Matthew Hanley

Graduate Appointment Application Presentation

Spring 2018

History

- Hired as part of CC class in 2016
  - Certified August 31, 2016

About Me

- **Major:** Mechanical Engineering
- **Minor:** Computer Science
- **Start Date:** August 2014
- **Expected Graduation Date:** May 2019
- Pursuing BS/MS concurrent degree with a focus in robotics
- Outside of Work
  - CAD/Manufacturing engineer for Senior Capstone
  - Robotics Club

General Responsibilities

Red Time

Fall 2016	14.25 hours + 6 On Call hours
Spring 2017	11.25 hours
Fall 2017	2.75 hours + 2 On Call hours
Spring 2018	2 hours + 2 On Call hours

- Friday QuikSCAT Scheduler in Fall 2016
- Dayproc Responsibilities in Fall 2017
- AIM TDRSS Scheduler in Spring 2017 and Fall 2017
- SORCE TDRSS Scheduler in Fall 2017 and Spring 2018
- I have commanded all 5 spacecraft

General Responsibilities

- QSCAT Check Products
  - Took over from Sierra in Spring 2017
  - Regularly fix bugs and make improvements
- Taking shifts and helping with anomalies where I can
- Help with IDL training during the summer
- Any offhand analysis needed

```
;*****************************************************************************
;Retrieve cx data for thruster seconds by the nic
;*****************************************************************************
retrieve_eng,['kp cxadthr1cntnic','kp cxadthr2cntnic','kp cxadthr3cntnic', $
              'kp cxadthr4cntnic','kp cxadthr5cntnic','kp cxadthr6cntnic', $
              'kp cxadthr7cntnic','kp cxadthr8cntnic'], $
              start_time,end_time,data_cx,info_cx

;add up all of the thruster seconds across the thrusters
totalcx_nic = data_cx.(1) + data_cx.(4) + data_cx.(7) + data_cx.(10) + data_cx.(13) + $
              data_cx.(16) + data_cx.(19) + data_cx.(22)

;subtract the first element to start at 0
totalcx_nic = totalcx_nic - totalcx_nic(0)
totalcx_time = data_cx.(0) - data_cx.(0)(0)
totalcx_time = totalcx_time

;*****************************************************************************
;Retrieve cx data for tank pressure
;*****************************************************************************

retrieve_eng,['kp cxadtankp'],start_time,end_time,data_pcx,info_pcx
cxtank_pressure = data_pcx.(1)
cxtank_pressure_jd0 = info_pcx(0).ref_jd-0.5d0
cxtank_pressure_time = (cxtank_pressure_jd0+data_pcx.(0)/86400.0 - start_timeJD) * 86400.0

;*****************************************************************************
;Combine the tank pressure data with the cx pressure data
;*****************************************************************************

final_pressure = make_array(2,n_elements(cxtank_pressure)+n_elements(tank_pressure))

for i=0,n_elements(tank_pressure_time)-1 DO BEGIN
```

Subsystem Assignments

Member of 9 spacecraft subsystems, of which I am the lead of 4

- SORCE
  - **Lead:** Power, SIM
  - **Current Member:** TIM, Therm, TDRSS
- QuikSCAT
  - **Lead:** ADCS
- MMS
  - **Lead:** HPCA
  - **Current Member:** ASPOC
- AIM
  - **Current Member:** Power
  - **Prior Member:** TDRSS

Early Projects

SORCE

Early Projects

SIM

- Wrote program to find and display potential motor faults to user
- Altered SIM Science script to present more useful data in weekly reports
- Identified reason SIM was missing step 60 and proposed a fix
  - Presented data to Jerry Harder to ensure science data would not be degraded
- Closed FLAWS 146
  - Generated FLAWS template with this
- Wrote script to automate most of Monthly process
  - Took about 1.5 hours off time to create monthly

