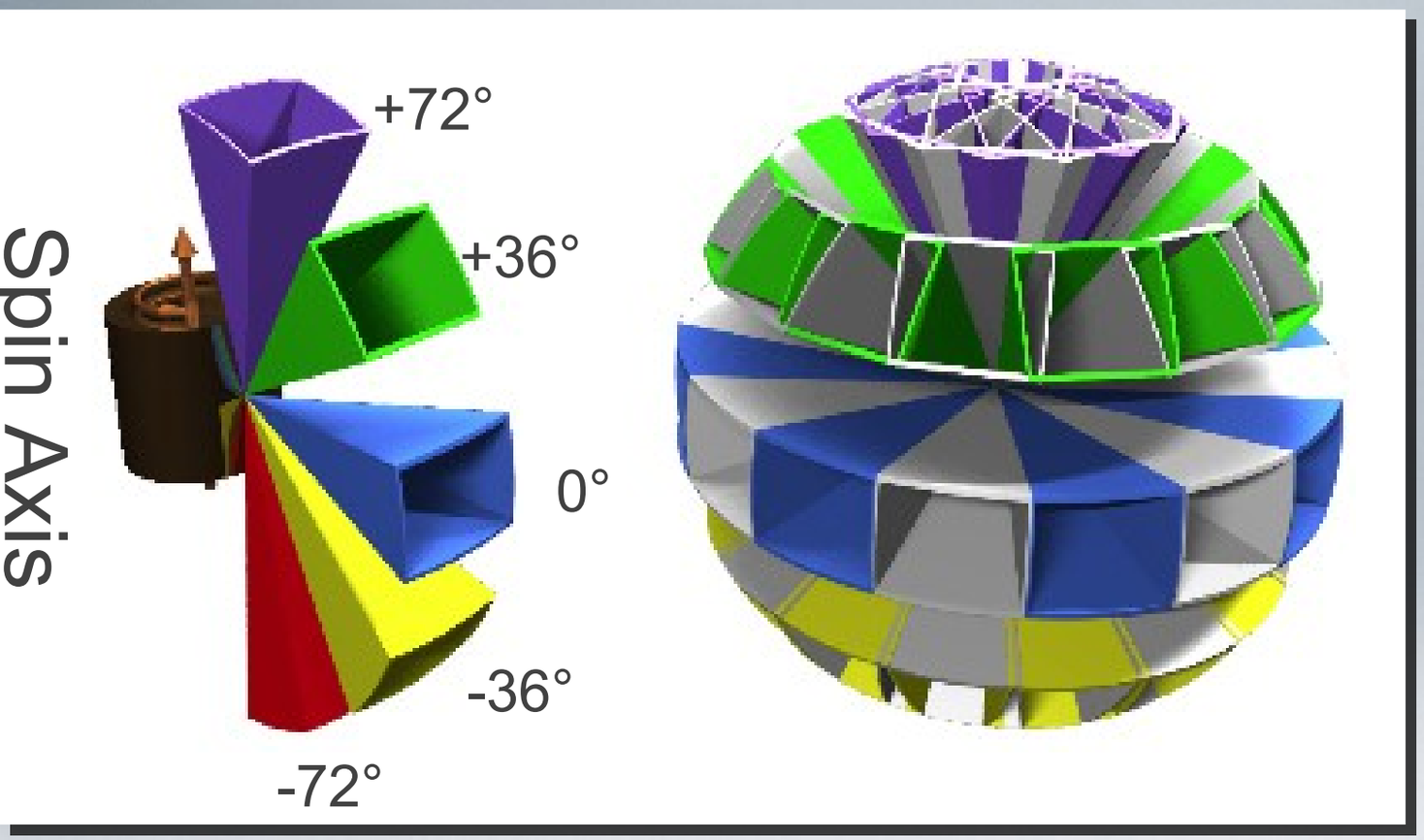
RBSP-ECT Burst Support

May 2012 SWG Meeting

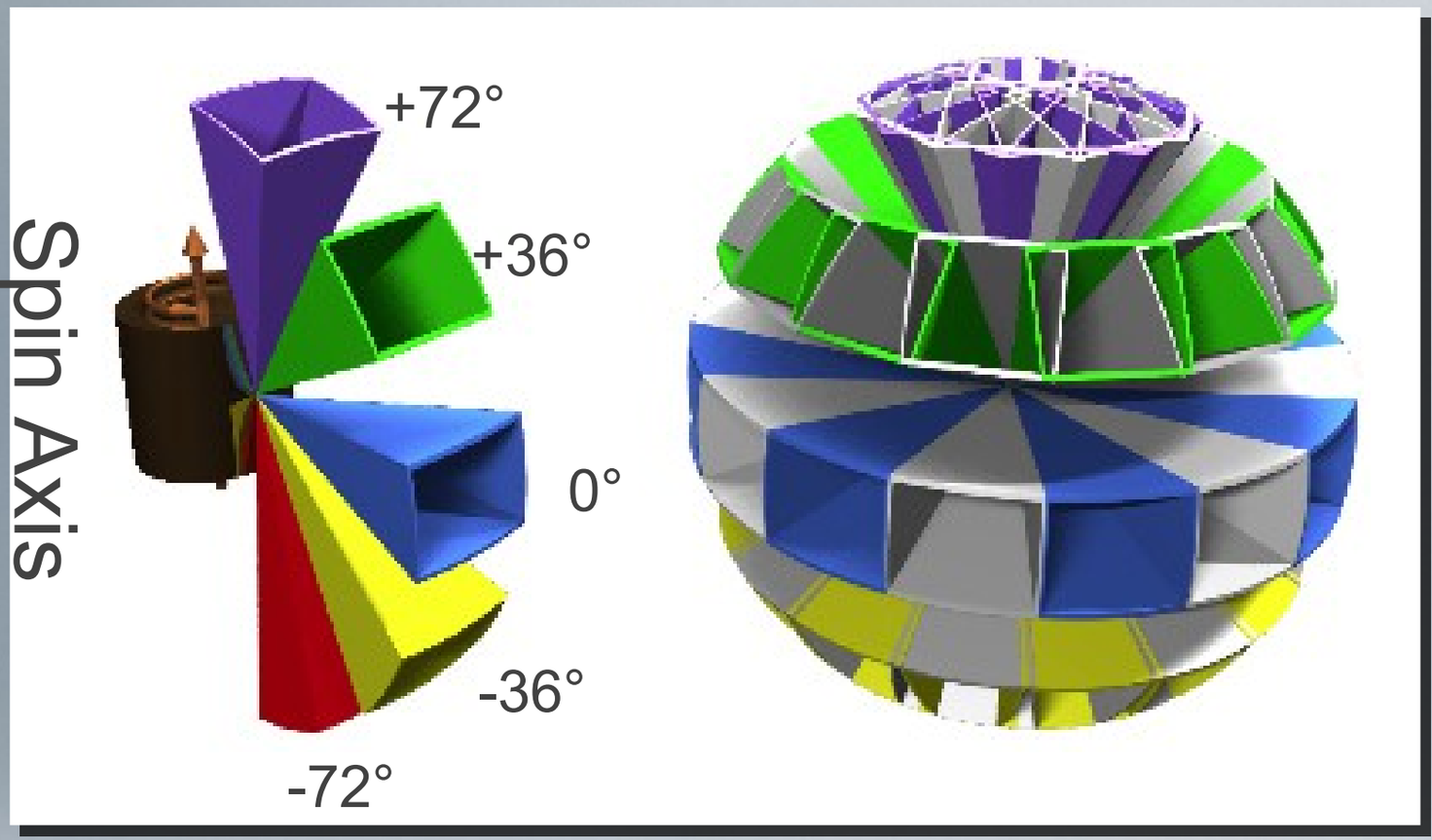
HOPE Measurements



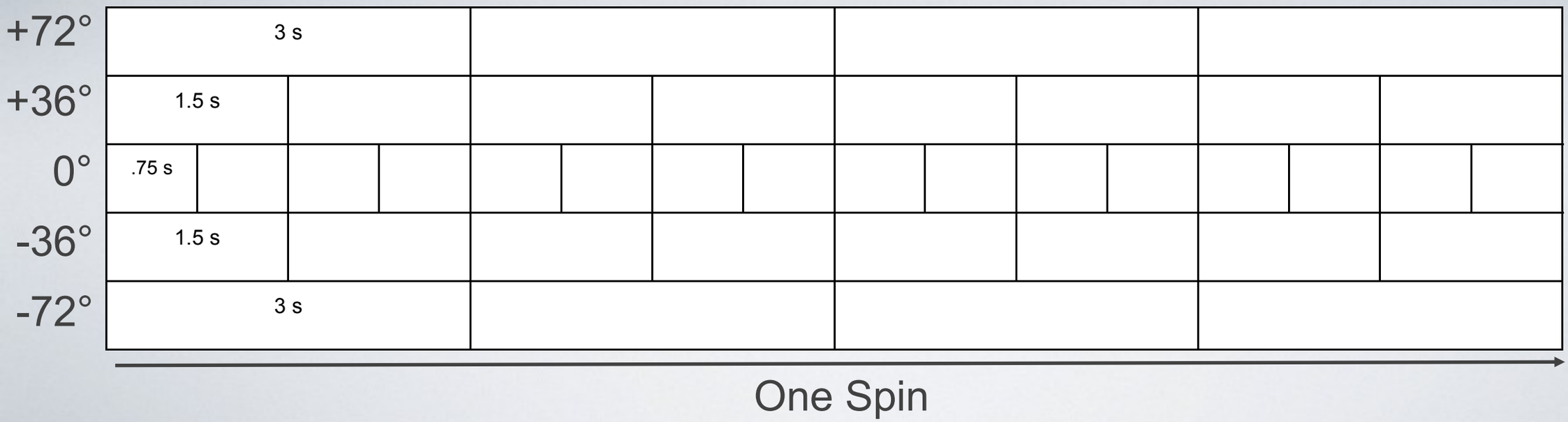
- 5 pixels in spin plane
- Entrance Angle 20°x11°

- Steps up & down in voltage as the spacecraft spins = “energy sweep”
- Normal Mode has one energy sweep every 0.75 s which produces 16 azimuthal angle sectors
- The ±36° detectors are summed over 2 sectors (1.5s). The ±72° detectors are summed over 4 sectors (3s)

