Mission Planning Updates

Scheduling with Constraints

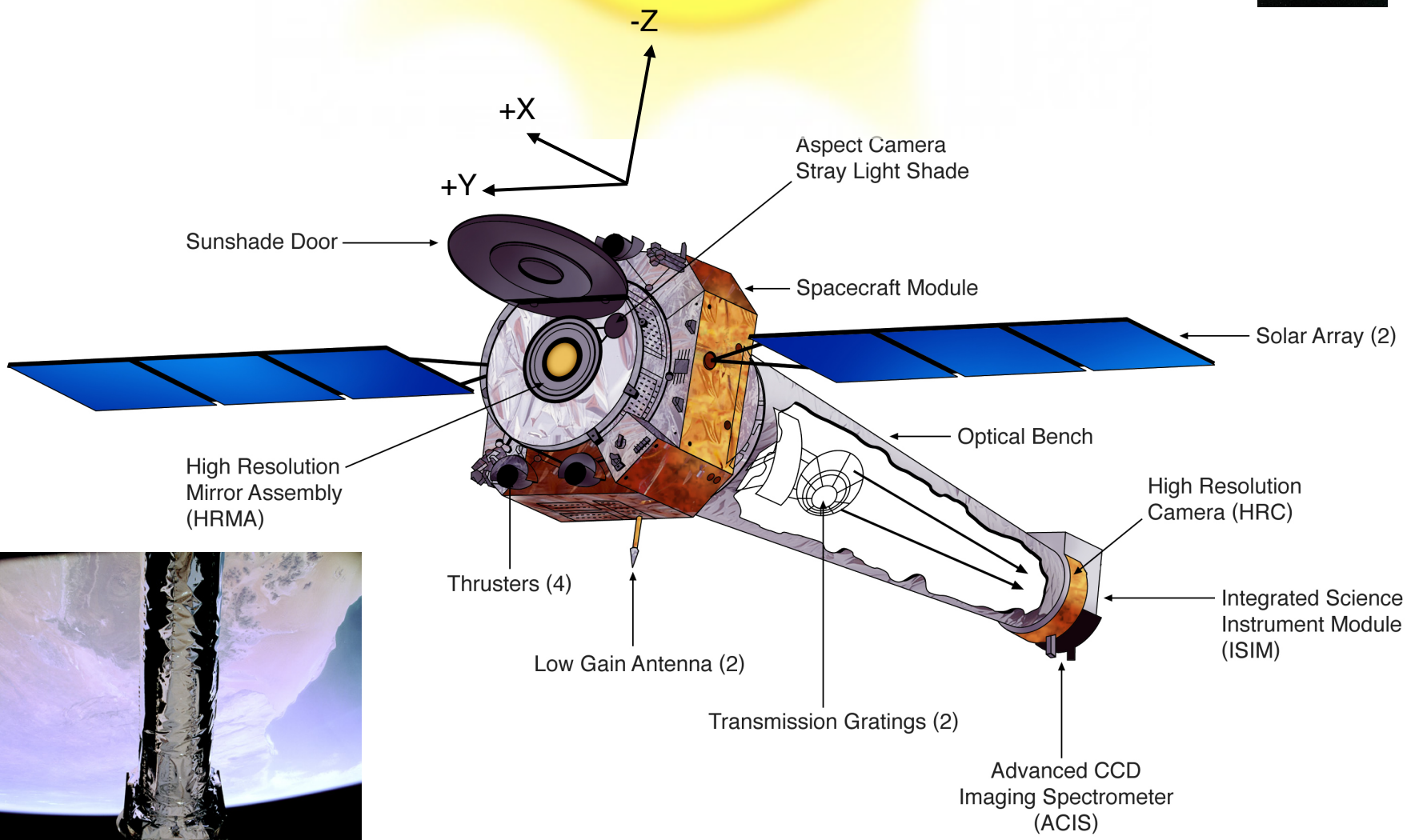
1. Science Constraints

   - Chandra currently accepts up to 15% constrained observations
     - Includes, e.g., roll, window, phase, un-interrupt constraints
     - Also coordinated observations.
   - Also accept up to 80 TOO observations (including follow-ups)
     - 8 very fast, 20 fast, 26 medium, 26 slow

