

# Chandra Joint Programs: Past and Future

*Paul J Green*  
Chandra Director's Office

# Why Have Joint Programs?

---

- When science demands
  - multiwavelength data (sometimes contemporaneous)
  - time coverage, given observatory visibility windows
  - TOO-triggered transient followup
- Quite difficult to survive multiple peer reviews (“double jeopardy”).
- Out-of-phase reviews *especially* difficult when contemporaneous observations are required.
- Agreements with Joint Partner Observatories (*JPOs*) allow one proposal to justify observations on multiple facilities.
- *JPOs* must pre-approve the technical feasibility.

# Current Chandra RPS Form

## Joint Proposals

This field should be set **only if** you have already been allocated Chandra time after review by the other observatory. This field should be set to **No** if you are requesting joint time at the Chandra peer review.

[Has this proposal already been allocated Chandra time by the HST, NRAO, Spitzer or XMM review panels?](#)

Optional. The Joint Proposal section should **ONLY** be filled out if this is a joint proposal which also requests time on one/more of the facilities listed below. If you are requesting Joint time through the Chandra Review, please enter your joint proposal parameters:

<a href="#">HST Orbits</a>	<input type="text"/>	<a href="#">Instruments</a>	<input type="text"/>
<a href="#">XMM Exposure time</a>	<input type="text"/>	(ksec)	
<a href="#">Spitzer Hours</a>	<input type="text"/>	(hours)	
<a href="#">Swift Exposure time</a>	<input type="text"/>	(ksec)	
<a href="#">NuSTAR Exposure time</a>	<input type="text"/>	(ksec)	
<a href="#">NOAO Nights</a>	<input type="text"/>	<a href="#">Instruments:</a>	<input type="text"/>
<a href="#">NRAO Hours</a>	<input type="text"/>	<a href="#">Telescopes</a>	<input type="text" value="GBT"/> <input type="text" value="VLA"/> <input type="text" value="VLBA"/>

# Chandra Joint Programs

JPO TAC	Maximum Allocation <i>CXO TAC</i>	<i>JPO</i>
HST	100orbits	400ks
XMM	400ks	400ks
Spitzer	60 orbits	200ks
NRAO	3%	120ks
NOAO	5%	
<del>RXTE</del>	500ks	
Suzaku	500ks	
Swift	300ks	
NuSTAR	500ks	

CXC Target Lists show JPO4CXO Time

## Information by Cycle

### ▼ Cycle 18

- [Peer Review Recommended Targets and Statistics](#)
- [Joint HST/Chandra accepted targets and abstracts](#)
- [Joint Spitzer/Chandra accepted targets and abstracts](#)
- [Joint XMM/Chandra accepted targets and abstracts](#)

### ▶ Cycle 17

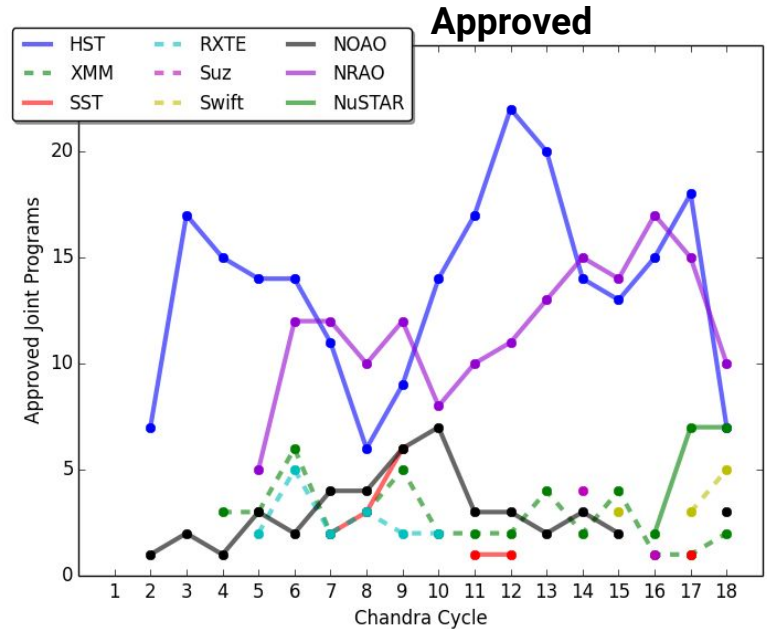
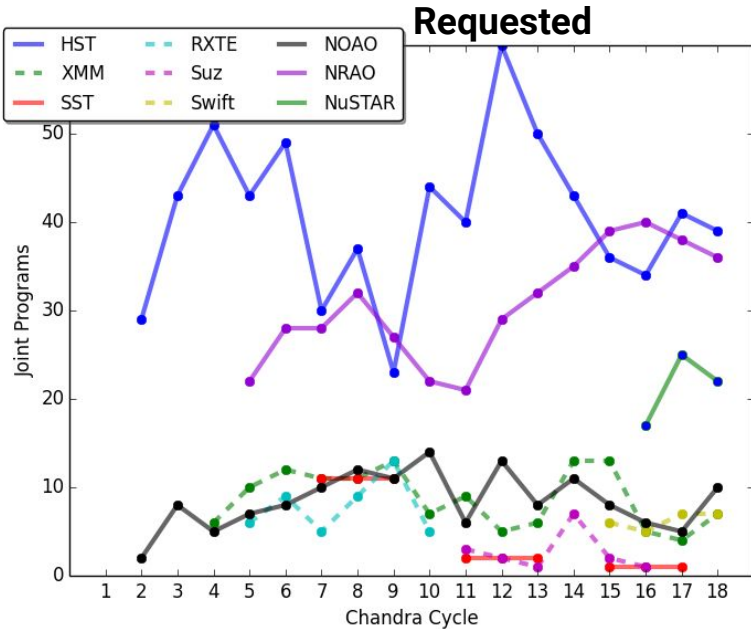
### ▶ Cycle 16

??