SORCE

Flight Anomaly Worksheet (FLAWS) #146

LASP Laboratory for Atmospheric and Space Physics University of Colorado Boulder

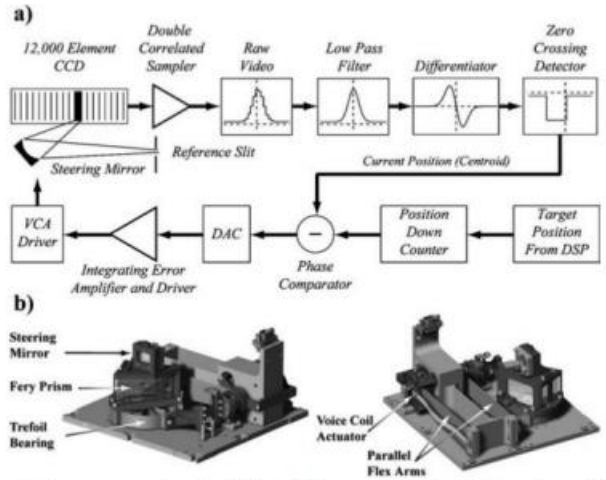


Figure 1- (a) Electro-mechanical block diagram of the SIM prism drive system. **(b)** Two views of the prism drive identifying important attributes to the mechanical design of the drive.

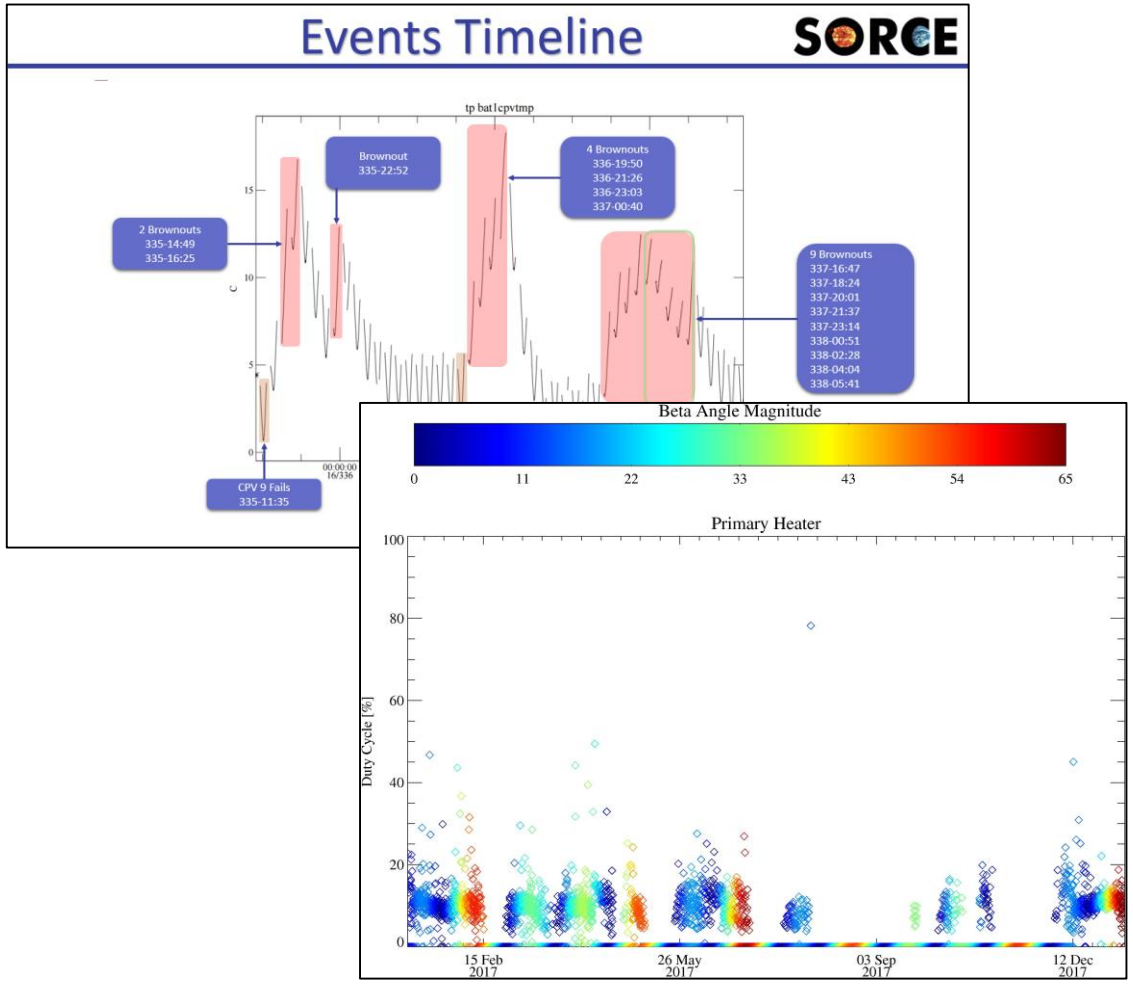
Analysis:

