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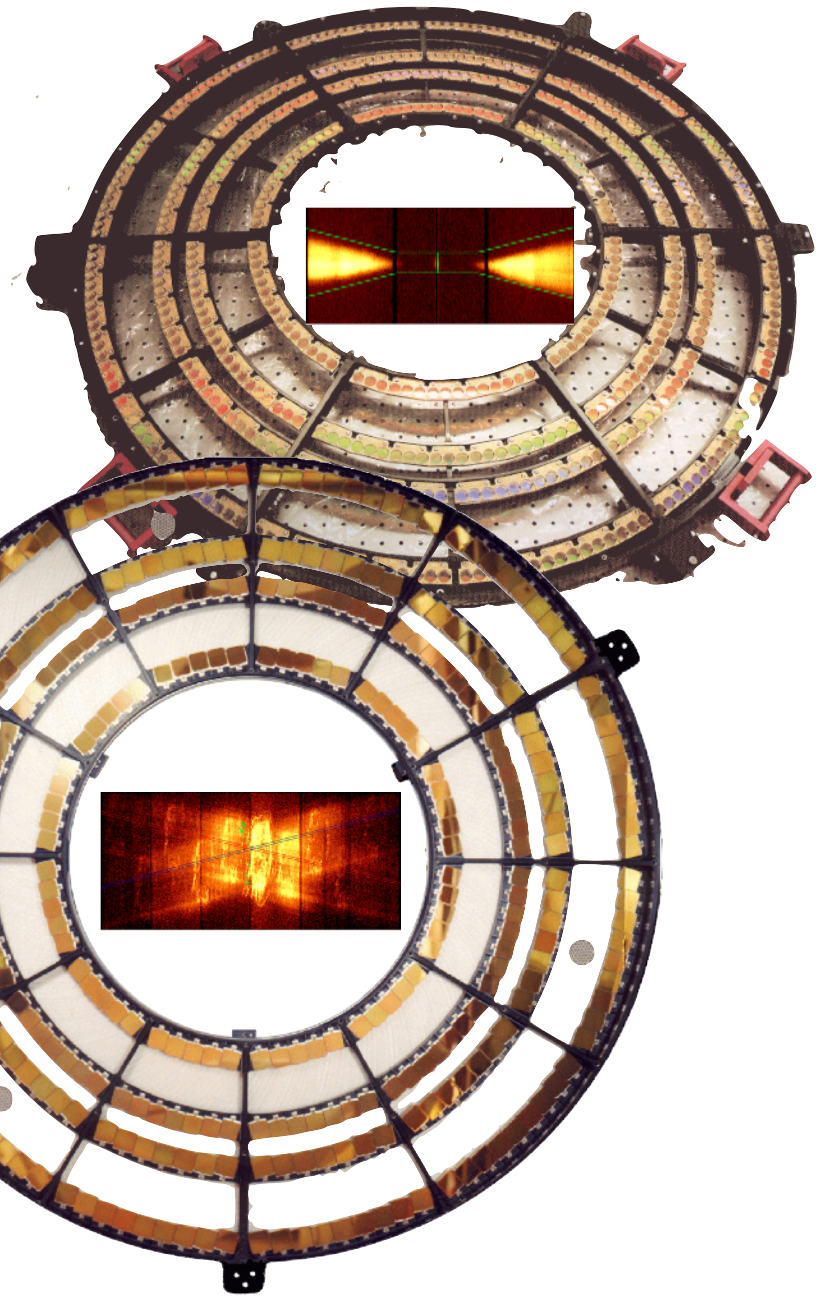
HETG/LETG — Status

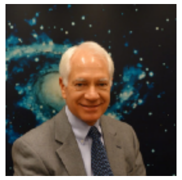


Chandra Quarterly Review No. 50

27 October 2020

David Huenemoerder
dph@space.mit.edu

HETG IPI: Prof. C.R. Canizares
MIT Kavli Institute



LETG IPIs: Dr. Peter Predehl
Max Planck Institute

Dr. Jelle Kaastra
SRON

HETG/LETG Activities Summary

Performance April 2020 — October 2020

HETG/ACIS-S 2200 ks

- 80 observations on 18 targets (51 GO, 8 GTO, 5 Cal, 4 TOO, 12 DDT)

LETG 450 ks, 8 targets

- 17 LETG/HRC-S observations (105 ks; 0 GO, 1 GTO, 6 Cal, 0 TOO, 9 DDT, 1 CoolCatTarg)
- 10 LETG/ACIS-S observations (240 ks; 10 Cal)
- 4 LETG/HRC-I observations (105 ks; 1 Cal, 2 GTO, 1 TOO)

Grating performance is nominal.

http://tgcat.mit.edu

TGCat has 2201 extractions for 521 objects (+102/+20 since last report)
Total volume: 486 GB
Downloads: 617 packages, 62 GB
Maintenance: port to modern infrastructure (PHP, MySQL), new server continuing.