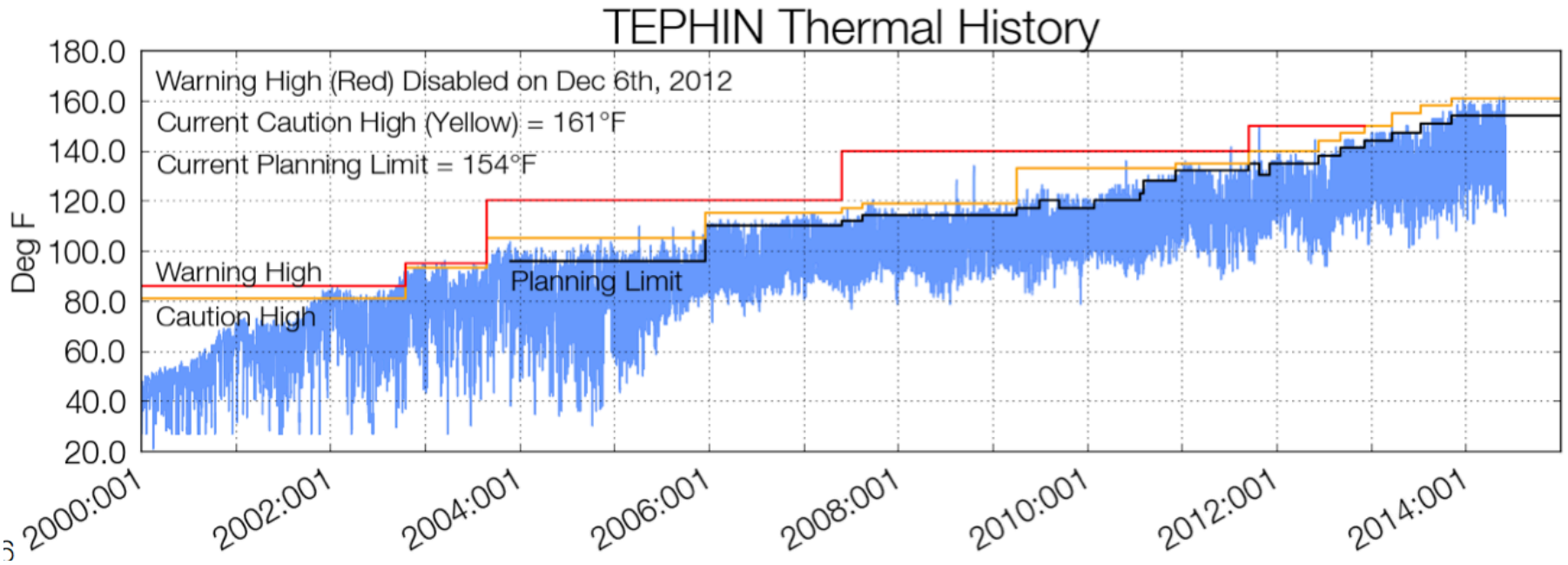
2. Spacecraft Constraints

   - Restrictions such as not pointing toward the Sun provide constraints on when targets can be observed
   - Over time, the number of such constraints has increased considerably, leading to challenges in planning, and some impacts on observing

