How Did I End Up in the Galactic Center?

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Nedfest 2017 --- UCLA

Ned @ 40

- My first research advisor
  - Quasar reddening
  - IRC +10 216
- I learned a lot about programming
- Ned's & Mark's 40th birthday party
  - Ned: "brevity is the soul of wit" – Hamlet
  - Francoise hiding Ned's rock 'n roll albums
- Playing tennis with Ned
  - Ned: "You don't *have* to hit the ball when you toss it."

Good Advice!


USTA LEAGUE
NATIONAL CHAMPIONSHIPS
USTA LEAGUE
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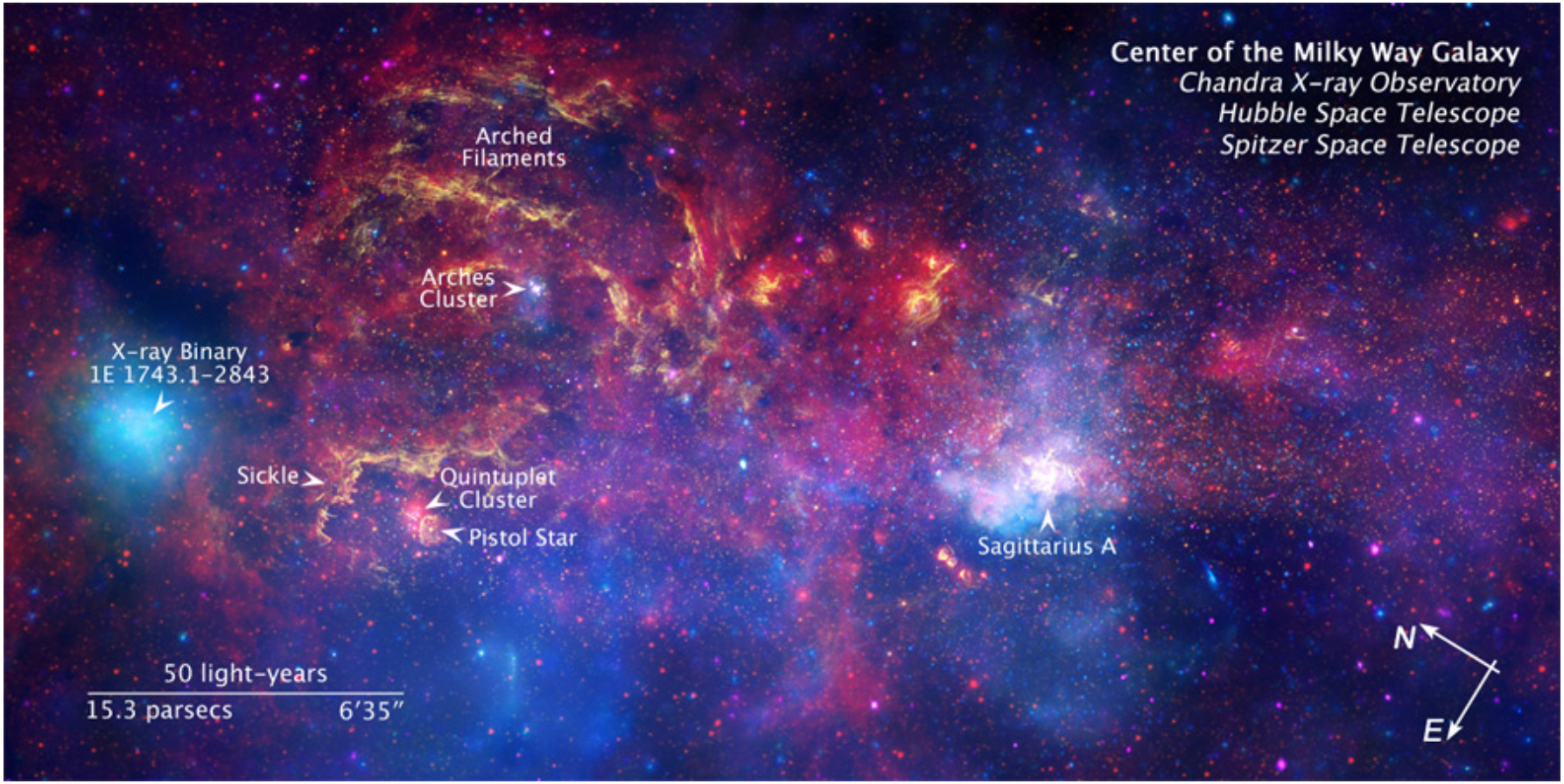
Ned @ 40