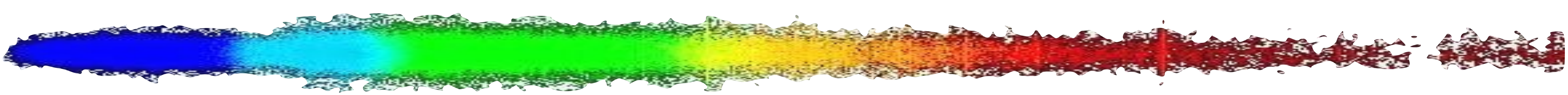
HETG GTO Science Program

Cycle 20:

★NS:	Terzan 5 X-2	0/200 ks	TOO (10%); Neutron Star Equation of State
★LIGO:	GW2019nnnn	0/300 ks	TOO (10%); Gravitational wave transient
★Stars:	SZ 96	246 ks	Young, low mass stellar accretion
★**XRB:**	**4U 1626-67**	48 ks	Neutron star accretion (monitoring)
★SNR:	Cas A	92 ks	Decadal visit — 20 yrs on, dynamics
★**AGN:**	**Mrk 335**	0/280 ks	TOO Narrow Lined Seyfert, w/ NuSTAR, NICER; warm absorbers
★SNR:	Cas A	92 ks	Decadal visit — 20 yrs on, dynamics

Cycle 21:

★Stars:	Brey 84	231 ks	Massive stars, stellar winds
★XRB:	IGR J16318-4848	0/250 ks	Fe diagnostics of neutron star accretion; with NuStar
★XRB:	4U 1636-53	0/140 ks	ISM survey, Si edge absorption, scattering.
★LIGO:	GW2020nnnn	0/300 ks	Gravitational wave transient (un-triggered)
★NS:	Terzan 5 X-2	0/200 ks	TOO (10%); Neutron Star Equation of State (un-triggered)
★NS:	4U 1820-30	0/200 ks	TOO; Neutron star gravitational redshift, radius (un-triggered)



HETG GTO Science Program (continued)

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Cycle 22:

★AGN:	Mrk 335	82 ks	TOO Narrow-Lined Seyfert, w/ NuSTAR, NICER; warm absorbers
★AGN:	NGC 1365	0/300 ks	Seyfert galaxy; outflows, ionization state, variability
★Stars:	ρ Oph A	0/200 ks	Massive star winds
★XRB:	4U 1626-67	0/60 ks	Ultra-compact binary; monitor disk emission lines.
★XRB:	GX 17+2	0/100 ks	ISM survey; Silicon gas-to-dust ratios
★XRB:	GX 3+1	0/100 ks	ISM survey, ionized Silicon variability
★BH:	SS 433	0/225 ks	Relativistic jets in a black-hole, massive star binary; monitor flow.
★NS:	4U 1820-30	0/250 ks	TOO; Neutron star gravitational redshift, radius

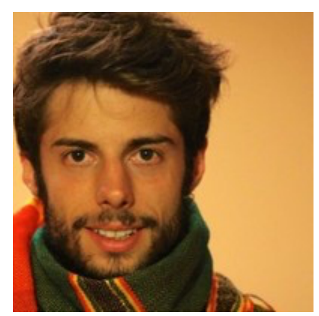
HETG Postdoc status/activities:

New hires:

Daniele Rogantini (SRON) - started 16 Oct

Peter Kosec (U.Cambridge) - starts 1 Jan 2021

Daniele



Peter

The rest of our postdocs on whom we depend…

Pragati Pradhan

Jun Yang

Steven Silverberg

Alan Garner

"New" faculty (since 7/2019) working with the group…

Erin Kara

LETG GTO Science Program

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Cycle 19:

★ NS: (Predehl/MPE) RX J2143.0+0654 173 ks Cyclotron Absorption Line in an Isolated Neutron Star (LETG/HRC-S)
★ ISM: (Kaastra/SRON) 4U 1608-522 25 ks ISM dust, Mg and Si K-edge absorption (HETG/ACIS-S)
★ Gal: (Kaastra/SRON) 1E 2216/1E 2215 147 ks Shocks in Galaxy Cluster Collisions (ACIS-I)
Gu et al (2019, Nature Astronomy, 3, 838) *Observations of a pre-merger shock in colliding clusters of galaxies*

Cycle 20:

★ NS: (Predehl/MPE) RX J1856.6-3754 166 ks Isolated neutron star, calibration (with eRosita) (LETG/HRC-S)
★ Gal: (Kaastra/SRON) NGC 5548 168 ks AGN outflows, absorption, ionization, obscuration (HETG/ACIS-S)

Cycle 21:

★ AGN: (Kaastra/SRON) Mrk 279 0/175 ks AGN outflows, ionization, absorption (LETG/HRC-S)
★ SN,SNR: (Predehl/MPE) DEM S5 0/171 ks Pulsar wind nebula, morphology, dynamics (ACIS-S)
★ Sol.Sys: (Predehl/MPE) Mars 0/75 ks Solar wind - atmosphere interaction (LETG/HRC-S)

Cycle 22:

★ Stars (Predehl/MPE) RX J0859.1+0537 0/60 ks Accretion onto white dwarfs (LETG/HRC-S)
★ Stars (Predehl/MPE) RX J1002.2-1925 0/48 ks Accretion onto white dwarfs (LETG/HRC-S)
★ AGN (Predehl/MPE) HSC J092120.56+000722.9 0/20 ks Confirmation of faint z=6.56 eROSITA Quasar (ACIS-S)
★ AGN (Predehl/MPE) 2MASX J09325962+0405062 0/50 ks Confirmation of eROSITA Compton-thick Seyfert (ACIS-S)
★ AGN (Kaastra/SRON) MR 2251-178 0/175 ks Galaxy outflows, absorption line density diagnostics (LETG/HRC-S)

