XRT Future

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Future Directions

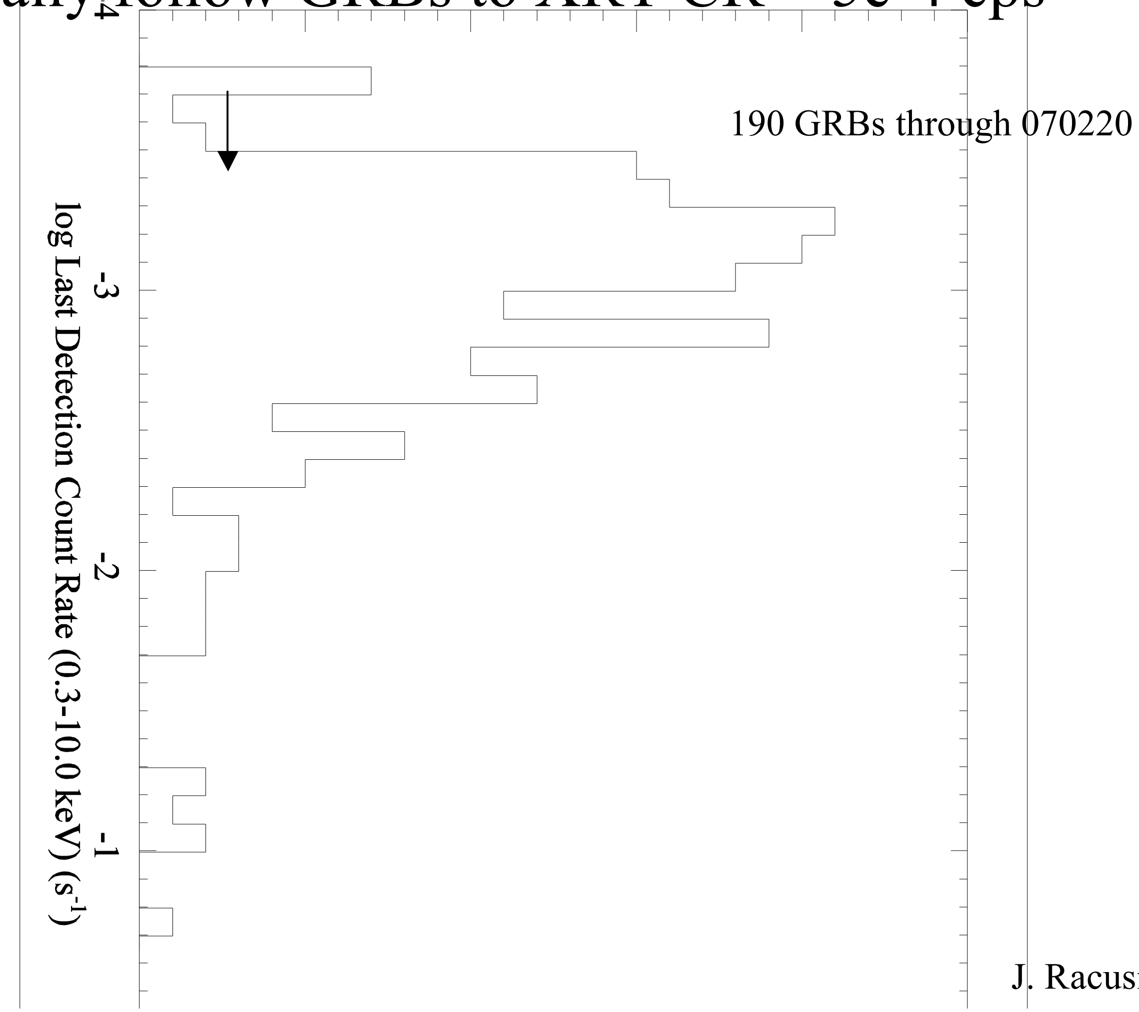
- No crystal ball – consider tradeoffs
  - GRBs vs non-GRBs
  - ToOs vs other targets
  - Various biasing of viewing angles
    - Northern vs southern hemisphere
    - Anti-sun vs 90 degrees to sun
- What new science can we expect?
  - GRBs:
    - Rare events
    - Increase catalog of short GRBs
    - We typically cannot tell when a burst goes off how interesting it will prove to be => argues for continued followup
  - Non-GRBs:
    - Multiwavelength campaigns
    - Transient objects
    - ?

XRT Status

- Hardware:
  - Excellent: no known degradation, with exception of
    - expected radiation damage to CCD => loss of energy resolution
    - Micrometeriod damage (5/27/05) and gradual increase in related dark current problems => gradually increasing number of masked-out columns and bad pixels
    - Potential work-arounds:
      - Offset pointing away from bad columns
      - Change substrate voltage to reduce dark current (June-July 2007?)
- Software
  - New capability to specify XRT readout mode (May 2007)
    - Increasingly important for ToOs and (future) GO program
    - Allows ability to suppress automated mode selection for specified target without forcing XRT into particular mode for specified time
    - Allows (for example) position determination on bright sources that would normally be observed in WT mode

