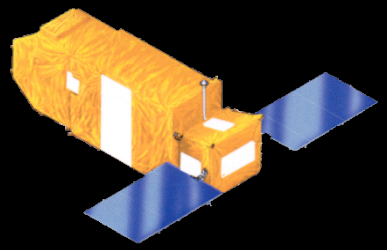

# Overbright Target Observing Techniques for FUSE: Status and Recommendations

Bill Blair

FUSE Deputy PI

Chief of Observatory Operations

FOAC Meeting-November 2, 2004
Paris, France

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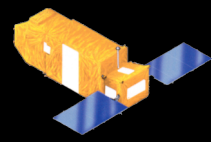
Johns Hopkins University

# Summary



- Lowered HV technique no longer considered operationally viable.
- Scattered light technique only viable in certain low impact applications.
- SiC-only option viable and being pushed to its useful limit.
- Defocus technique
  - Has been shown to produce scientifically viable data sets, but
  - Operational difficulties and human resource issues will at best severely limit usage.
- Recommendation follows at end.

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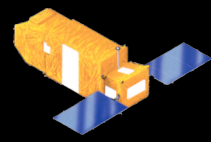
# Overbright Target Techniques



- **Lowered HV method:** (35-100x bright limit) Tests and analysis indicate only limited utility of this technique. White paper written to document, but no operational use is planned.
- **Scattered light technique:** In principle, usable in certain limited cases that can tolerate use of LWRS aperture (lowered spectral resolution) or other apertures >30" from overbright source.
  - Still requires IDS script reload and IDS reboot before reasonable safety can be guaranteed. (Scheduled for early December.)
- **SiC only technique:** (3-5x brightness limit) Targets needing this technique have been released from hold.
  - Many previously on HOLD targets have been assessed and added to this category.
- **Defocus technique:** (<15x brightness limit) Further testing has demonstrated it is viable scientifically, but very difficult operationally. (See following.)

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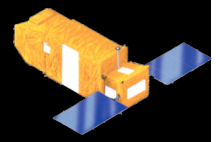
# Testing Summary



- 67 observations scheduled for 424 ks.
  - S523 (defocus): 46 for 363 ks.
  - S525 (lowered HV): 21 for 61 ks.
  - Major tests 9/17-19/03, 11/10-12 and 11/21-23/03, 1/27-29/04, 3/29/04, 5/6-9/04, 5/17-19/04, 6/4-7/04, 6/21-23/04, 6/27-30/04, 10/6-8/04.
- Wall clock time expended: 1.2 Msec (~14 days).
- Number of extra thermalizations/alignments: 13 instances for total of 711 Ksec (8.2 days).
- Each test has required substantial effort by MP/ops staff to plan, execute, and assess.

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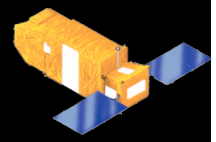
# Defocus Testing Details
## (Good news and Bad news…)



- Tests have sampled characteristics/systematics of different *directions* of defocus.
  - Grid wires apparent in data from both directions.
- Spot size does not get as large as expected from ray traces.
  - Possible vignetting effect?
  - Full attenuation is ~15x. (Somewhat less than expected.)
- Defocused spot positioning is not well behaved.
  - One defocus direction is better behaved than the other.
  - Complicated and time consuming alignment procedures are apparently required each time we defocus.
- Scientific utility of defocus data has now been demonstrated.
  - FP-Split technique can successfully remove grid wires.

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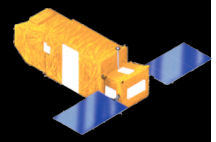
# S523:11:06



- Most recent, full-up science test observation.
- HD 188209 O9.5 Iab
- F(1150 Å) = 4.3 x $10^{-10}$ erg/s/cm$^2$/Å
  - substantially above the nominal bright limit
- Observed October 8, 2004
  - Side 2 only; HIST; HIRS aperture
  - Full FP-split, multiple PKUPs per orbit.
  - 24 exposures: 11,542 ks
- Partially processed with CalFUSE 3.0.7
  - up to “cf_remove_motion” since astigmatism calibration files are inappropriate for defocussed image.

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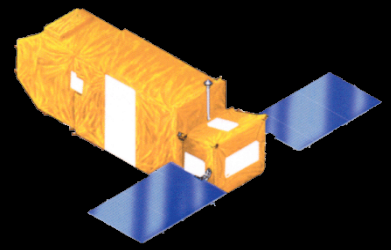

# Test

Compare the extracted spectrum with a reference spectrum selected from the input to the FP-SPLIT algorithm.

The next 4 slides make the comparison at a compressed scale of 3400 pixels per plot.

For display purposes, all curves have been smoothed by 2 pixels.

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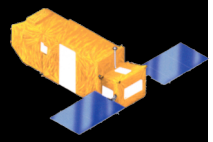