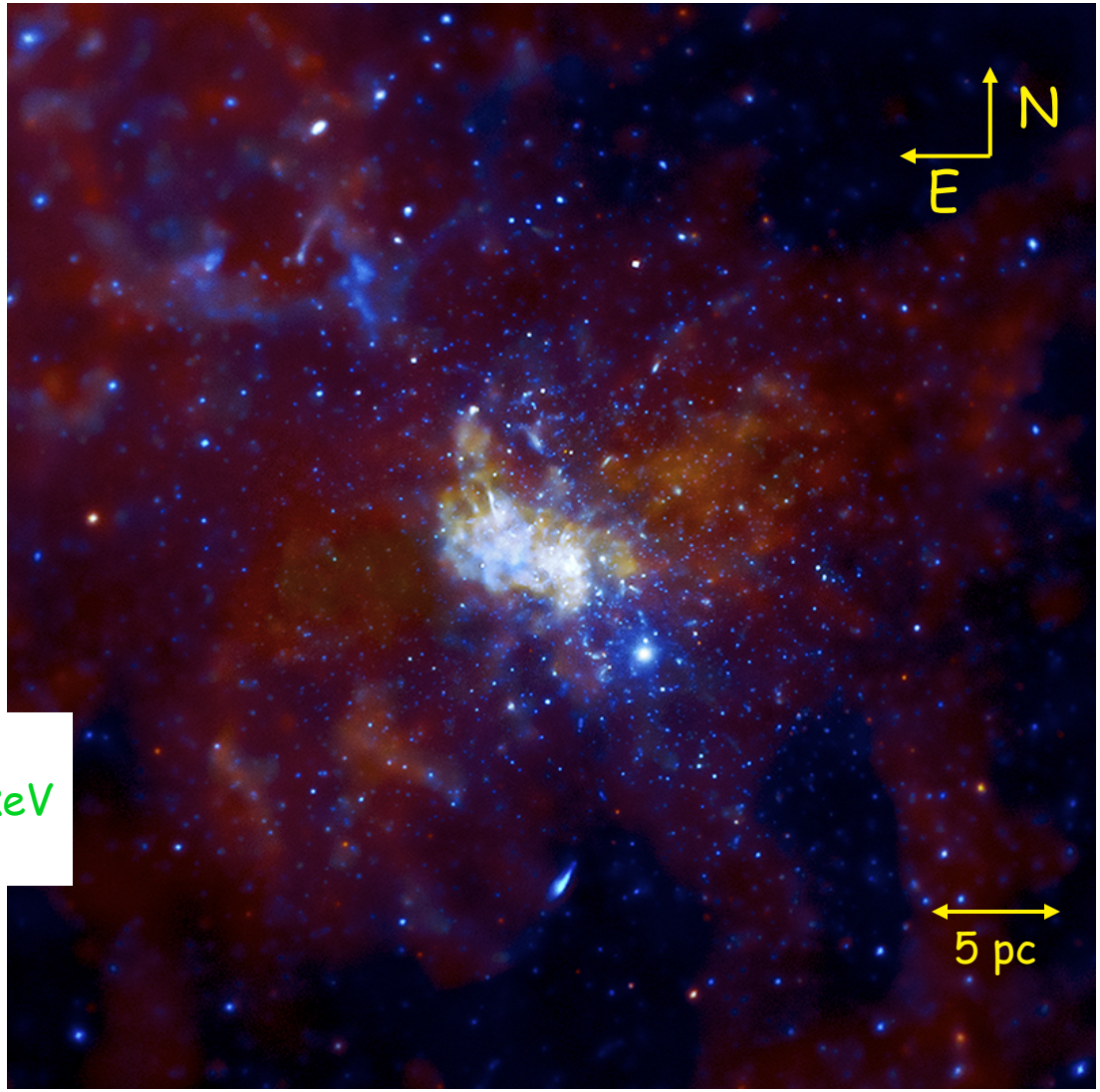
- Thesis project?
  - COBE launch 2+ years away
  - Ned: "All I have are programming projects. You don't want to do that."
- Off to work with Matt on AGN variability
- Which lead to Sgr A* and the Galactic Center