GRB Observations

- Typically follow GRBs to XRT CR ~ 5e-4 cps



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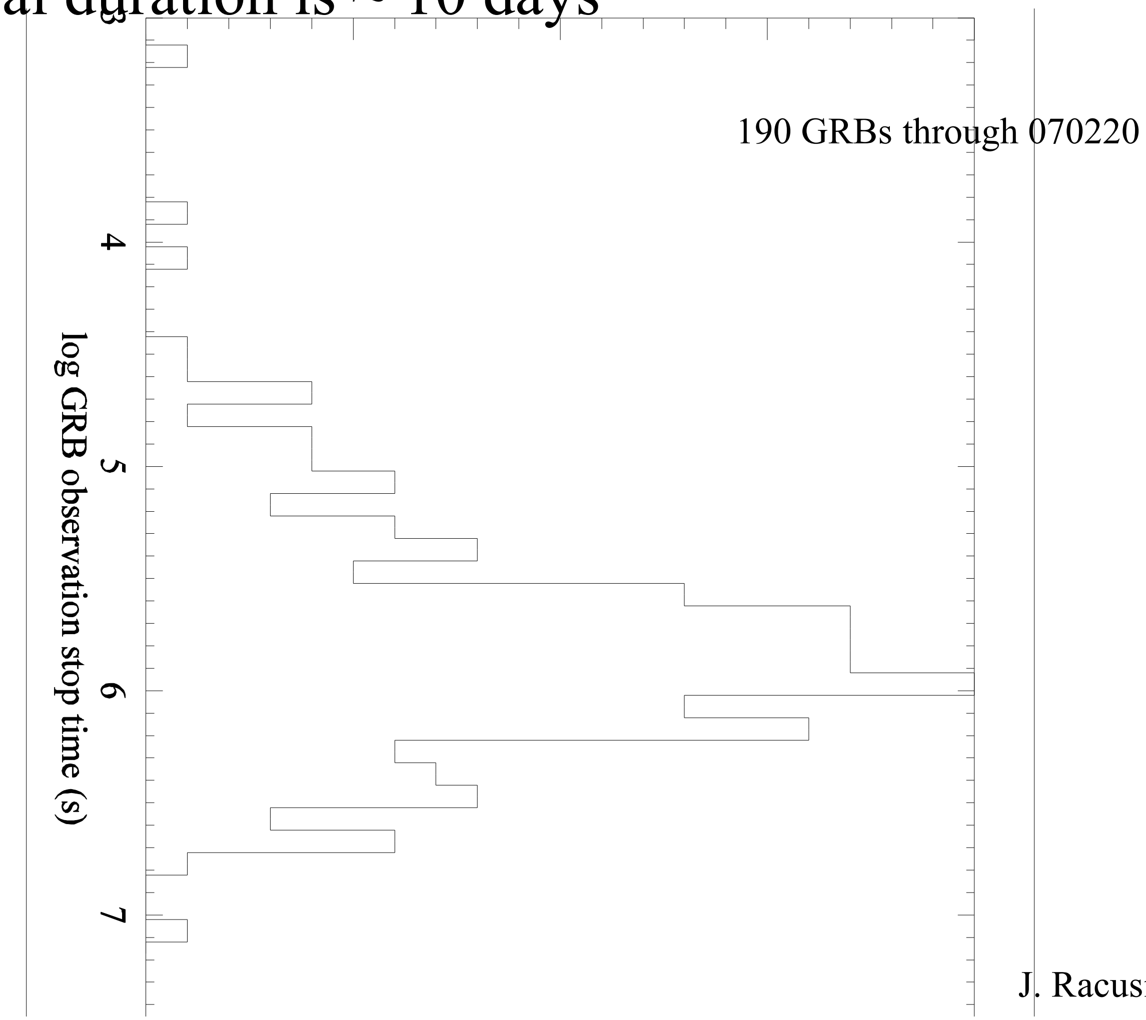
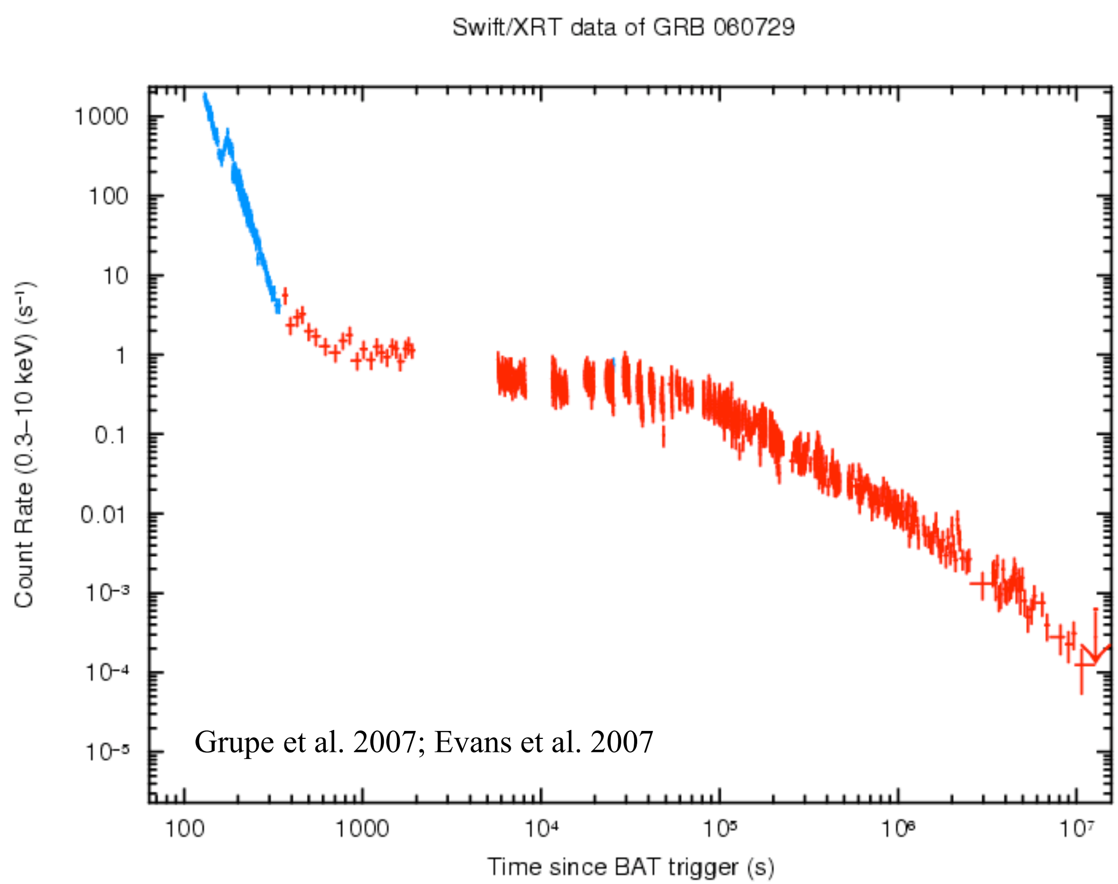
GRB Observations