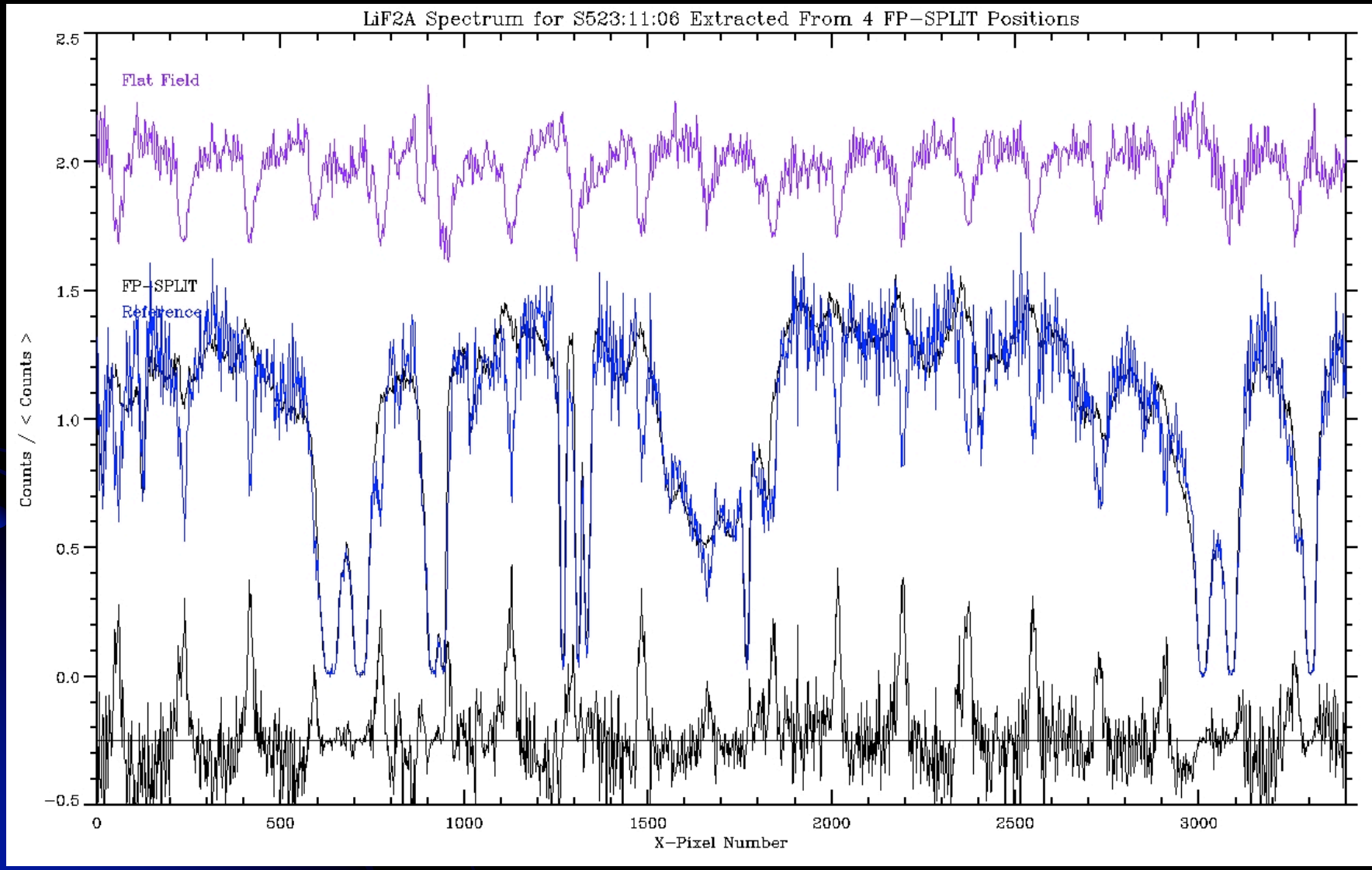

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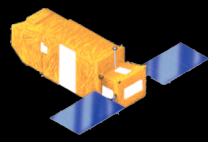