# Conditions

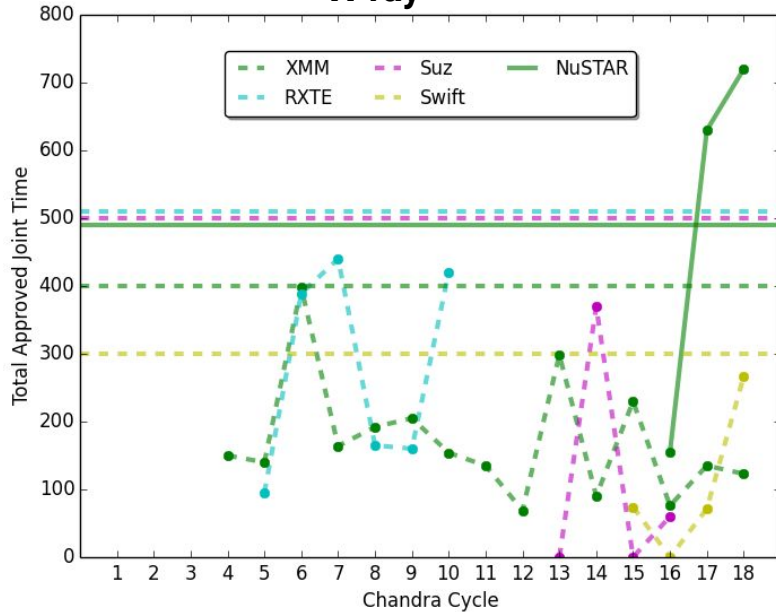
- Joint time must be scientifically *justified*.
- No joint time without *Chandra time*.  
Exception for *Archive* proposals requiring NOAO nights.
- *Multi-cycle* joint time if scientifically required:  
up to 10% (5%) of the available joint time in Cycle  $N+1$  ( $N+2$ )
- Can be *coordinated* if required, but time constraints are limited.