On a nominal orbit when SIM is sent to safe mode, the instrument's science stops and is put into a safe configuration. A nominal safehold entry can be seen in **Figure 2**. In a nominal sunset, the instrument is safed, the scan terminates, and safehold is entered. However, in the case of a GCI lockup as in

Early Projects

Therm

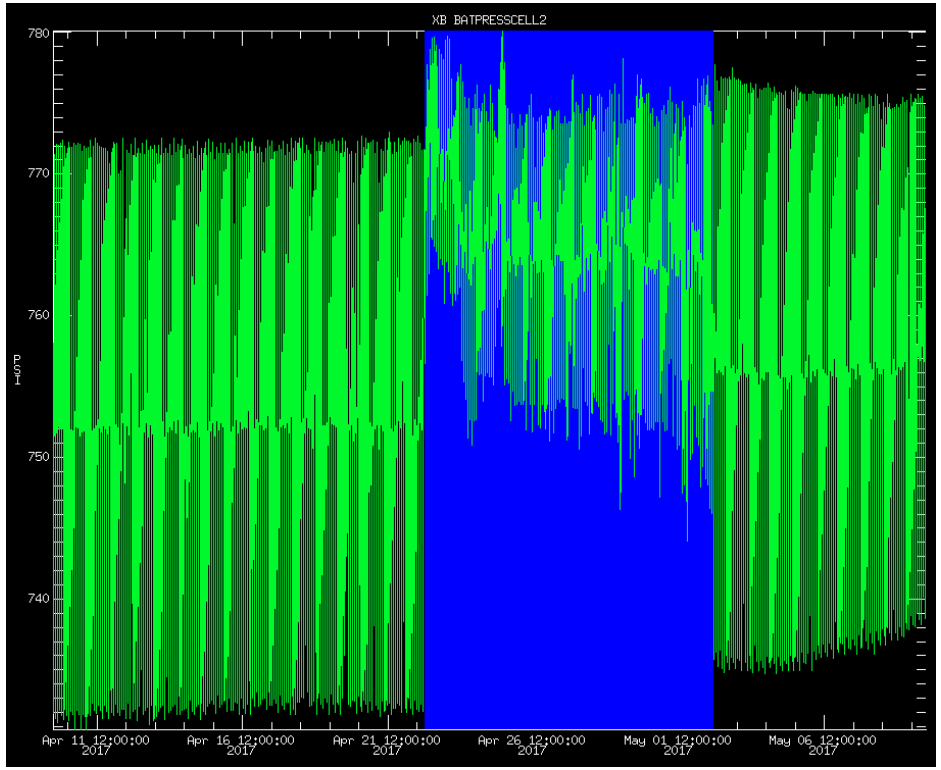
- Brownout trending analysis (top right)
  - Led effort to create presentation for all subsystems
- Color coded duty cycle plot in monthly to beta angle (bottom right)
- Characterized survival heater “set points”