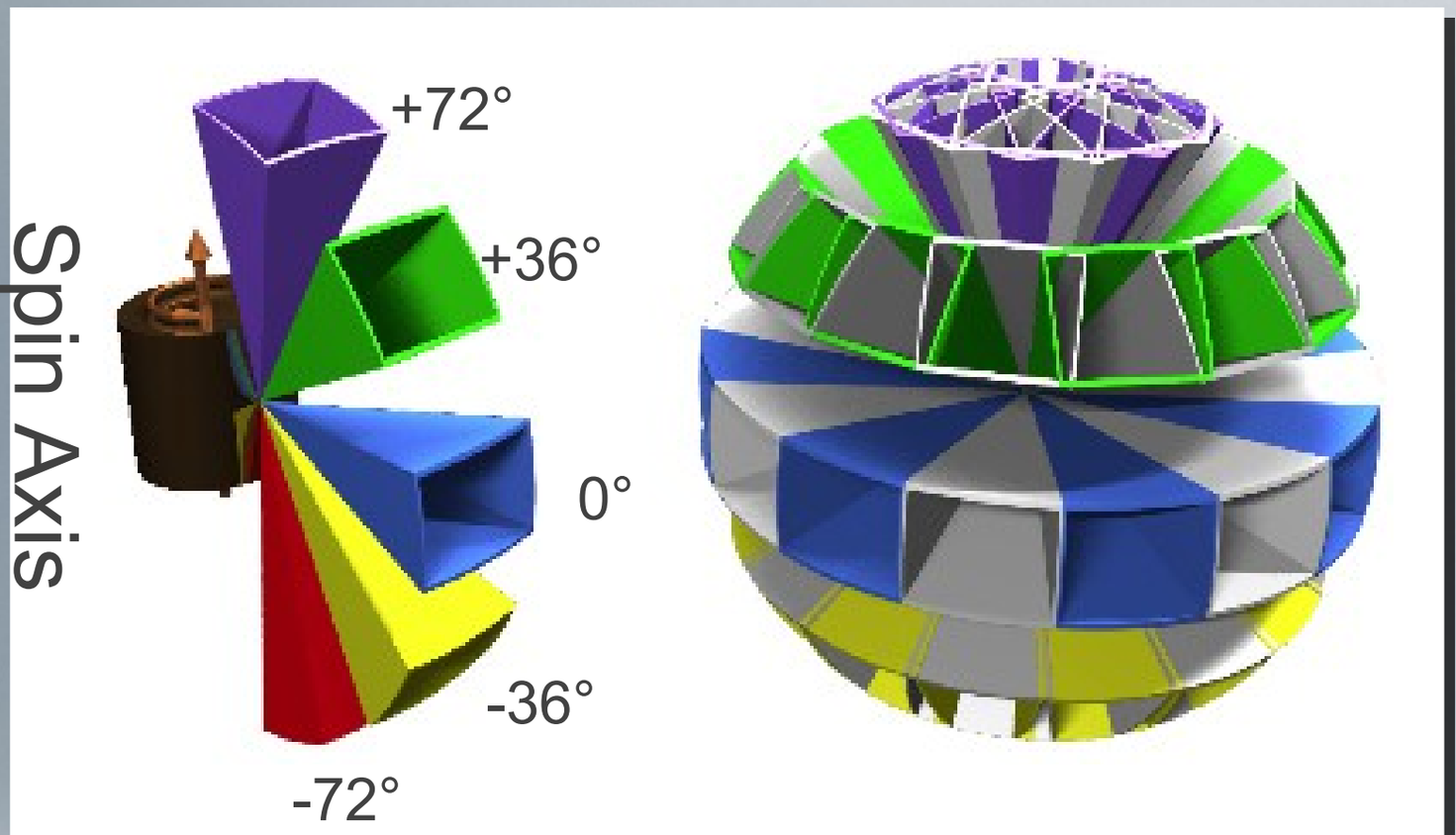
HOPE Measurements



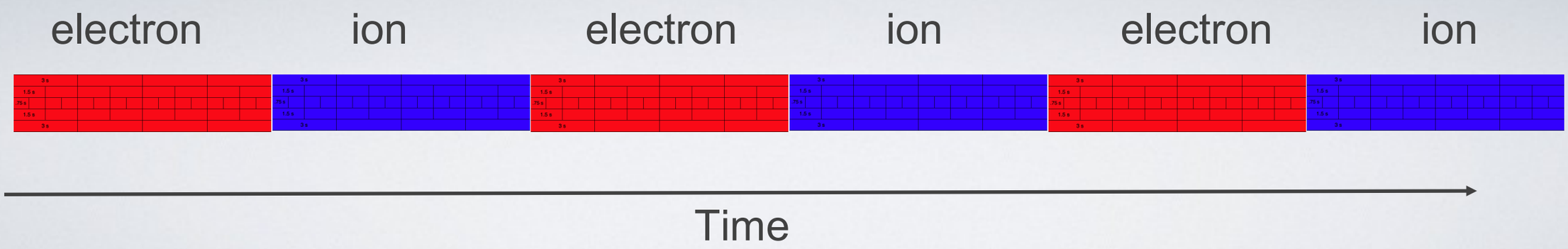
- If we make a mercator projection of the spin it looks something like this



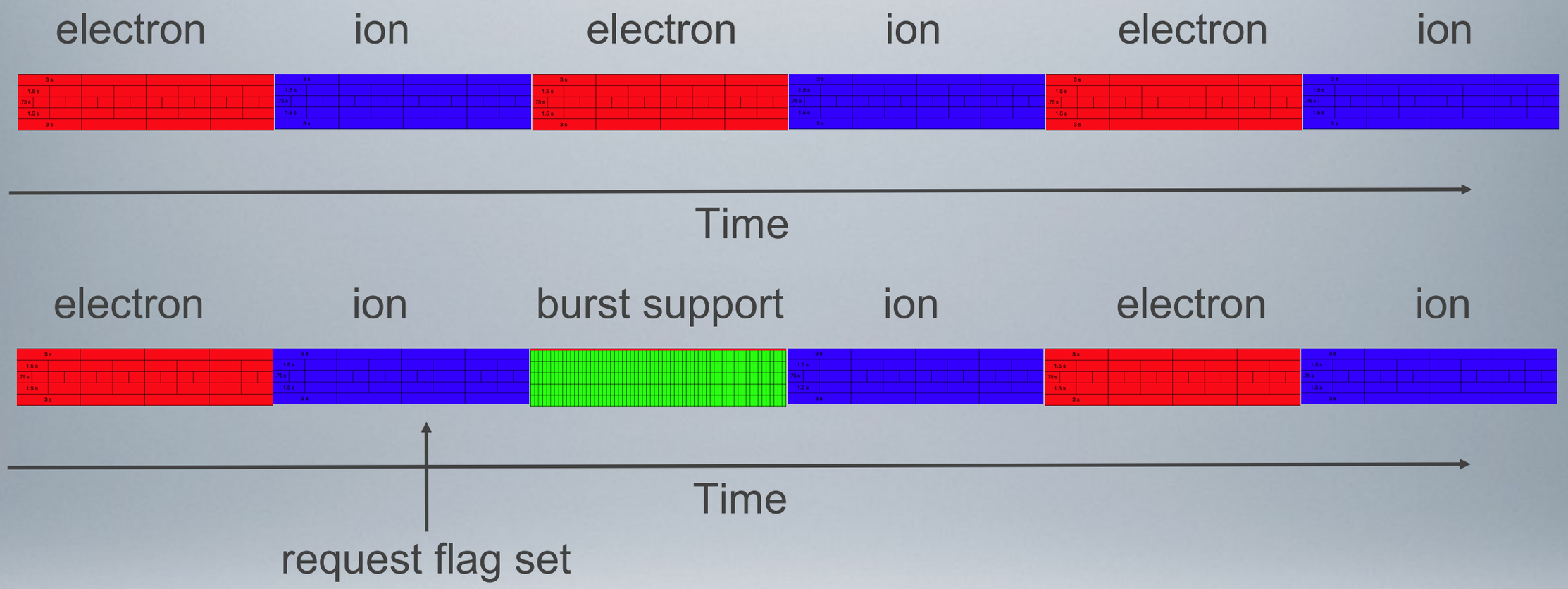
Normal Mode



- HOPE sweeps the ESA alternately through positive and negative voltages
- It alternates electron spin, ion spin, ...