# Chandra Joint Programs

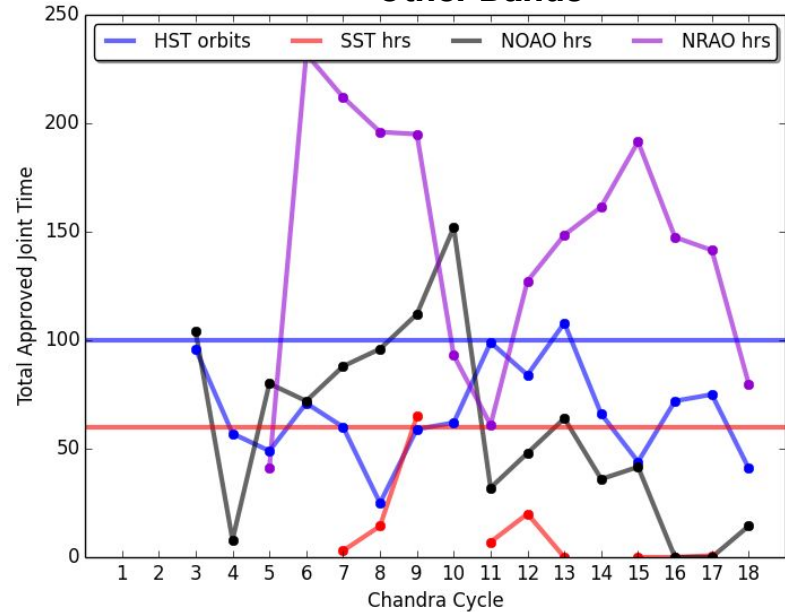


# Chandra-Awarded JPO Time

## X-ray



## Other Bands



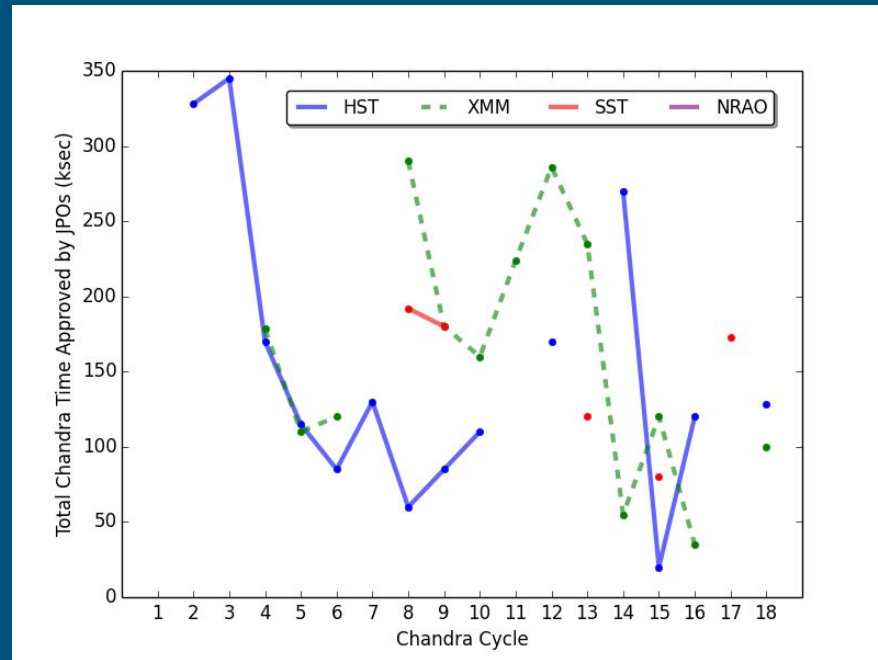
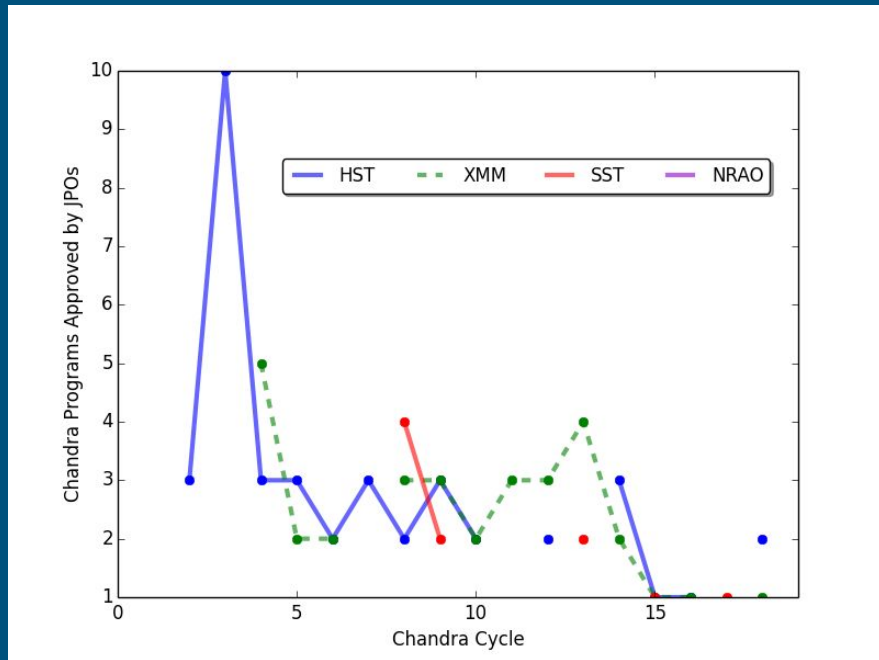
# Joint Program Oversubscription

Requested/Approved

- The harder part is surviving the *Chandra* TAC.
- For joint programs is  $\sim 3X$  but noisy (small number stats)
- For JPO Time is  $\sim 5X$ , but very noisy, because sometimes few JPO units awarded.
- By comparison, for GOs oversubscription is about  $4X$  by proposal, and  $5X$  by *Chandra* time.



