High Resolution Gratings Analysis & Proposal Planning Threads
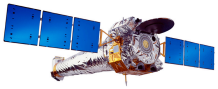
John Houck (MIT-CXC, SDS)

- on behalf of -

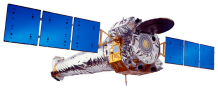## The HETG Group & SDS

Chandra Users Committee Meeting, 9 April 2008

User Resources for Gratings Analysis

- **Chandra Help Desk -** http://asc.harvard.edu/helpdesk/

  ✳ Primary resource for users familiar with analysis threads and guides on the CIAO web pages

- SDS, Calibration, and Instrument team Scientists

  ✳ We can & do provide one-on-one help, including custom analysis scripts, & help with users writing their own scripts.

- CIAO, Calibration, & Instrument Team Web Pages

  ✳ Threads need to be "turn key" - detailed explanations, without assuming *any* prior knowledge

  ✳ What can we do to attract new users (proposal threads) and help existing users (analysis threads)?

Presentation Overview

- **Proposal Planning Threads**

  ✳ Brief description of existing thread on simulating emission lines & pileup in X-ray binaries

  ✳ Brief description of threads in development

    - Simulating emission line triplets

    - Simulating LETG-HRC, with background & multiple orders

  ✳ Description of future threads

    - Simulating absorption line spectra in AGN.

- **Analysis Threads**

  ✳ Motivations for an improved end-to-end guide.

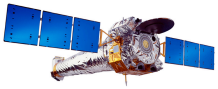 ✳ Thread plans based on tricky situations we've encountered.

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Existing User Resources - Proposals

- Proposal Threads

  * "Simulate HETG Spectrum of an X-ray Binary" -
    http://asc.harvard.edu/proposer/threads/binary/

    - Provides the basics of continuum, emission & absorption line simulations, and fitting. Shows how to estimate pileup.

    - Could be used for fainter sources, & those with more lines.

    - Does *not* discuss using plasma databases to simulate realistic line dominated models.

    - Does *not* discuss more technical/statistical (e.g., using Cash statistics) issues of the differences between fitting emission and absorption lines.

    - Does *not* discuss simulating LETG-HRC observations.

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Proposals: XRB Lines & Pileup

- **Start with CCD Spectra**

- **Use proposal responses to create fake spectra with ISIS - normalize to observed fluxes & EWs**

- **Fit & combine data, determine error bars for line physical & equivalent widths.**