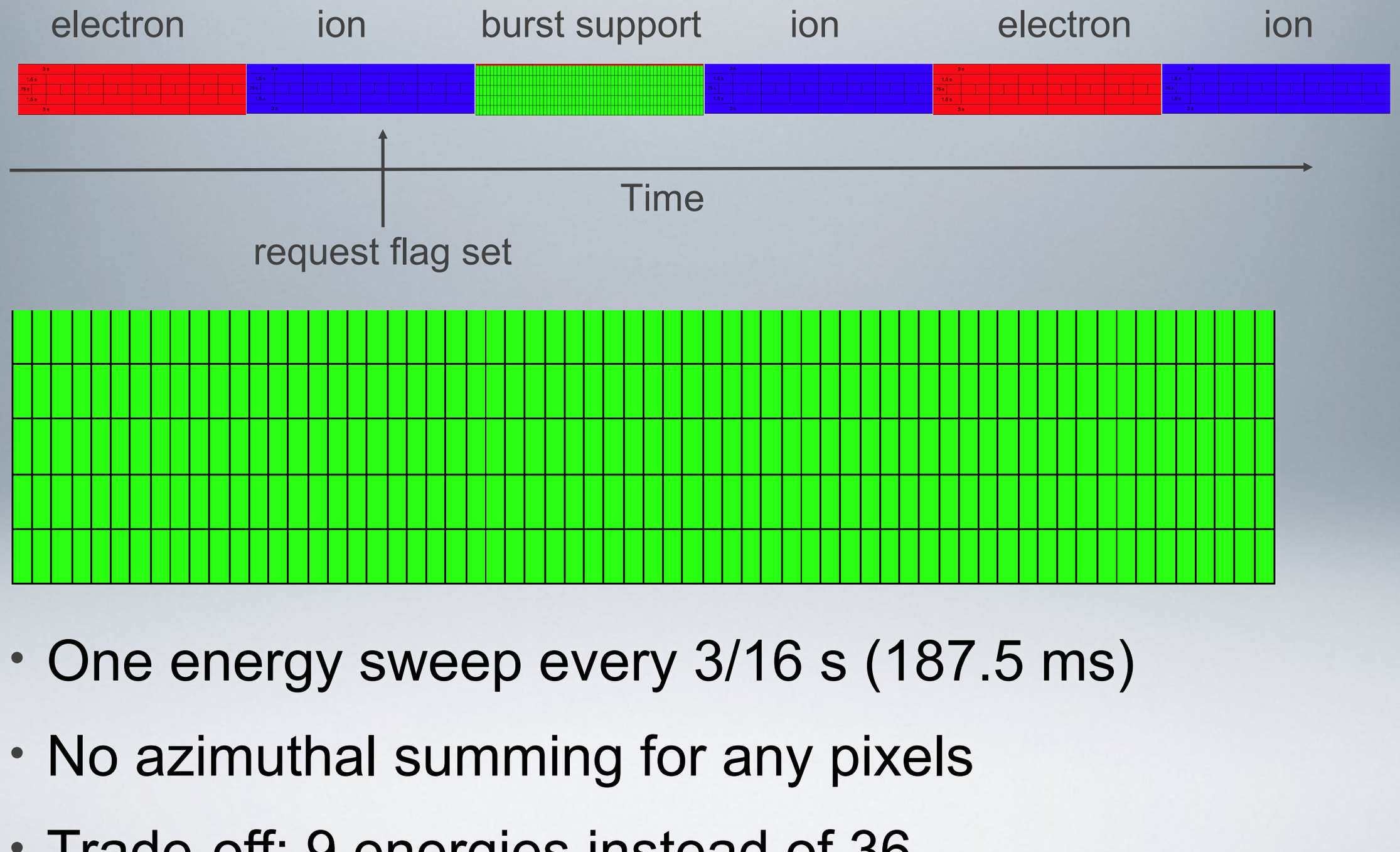


Burst Requests



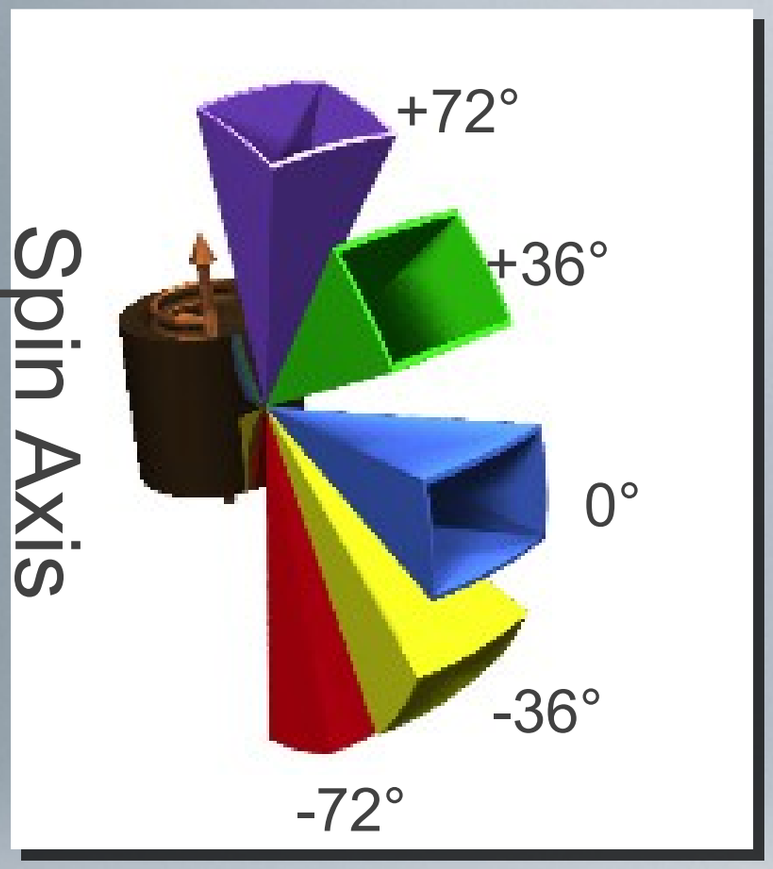
- HOPE responds to burst support request flags starting on the next spin
- It can go into any one of several pre-defined “plans”