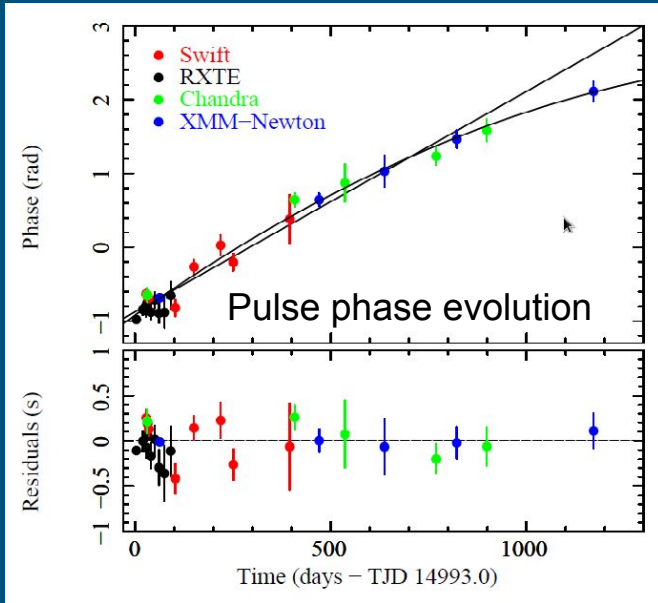
# Chandra Time Awarded by JPOs



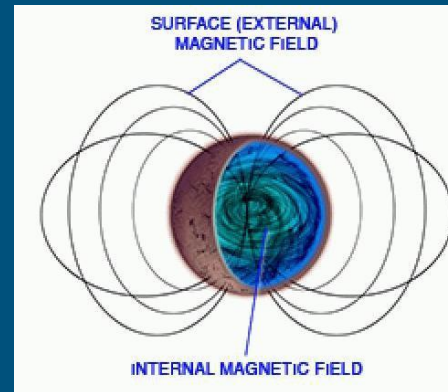
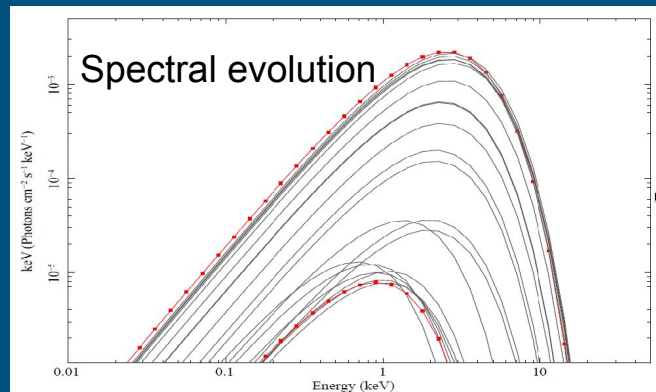
---

# Examples of Chandra Joint Program Science

# Joint XMM/Chandra Monitoring of SGR0418+5729

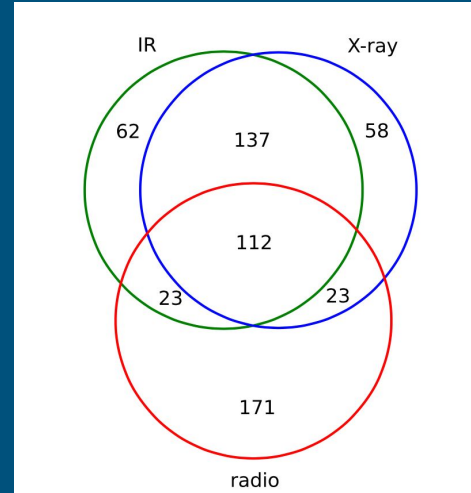
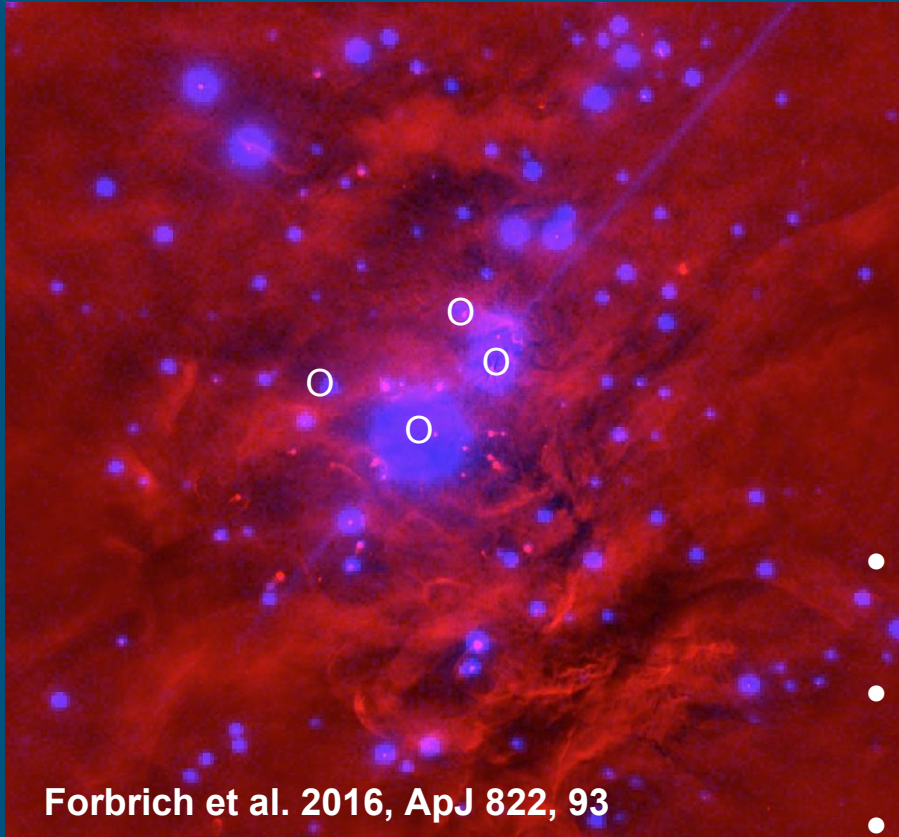


- Magnetar: relatively slow spin rates, large X-ray flares. Behavior usually attributed to *strong* B-fields
- SGR 0418+5729 has an extremely low B-field for a magnetar
- Long term (>3 yrs) monitoring of the outburst decay with RXTE, Chandra, XMM-Newton, Swift
- $\dot{P} = 4 \times 10^{-15} \text{ s s}^{-1} \Rightarrow B_{\text{dipole}} = 6 \times 10^{12} \text{ Gauss}$
- Modeling yields age  $\sim 550,000 \text{ yr}$ , older than most magnetars. Initial B-field was 25x stronger



