High Resolution Gratings
Analysis & Proposal
Planning Threads

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- on behalf of -
The HETG Group & SDS
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.
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.
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
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.
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/
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.
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.)
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.