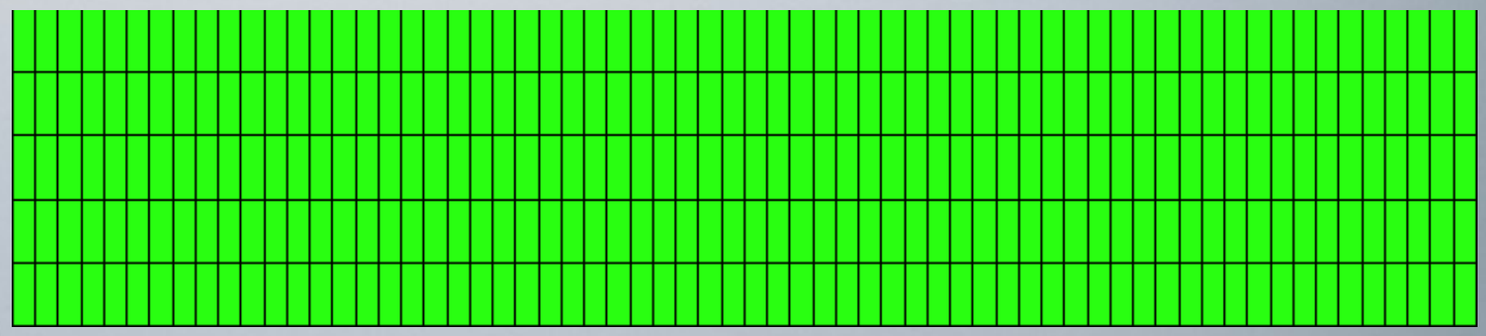
Burst Support Default Plan



- One energy sweep every 3/16 s (187.5 ms)
- No azimuthal summing for any pixels
- Trade-off: 9 energies instead of 36