- **Look at low energy spectra with MEG**
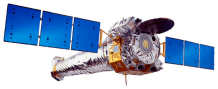
Combined HEG Data
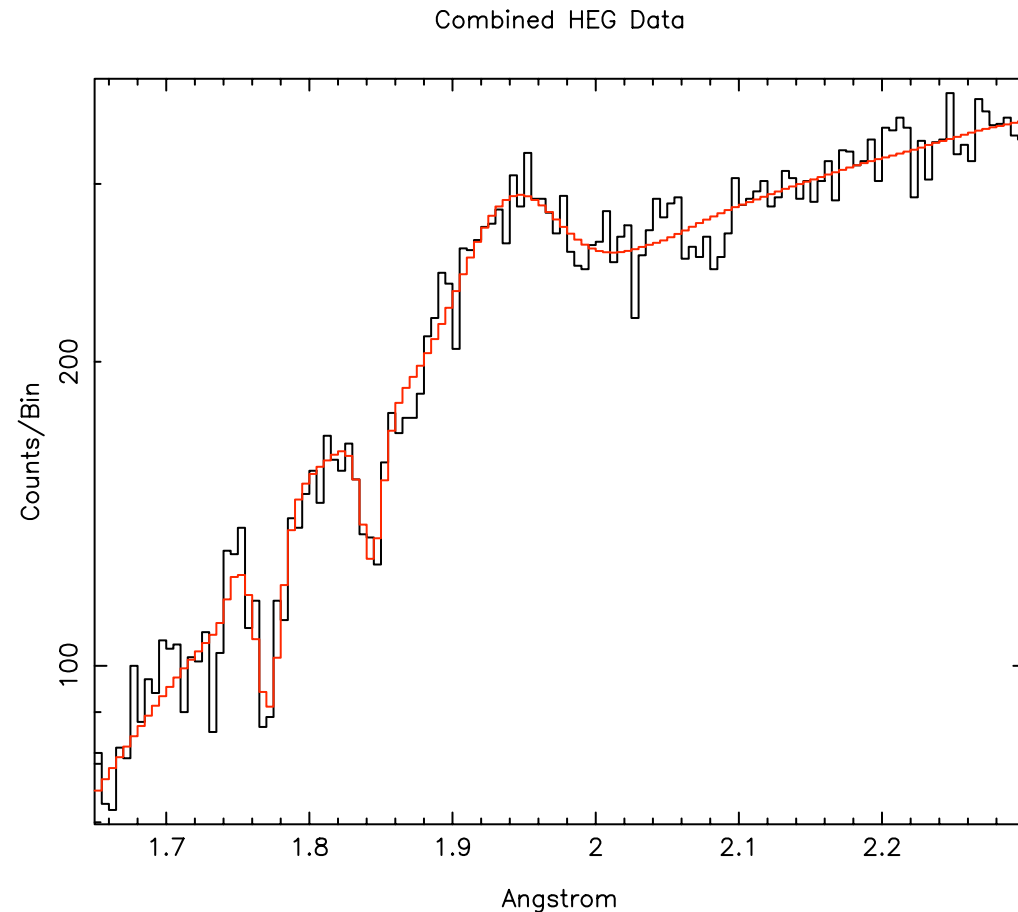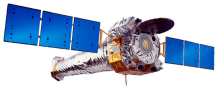
Proposals: XRB Lines & Pileup

- Plot counts/sec/Å - proportional to expected pileup level.

- Convert to pileup fraction

- Give advice on whether mitigation methods will be necessary.

- Thread is "turn key" - do from scratch via cut & paste, or custom modify start-to-finish S-lang script.

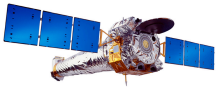*Chandra Users Committee Meeting, 9 April 2008*
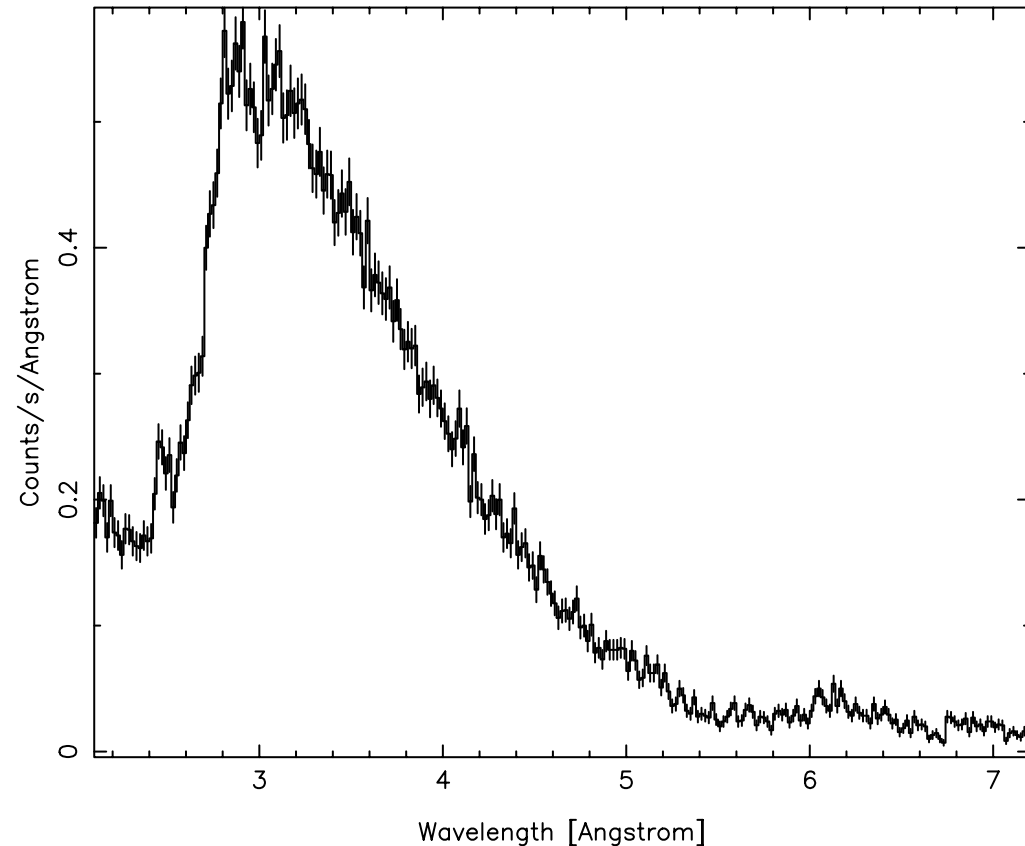
Proposals: Triplet Simulations