=> typical duration is ~ 10 days



Jet Breaks and other late-time behavior

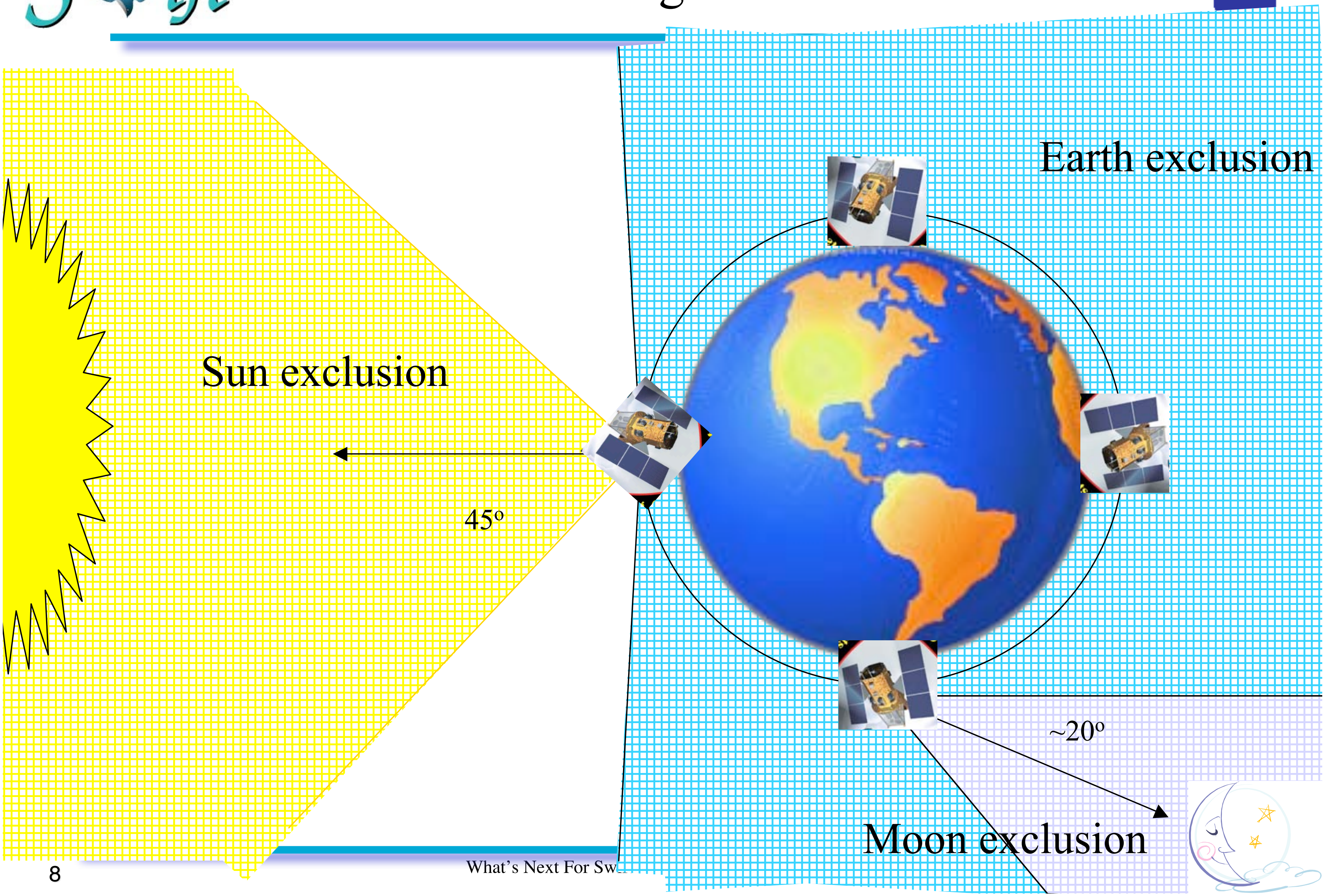
=> long follow-up is important for studying jet breaks and other late-time behavior