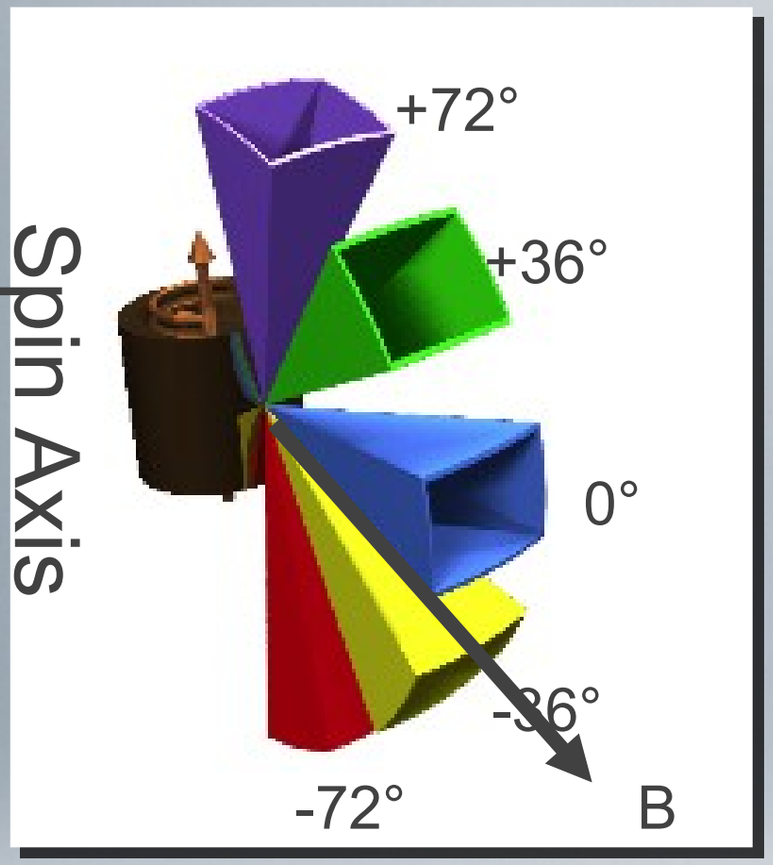
Burst Support Measurements

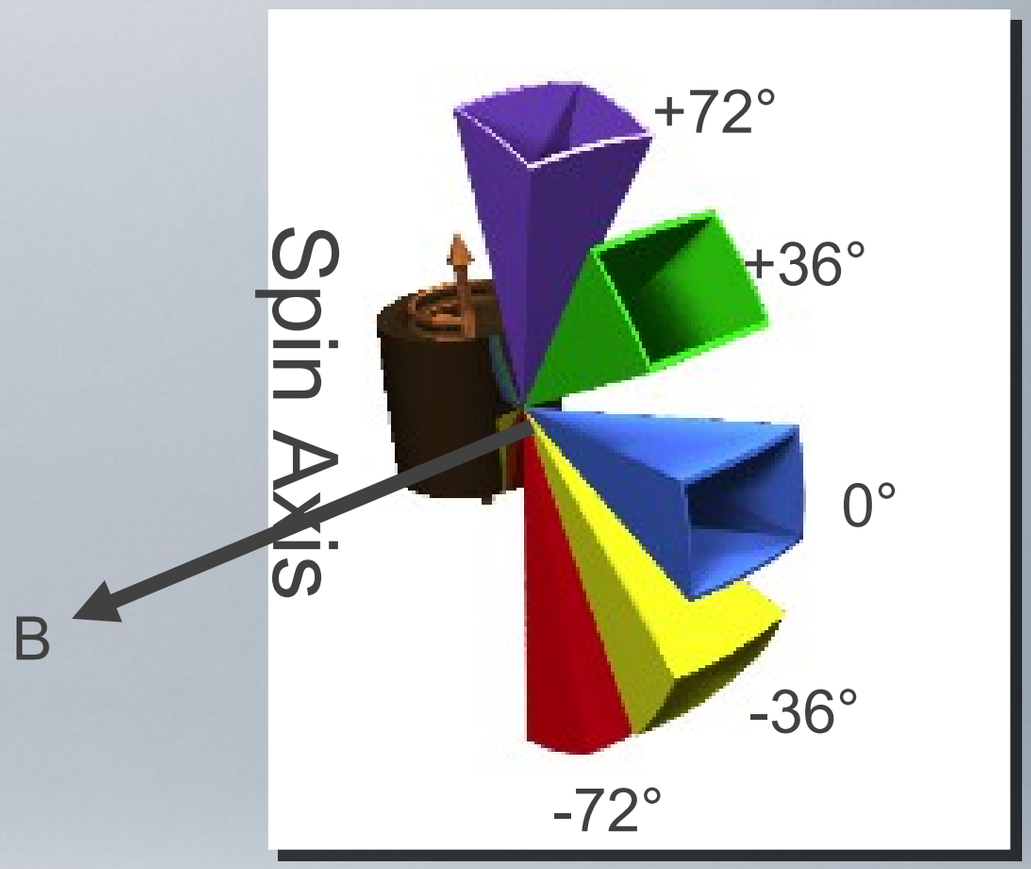


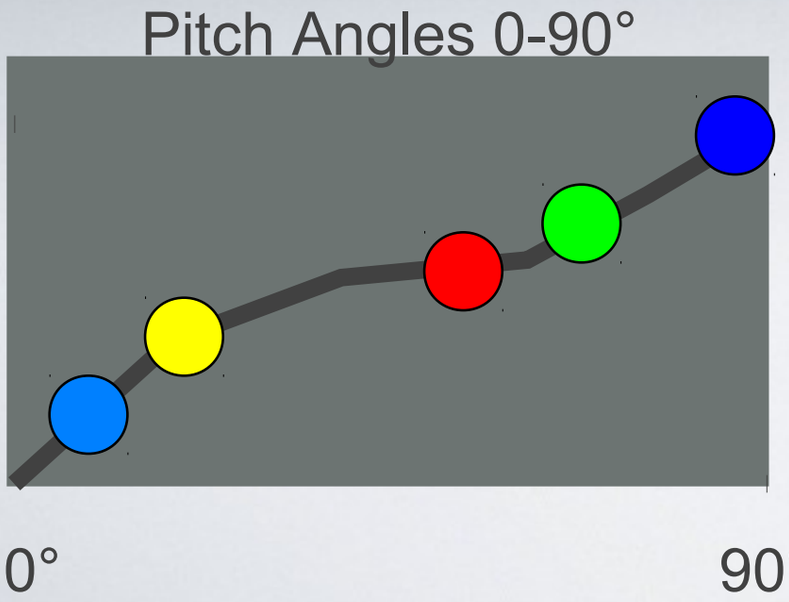


- Remember, a spin still takes 12 s
- In burst support it is better to think of HOPE as taking 5 pitch angle samples with 9 energies every 187.5 ms
- Sometimes you get 5 “good” pitch angles. Sometimes they are all 90°
- Each sample has only 9 energies and limited counting statistics

Burst Support Measurements







Burst Support Measurements

- The trick will be to calculate Tperp/Tpar for each 187.5 ms sample with only 9 energies, 5 pitch angles, and limited counts
- Different plans (LUTs) sample different energies.
- The default plan (synoptic mode) measures from ~0.5 - 50 keV
- Other plans measure faster (6 energies), a more limited range of energies, or ions instead of electrons

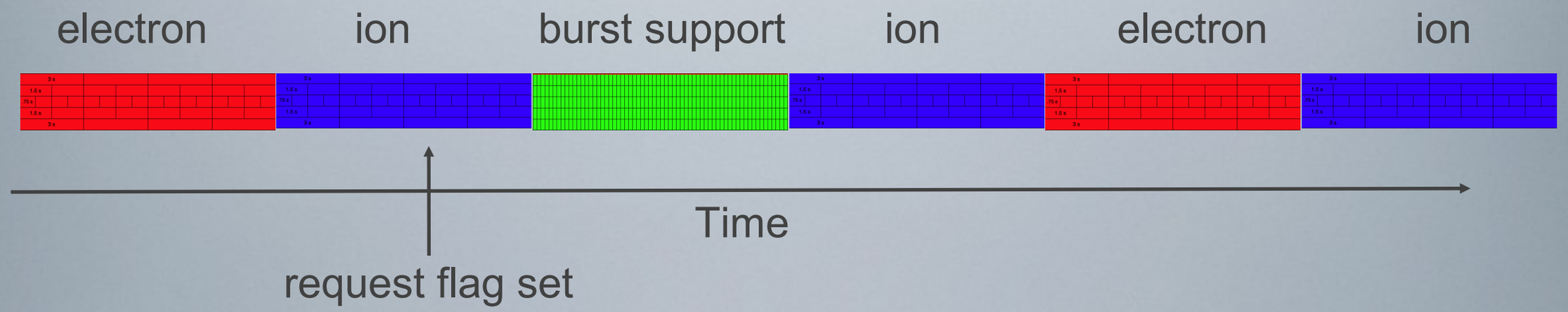
LUT #	Mode Name	# of energies: Energy values (eV)	# of sect	Rate (Hz)
9	E Synoptic	9: 443, 951, 2037, 5084, 10863, 20038, 31653, 42932, 50000	64	5.33
10	E high	9: 1107, 2037, 5921, 8031, 10892, 14774, 23337, 31653, 42932	64	5.33
11	E high fast	6: 1107, 5921, 10892, 20038, 31653, 42932	96	8.00
12	E med	9: 517, 951, 1289, 1749, 2373, 3218, 4365, 5921, 8031	64	5.33
13	E med fast	6: 517, 701, 1289, 3218, 5921, 8031	96	8.00
14	H+ high	9: 2037, 5921, 8031, 10892, 14774, 20038, 27179, 36864, 50000	64	5.33
15	H+ med	9: 701, 951, 1289, 1749, 2373, 3218, 4365, 5921, 8031	64	5.33