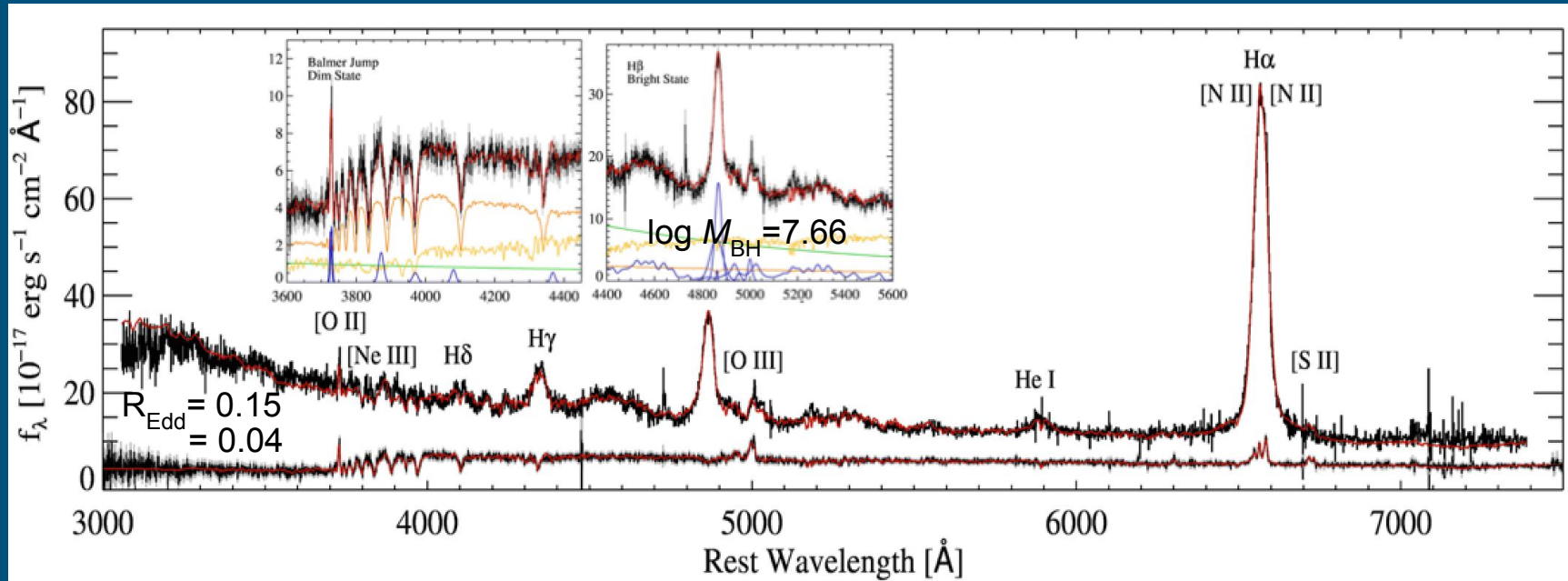
Nanda Rea, PI

# Joint Chandra/VLA Observations of Orion Nebula Cluster



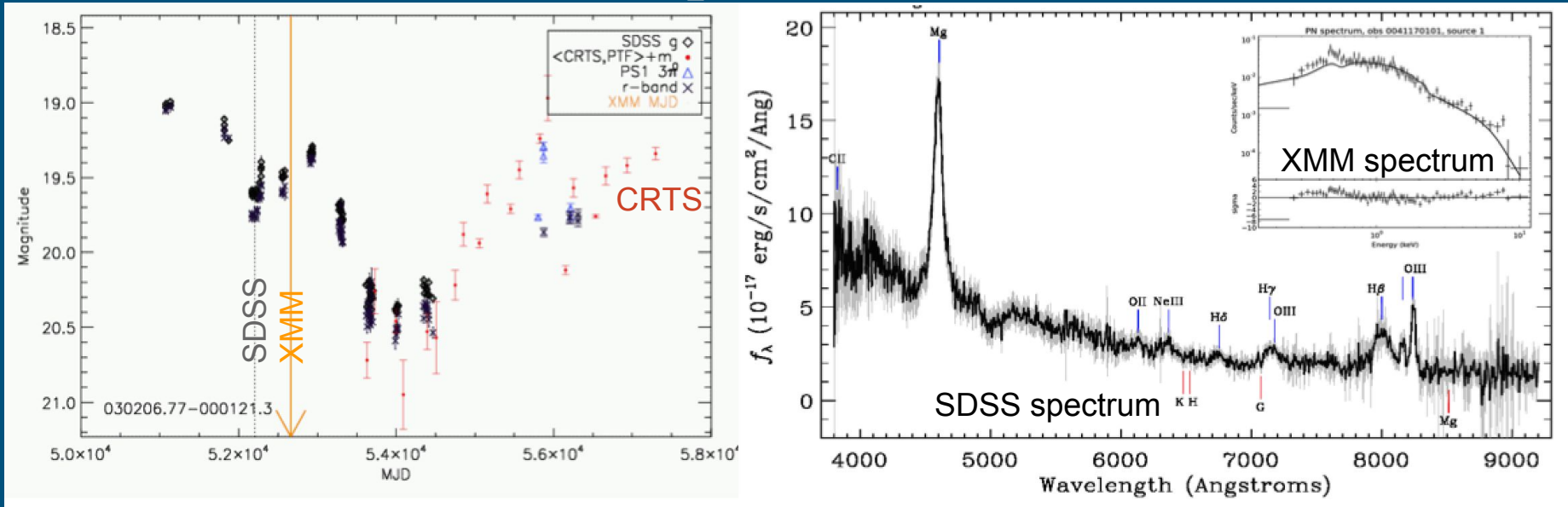
- Four 22ks Chandra visits simultaneous with 24hrs JVLA.
- To study dynamic flux relationship between radio and X-ray from low-mass YSOs.
- Surprisingly diverse R/X relationships revealed.