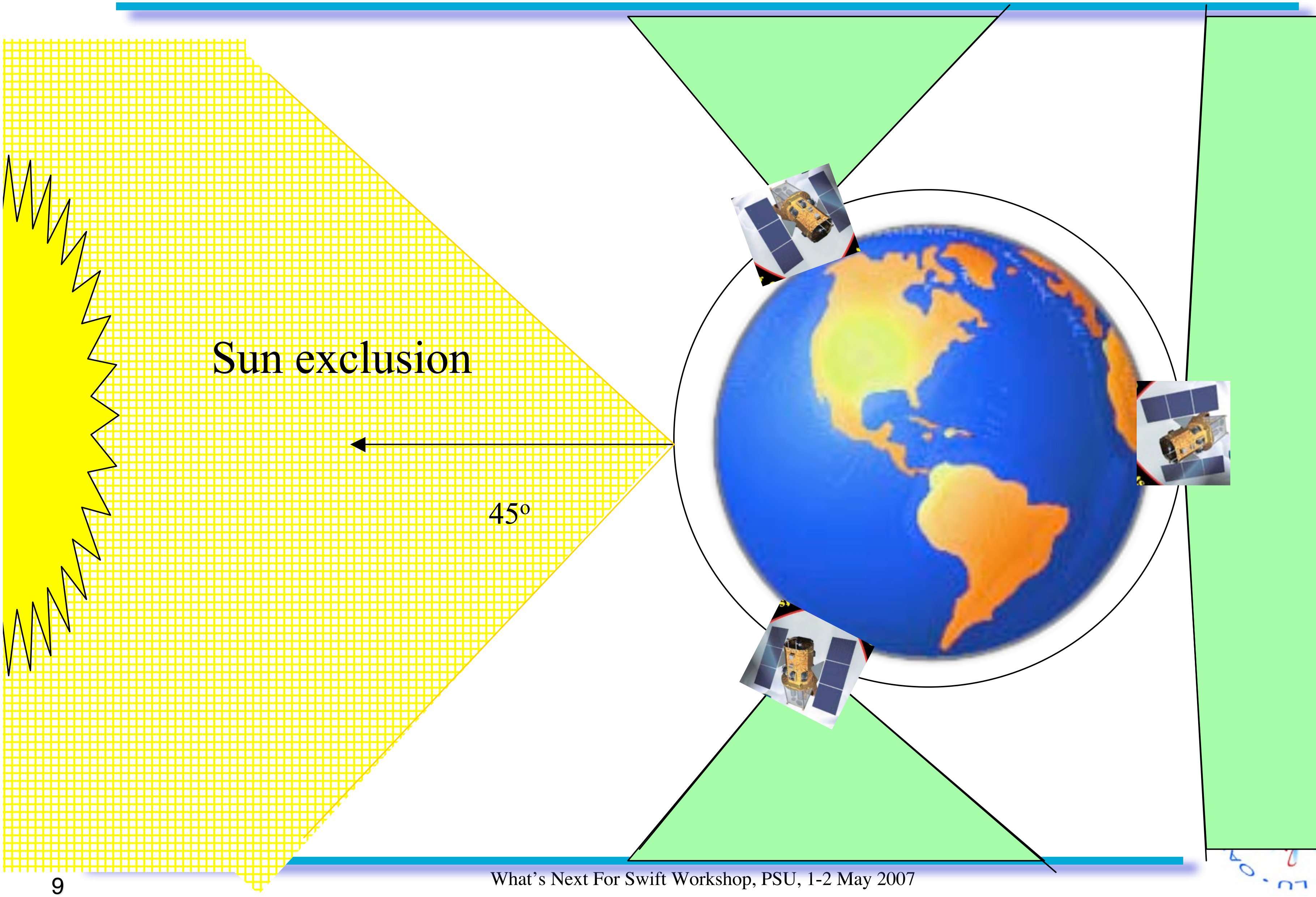
Scheduling

- Possible scheduling techniques:
  - Randomly distributed (first year)
  - Maximize average sun angle (second year)
  - Maximize average sun hour angle
  - Maximize time near anti-sun direction
    - Bimodal distribution
    - Maximize sun hour angle for all targets
- Constraints:
  - Final result driven by distribution of required observations
    - GRBs (~ 2/3 of observing time over first 2 years of mission)
    - ToOs (~ 12% of observing time)
  - Small amount of flexibility remains in fill-in targets, but these make very little difference in overall distribution
  - Must maintain acceptable XRT temperature, avoid anti-sun slews and other hazardous slews, minimize number of targets per orbit

Observing Constraints



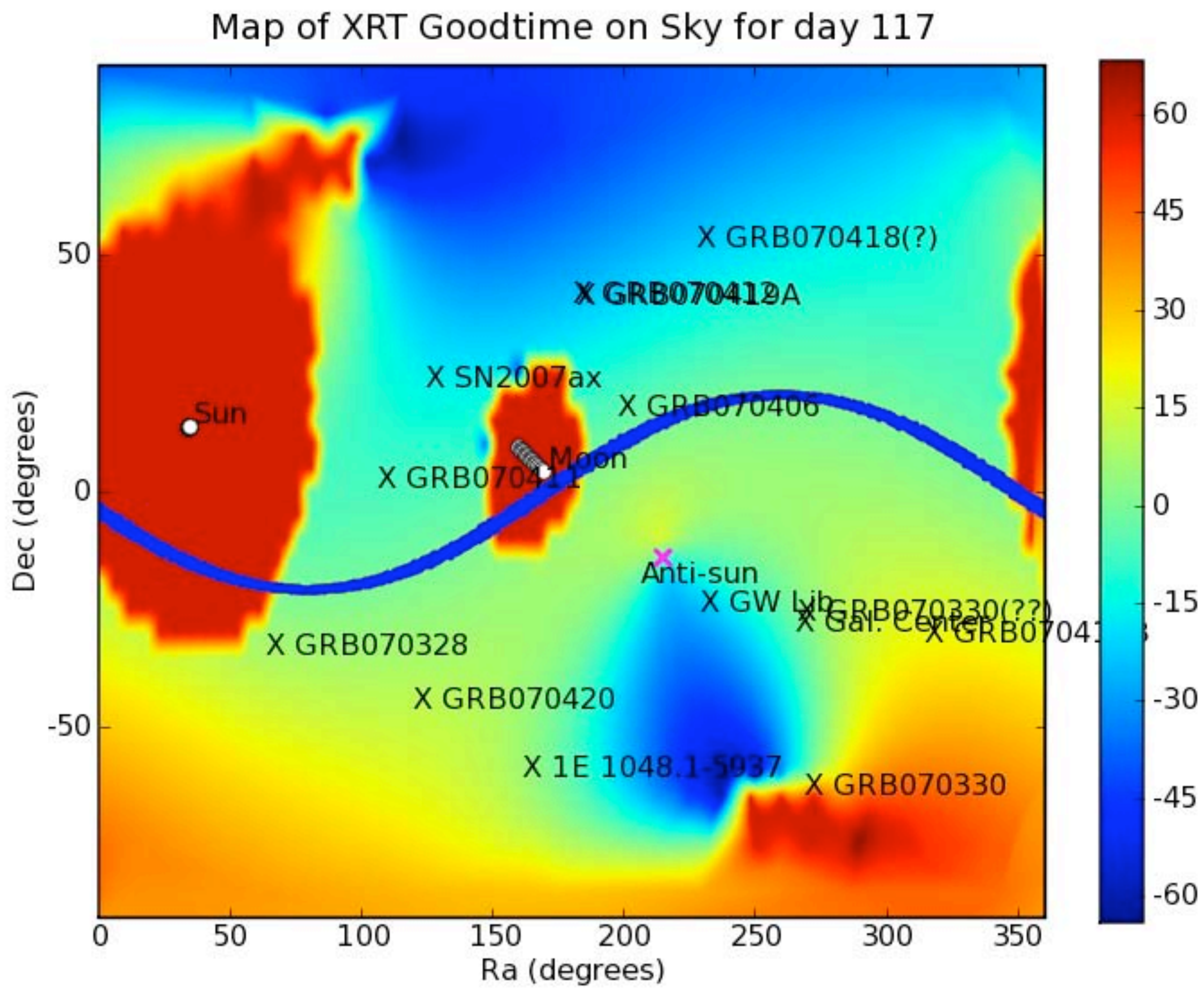
Observing Constraints – at least 3 observations per orbit are required



