XRT active region observations

Science topics

1. The dynamics of active region structures from the photosphere to the corona.
2. Topology for structures from the photosphere to the corona.
3. Thermodynamics of active region structures

Science topic #1: Dynamics

- These observations will obviously require cadences short enough to resolve rapid changes in the emission measure for structures of interest. For this study, the main point is to determine how rapidly the vertical/horizontal components of the magnetic field vary; the rate of change in intensity for several emission lines by EIS; and high-cadence XRT images that will study the high speed flows seen in active regions.

- XRT XOB: High cadence, small FOV, one filter

XRT XOB for Dynamics

PRG: 15F8: AR Dynamics

Name	Loop	Int	Duration	Size(Bits)	Center	Size	Comp	AEC	DMF	Buffer	L	Er
AR Dynamics (15F8)			:30:00.6	29.8 M								
Subr-1	30	:30.0	:16:36.1	27.6 M								
Al/poly - 1x1 - Q98 (2827)	1	:02.0	:03.2	921. K								
Ti/Poly (Thick Al) - 1x1 -1024ms		:02.0	:03.2	921. K	1024x1024	384x384	52%	1	KSC, SSOC	Regular		
Al/poly - 1x1 - Q98 - preflare (2828)	2	:02.0	:30.0	00.0 M								
Ti/Poly (Thick Al) - 1x1 -1024ms		:05.0	:05.0	00.0 M	1024x1024	384x384	52%	1	KSC, SSOC	Preflare-3		
Ti/Poly (Thick Al) - 1x1 -1024ms		:05.0	:05.0	00.0 M	1024x1024	384x384	52%	1	KSC, SSOC	Preflare-2		
Ti/Poly (Thick Al) - 1x1 -1024ms		:05.0	:05.0	00.0 M	1024x1024	384x384	52%	1	KSC, SSOC	Preflare-1		
Subr-2	1	:13:1...	:13:17.0	2.16 M								
Ti/Poly - 2x2 - 1024x1024 - 4096ms (2829)	1	:04.0	:05.7	1.63 M								
Ti/Poly - 2x2 - 4096ms		:02.0	:05.7	1.63 M	1024x1024	1024x1024	52%	0	KSC, SSOC	Regular		
G-Band Alignment - 64ms - 384x384-centered (2839)	1	:04.0	:04.3	530. K								
G-Band - 1x1 - 64ms		:02.0	:04.3	530. K	1024x1024	384x384	30%	0	KSC, SSOC	Regular		

- Runs 1 filter (Ti/poly) with 30 cadence, in burst mode
- Pre-flare images at a 5 sec cadence (no effect on main data rate)
- Binned image with larger FOV for context every 30 mins
- Data rate - intensive - 44.6 Mb/hour. Could be decreased by increasing lag time between bursts.
- Burst starts exactly every 30 mins, for easy coordination with other instruments
- G-band for alignment every ~15 minutes

Complementary studies for Dynamics program

This program is very flexible, and can be used with a variety of EIS and SOT programs for different science goals, e.g.

- AR filament dynamics - SOT h-alpha. EIS, TRACE, AIA provide the filament imaging, XRT provides the overlying loop structure and the shear in AR core.

- Intensity oscillations/flows at the edge of ARs - EIS: many cool lines plus coronal lines, SOT: low cadence magnetograms.

- Hot dynamics - Change filter in XOB to a thicker filter (thin Be or Be_med), combine with EIS slots for full thermal coverage

Science topic #2: Morphology

- Determination of the vector photospheric magnetic field, the line-of-sight chromospheric magnetic field, and the orientation of structures in the corona relative to the underlying high beta magnetic field is the goal of this study.

- XRT XOB: Large FOV, moderate cadence, one thicker filter and one thinner filter, compression OK. Follow AR for a few hours a day as it crosses disk.