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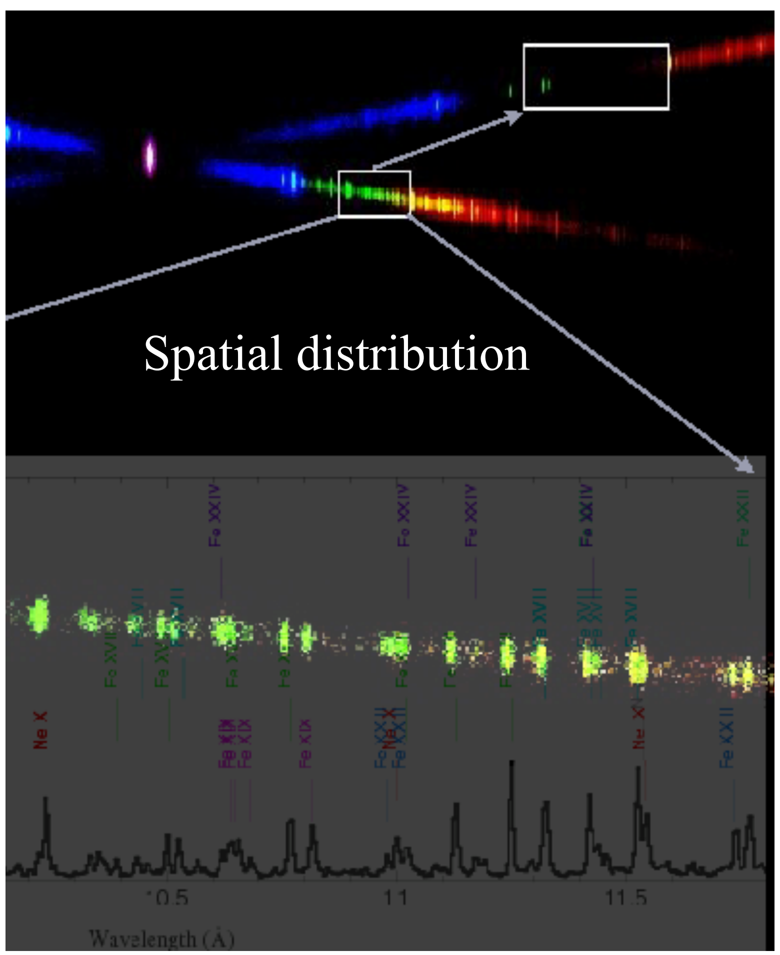
Effects of a Warm ACIS Focal Plane on HETGS Spectroscopy

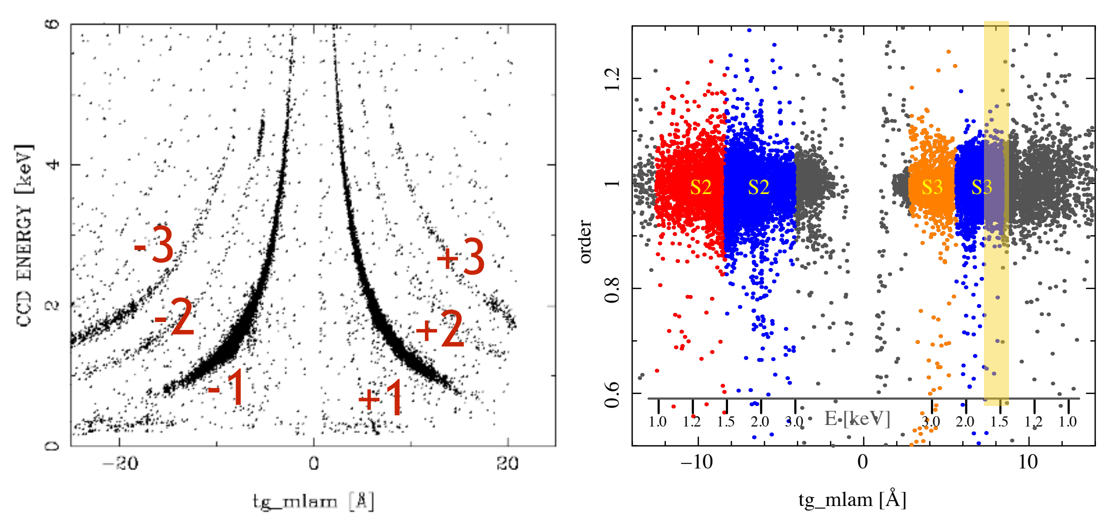
Possible effects investigated:
- Change in detector Quantum Efficiency
- Gain changes in centroid of order selection
- RMF width change affects flux collected

Methods:
Took several datasets with observations over a range in focal-plane temperatures (θ[1] Ori C, Capella, 4U 1626), looked at fluxes (QE), order-sorting centroids (gain), and order-sorting widths (RMF).



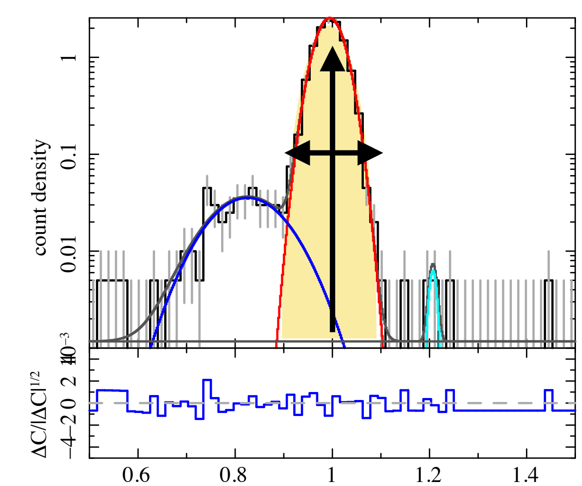
A *very brief* guide to HETG spectral calibration:

CCD Energy distribution … and 1st order *flattened*.