# 'Changing Look' Quasars



SDSS J101152.98+544206.4 from Runnoe et al. (2016)

# TOO to be Triggered by Joint Gemini Spectrum



18700157: Green, MacLeod, Anderson, Eracleous, Ruan, Runnoe, Graham, & Civano.  
Joint-triggered TOO also using archival X-ray data!

# Joint Contingent Large Programs

---

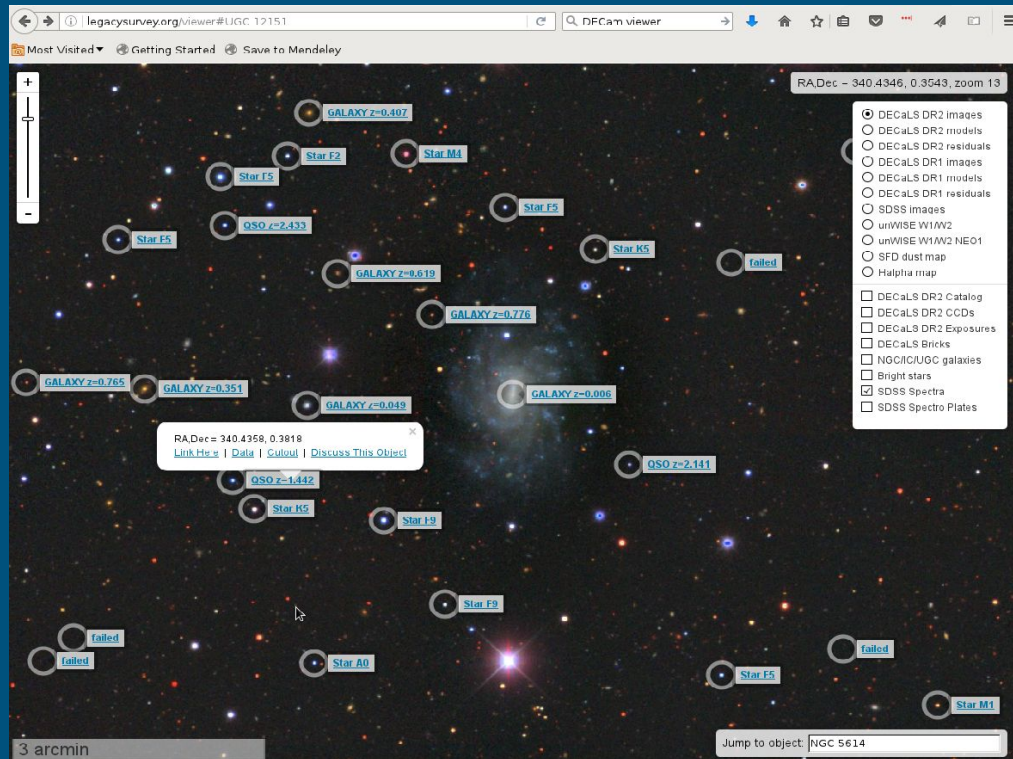
- Science programs requiring a large fraction of available joint time remain prohibitively difficult to achieve.
- Chandra review panels are reluctant to approve Chandra time without assurance that time on the other (Contingent) Observatory will also be approved, *especially* if needed all within ~year.
- JCLPs were implemented in Cycle 18. COs currently limited to NASA/ESA missions. Minimum *Chandra* and CO requests apply.
- Total JCLP time limited to 500ks.
- Let us know if you are interested!

# Ideas

- Expand the
  - current joint programs to allow larger time awards.
  - JCLP allotment.
  - NRAO program to include *ALMA*.
  - Archival joint time beyond NOAO.
- Expand joint programs to important new *pointed* space-based observatories e.g., *JWST*. Lay the groundwork with preparatory science observations?
- Expand to include space survey facilities e.g., GAIA, Euclid, TESS, eROSITA. (Coordinate with coverage schedule?)
- Time Domain science e.g., expand long-term monitoring capability.

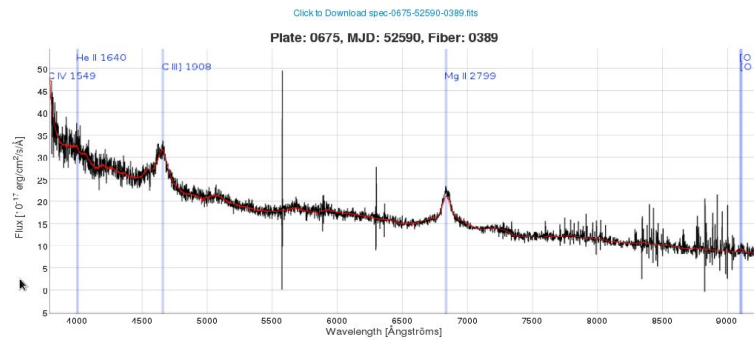


# Expand Access to Survey Portals



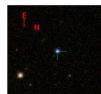
## Optical Spectrum Detail — Optical Spectra