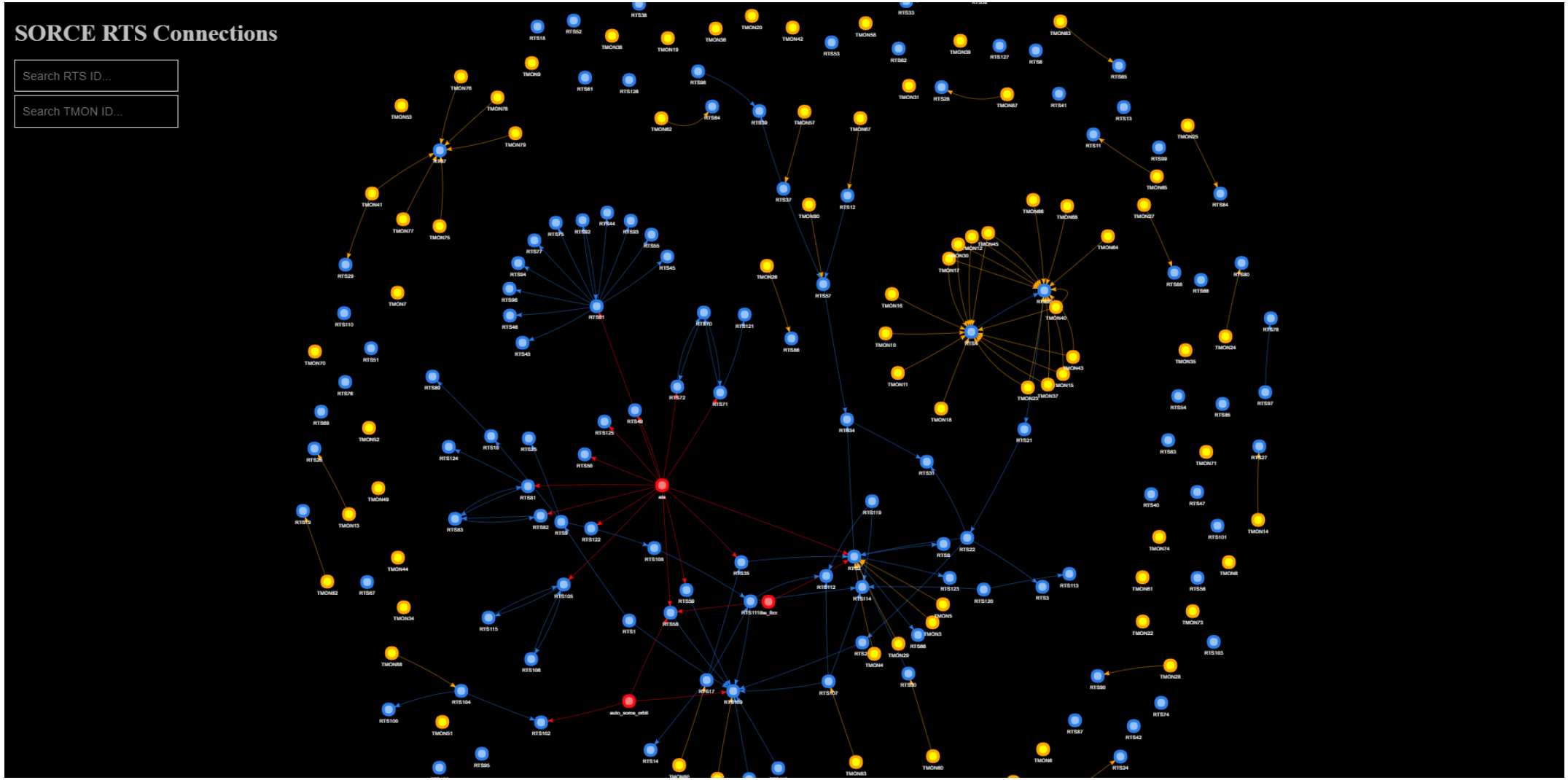
Early Projects

Power

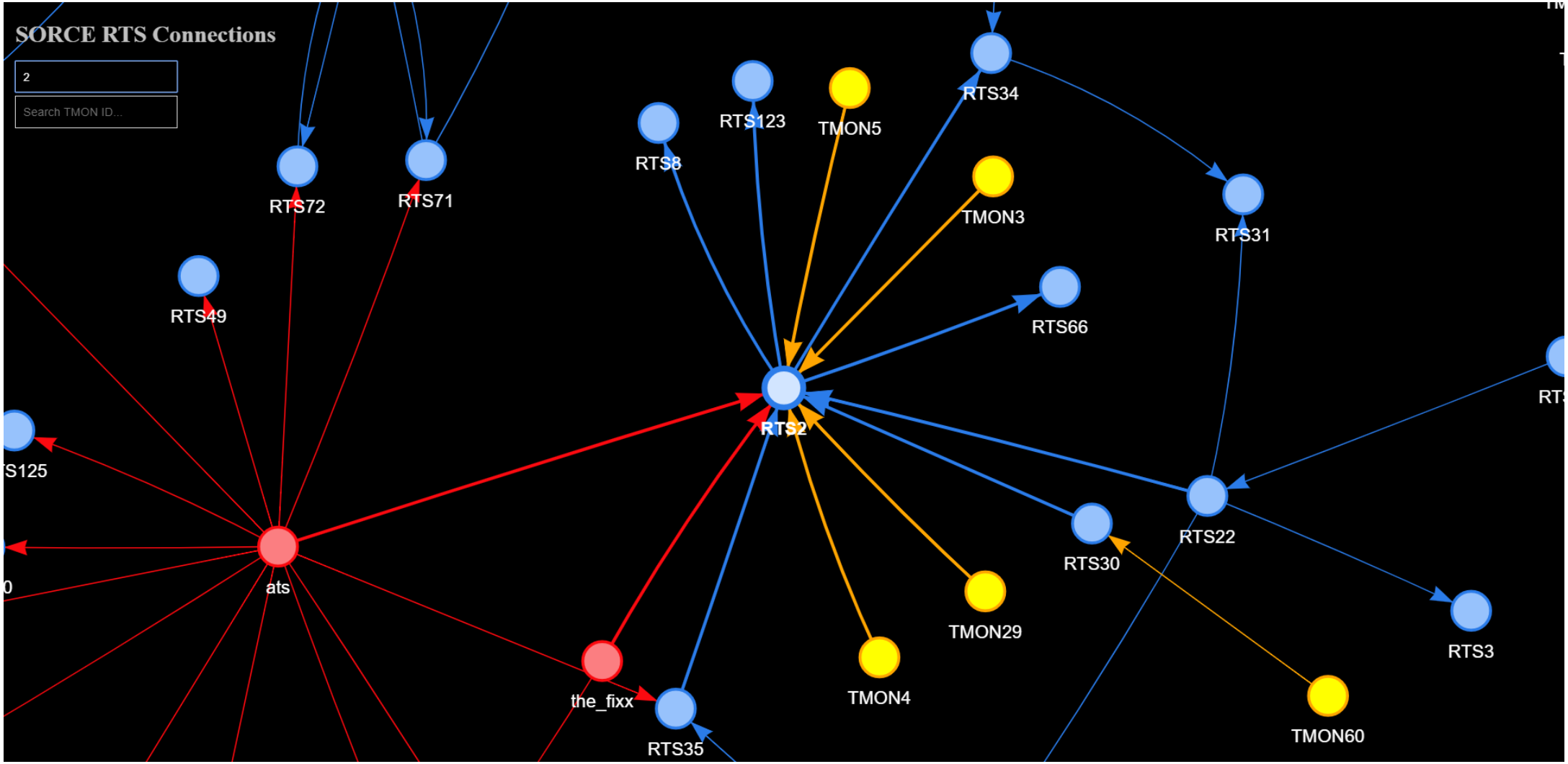
- Brownout trending analysis
  - Wrote a program that fits different types of functions to data to try to predict next brownouts
- Worked with Sierra to take the lead of the subsystem
- Tool to shade telemetry plots during periods of brownout (right)