Chandra Spacecraft

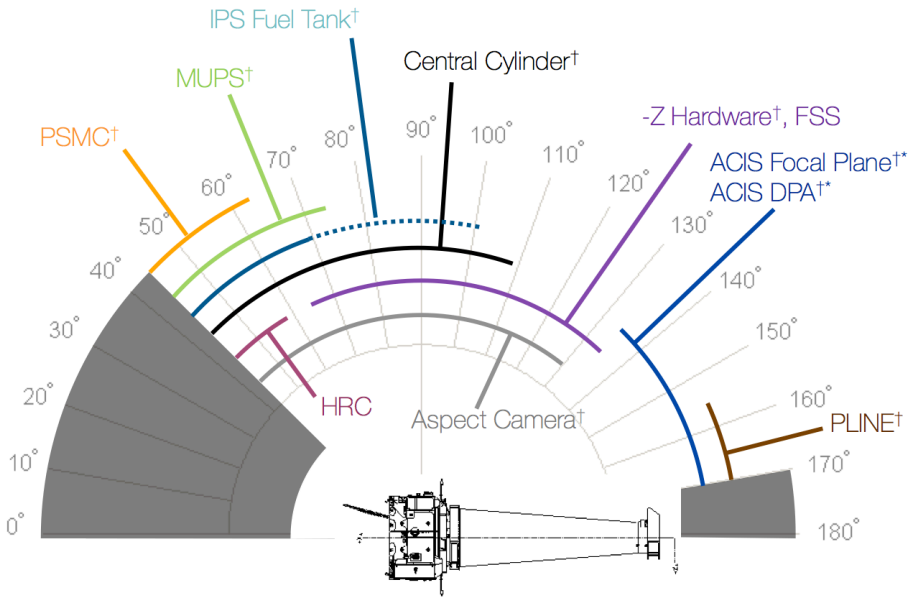


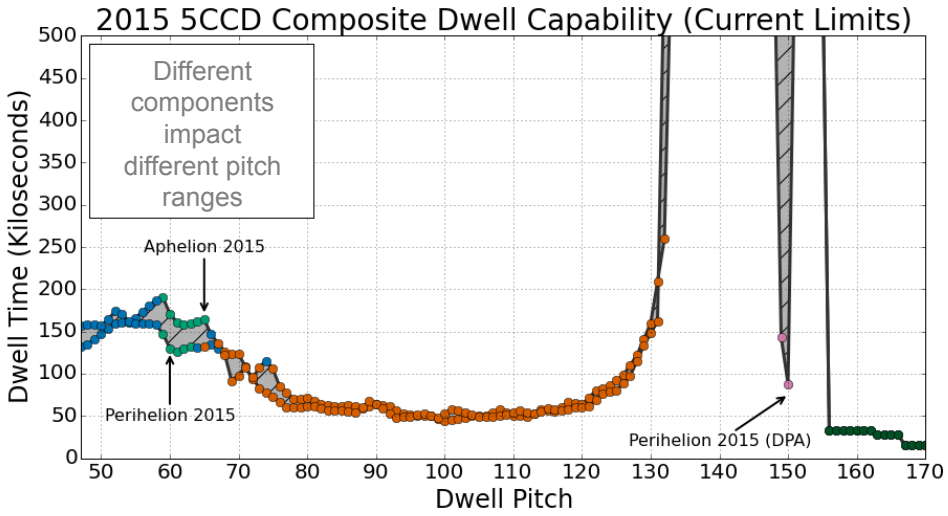
Thermal Issues



- Degradation of MLI results in increasing temperatures for many spacecraft components (e.g., EPHIN, shown above).
  - Monitoring, investigation, and modeling has permitted relaxation of some constraints to minimize impact to science observing
  - Major modifications to planning and scheduling observations have allowed continued highly-efficient observing
    > But not without some impact