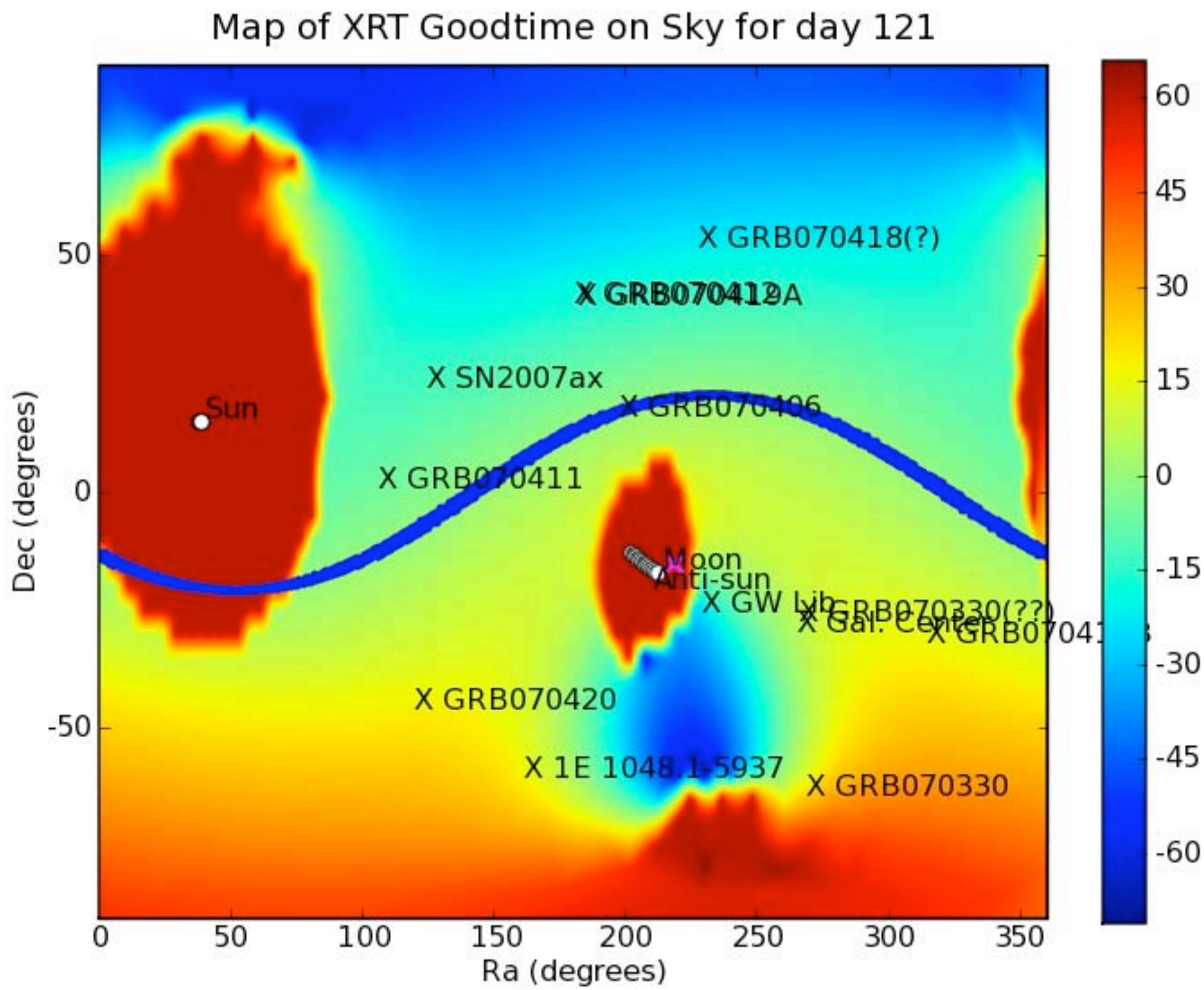
Other constraints

- Roll angle: must keep solar panels pointed within 10° of sun. Roll angle restricted to +/- 10° of optimal for targets 90° from sun, unlimited for 180° from sun.
- XRT temperature depends on viewing factor between radiator and Earth. Must minimize time spent with radiator viewing Earth. Depends on roll angle, which in turn depends on target direction and is constrained by solar panel requirements. We adjust roll angle for each target to provide best thermal profile.
- Average effect of a given target on XRT temperature depends on many factors including orbit beta angle (angle between orbit plane and sun) and changes with time.