Ned @ 70



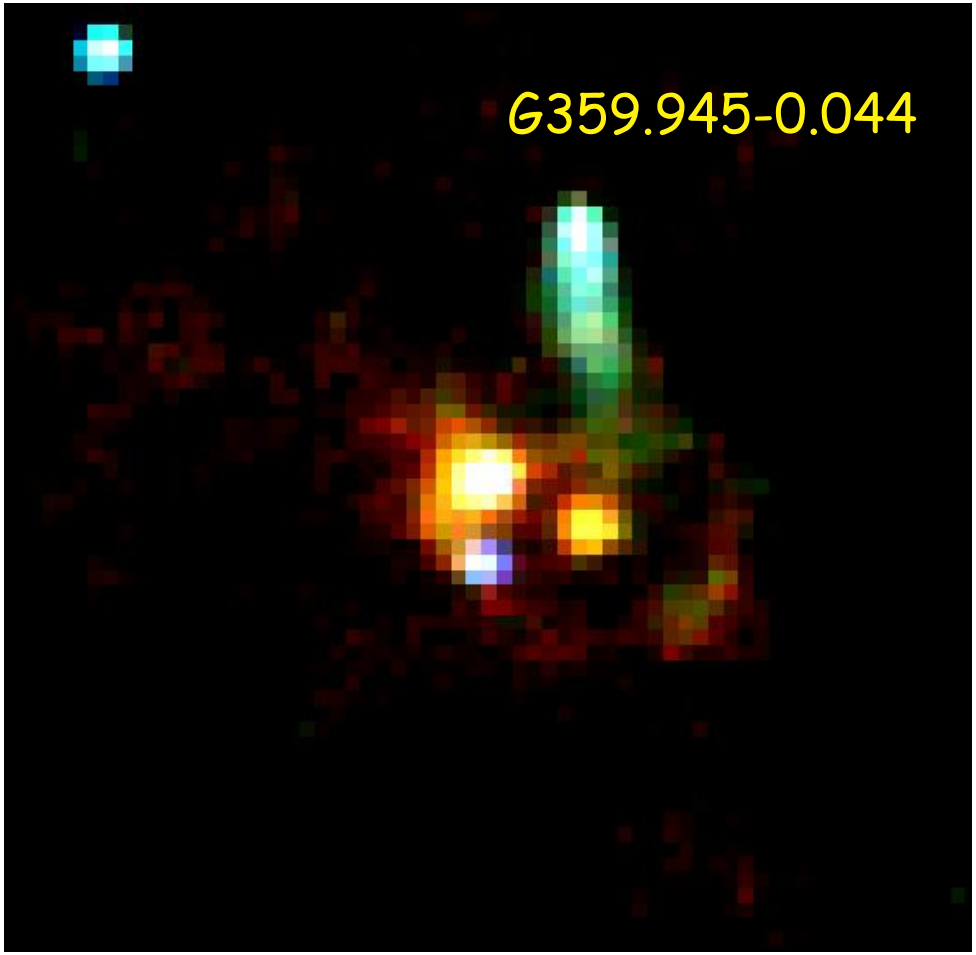
Chandra, Hubble & Spitzer Views of the Galactic Center