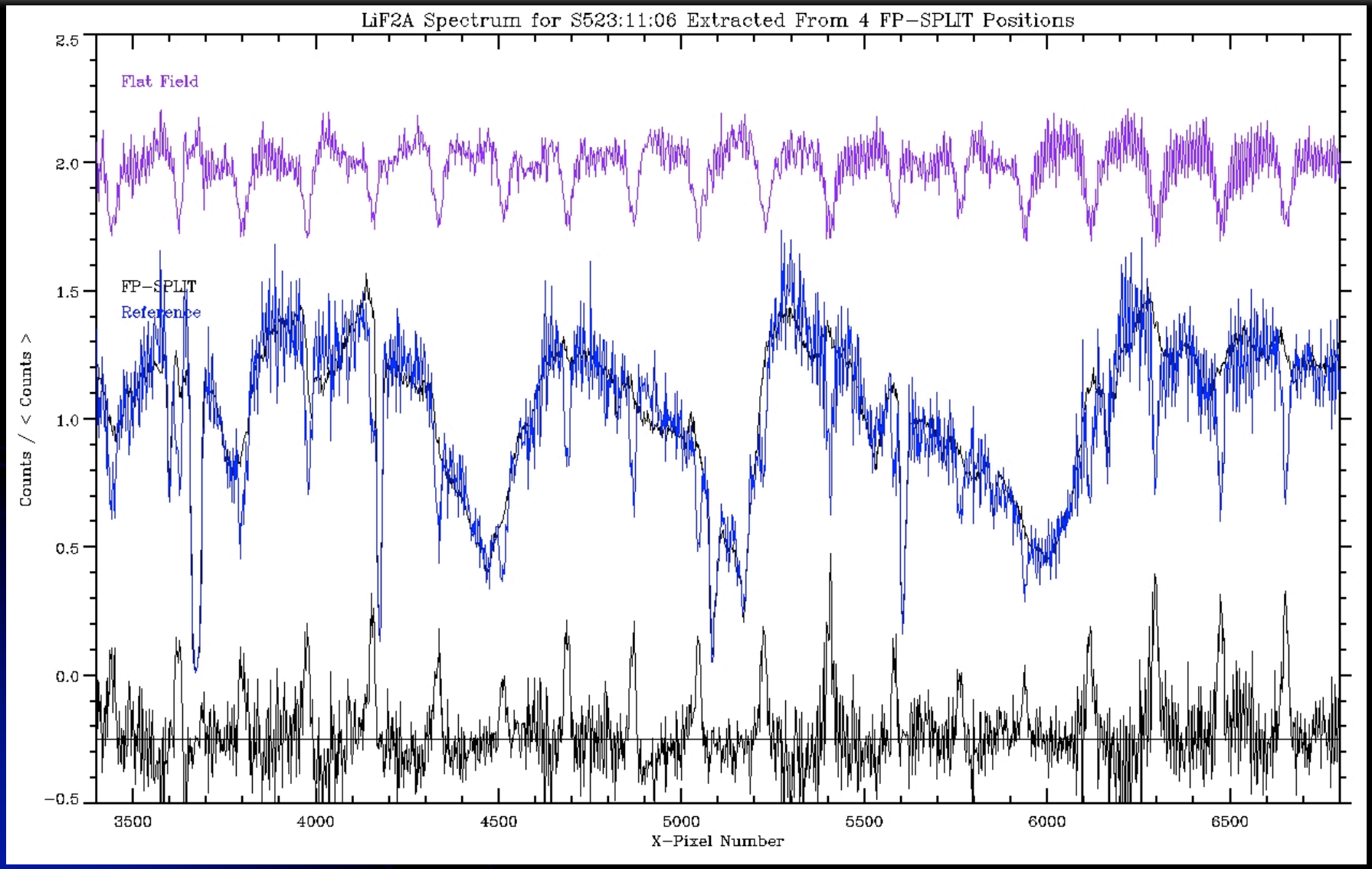

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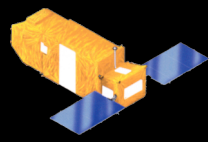

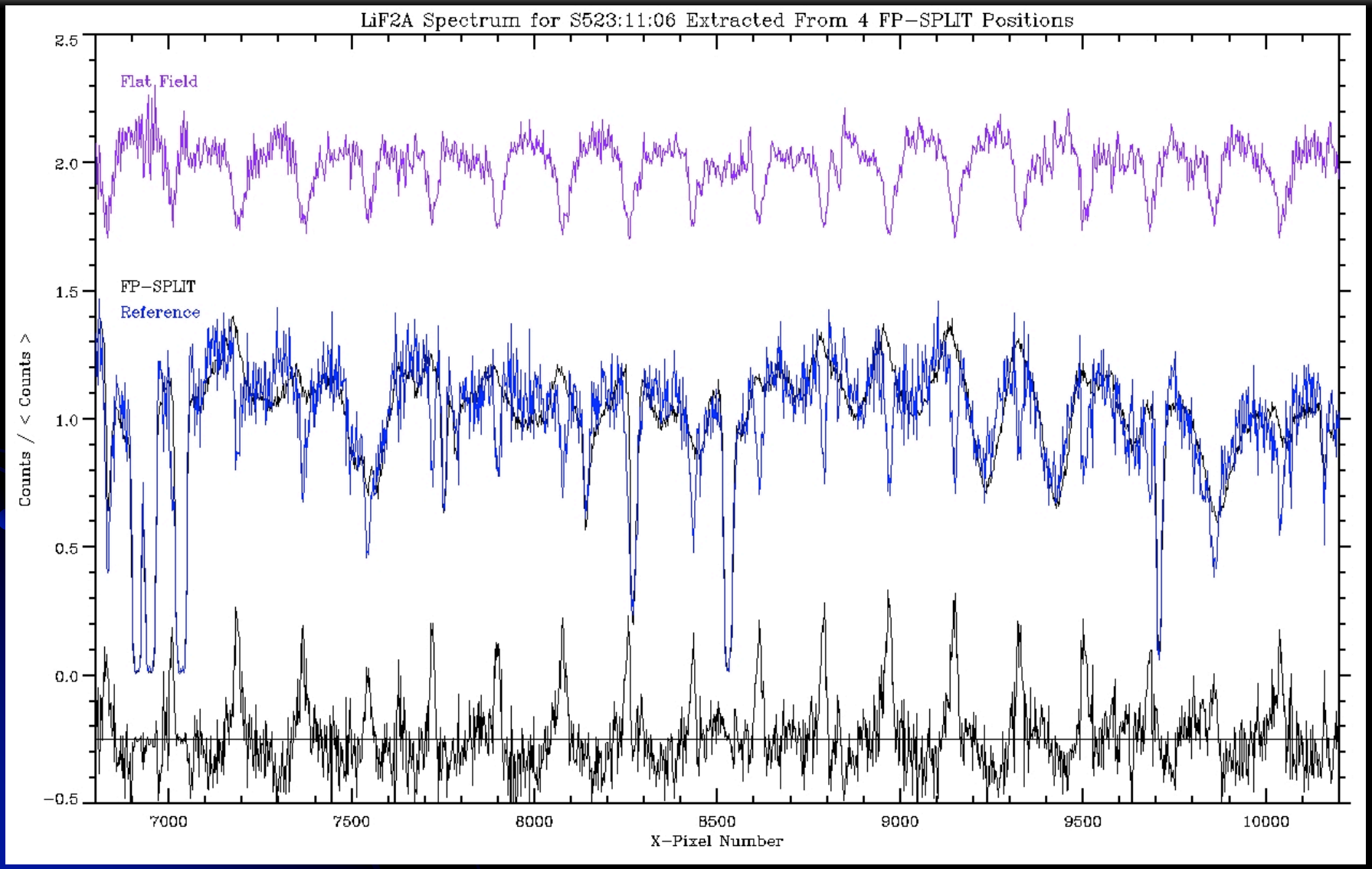

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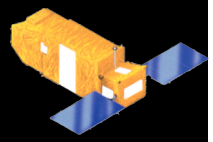