Average effect on XRT temp vs target direction



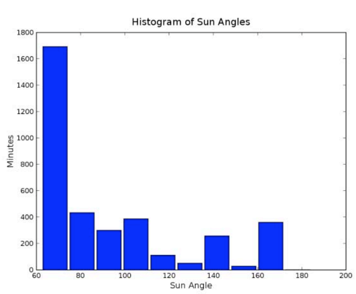
Average effect on XRT temp vs target direction

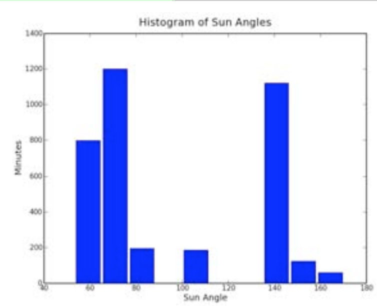


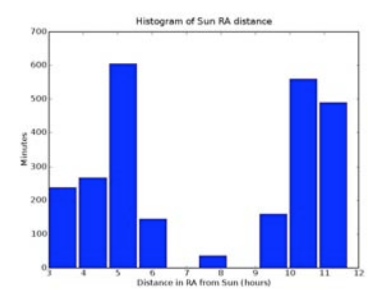
Scheduling

- Current Strategy:
  - Goal: Maximize the amount of time with sun hour angle > 9 hrs
  - Schedule all required targets (GRBs and ToOs)
  - Fill gaps in schedule from fill-in target list, starting with highest sun hour angle that can fill the gap
  - Still driven by distribution of required targets:

070103	-4.6	**070208**	8.2	**070306**	-10.8	**070406**	11.8
070107	8.6	**070209**	-5.6	**070318**	-3.4	**070411**	-5.8
070110	-4.6	**070219**	4.8	**070328**	-3.9	**070412**	-10.8
070126	-5.7	**070220**	-4.1	**070330**	6.6	**070419A**	-10.4
070129	-5.7	**070223**	-11.8			**070419B**	4.7
		070224	10.6			**070420**	-6.2
		070227	-9.3				