RUN2D: **26** - Plate ID: **675** - MJD: **52590** - Fiber: **389** - Tile ID: **499** - Chunk: **chunk22** - Class: **QSO**



### General Spectrum Information

Image Cutout



Right Ascension  
340.44727

### Line Measurement Information

Line Name	Rest Wavelength [Å]	Line z	Line $\sigma$ [km s <sup>-1</sup> ]	Line Flux [ $10^{-17}$ erg/cm <sup>2</sup> /Å]	Continuum [ $10^{-17}$ erg/cm <sup>2</sup> /Å]
C_IV	1549.5	1.443	1840	339.9	36.12
He_I]	1640.4	1.443	1840	80.11	30.97
C_III]	1908.7	1.443	1840	491.7	25.03

# Ideas for Ground-Based Observatories

---

- New programs at low radio frequencies e.g., *LOFAR*, *MWA*.
- *Chandra* facilitate buy-in to pay-to-play observations (e.g., *LCOGT?*)
- Robotic fiber buy-in?
  - *DESI* (2020-2026) on Kitt Peak 4m will obtain  $R \sim 4000$  optical spectra over  $14,000 \text{ deg}^2$  in 5 separate epochs. 5,000 robotic fiber actuators over  $8 \text{ deg}^2$  field; 30 million targets.
  - *SDSS-V* (2020-2026) is in planning mode, but may have robotic multi-fiber options on  $\sim 2\text{m}$ -class telescopes North & South (APO and LCO).
- Coordinate with e.g., *LSST*.
- How/could *Chandra*/NASA fund such observations?
- ***Your ideas!?***

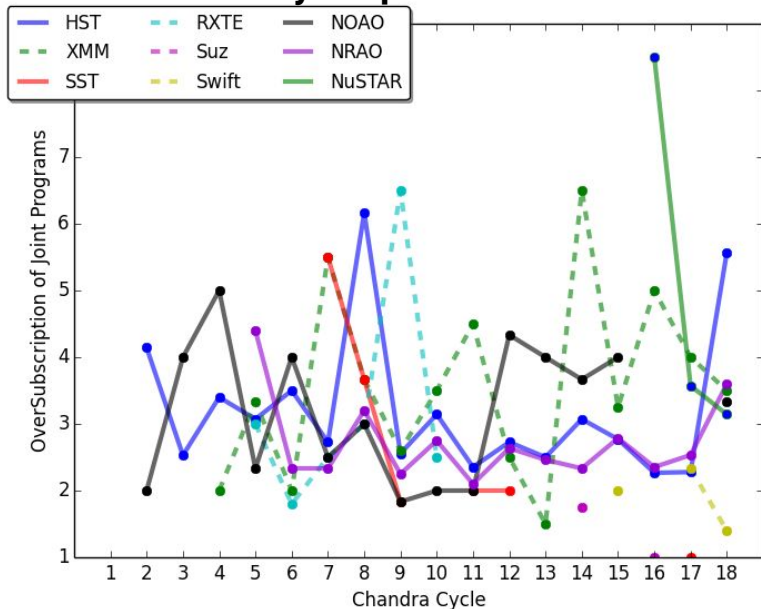
[pgreen@cfa.harvard.edu](mailto:pgreen@cfa.harvard.edu)