XRT XOB for Morphology

PRG: 15F9: AR morphology

Name	Loop	Int	Duration	Size(Bits)	Center	Size	Comp	AEC	DMF	Buffer	L	Err
AR morphology	0...		:21:19.3	11.8 M								
Subr-1	3	:07:0...	:21:00.0	11.3 M								
AR Morphology - Al/poly long/short pair (282A)	1	:04.0	:07.5	1.88 M								
Al/poly (C/poly) - 1x1 - 1024ms		:02.0	:03.7	943. K	1024x1024	512x512	30%	2	KSC, SSOC	Regular		
Al/poly (C/poly) - 1x1 - 1024ms		:02.0	:03.7	943. K	1024x1024	512x512	30%	3	KSC, SSOC	Regular		
AR Morphology - thin-Be (281D)	1	:04.0	:16.6	1.88 M								
Thin-Be (Med-Be) - 1x1 - 4096ms		:02.0	:09.8	943. K	1024x1024	512x512	30%	2	KSC, SSOC	Regular		
Thin-Be (Med-Be) - 1x1 - 4096ms		:02.0	:06.8	943. K	1024x1024	512x512	30%	3	KSC, SSOC	Regular		
AR Morphology - Al/poly and thin-Be long/short pair-preflare3 (2832)	6	:01:0...	:06:00.0	00.0 M								
Al/poly (C/poly) - 1x1 - 1024ms		:02.0	:06.7	00.0 M	1024x1024	512x512	30%	2	KSC, SSOC	Preflare-3		
Al/poly (C/poly) - 1x1 - 1024ms		:02.0	:03.7	00.0 M	1024x1024	512x512	30%	3	KSC, SSOC	Preflare-3		
Thin-Be (Med-Be) - 1x1 - 4096ms		:02.0	:09.8	00.0 M	1024x1024	512x512	30%	2	KSC, SSOC	Preflare-3		
Thin-Be (Med-Be) - 1x1 - 4096ms		:02.0	:06.8	00.0 M	1024x1024	512x512	30%	3	KSC, SSOC	Preflare-3		
Subr-2	1	:02.0	:11.8	530. K								
G-Band Alignment - 64ms - 384x384-centered (2839)	1	:04.0	:11.8	530. K								
G-Band - 1x1 - 64ms		:02.0	:11.8	530. K	1024x1024	384x384	30%	0	KSC, SSOC	Regular		

- Al/poly and Thin Be long/short exposure pairs every 7 minutes for imaging hot and cool plasma with a large dynamic range.
- Large field of view (512x512) for imaging entire active region
- High compression (Q90) for data rate concerns
- Moderate data rate - 22 Mb/hr
- G-band for alignment every 20 minutes.

Complementary programs for morphology study

- Magnetic structure of ARs - MDI/HMI, SOLIS, SOT SP magnetograms, some chromospheric observations.
- EIS slot raster
- This program would work well as a standardized set of observations that run 1-2 hours a day when an active region is on the disk, in order to follow its evolution.
- Running this program on a collection of ARs would be ideal, to get information about the AR morphology in a variety of situations and configurations.

Science topic #3: Thermodynamics

- This study will focus on the temperature and density structures in ARs in order to gain insight into coronal heating.
- XRT XOB: Multi-filter DEM XOB. Large number of filters, small FOV (or use binning), moderate cadence, lossless compression.