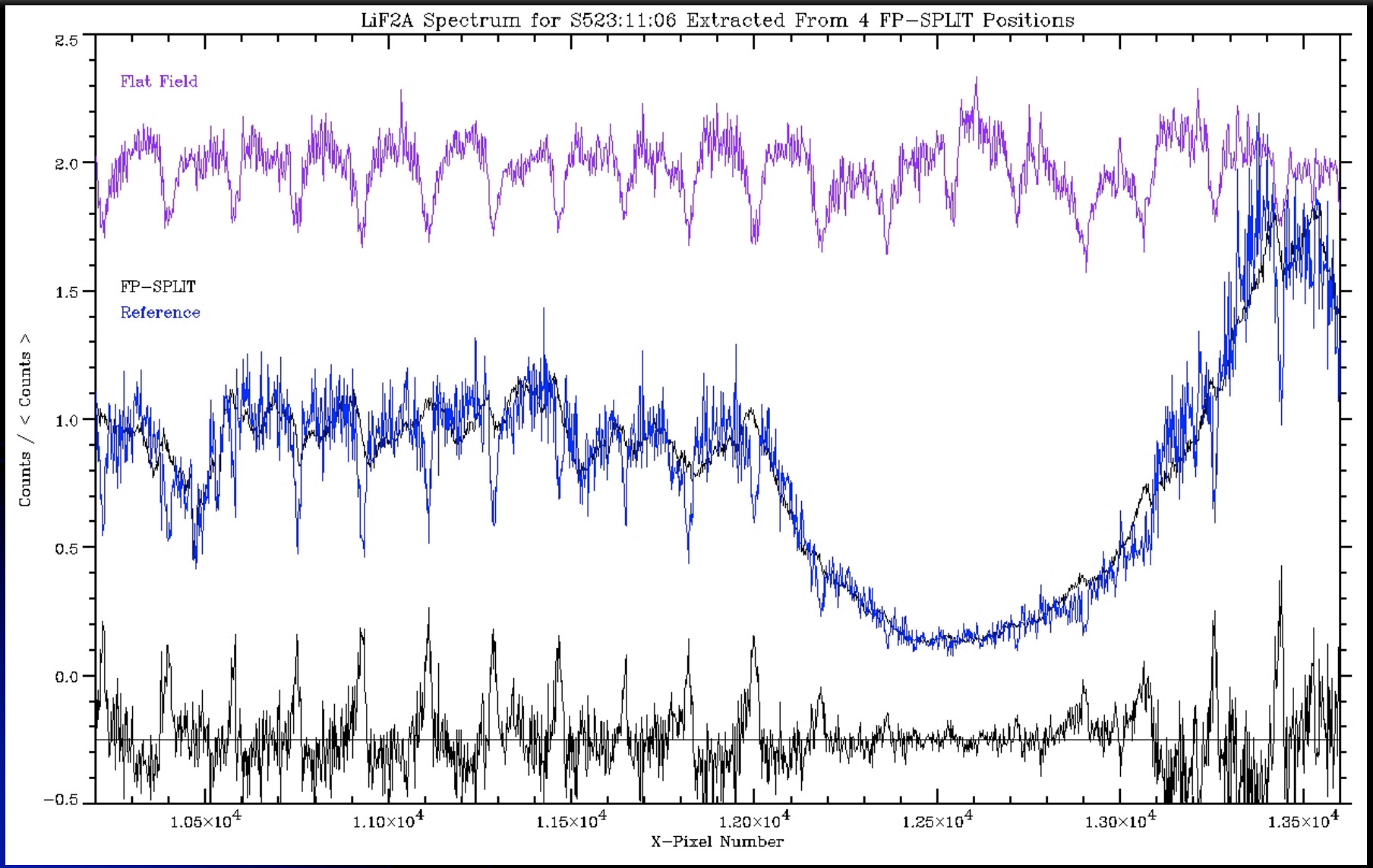

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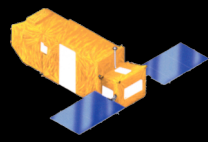