- Simulate a coronal plasma model using APED (low density plasma, collisional ionization)

- Fit the simulations with gaussian lines, e.g., at Ne IX.

- Calculate R ratio (forbidden/intercombination line)

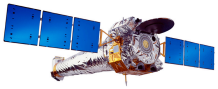- Exists as a script - needs full step-by-step descriptions and to be made "turn key"
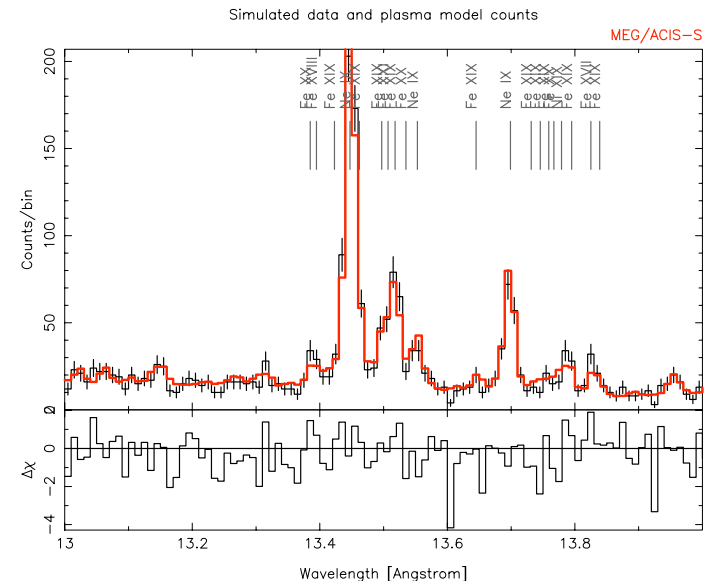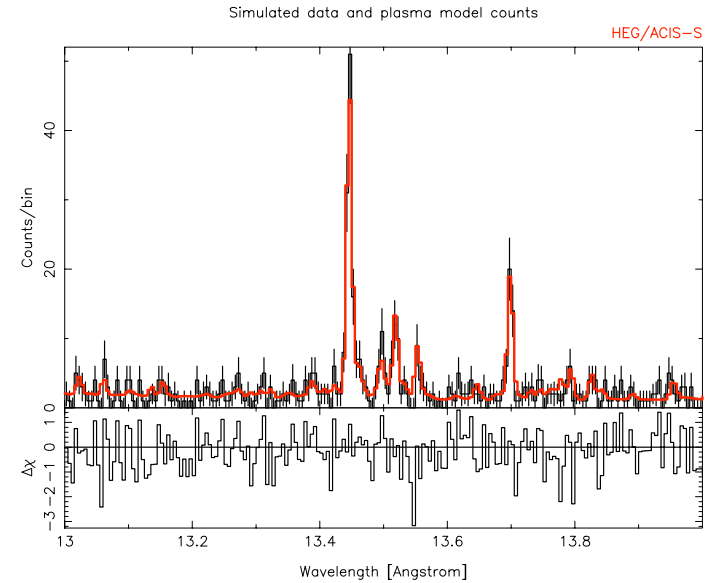
Proposals: LETG-HRC

- LETG-HRC is tricky to simulate - multiple, overlapping orders, and significant background

  ✳ Neither back of the envelope nor PIMMS is sufficient

  ✳ Proposal planning really needs a proper simulation.