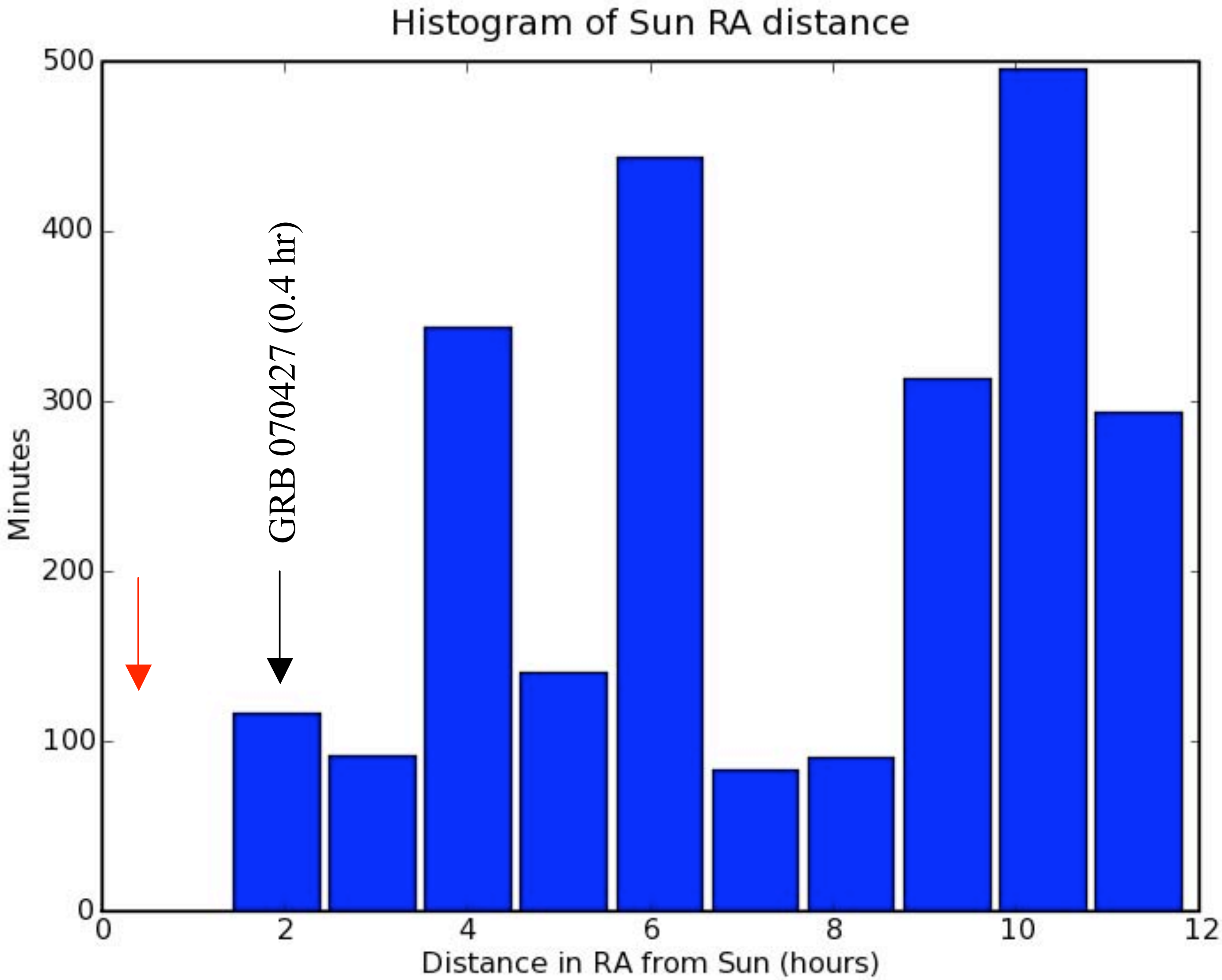




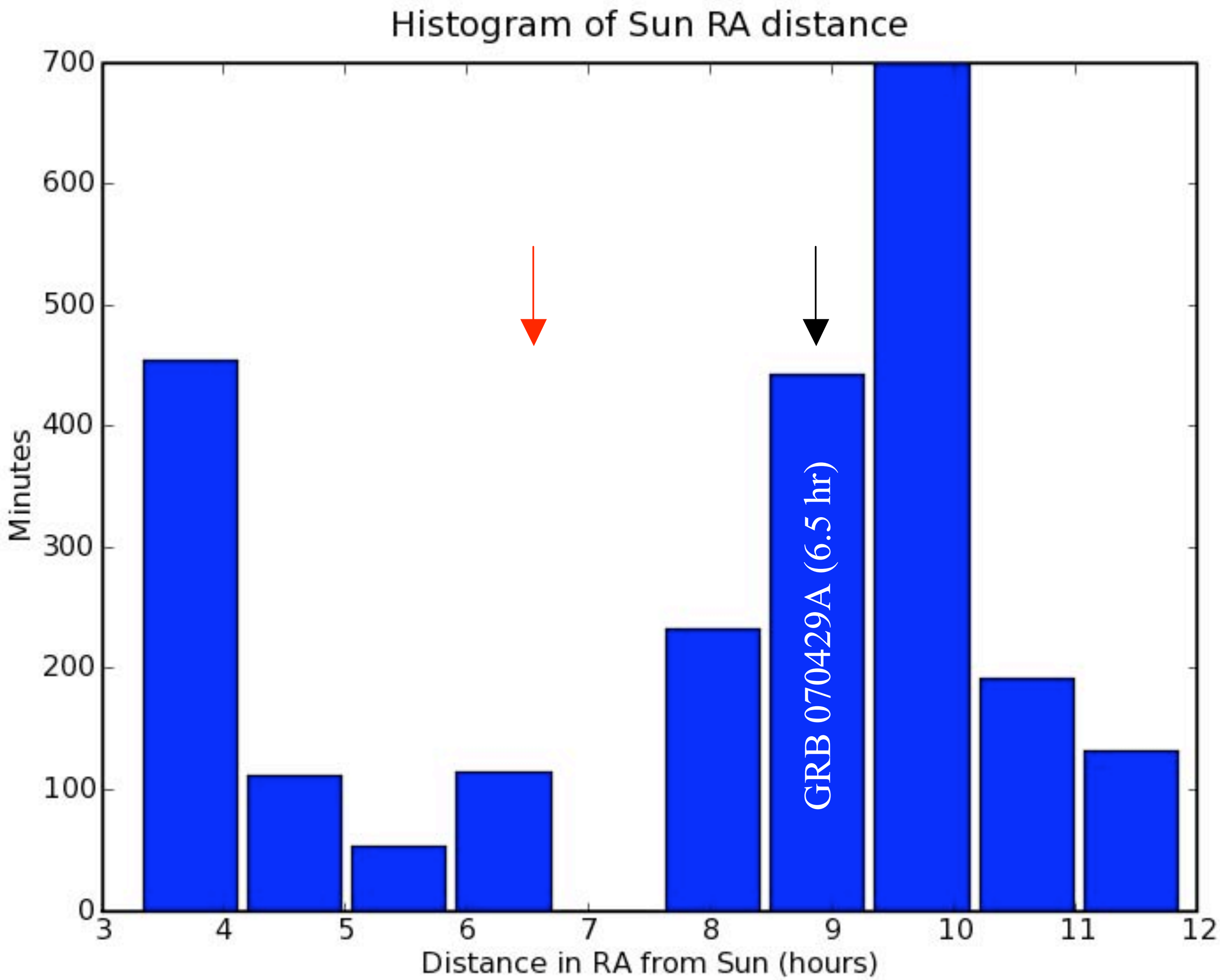
Future?

- Need clear planning priorities / strategies
- "Improvements" can be made in scheduling if
  - We provide more flexibility to planners by scheduling fewer required targets
  - We stop observing ToOs at unfavorable locations on the sky
  - We stop following up GRBs at unfavorable locations on the sky
- What should drivers be?
  - Sun angle or sun hour angle or visibility from your favorite observatory?
  - Tradeoffs between ground-based and space-based followup?
  - Tradeoffs between complete unbiased X-ray afterglow catalog and more optical observations?
  - Tradeoffs between bursts with and without optical counterparts?
  - Tradeoffs between primary and secondary science:
    - should we observe anti-sun blank sky or fill-in targets if no GRBs or ToOs?)
    - Should we reject interesting ToOs that are not sufficiently anti-sun?
- What about bursts like GRB 060729 (sun angle: 85 degrees, 2.2 hr W)?