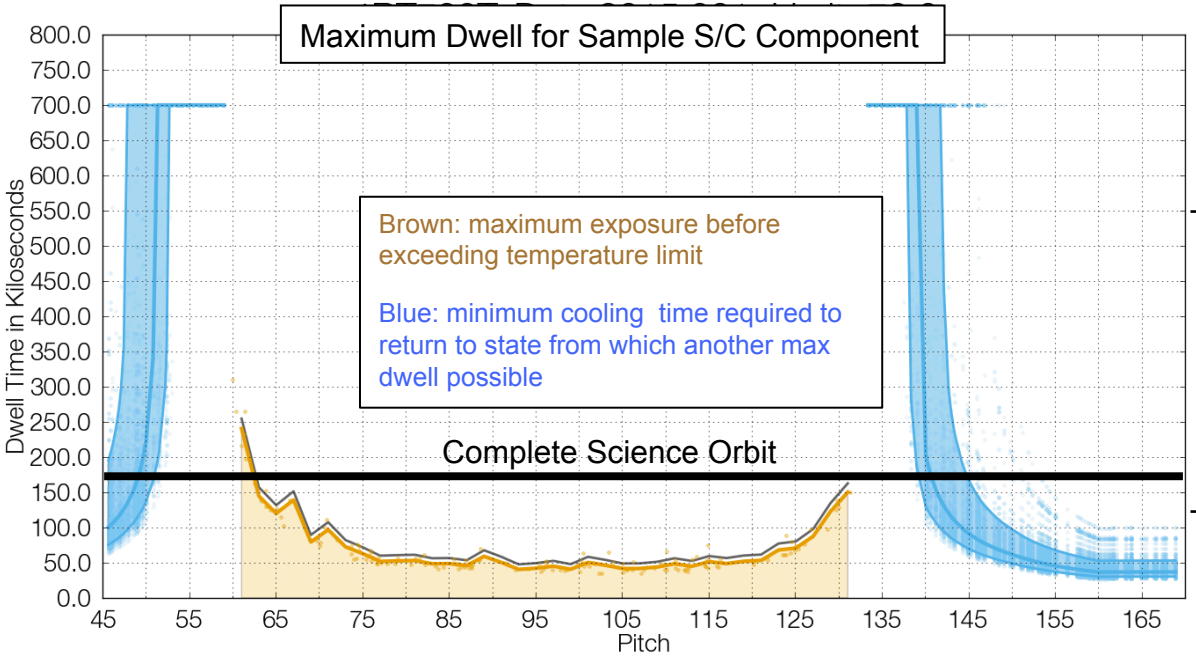
Pitch Angle Limitations



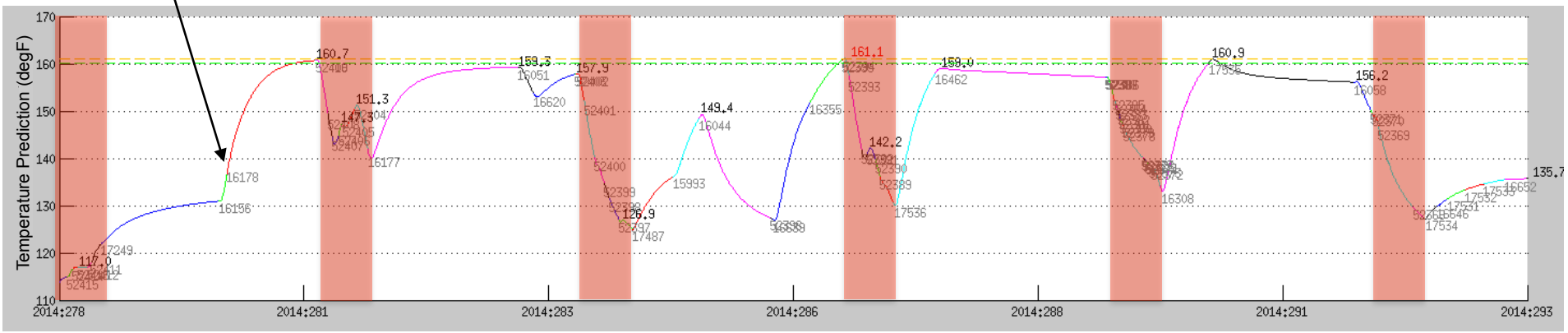


- At present, some component is impacted at every possible pitch angle.
- Maximum dwell time are significantly restricted at near-normal attitudes.
  - This presents challenges for long observations, particularly in portions of the sky far from the ecliptic.
  - Challenges also exist for coordinated observations with observatories that always observe at near-normal Sun attitudes (e.g., XMM)