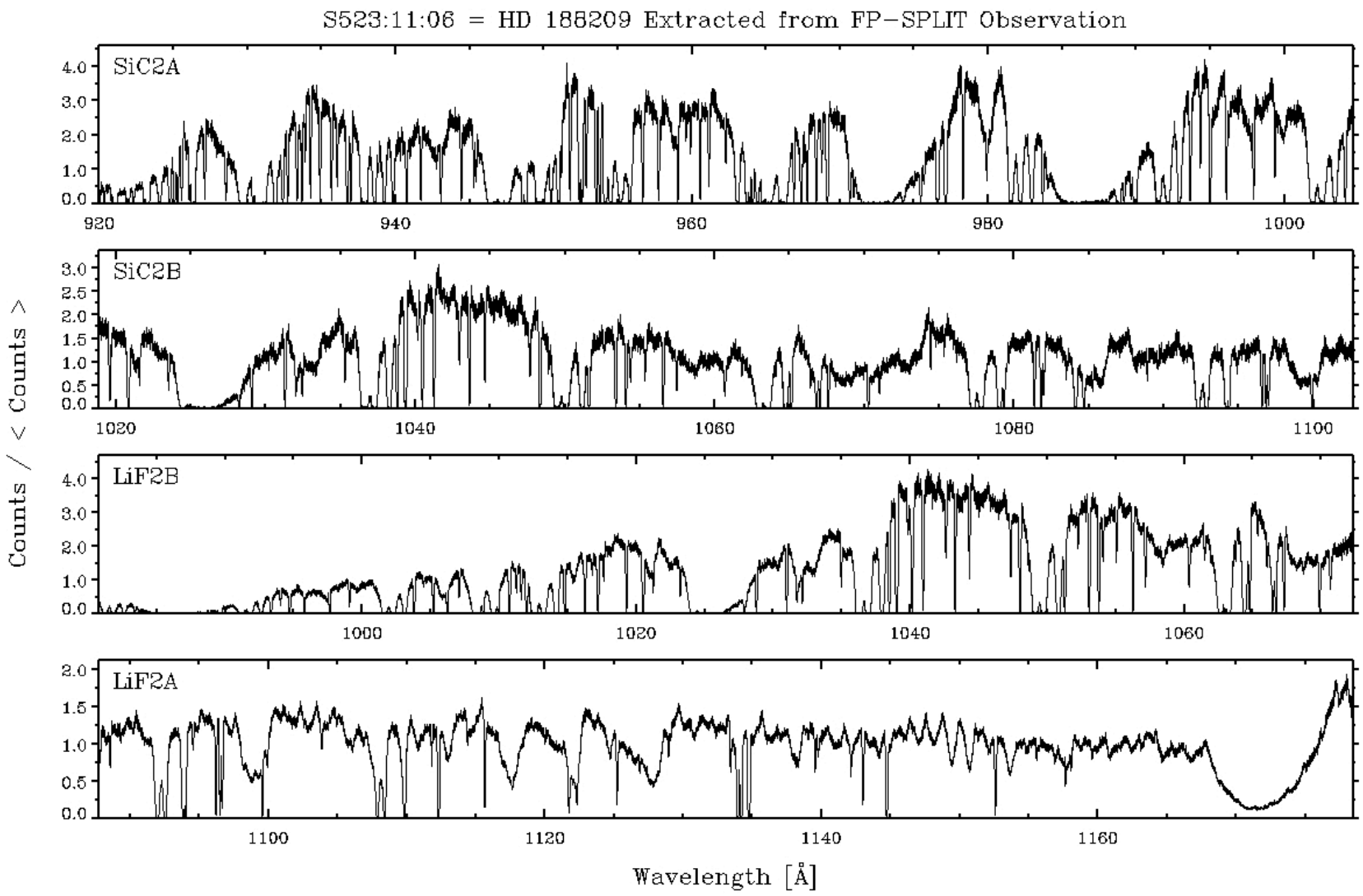
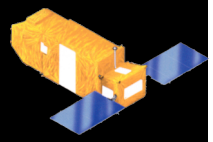
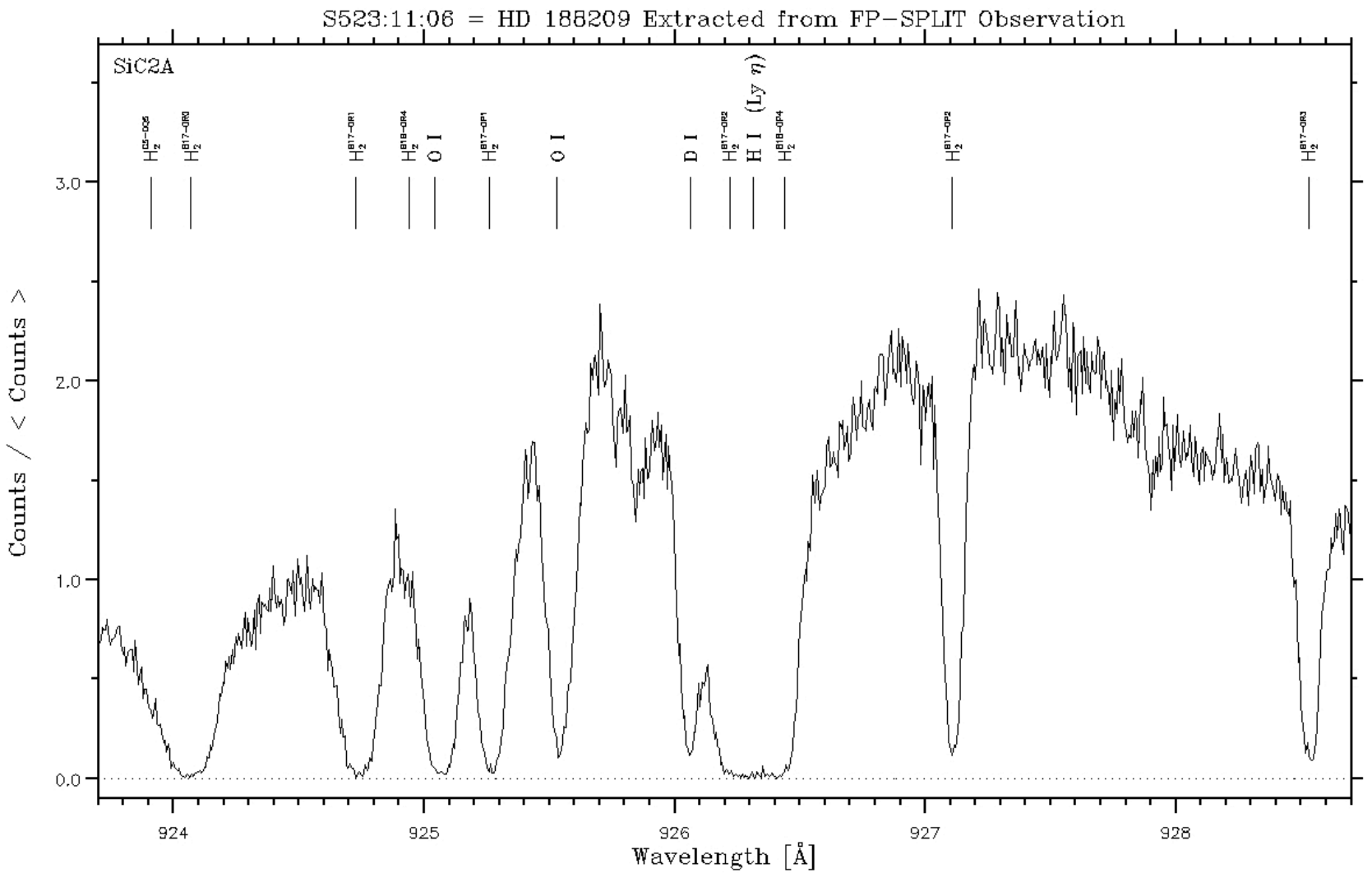
# Science Summary