Synoptic Burst Support

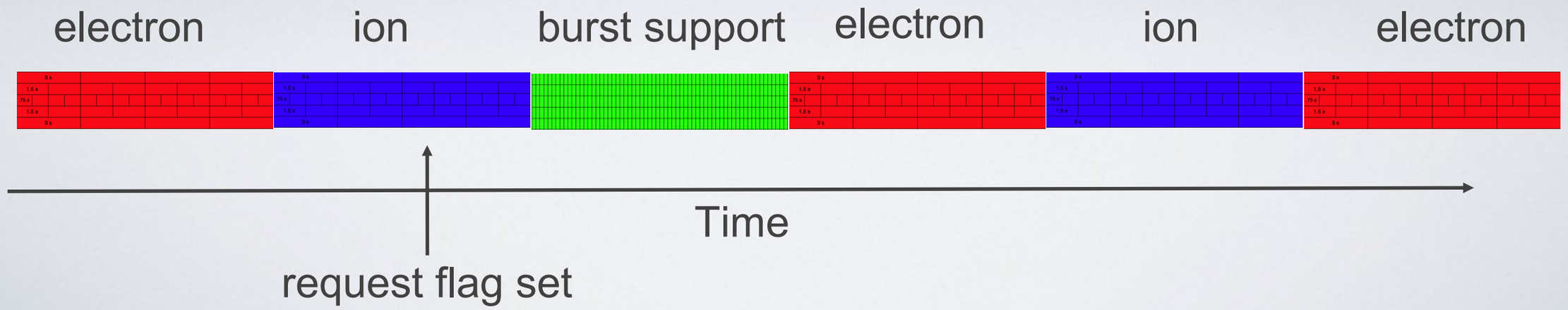
- In normal operations HOPE will take one sweep of data in synoptic (not triggered) burst support mode every ~10 min
- The purpose is to get a somewhat “random, uniform” sampling of the electron distribution at high temporal resolution
- Synoptic burst support spins will occur every 624 s. HOPEs clock is free-running so this is not synched to the spin.
- EMFISIS can be in the same free-running mode and collect burst data in synoptic mode at the same time as HOPE
- EFW can grab burst data for whatever synoptic burst support spins they chose (but only a few due to telemetry limits

Unresolved Issue

- We thought HOPE was programmed to do this



- It actually does this. So burst requests put synoptic timing out of synch. i.e. the next synoptic will be 12 s later than planned



Proposed HOPE Plan

- Our preferred option is to reprogram HOPE before launch so that it replaces the next spin when it responds to a burst request (instead of delaying then resuming the cycle)

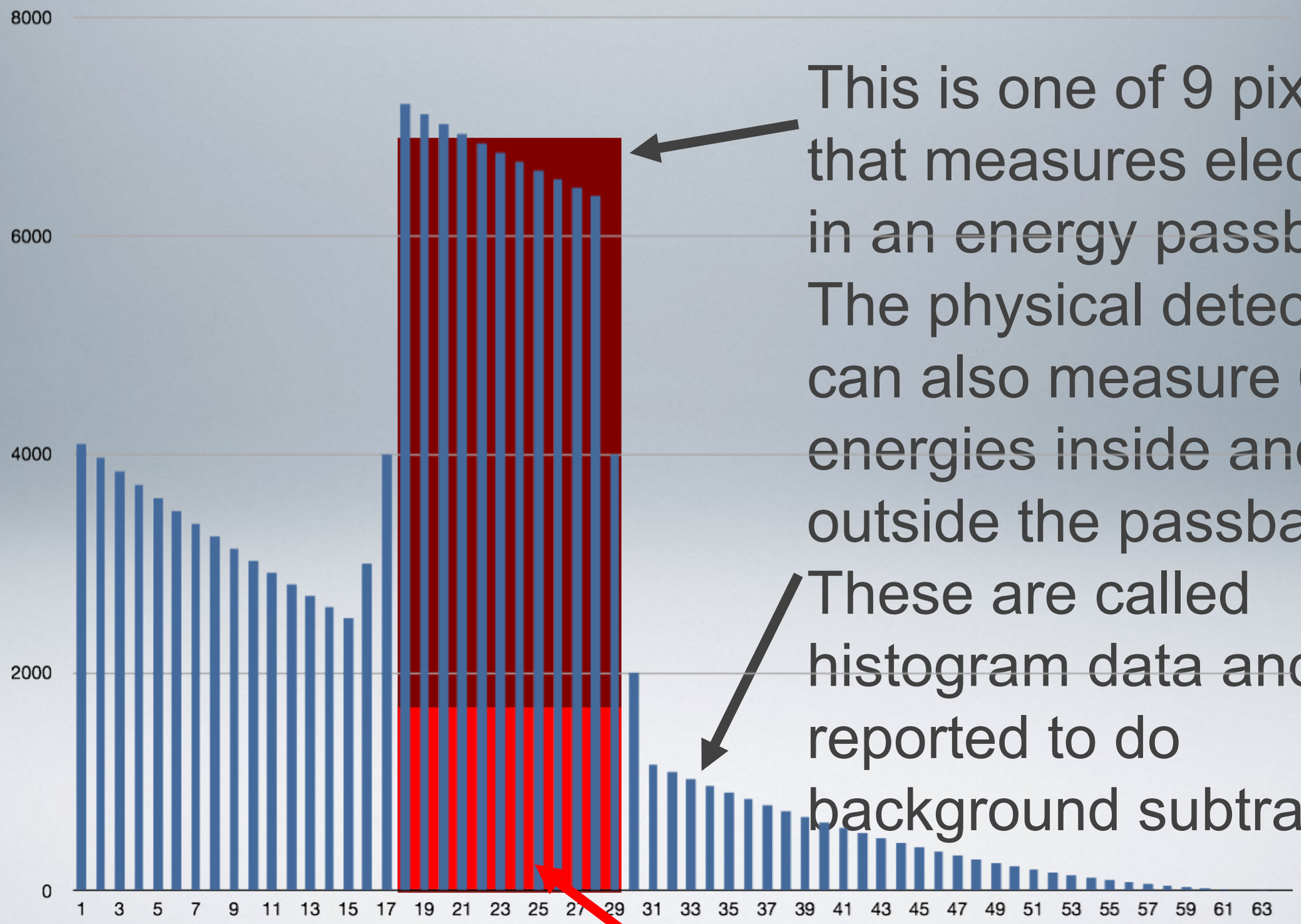
- Our second option is to resynchronize with EMFISIS once per hour until we can reprogram HOPE on orbit. EMFISIS takes
  24 s of burst data in synoptic mode so we can get a little off and still get simultaneous data