Thermal Balance

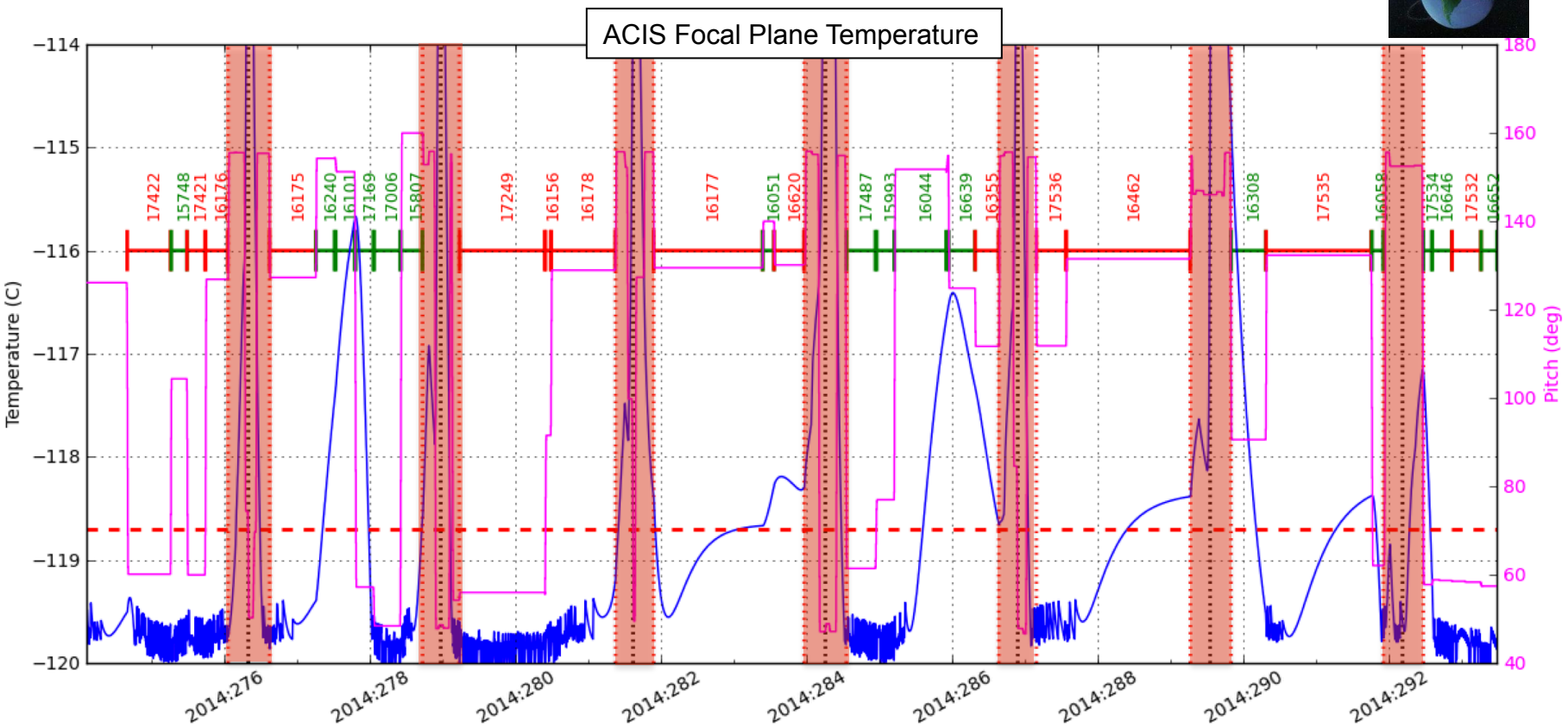


Note that this is only for <u>one</u> of the multiple spacecraft components with temperature limits



