Automatic Identification of Solar X-ray Bright Points in Hinode X-ray Data

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Abstract

We have automated a method that is used to find point sources in Chandra X-ray telescope data, to identify solar bright points in Hinode X-ray data. This tool, called lextrect, first identifies candidate sources that are brighter than the surrounding background. The algorithm also allows selected pixels to be excluded from the source-finding, thus allowing saturated pixels (from flares and/or active regions) to be ignored. We then use lextrect to fit the sources to two-dimensional, elliptical Gaussians. The size and orientation give an approximation of the shape of the bright points. We are in the process of analyzing observations through the Al-poly filter with a four-second exposure time, to obtain a catalogue of bright points, which will include their sizes, lifetimes, intensities, and position on the solar disk.
Abstract

We have automated a method that is used to find point sources in Chandra X-ray telescope data, to identify solar bright points in Hinode X-ray data. This tool, called lextrct, first identifies candidate sources that are brighter than the surrounding background. The algorithm also allows selected pixels to be excluded from the source-finding, thus allowing saturated pixels (from flares and/or active regions) to be ignored. We then use lextrct to fit the sources to two-dimensional, elliptical Gaussians. The size and orientation give an approximation of the shape of the bright points. We use the lextrct default, square root of DN. Background subtraction yields negative values in the data, to identify solar bright points in Hinode X-ray data. This tool, called lextrct, the Low Energy (X-ray) Telescope Data Analysis Package and may be found here: http://wwwastro.msfc.nasa.gov/qdp/lextrct/lextrct.html

Analysis

We exclude data that are greater than 95% of a solar radius from sun center. In addition, we exclude from analysis, data on the disk that are saturated. The analysis package used in astrophysics data analysis is called lextrct, the Low Energy (X-ray) Telescope Data Analysis Package and may be found here:

Source-Finding Component: Computes Fixed-Size, Best-Fit Gaussian to Every Pixel

Background is Locally Constant
SN = Number of counts in Gaussian Uncertainty
A Source = Local Maximum with SN Above Threshold
Scale Size = Approximate Size of Bright Points

Errors and Signal to Noise

We use the lextrct default, square root of DN. Background subtraction yields negative values in the data, those are flagged and not considered in the analysis. To determine signal-to-noise threshold, we construct a histogram of the data in a region of quiet Sun. The break between components (Gaussian and power-law) gives a lower bound on the threshold. Examples are shown below.

Discussion and Conclusions

Using an algorithm designed for finding astrophysical sources in data from the Chandra X-ray observatory, we examined 33 sets of solar data to find bright points. Our results are consistent with those reported in the literature.

We will then catalogue bright points found in Hinode data with at least the following parameters: position, size, orientation, lifetime, intensity, and number of pixels.

References and Acknowledgements


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