***Thanks!***

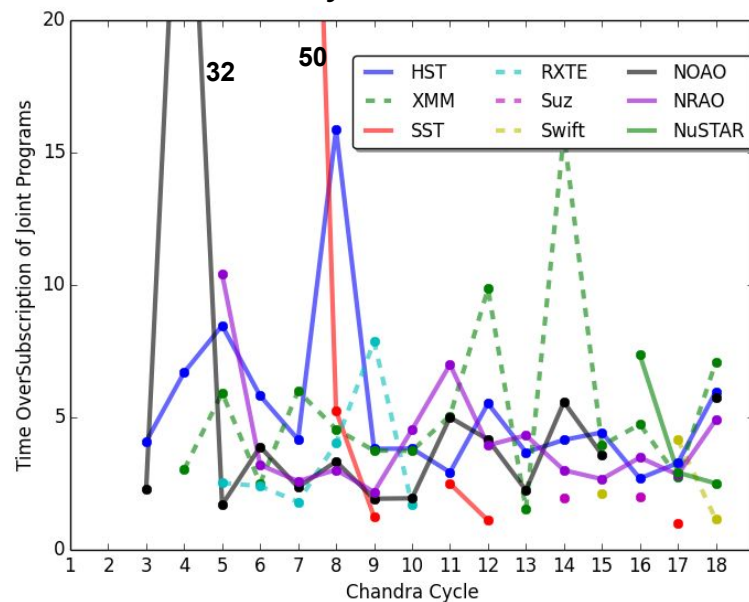
# Joint Program Oversubscription

Requested/Approved

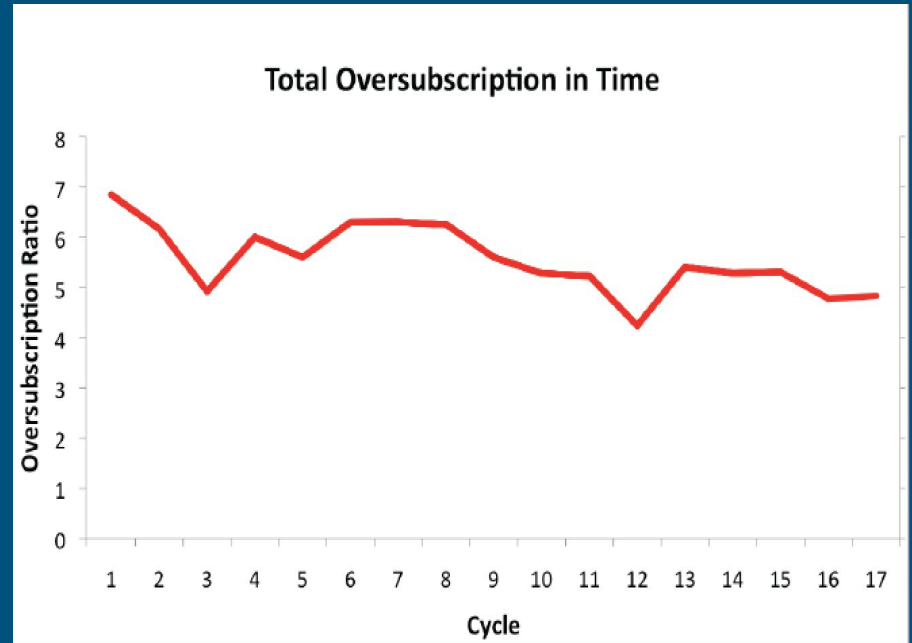
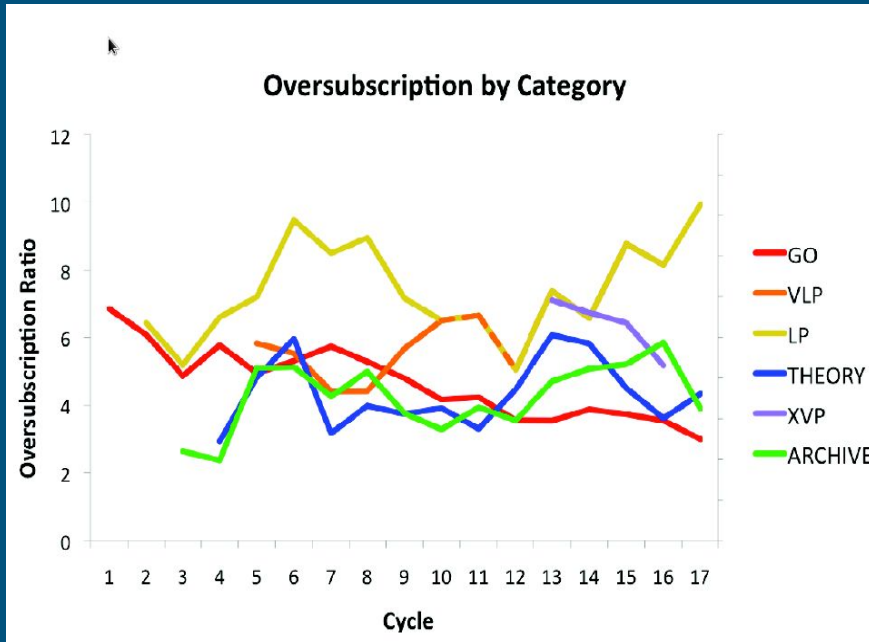
## By Proposal



## By JPO Time



# General Oversubscription



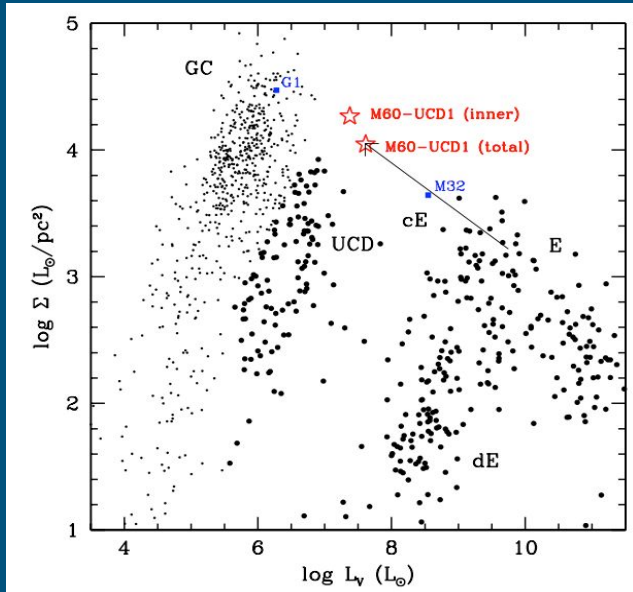
# Joint Chandra/Hubble of the giant Virgo galaxy

## NGC4649 (PI: Fabbiano)

- 6 ApJ papers, including two unexpected discoveries:

–The 'densest galaxy'

–Asymmetrical distributions of GCs and XRBs of the giant Virgo E NGC 4649, suggests accretion of companion galaxy



Residuals in the  $K$ -th nearest neighbor density map from an azimuthally symmetric GC distribution