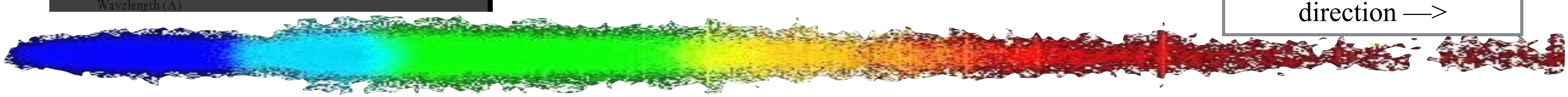


< — dispersion direction —>

Do the centroid, width, or area change with temperature?



< — cross-dispersion direction —>



HETG: Calibration Update (continued)

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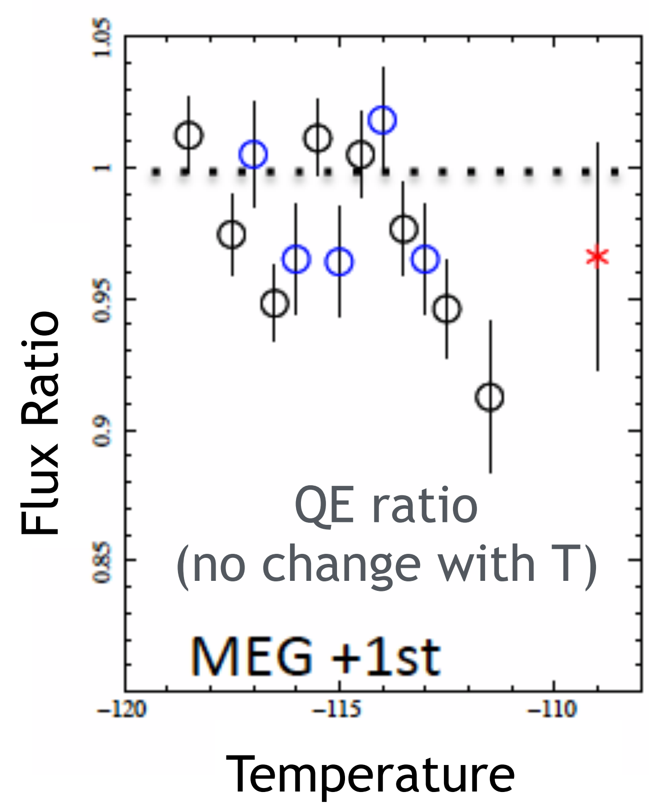
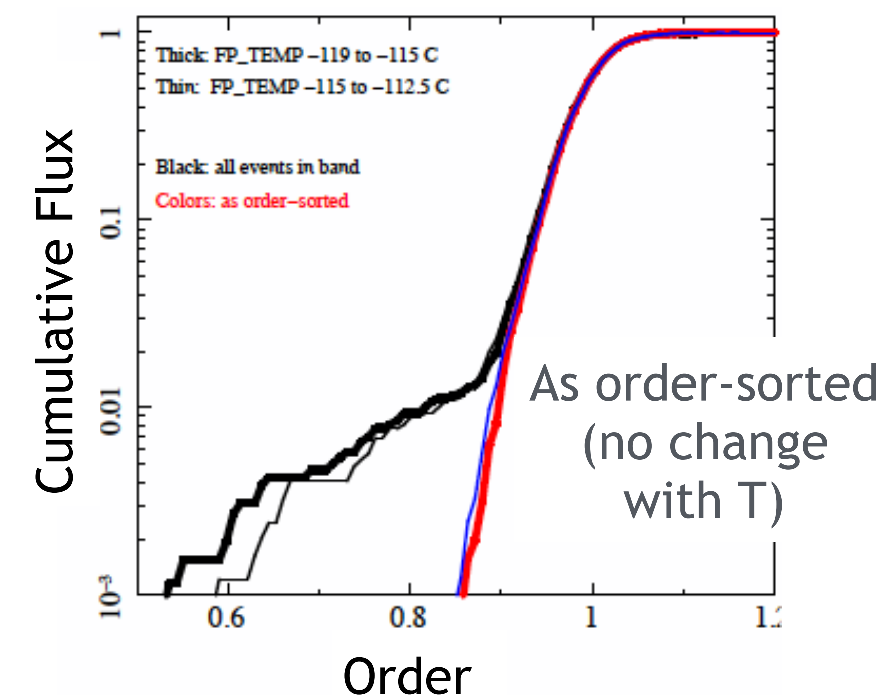
Do the centroid, width, or area change with temperature?