Early Projects



Early Projects



Early Projects

QuikSCAT

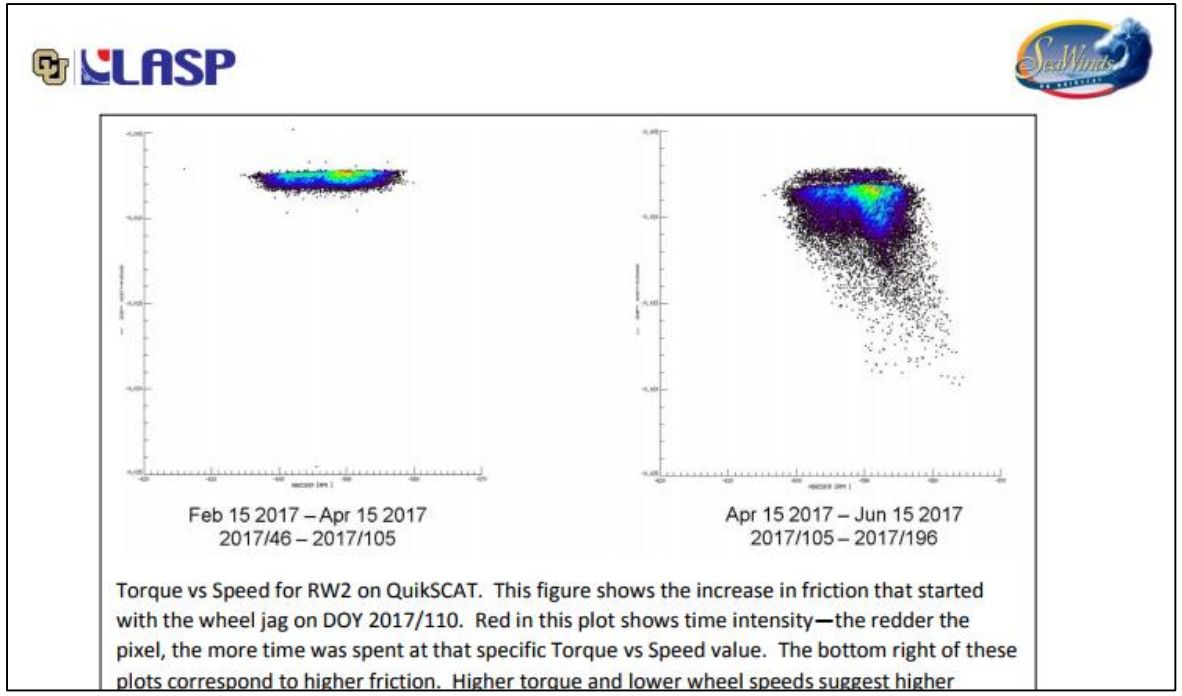
Early Projects

Reaction Wheel "Jag" SER

- Investigated friction increases on RW2
- Looked into possible correlation between jag frequency and wheel temperature

Star Tracker Occultation Prediction Tool

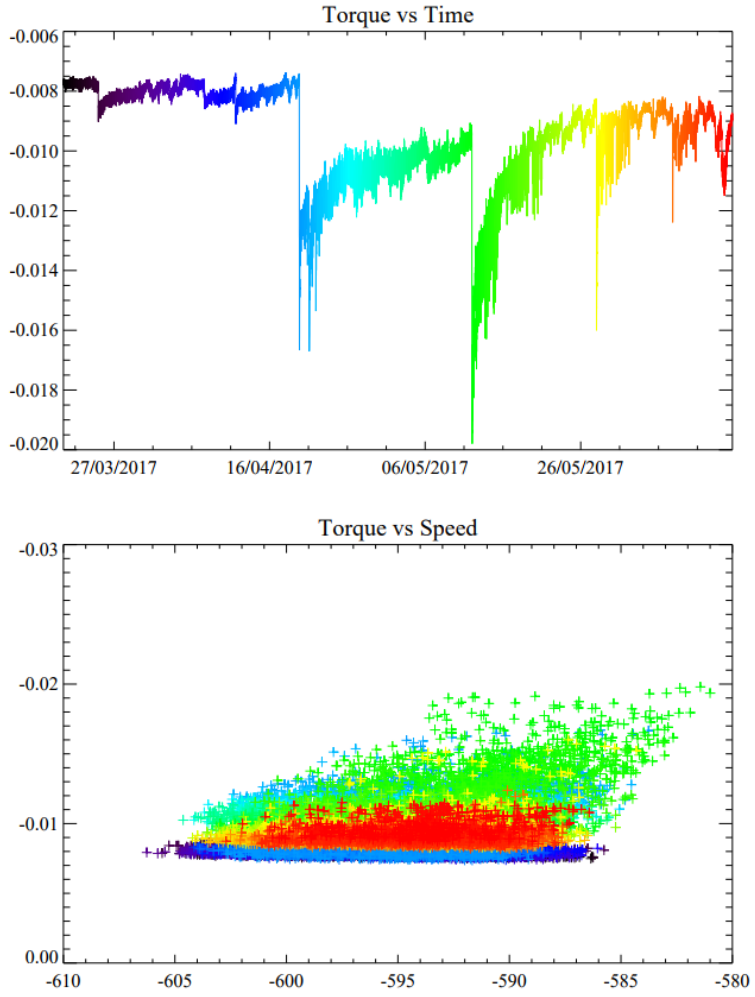
- Generated a script to largely automate a process using Perl, STK Connect, and IDL
- Reduced the time to complete the task from ~1 hour to ~5 minutes



