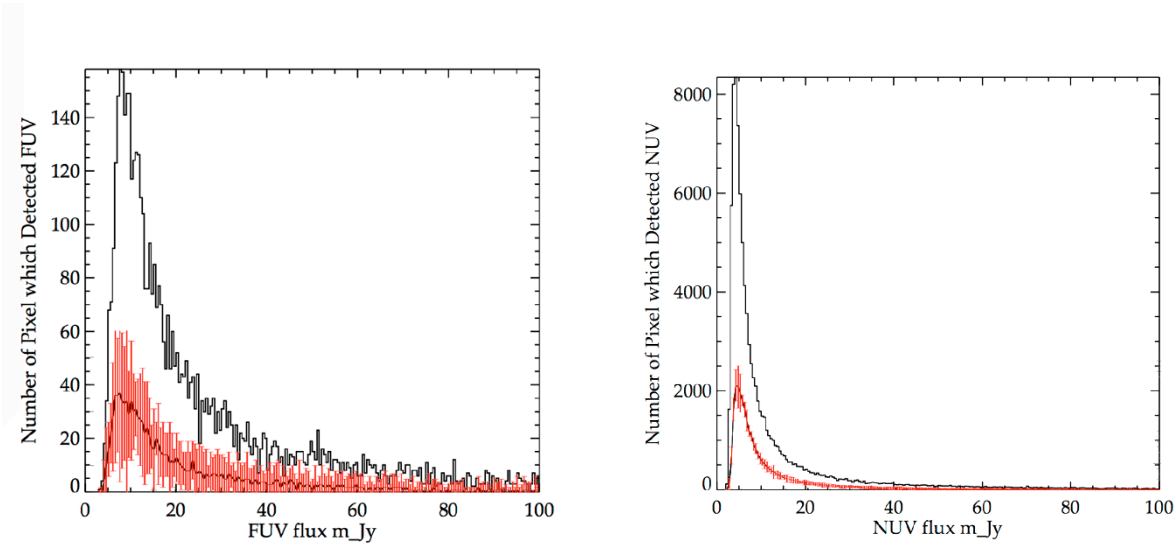

Figure 2. Left: Shows histogram of detected FUV signal pixels in the unusual high spectral index region (top line) and average histogram of detected FUV signal pixels in 7 normal regions (bottom line). Right: shows histogram of detected NUV signal pixel in the unusual high spectral index region (top line) and average histogram of detected NUV signal pixels in 7 normal regions (bottom line)

4. Result

From figure 2, we show a map of spectral index and temperature for frequency 143 GHz in 2 unusual high spectral index regions (figure 3 A and B). The temperature maps at frequency 143 GHz shows the low temperature area at the same location with unusual high spectral index regions but do not appear in the normal spectral index regions (figure 3 C and D) and also in the low temperature region for 143 GHz temperature map.

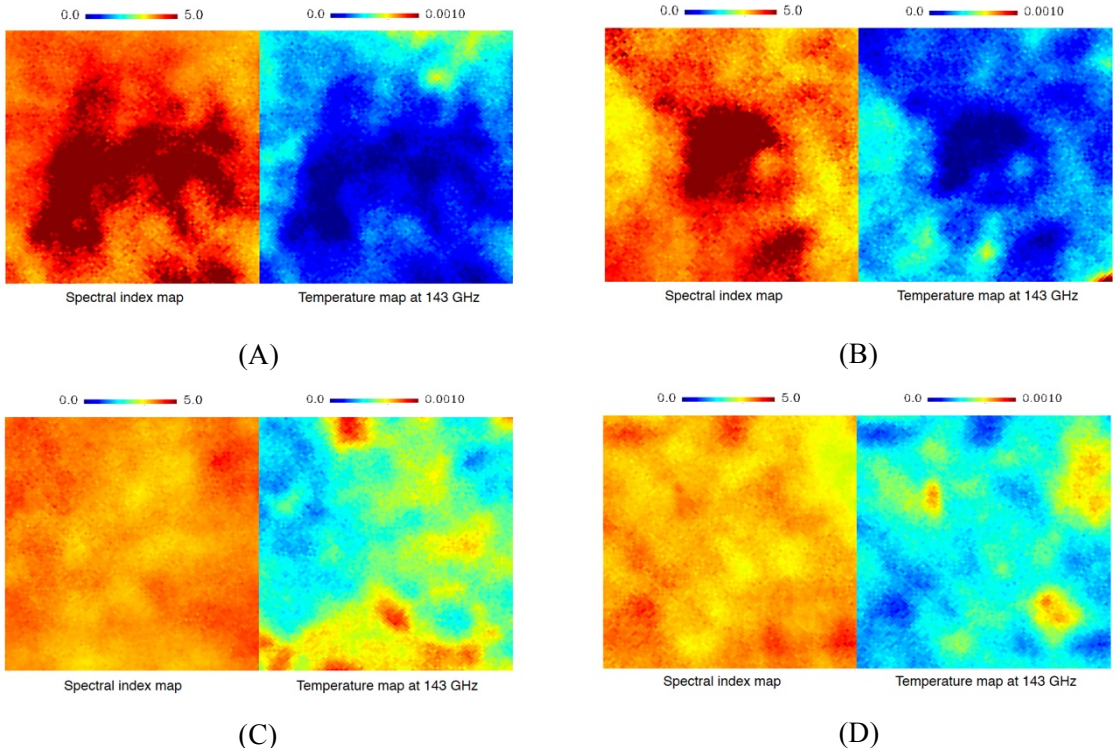

Figure 3. (A) The maps for unusual high spectral index region 1: left - spectral index map, right - temperature map at 143 GHz, (B) The maps for unusual high spectral index region 2: left - spectral index map, right –temperature map at 143 GHz, (C) the maps for normal spectral index region: left - spectral index map, right - temperature map at 143 GHz, (D) the maps of normal spectral index region: left - spectral index map, right - temperature map at 143 GHz

5. Conclusion

From the result of the spectral index map and the temperature map for the unusual high spectral index region, we found that the location of the unusual high spectral index region is more or less the same location of low temperature region in 143 GHz map. This shows that the unusual high spectral index region probably has some correlation with the mechanism of low temperature region in 143 GHz frequency which can be seen in the FUV and NUV results. These regions might be star forming regions or protostars in a supernova remnant or high energetic interstellar dust which emitted UV radiation.

6. References

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