Recent Bursts

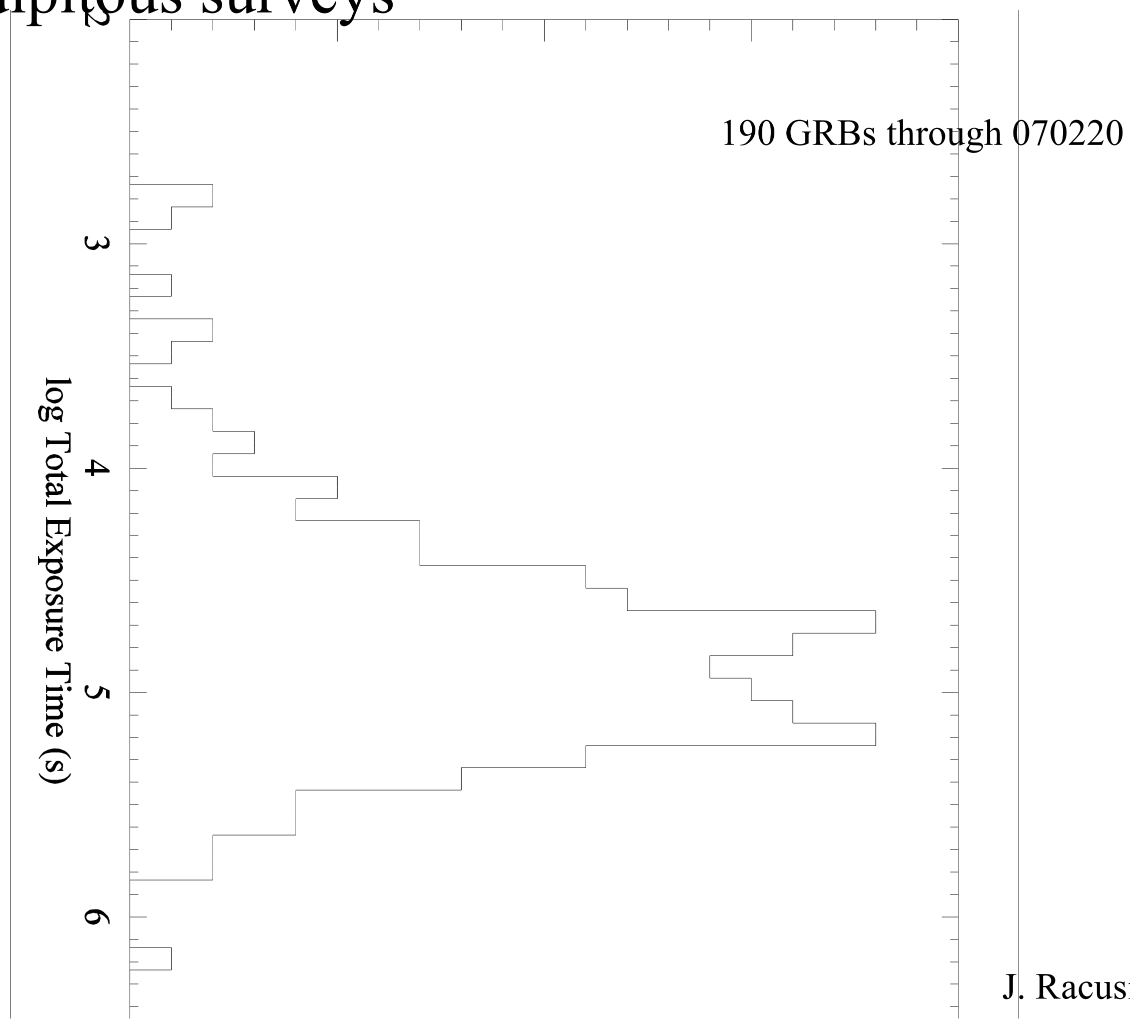


Recent Bursts



Serendipitous Observations

- Typical exposure is ~ 100 ks => useful for deep serendipitous surveys



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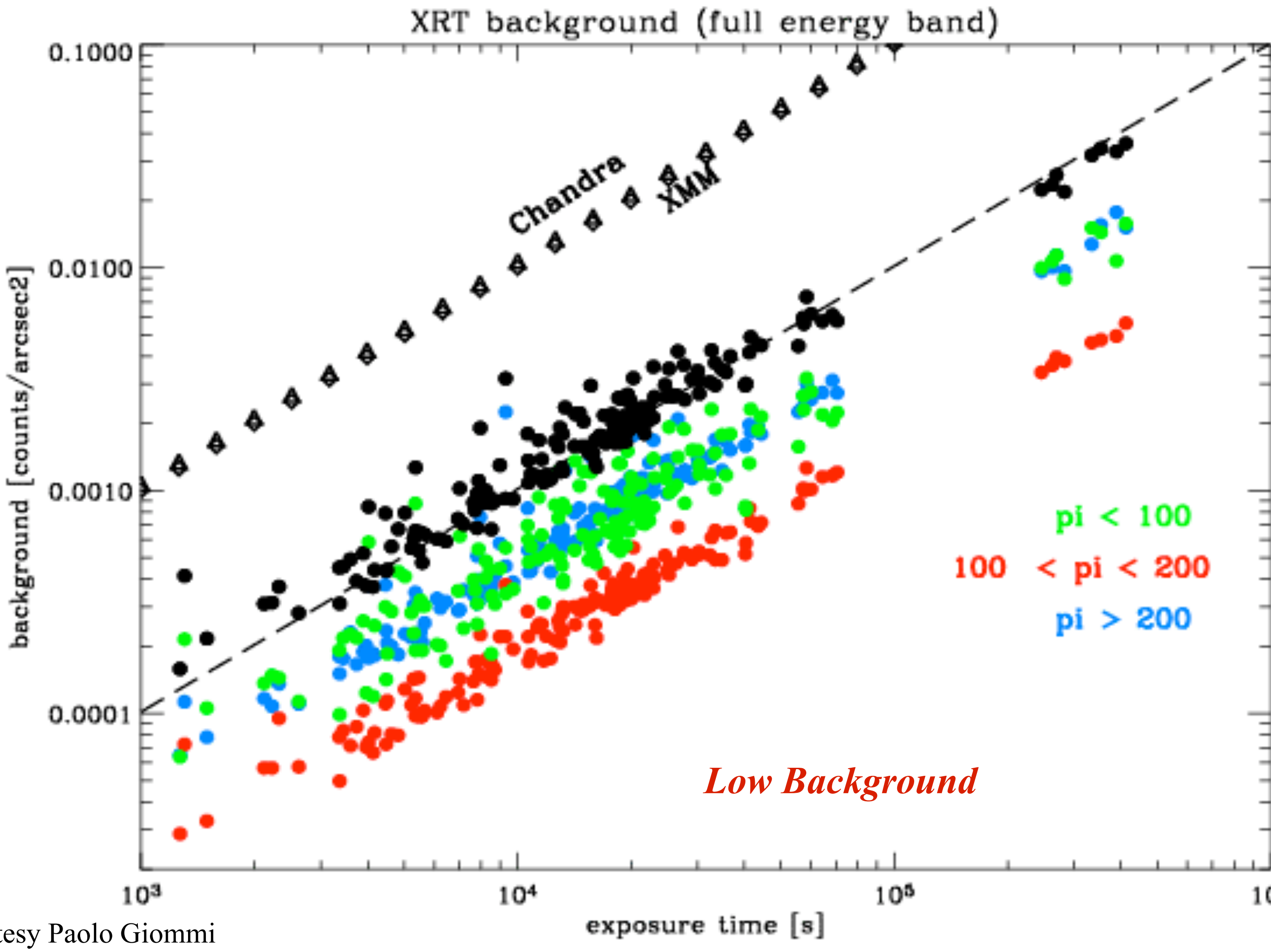
Serendipitous Observations



Courtesy Paolo Giommi