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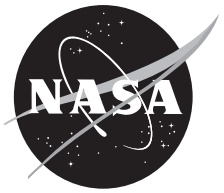

Support the Design of Improved IUE NEWSIPS High Dispersion Extraction Algorithms:

Improved IUE High Dispersion Extraction Algorithms

Final Report

Pat Lawton

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

May 2004

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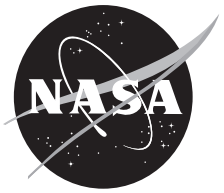

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L-3 Communications Government Services, Inc., Chantilly, Virgina

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FINAL REPORT

FOR

NASA PURCHASE ORDER NUMBER S-50690-G
May 30, 2001 – May 29, 2004

Submitted By
L-3 Communications Government Services, Inc.
(Formerly EER System, Inc.)
3750 Centerview Drive
Chantilly, VA 20151

The objective of this work was to support the design of improved IUE NEWSIPS high dispersion extraction algorithms. The purpose of this work was to evaluate use of the Linearized Image (LIHI) file versus the Re-Sampled Image (SIHI) file, evaluate various extraction methods, and design algorithms for evaluation of IUE High Dispersion spectra. It was concluded the use of the Re-Sampled Image (SIHI) file was acceptable. Since the Gaussian profile worked well for the core and the Lorentzian profile worked well for the wings, the Voigt profile was chosen for use in the extraction algorithm. It was found that the gamma and sigma parameters varied significantly across the detector, so gamma and sigma masks for the SWP detector were developed. Extraction code was written.

Improved IUE High Dispersion Extraction Algorithms

The objective of this work, which was done in collaboration with the the US Naval Observatory, was to support the design of improved IUE NEWSIPS high dispersion extraction algorithms. This work was from the peer reviewed and accepted Astrophysics Data Program (NRA 99-OSS-01 ADP) proposal: "Improved IUE High Dispersion Extraction Software for NEWSIPS Data".

The purpose of this work was to:

- evaluate use of the Linearized Image (LIHI) file versus the Re-Sampled Image (SIHI) file,
- evaluate various extraction methods, and
- design algorithms for evaluation of IUE High Dispersion spectra.

It was concluded that the problems associated with the IUE high dispersion spectra are in the extraction - not in the geometric resampling. Therefore, starting with the Re-Sampled Image (SIHI) file instead of the early processing stage Linearized Image (LIHI) file was acceptable.

Several extraction algorithms were tried - including Gaussian and Lorentzian. The Gaussian worked well for the core, but not always for the wings. The Lorentzian was

promising for the wings. This information lead to a Voigt profile. Although the Voigt profile works well for the detector, values - that were being assumed to be fixed parameters – where showing significant inconsistencies for different locations on the detector.

A more methodical - and rather computer intensive - analysis was done using SWP SIHI files of BD +28 4211 and HD 60753. The fits were done with 3 orders at once with a Voigt function for the wings. The two stars each had 80+ images processed individually to get a better sampling of the point spread function perpendicular to the dispersion direction. Each image was divided into small regions (8 pixels wide) by 3 orders for each order. A three Voigt profile with a linear background was then fit to each region. The sigma and gamma were set to be the same for all three but allowed to vary, the parameters of the fit are: A(n-1), A(n), A(n+1), slope, intercept, sigma, and gamma where the A's are the peak height for each of the 3 orders.

The results of each image were then set to a common centroid (delta x) for each region and then combined. This combined set of regions was then fit producing gamma and sigma masks for each star. These masks were compared with each other. If for one star the mask value was pegged at the high end of the allowed range, the value for the other star at that location on the detector was substituted. Then the mask values for each variable at each location were averaged to create gamma and sigma masks to use in the extraction procedure. Error estimates were included.

Interactive Data Language (IDL) code was written to use the gamma and sigma masks and extract the spectrum from an IUE SWP SIHI image. A README file was written to assist the PI when he is ready to deliver the code to MAST for use with the IUE RDAF library. Contributed to a paper being prepared for submission to "The Publications of the Astronomical Society of the Pacific".

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Improved IUE High Dispersion Extraction Algorithms

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14. ABSTRACT

The objective of this work was to support the design of improved IUE NEWSIPS high dispersion extraction algorithms. The purpose of this work was to evaluate use of the Linearized Image (LIHI) file versus the Re-Sampled Image (SIHI) file, evaluate various extraction methods, and design algorithms for evaluation of IUE High Dispersion spectra. It was concluded the use of the Re-Sampled Image (SIHI) file was acceptable. Since the Gaussian profile worked well for the core and the Lorentzian profile worked well for the wings, the Voigt profile was chosen for use in the extraction algorithm. It was found that the gamma and sigma parameters varied significantly across the detector, so gamma and sigma masks for the SWP detector were developed. Extraction code was written.

15. SUBJECT TERMS

IUE NEWSIPS, SWP, high dispersion, extraction

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