- Our third option is to set HOPE so it responds to burst requests for half the orbit (outbound) and is in synoptic mode half the orbit (inbound)

MagEIS High Rate Mode

- MagEIS does not respond to burst request
- Normal operations will involve two modes: “normal” mode and “sample” mode.
- Normal mode is planned to have 29 azimuthal sectors/spin
- Sample mode *can have* >1000 azimuthal sectors/spin
- But it still takes 12 sec to get a pitch angle distribution and the entrance angle of each detector isn’t smaller
- Sample mode is designed to see if there is a dip in counting rate as the detector sweeps across the loss cone direction

MagEIS “pixels” are energy pixels with a common look direction. The low & med units have 9 pixels, high has 8

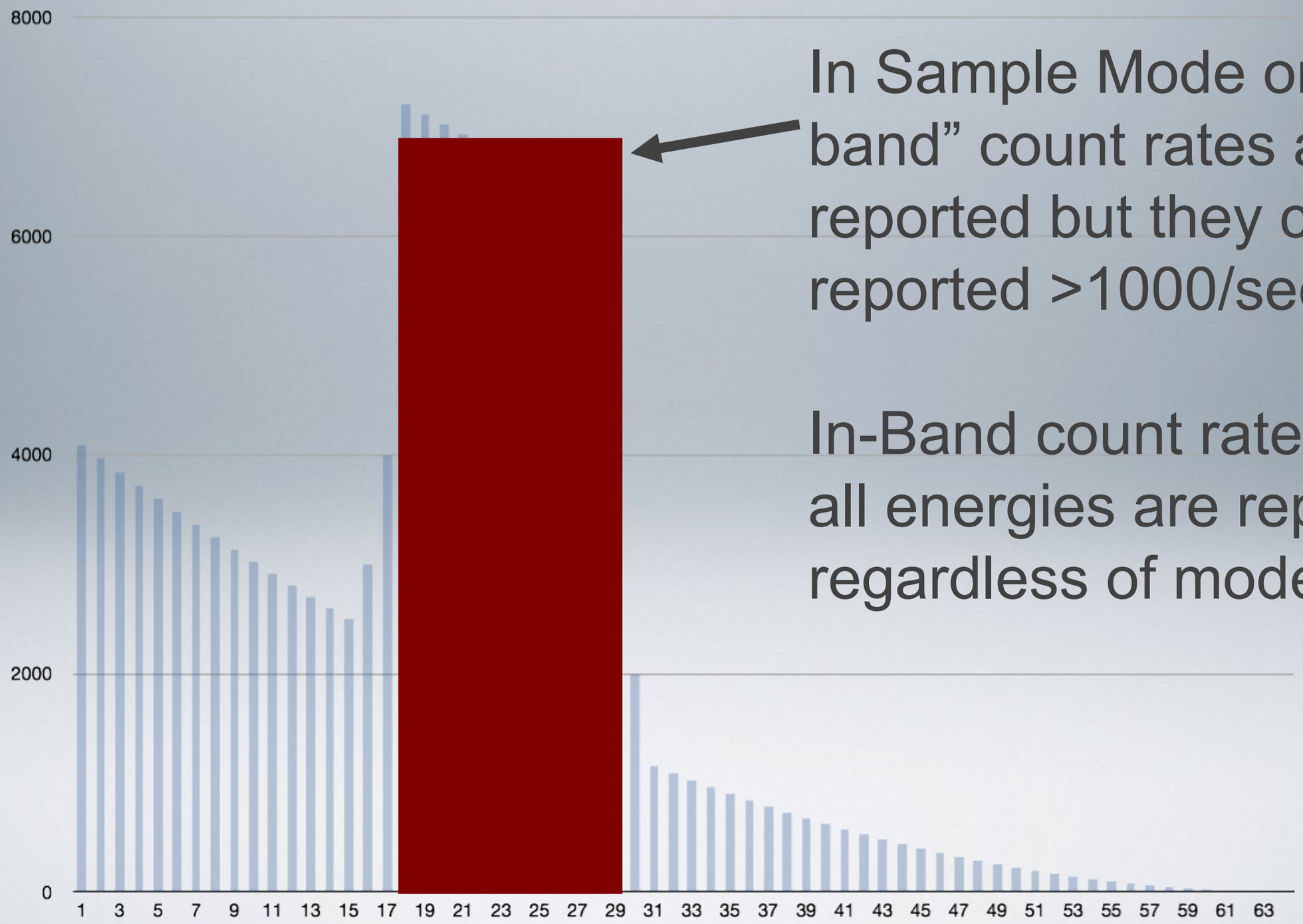


This is one of 9 pixels that measures electrons in an energy passband The physical detector can also measure 64 energies inside and outside the passband.

These are called histogram data and are reported to do background subtraction

Background Rates from

MagEIS “pixels” are energy pixels with a common look direction. The low & med units have 9 energy pixels, high has 8



In Sample Mode only “in band” count rates are reported but they can be reported >1000/sec

In-Band count rates at all energies are reported regardless of mode

What Does Sample Mode Lose?

- Histogram data could swamp the telemetry so they are reported once per 9 spins in normal mode

- Sample mode will not report any histogram data. Backgrounds will not be subtracted in sample mode.

- We assume backgrounds will be negligible outside the proton belt but this will be tested.

- The MagEIS operations plan is to be in normal mode below R=4 and in sample mode above R=4. The exact radial distance (or L) is TBD