- Effect of higher *T* on Quantum Efficiency looks negligible.
- <1% effect on order-sorting window due to shift in energy centroid (gain)
- <1% effect due to wider energy distribution width (RMF)

Caveats:

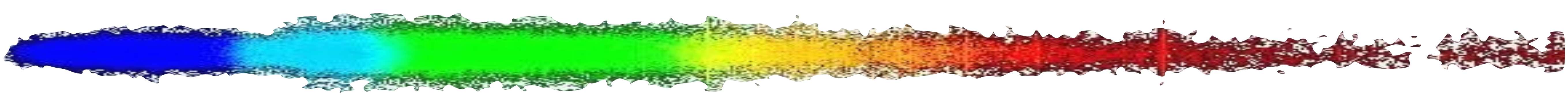
- Small RMF effects need more data
- Some inconsistencies between datasets



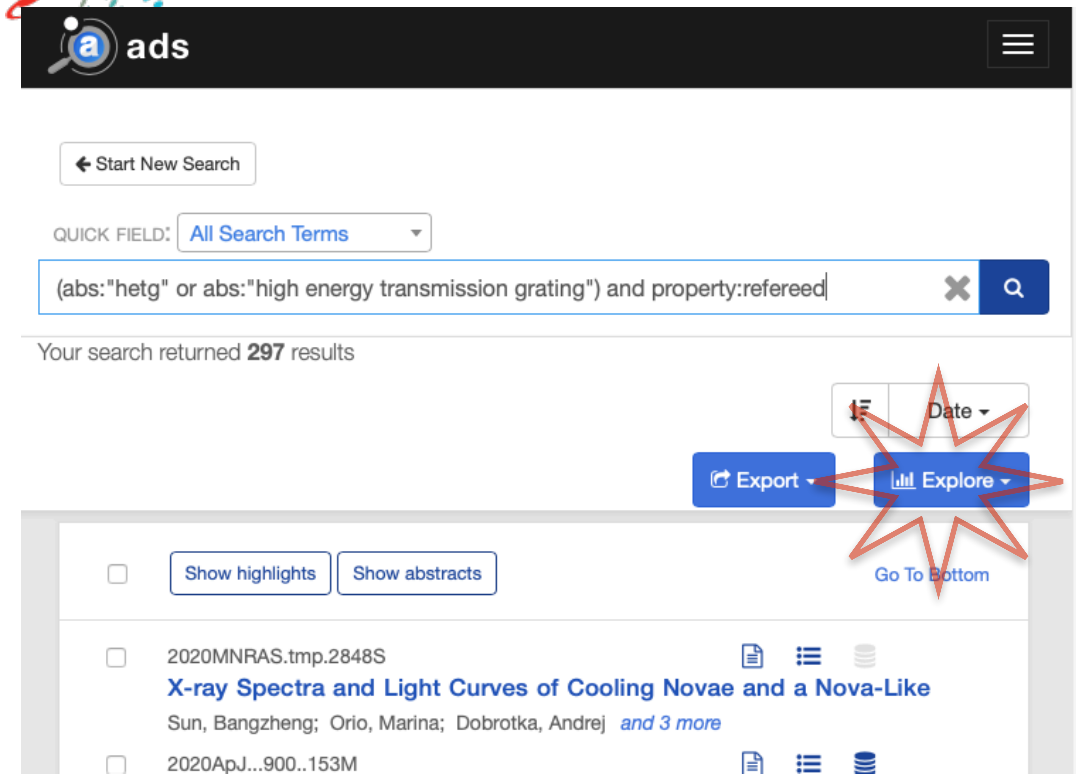


Overall impression: OK to use HETG at warm ACIS temperatures
(which is an aid to Chandra operations)

For details, see: <https://space.mit.edu/cxc/docs/WarmACISeffectsOnOSIP_20200611.pdf>