XRT XOB for thermodynamics

PRG: 15FA: AR thermo

Name	Loop	Int	Duration	Size(Bits)	Center	Size	Comp	AEC	DMF	Buffer	L	Er
AR thermo	0...		:30:13.3	38.5 M								
Subr-1	6	:05:00.0	:30:00.0	37.9 M								
AR thermo - Al/mesh long/short pair 256x256 (2838)	1	:04.0	:04.2	904. K								
Al/Mesh (Ti/poly) - 1x1 - 512ms		:02.0	:02.1	452. K	1024x1024	256x256	57%	2	KSC, SSOC	Regular		
Al/Mesh (Ti/poly) - 1x1 - 512ms		:02.0	:02.1	452. K	1024x1024	256x256	57%	3	KSC, SSOC	Regular		
AR thermo - Al/poly long/short pair 384x384 (2833)	1	:04.0	:08.2	904. K								
Al/poly (C/poly) - 1x1 - 1024ms		:02.0	:02.6	452. K	1024x1024	256x256	57%	2	KSC, SSOC	Regular		
Al/poly (C/poly) - 1x1 - 1024ms		:02.0	:02.6	452. K	1024x1024	256x256	57%	3	KSC, SSOC	Regular		
AR thermo - C/poly long/short pair 384x384 (2835)	1	:04.0	:06.7	904. K								
C/Poly (Thin-Be) - 1x1 - 1024ms		:02.0	:02.6	452. K	1024x1024	256x256	57%	2	KSC, SSOC	Regular		
C/Poly (Thin-Be) - 1x1 - 1024ms		:02.0	:02.6	452. K	1024x1024	256x256	57%	3	KSC, SSOC	Regular		
AR thermo - Al/poly+Ti/poly long/short pair 384x384 (2834)	1	:04.0	:15.9	904. K								
Al/poly+Ti/Poly (Al/poly+Thick-Al) - 1x1 - 4096ms		:02.0	:05.7	452. K	1024x1024	256x256	57%	2	KSC, SSOC	Regular		
Al/poly+Ti/Poly (Al/poly+Thick-Al) - 1x1 - 4096ms		:02.0	:05.7	452. K	1024x1024	256x256	57%	3	KSC, SSOC	Regular		
AR thermo - thin be long/short pair 384x384-2 (2836)	1	:04.0	:17.4	904. K								
Thin-Be - 1x1 - 4096ms		:02.0	:05.7	452. K	1024x1024	256x256	57%	2	KSC, SSOC	Regular		
Thin-Be - 1x1 - 4096ms		:02.0	:05.7	452. K	1024x1024	256x256	57%	3	KSC, SSOC	Regular		
AR thermo thick filters (2837)	1	:04.0	:01:44.9	1.80 M								
Med-Be - 1x1 - 8192ms - 2		:02.0	:09.8	452. K	1024x1024	256x256	57%	1	KSC, SSOC	Regular		
Med-Al - 1x1 - 16384ms		:02.0	:18.0	452. K	1024x1024	256x256	57%	1	KSC, SSOC	Regular		
Thick-Al - 1x1 - 23142ms		:02.0	:24.7	452. K	1024x1024	256x256	57%	1	KSC, SSOC	Regular		
Thick-Be - 1x1 - 32768 ms		:02.0	:34.3	452. K	1024x1024	256x256	57%	1	KSC, SSOC	Regular		
Subr-2			:05.8	530. K								
G-Band Alignment - 64ms - 384x384-centered (2839)	1	:04.0	:05.8	530. K								
G-Band - 1x1 - 64ms		:02.0	:05.8	530. K	1024x1024	384x384	30%	0	KSC, SSOC	Regular		

XRT XOB for thermodynamics

- Nine X-Ray filter combinations, including Al/mesh (thinnest filter) and thick Be (thickest filter).
- long/short exposure pairs in thinner filters for good counts in all parts of AR.
- Small FOV - good for studying thermodynamics in AR core.
- Lossless compression for best data rate fidelity - necessary for quantative studies like this.
- Intensive data rate - 65 Mb/hr. Run for a few hours per OP period.
- G-band for alignment every 30 minutes.

Complementary studies for thermodynamics program

- EIS Observations: Many lines, Field of View (1" x 150") with 20" in y-direction extending into quiet sun (for calibrations)Exposure time=20sec with Q=95
- SOT observations: NFI: Na IV 164"x82", 2x2, Q65, BFI: Ca 149"x87", 2x2, Q65, 120 sec, SP: scan 120"x"120"
- TRACE/AIA EUV: 195/171