# Full FP-split Reduction





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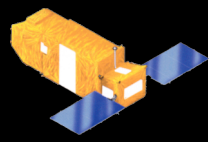
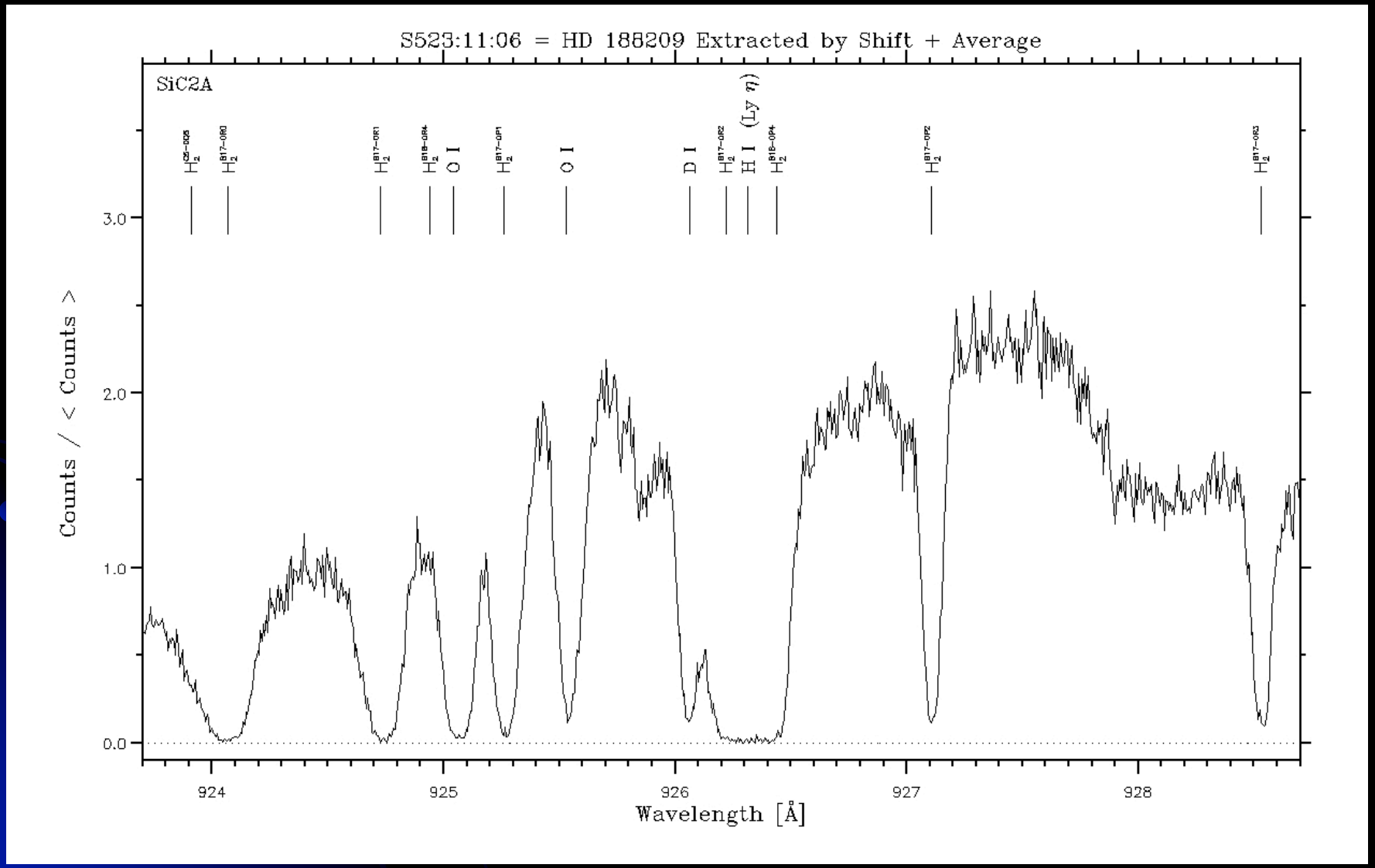
# Shift and average reduction





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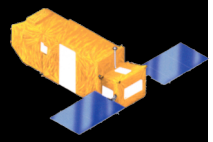
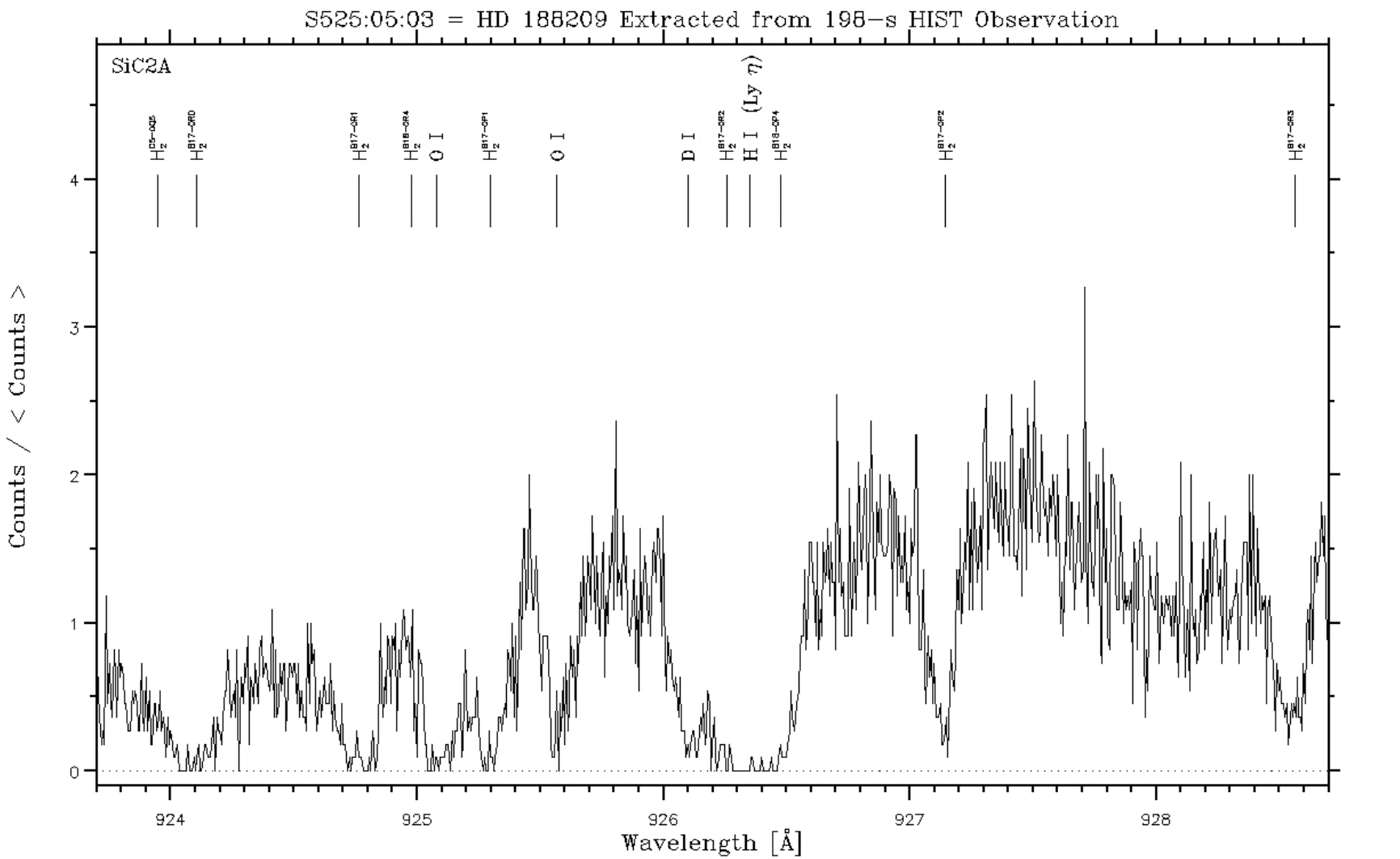
# SiC-only SAFTSNP