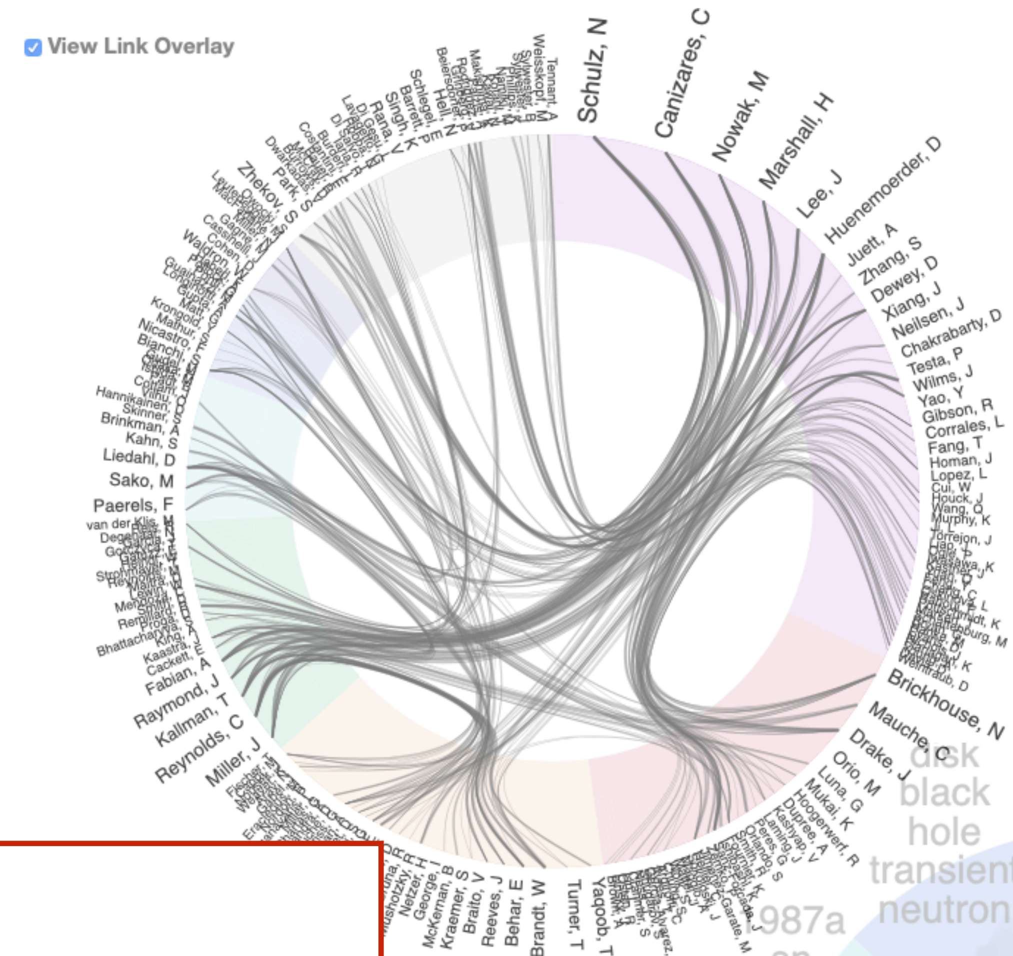


HETG GTO/GO Science: Let's look at *ALL* * the papers…



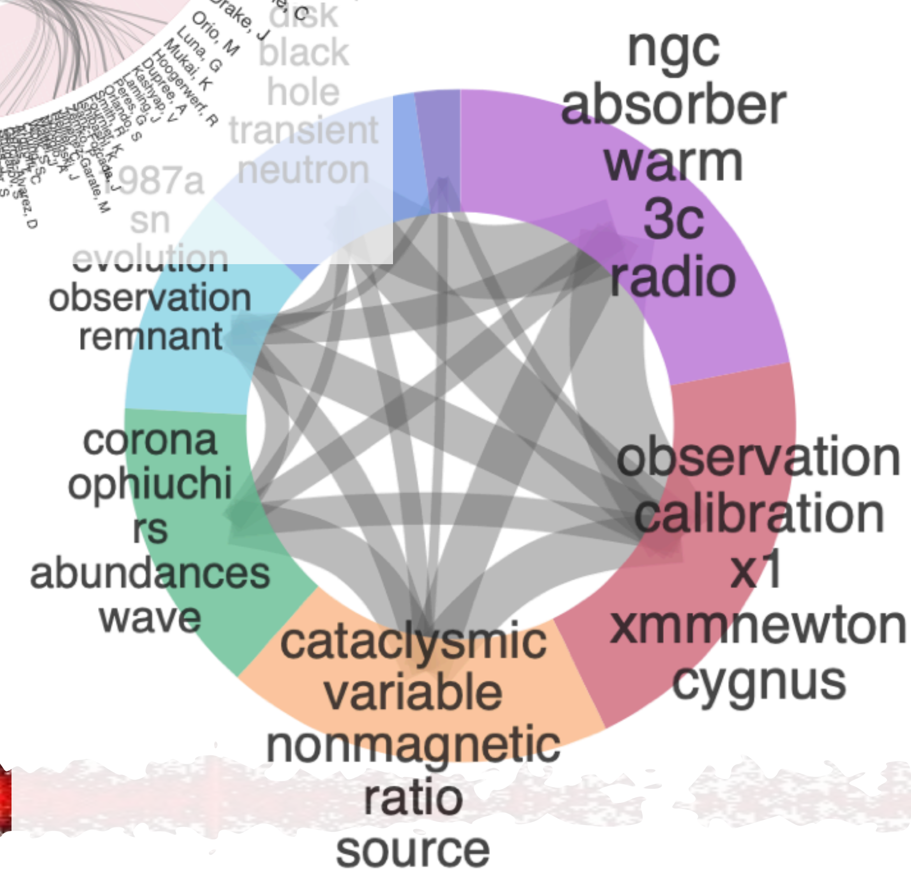
* which have "HETG" in the abstract and are refereed.

(Or, having fun with the "new" ADS.)