Chandra Image of the Galactic Center



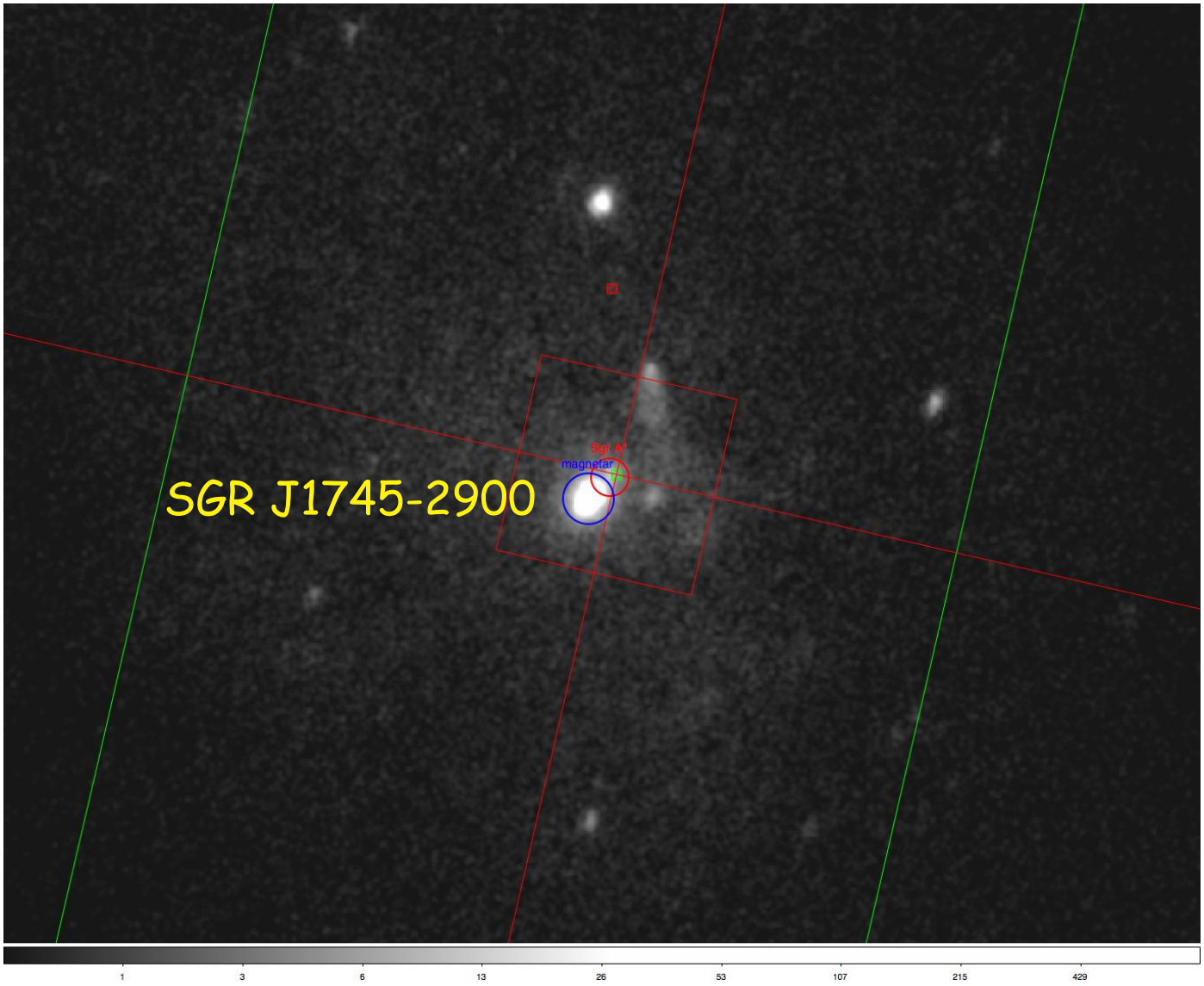
Red: 2-3.7 keV
Green: 3.7-4.5 keV
Blue: 4.5-8 keV