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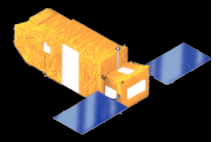
# Operational Issues



- Technique is extremely cumbersome and requires excessive manual resources.
  - Most recent test (early October) required ~1.5 FTE months of "extra" ops team effort (by the same key people needed for other important activities like alignments and gyro work).
- Large overheads required for defocus/alignment, and refocus/alignment activities.
  - Ground station coverage issues for near-real time updates.
- "Campaign" scheduling could help in principle, but apparently not very much in practice.
- Further development (operations, calibration, data processing, and analysis tool work) will be required to take full advantage.
- Overheads would decrease with additional experience, but will always be high.

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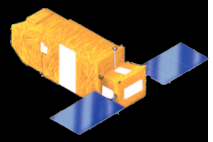
# Defocus Recommendations



- Option 1: Stop further development/implementation and eliminate all pending defocus observations.
  - We simply do not have the resources to further develop and carry out these observations.
  - Further work will (continue to!) impact other work to prepare for further downsizing.
- Option 2: Extremely limit the application of this technique to a few targets of bona fide highest scientific priority.
  - Requires careful reassessment and prioritization of all requested observations needing defocus.
  - Requires delay/deferment of other important activities.

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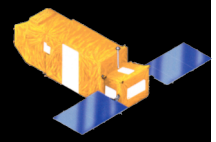
# My Recommendation:



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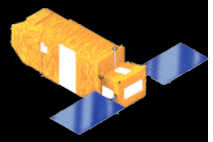
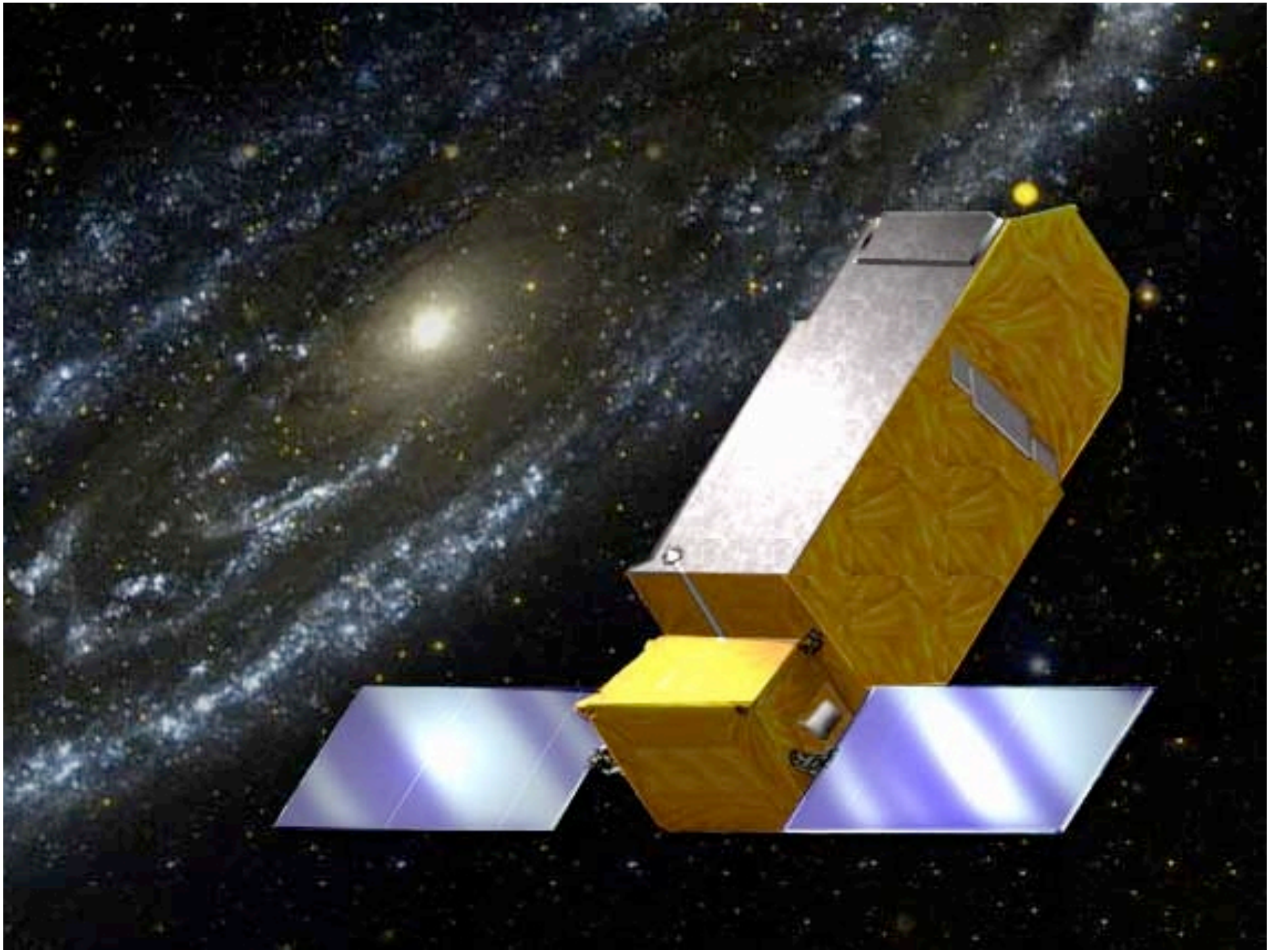
# "Development" needs