    - Have a script that creates a realistic, simulated background, and the overlapping orders.

    - Needs detailed description for thread.

    - Initial scripts were outgrowth of related work in assisting calibration, and answering analysis questions of users.

Future Proposal Threads

- Proposal Planning - Absorption lines in AGN, observed with HETG & LETG-ACIS

  ✳ Absorption lines are different than emission - the latter can go to infinity, the former only to 0.

  ✳ Statistical issues of significance at a known location, vs. blind searches need to be discussed in this thread.

  ✳ AGNs are potentially faint sources, so this would be an appropriate thread for discussion of, e.g., fitting gratings spectra using Cash statistics.
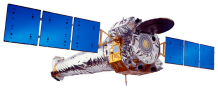
Existing Resources - Analysis

- **CIAO web pages**

  ✳ "Science Threads for CIAO 4.0"-
    http://asc.harvard.edu/ciao/threads/all.html

    - Includes links to gratings analysis resources, some listed here.

  ✳ "Analysis Guide for Chandra High Resolution Spectroscopy"
    http://space.mit.edu/ASC/analysis/AGfCHRS/AGfCHRS.html

    - Provides basic end-to-end overview, but could be updated

  ✳ "HETG/ACIS-S Grating Spectra" (basics of data reprocessing)
    http://asc.harvard.edu/ciao/threads/spectra_hetgacis/

  ✳ "ACIS-S Grating RMFs", "HETG/ACIS-S Grating ARFs" -
    http://asc.harvard.edu/ciao/threads/mkgrmf_aciss/
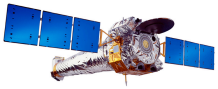   http://asc.harvard.edu/ciao/threads/mkgarf_hetgacis/

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Existing Resources - Analysis

- CIAO web pages (continued)

  - ✳ "Grating Spectra for Multiple Sources - ACIS"-
    http://asc.harvard.edu/ciao/threads/spectra_multi_acis/

  - ✳ "Source Position for Grating Data with a Piled or Blocked Zero Order" - http://asc.harvard.edu/ciao/threads/tg_piled_zero/

    - See also: http://space.mit.edu/cxc/analysis/findzo/

  - ✳ "LETG/HRC-S Grating Spectra", "Higher Order Responses for HRC-S/LETG Spectra" -
    http://asc.harvard.edu/ciao/threads/spectra_letghrcs/
    http://asc.harvard.edu/ciao/threads/hrcsletg_orders/

   - Advanced script, but with little description, also exists:
      http://space.mit.edu/ASC/ISIS/examples.html

Analysis Thread Plans

- Given the numerous listed pages, why new guides?

  ✳ The numerous listed pages ... we can simplify by providing an end-to-end guide, more up to date than existing guide.

  ✳ We have been developing scripts for automated processing

    - Gratings equivalent of psextract - can provide alpha-level scripts to interested parties willing to provide feedback.

    - Needs to be thoroughly documented within a guide context.

  ✳ There are still some things that are tricky to do, for which we can provide user guidance

    - Example - gratings timing analysis of a bright source.

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Future Threads - Timing

- Gratings lightcurves rely on same wavelengths from different chips.

- Chips can have different exposures & data dropouts

- Tricky to get right via tool-based approach.

- Thread to show scripted approach (*aglc.sl* module)

- Necessary, for example, to reveal "Z-track" color-intensity of Cyg X-2

(N. Schulz, in prep.)