Central Parsec



2-3.5, 3.5-5, 5-8 keV

GC Magnetar Outburst



GC Magnetar SGR J1745-2900

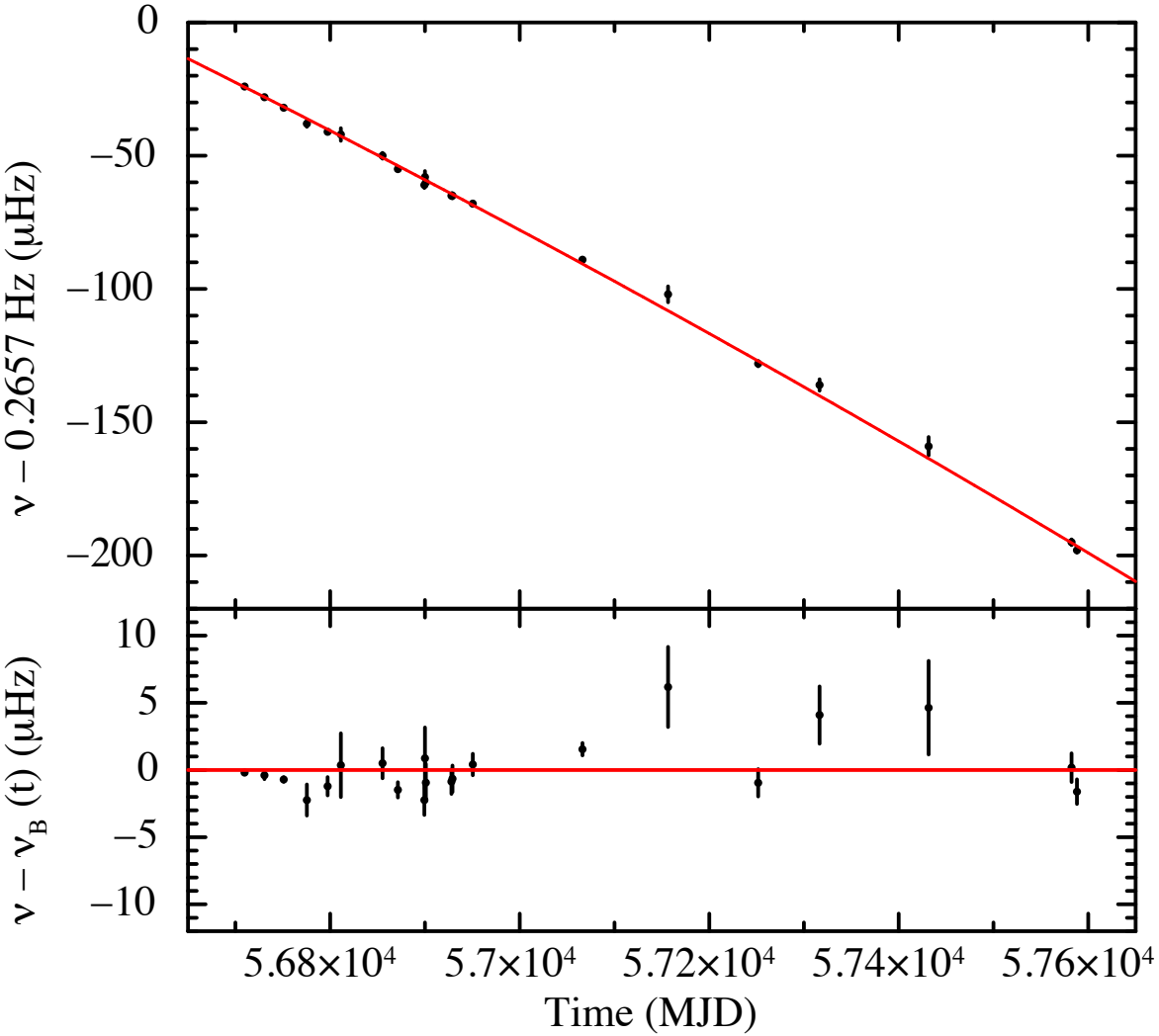
- Swift/BAT discovered outburst 2013 Apr 24 (Kennea et al. 2013)
- NuSTAR follow-up revealed 3.76 s period (Mori et al. 2013)
- Chandra imaging places it 2.4″ SE of Sgr A* (Baganoff et al. 2013)
- One of a handful of radio magnetars
- Eatough et al. (2013) infer super-equipartition B ~ 8 mG near Bondi radius

GC Magnetar SGR J1745-2900

- VLBA proper motion yields transverse velocity 236 +/- 11 km/s wrt Sgr A* (Bower et al. 2015)
- Radial velocity unknown but chance alignment unlikely
- Velocity & position consistent with bound orbit originating within CW disk of massive stars orbiting Sgr A*
- Orbital period 700+ yr

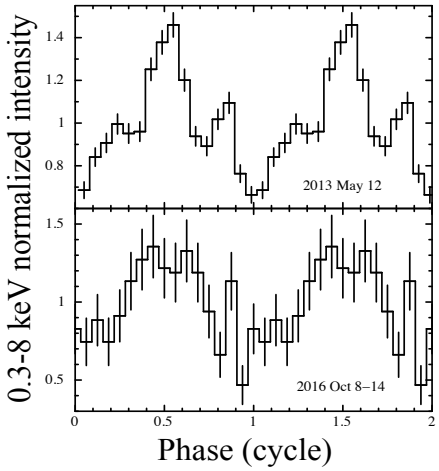
Chandra monitoring of initial 3.5 yr of outburst decay analyzed by Coti Zelati et al. (2015, 2017)