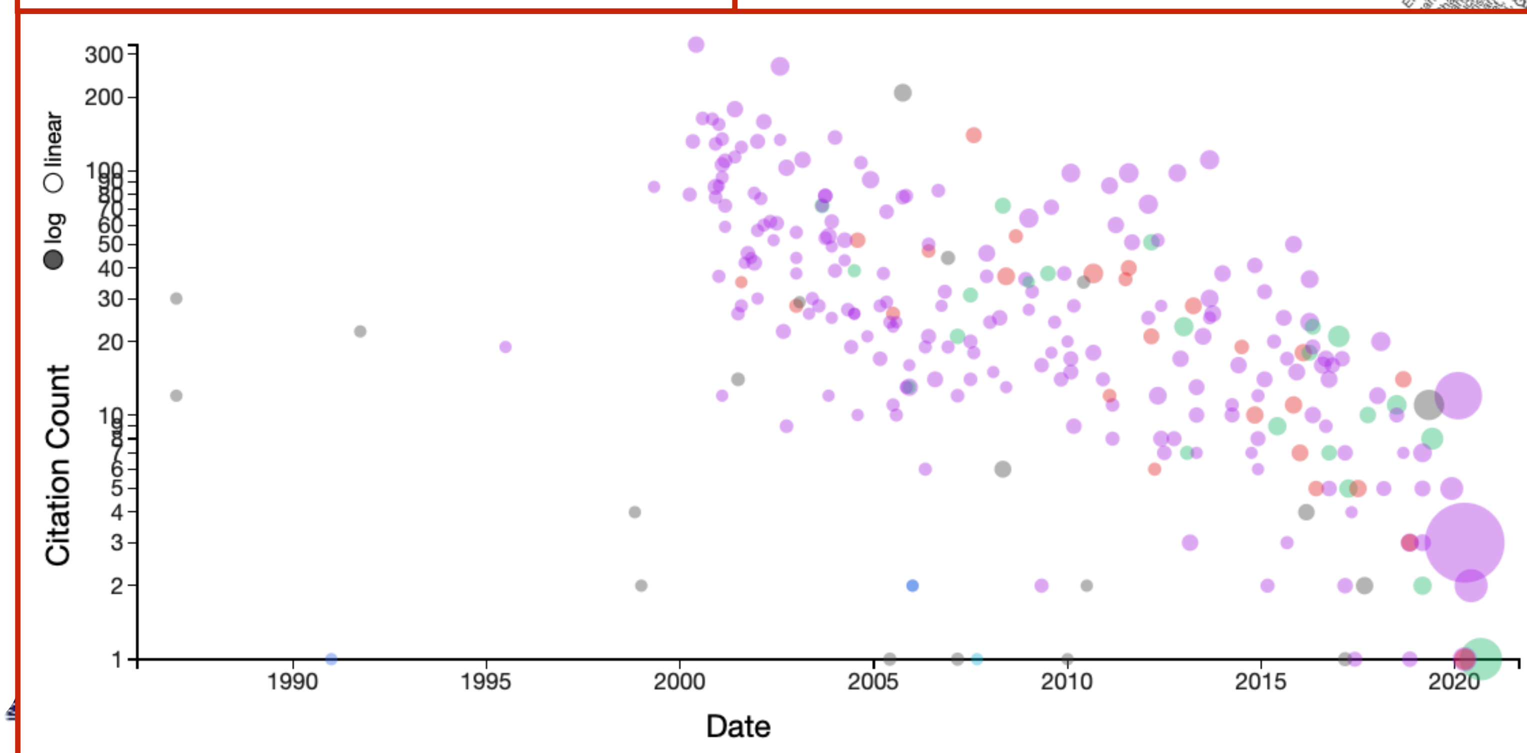


Authors

Subjects



#Citations, #Reads, Journals

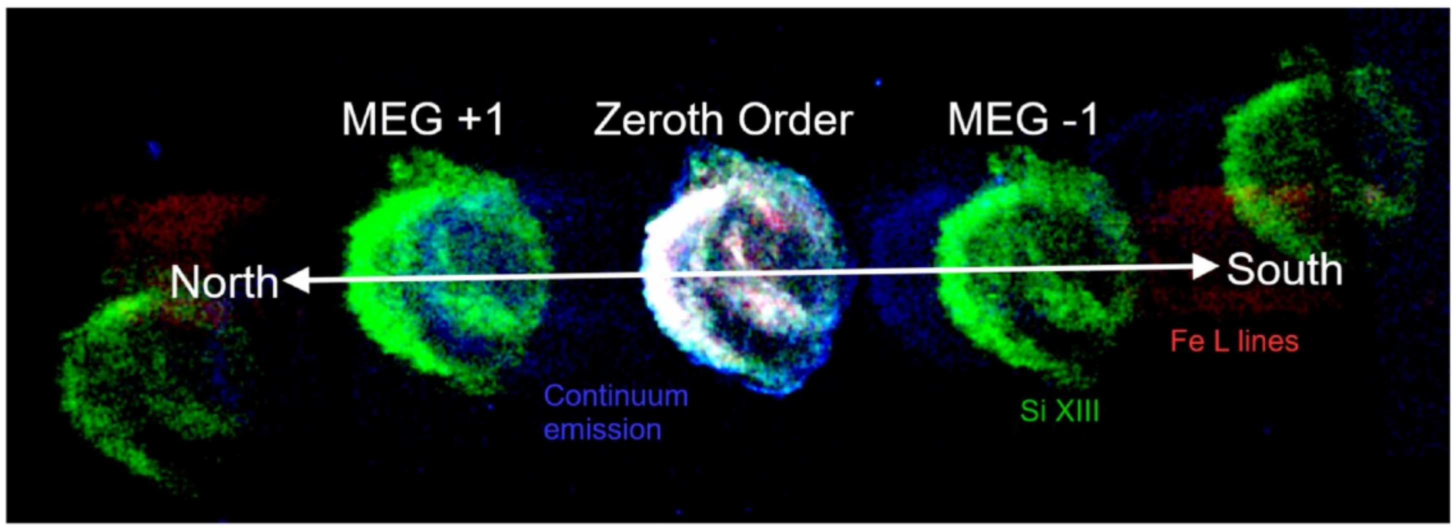


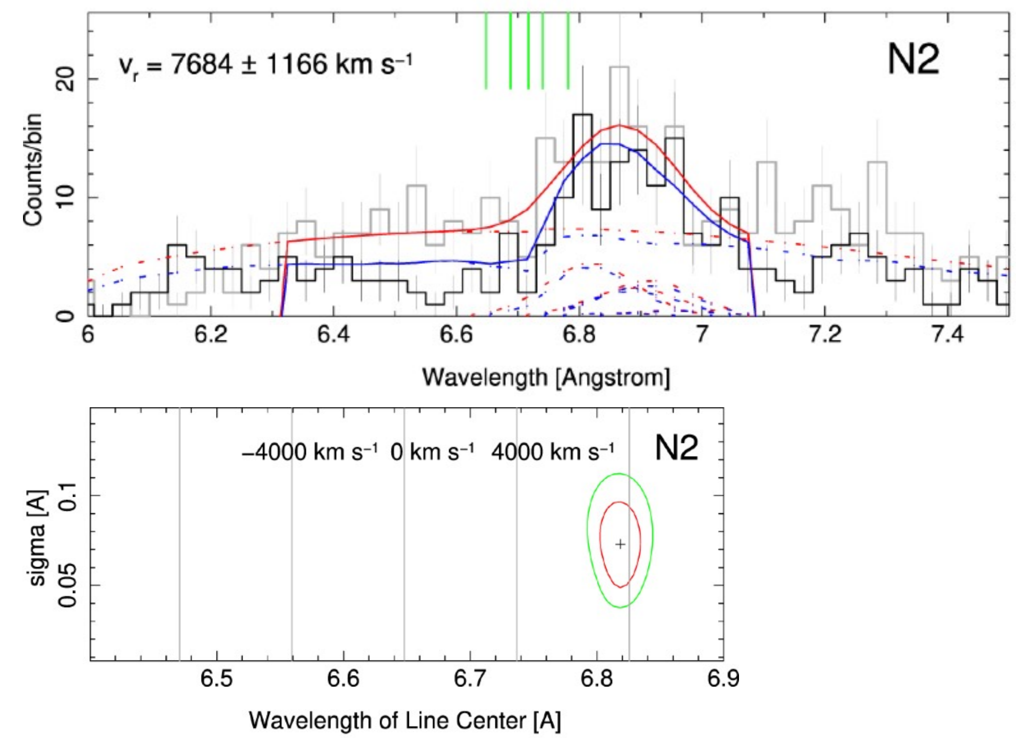
HETG GO Science:

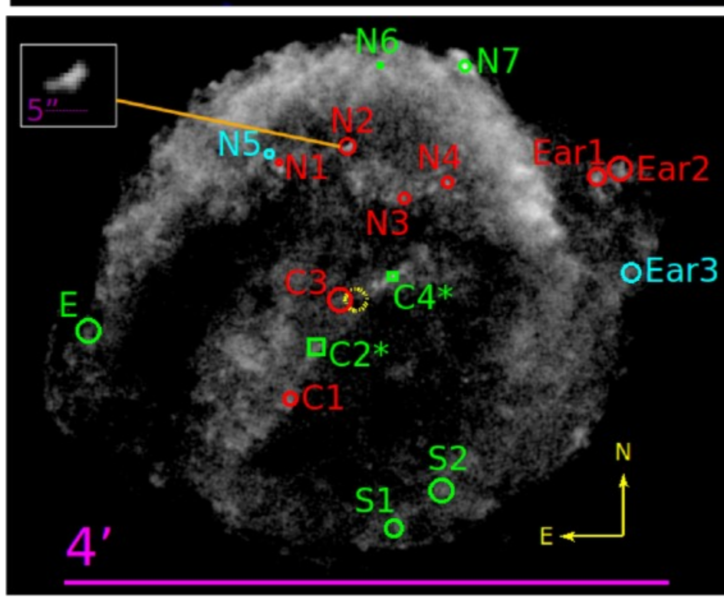
THE ASTROPHYSICAL JOURNAL, 893:98 (13pp), 2020 April 20
https://doi.org/10.3847/1538-4357/ab7db1

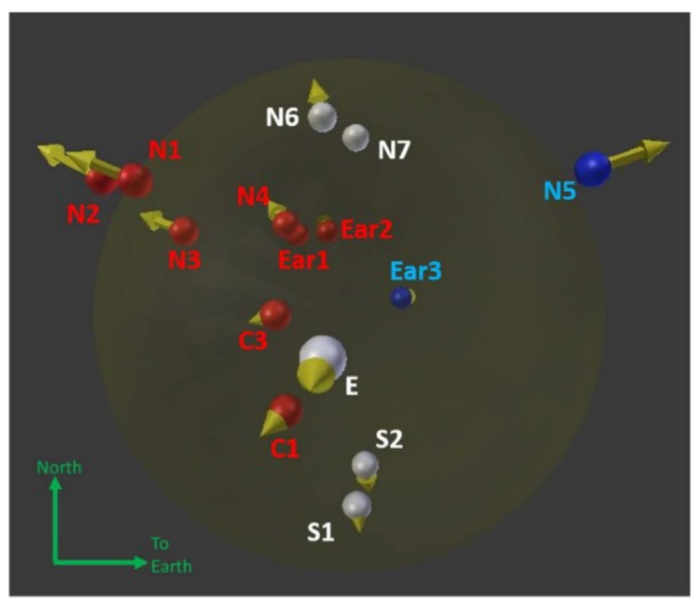
An Ejecta Kinematics Study of Kepler's Supernova Remnant with High-resolution Chandra HETG Spectroscopy

Matthew J. Millard[1], Jayant Bhalerao[1], Sangwook Park[1], Toshiki Sato[2,3,4], John P. Hughes[5], Patrick Slane[6], Daniel Patnaude[7], David Burrows[8], and Carles Badenes[9,10]









"We find that a handful of knots are moving at speeds approaching ~104 km/s, with expansion indices approaching η ~ 1, indicating nearly a free expansion. Based on our radial velocity measurement of such a fast-moving ejecta knot, we estimate the distance to Kepler. … a relatively long distance of d > 5 kpc is favored. Our estimated distance range generally supports an energetic SN Ia for Kepler."