- Scheduling is a balance of heating and cooling multiple s/c components
  - Observations often split to accommodate temperature limits

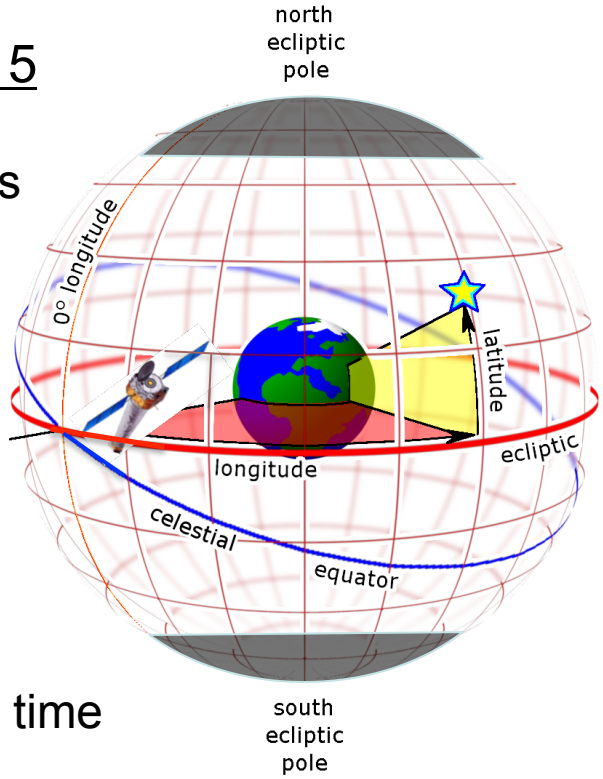
ACIS Considerations



- ACIS electronics (DPA) and focal plane temperatures increase at high pitch
  - competes with restriction for S/C heating at Sun-normal attitudes
- Reducing # of CCDs in use results in lower FP and DPA temperatures
  - Max dwell ≲100 ks for 5 CCDs for pitches of 145-155; no current limits for <5 CCDs
  - Long tail-Sun dwells can yield FP temperature swings that could affect spectroscopy

Constraint Mitigation

- Observation splitting
  - Short durations for “bad pitch” targets
  - Splitting of “cold” targets for cooling
- GOs encouraged to use < 5 CCDs since Cycle 15
  - most programs meet science goals with < 5 CCDs
  - GOs can still request 5 or 6 CCDs; such observations can be more complicated to schedule
  - GOs are encouraged to specify optional CCDs that could enhance science if available
- Limit time at high ecliptic latitude
  - Maximum time at $|\beta| > 60^\circ$ limited to 2 Ms for XVP in Cycle 16; limits will continue in future cycles
- Two-week loads (start_my_week ➔ commence_thine_fortnight)
  - Facilitates handling of components with long thermal time constants (e.g., IPS tank)
- Increased scrutiny on constraints (particularly hidden constraints) at peer review
  - Emphasis on “preference” nature of Preferences as well



Future

- With current constraints, **continued high-efficiency observing expected**
  - No changes to observing requirements in Cycle 17
  - None anticipated for Cycle 18 at present, but this will be revisited in 1 yr
- Thermal constraints have, for quite some time, blurred the transition between observing Cycles; this will continue
  - Some targets get pulled forward to help with thermal issues; this necessarily delays some targets from current Cycle
  - Coupled with “borrowed” time in XVP programs, Cycle 15 will “end” (50/50 split of Cycle 15/16 targets) in early/mid-March 2015
  - Future Cycles will run on similar calendars, roughly March-to-March.
- Modeling and evaluation of spacecraft thermal conditions will continue in order to assess operational and scientific impact of evolving thermal conditions on S/C
- New mitigation strategies will continue to be developed as required
  - Discussions will proceed through Project Office and CUC