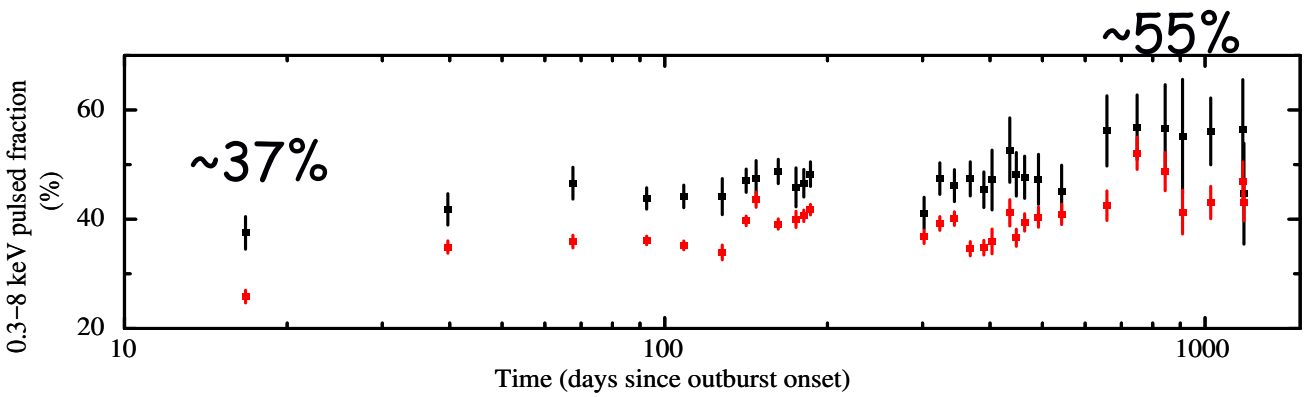
Temporal Evolution of Spin Frequency



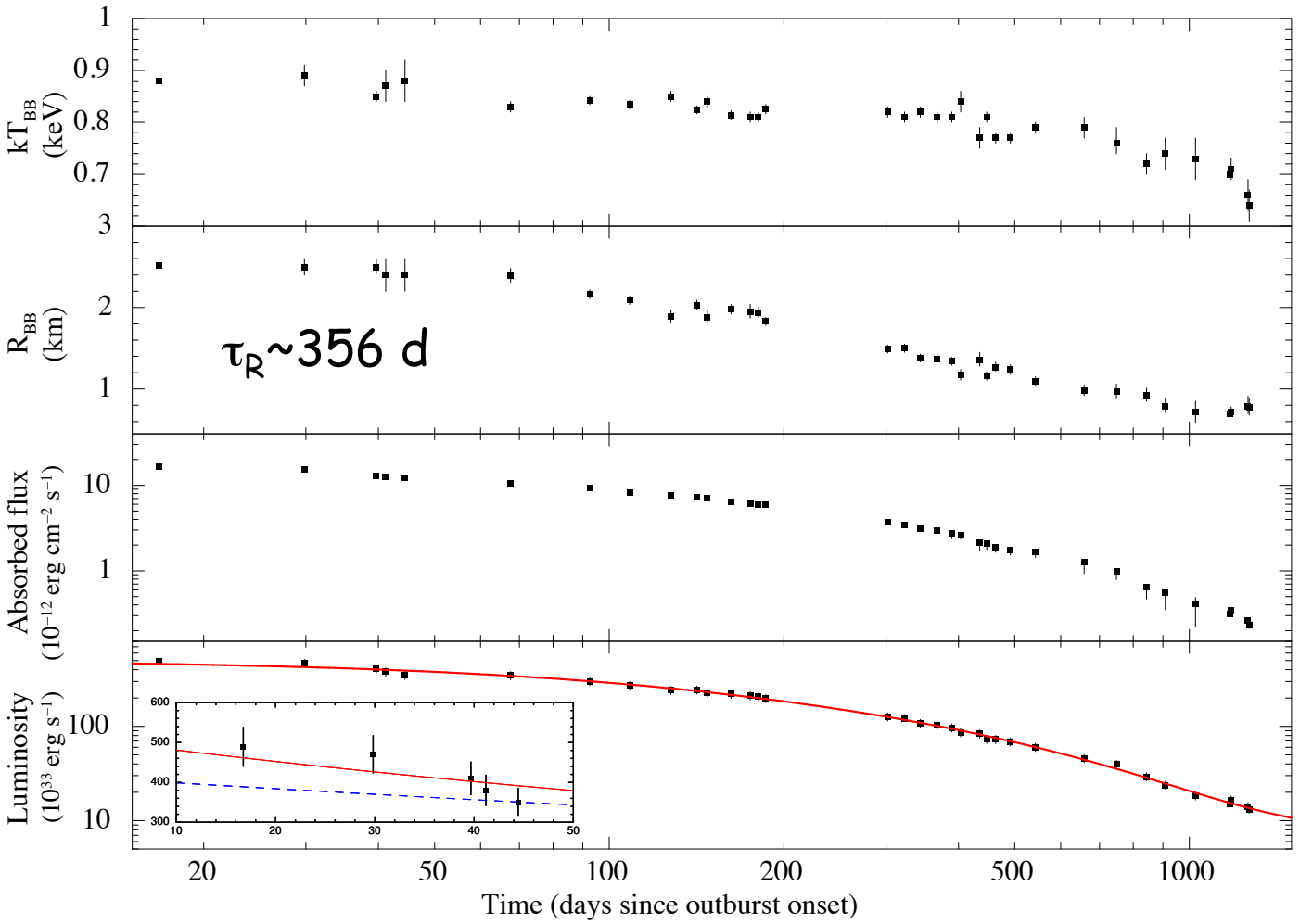
Approximately linear spin down

Pulsed Fraction Slightly Rising



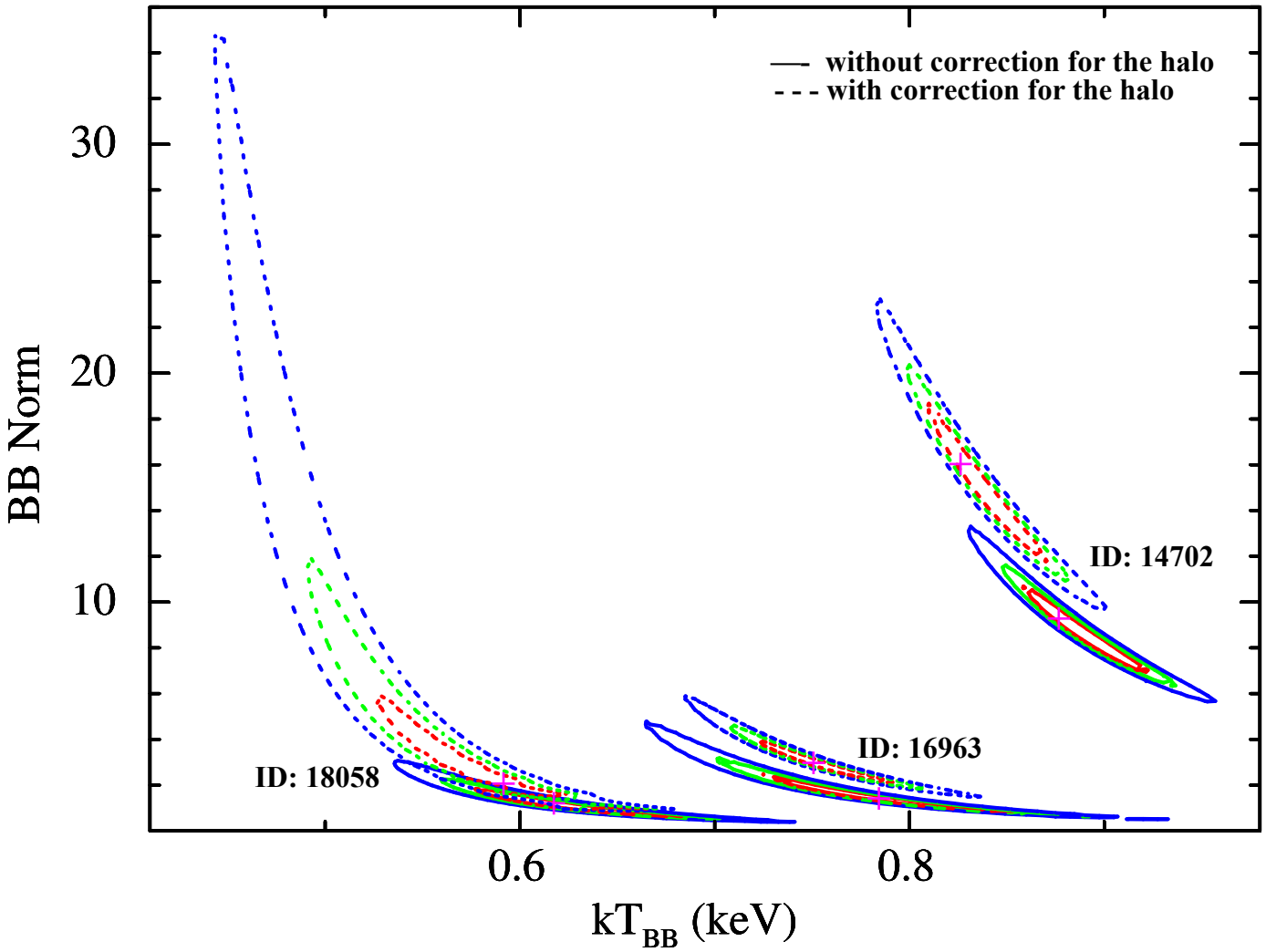


Time Evolution of Blackbody T & R

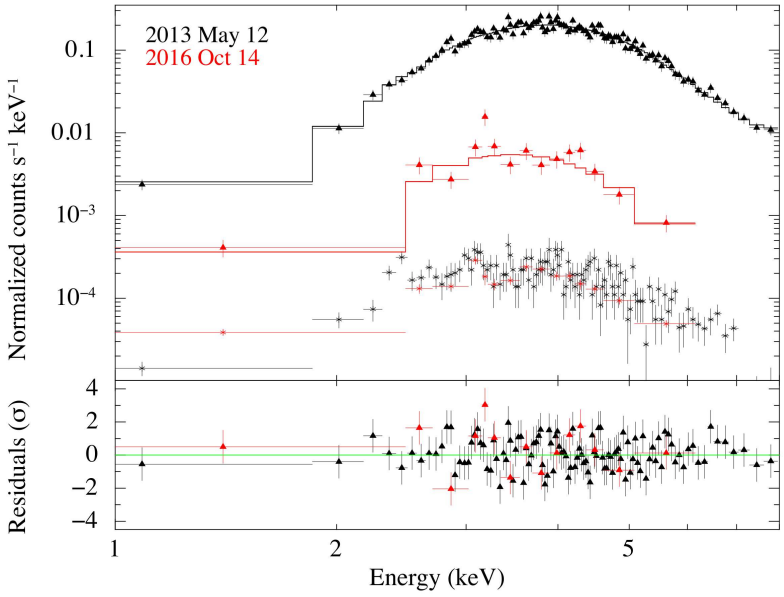


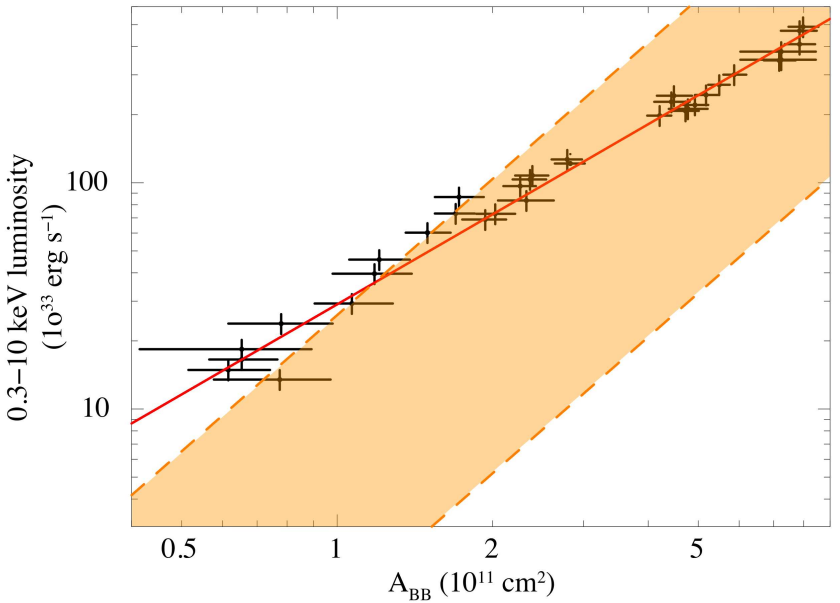
L has double exponential decay: τ_1 ~ 96 d, τ_2 ~ 326 d

Correcting for Dust Scattering Halo



Spectral Fits & Beloborodov Model





Summary

- Crustal cooling model predicts hotspot should remain fairly constant in size while it cools as internal heat conducted up to outer crust; inconsistent with our observations
- Alternative model of untwisting bundle of current-carrying closed field lines in magnetosphere works better (Beloborodov 2009)
- Other models being tested

Summary

- Magnetar was still visible to Chandra in 2017 July
- Day-long exposures measured spin
- Two more long Chandra observations approved for 2018 July => follow spin evolution for 5 yr

Lots more to do in the GC

Thanks, Ned!

Happy Birthday!

Ned @ 100?