- Alignment tools and modeling.
  - Feedback process to improve predictive motions.
  - Would improve alignments and data quality for everyone.
  - Might allow lowered frequency of alignment activities.
- Calibration file production: automate/streamline.
  - To ease burden on reduced staff downstream.
- Calibrations to improve final archive.
  - LSF characterization, "Worm" mapping, etc.
- Reprocessing/final archive of earlier data.
- 1-wheel contingency planning.
  - In project's best interest to scope this out before it happens.



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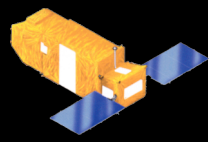
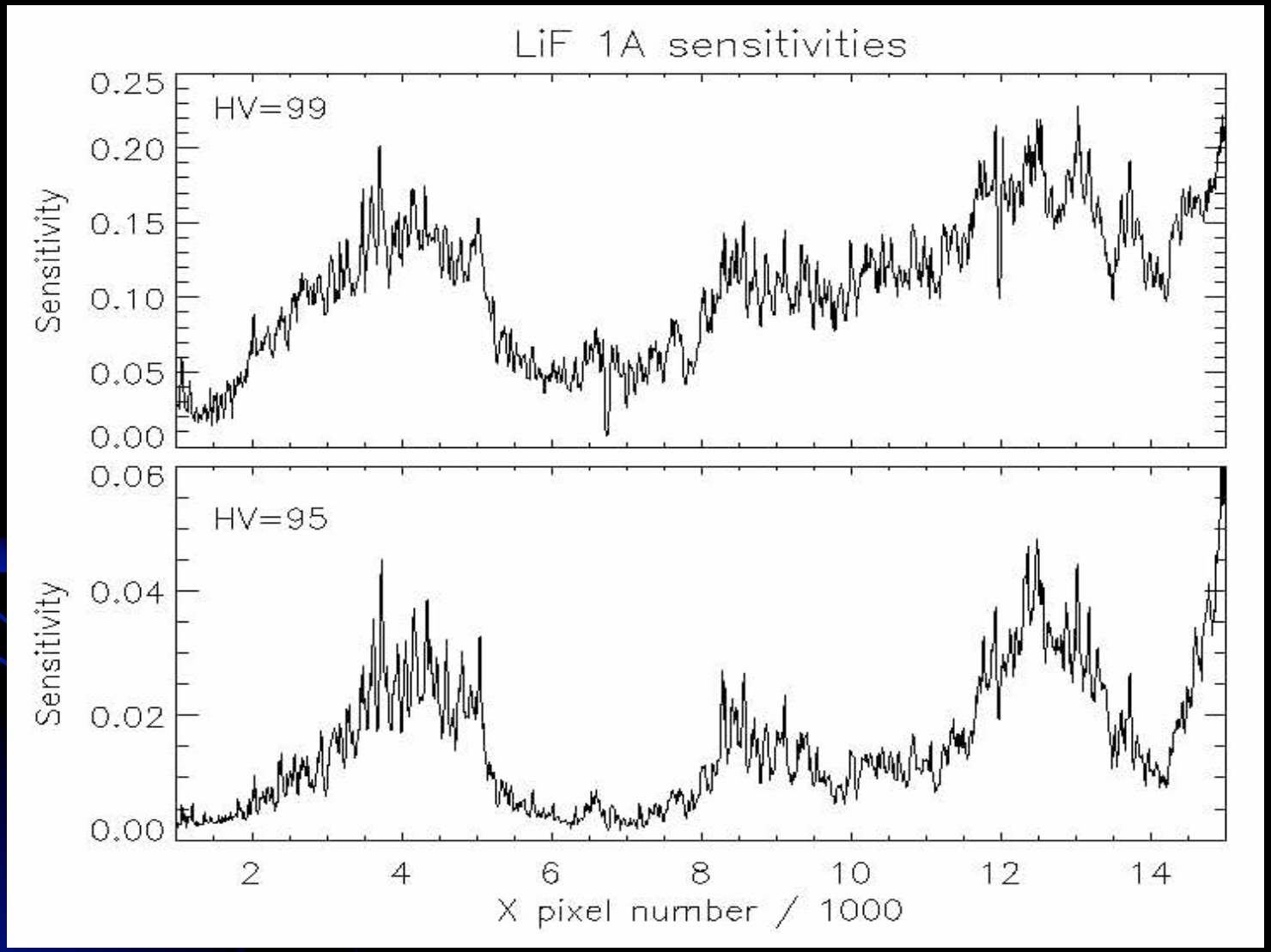
# Lowered HV Technique





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# Lowered HV-Detail