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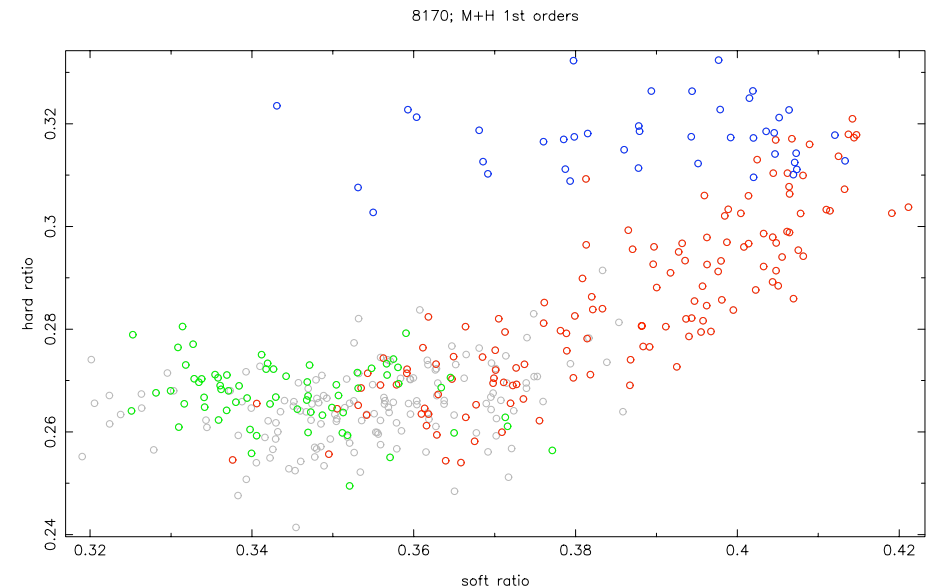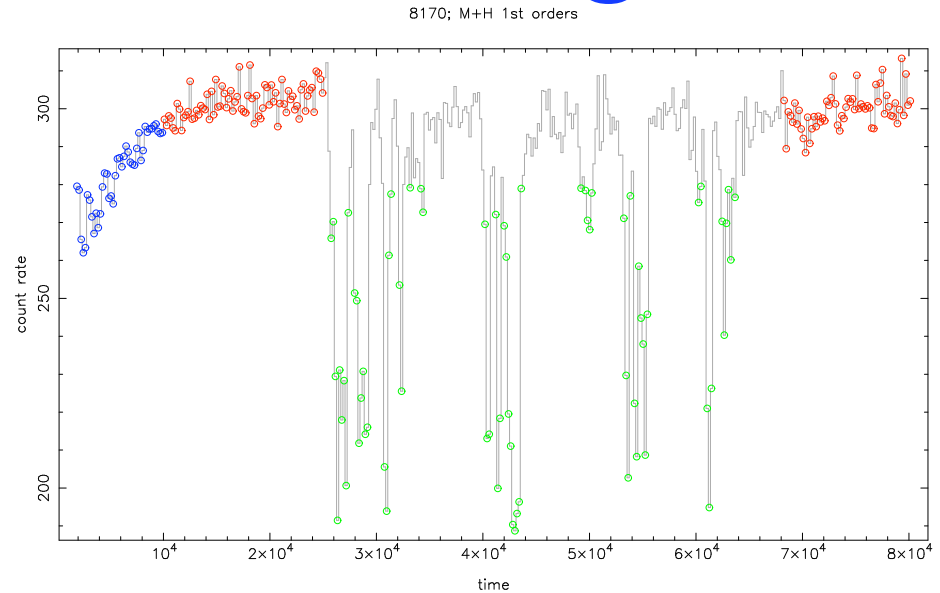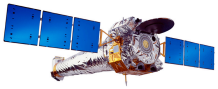
Requested Feedback from CUC

- We plan (summer/fall) to add additional threads/guides

  ✳ What are the highest priority proposal & analysis threads?

    - Based upon experience, in order to get a good end-to-end thread that is tested and fully integrated into the CIAO web pages, we can add ~3-4 new threads/analysis guides before next cycle.

  ✳ What is the best balance between proposal & analysis threads?

  ✳ Suggestions for refinement/enhancement of existing threads?

  ✳ What's the proper balance between a detailed descriptive narrative vs. a customizable script?

    - Answer is likely different for proposal vs. analysis thread.