Early Projects

Other

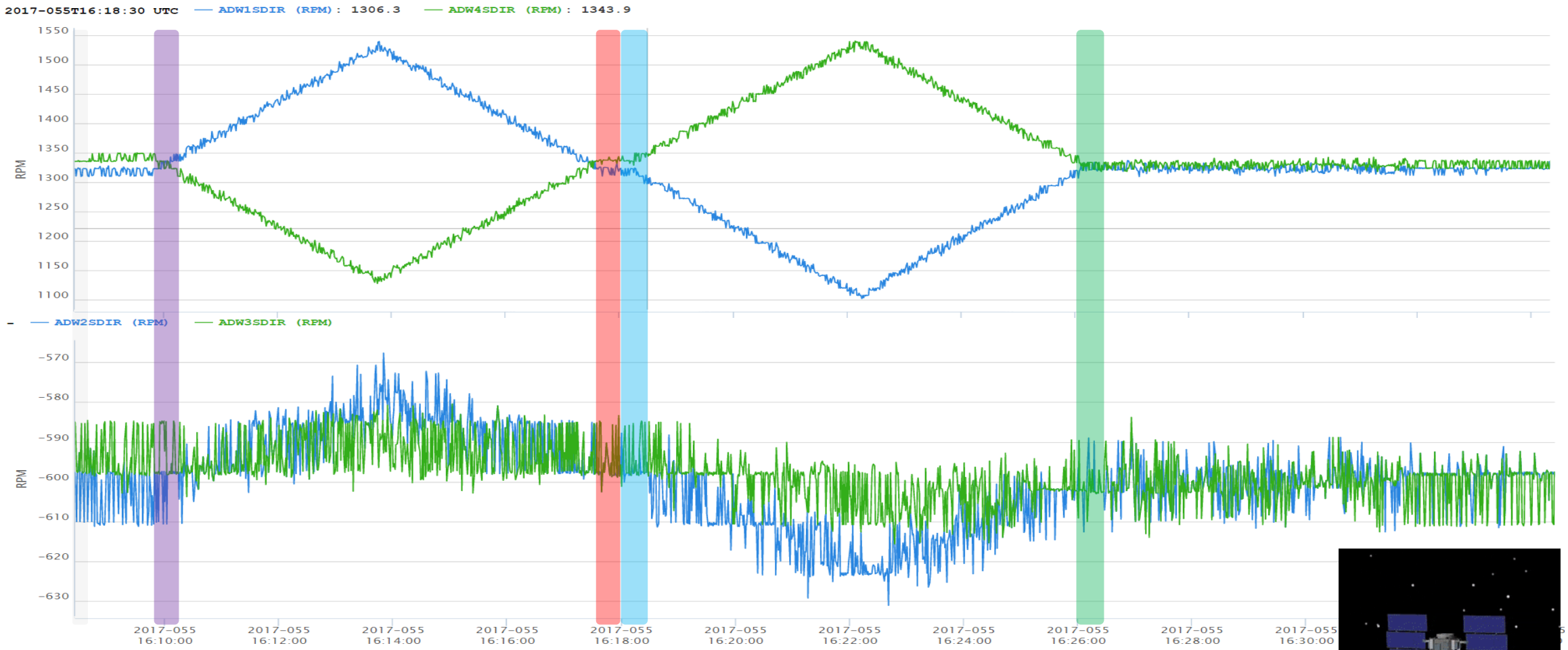
- Revamped monthly process to decrease time to create monthly significantly
- Created a tool to track reaction wheel revolution trending now versus in the past
- COLA Maneuver analysis (see next slide)
- Created tool to correlate friction plots and torque plots (right)
- Modified `qs_check` to be more user friendly

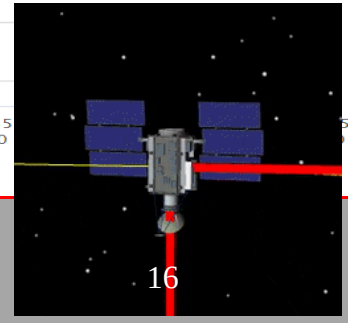


COLA Analysis Presentation

1 & 4

2 & 3





TID 5 | "BURN" | TID 0 | Maneuver End

Early Projects

AIM

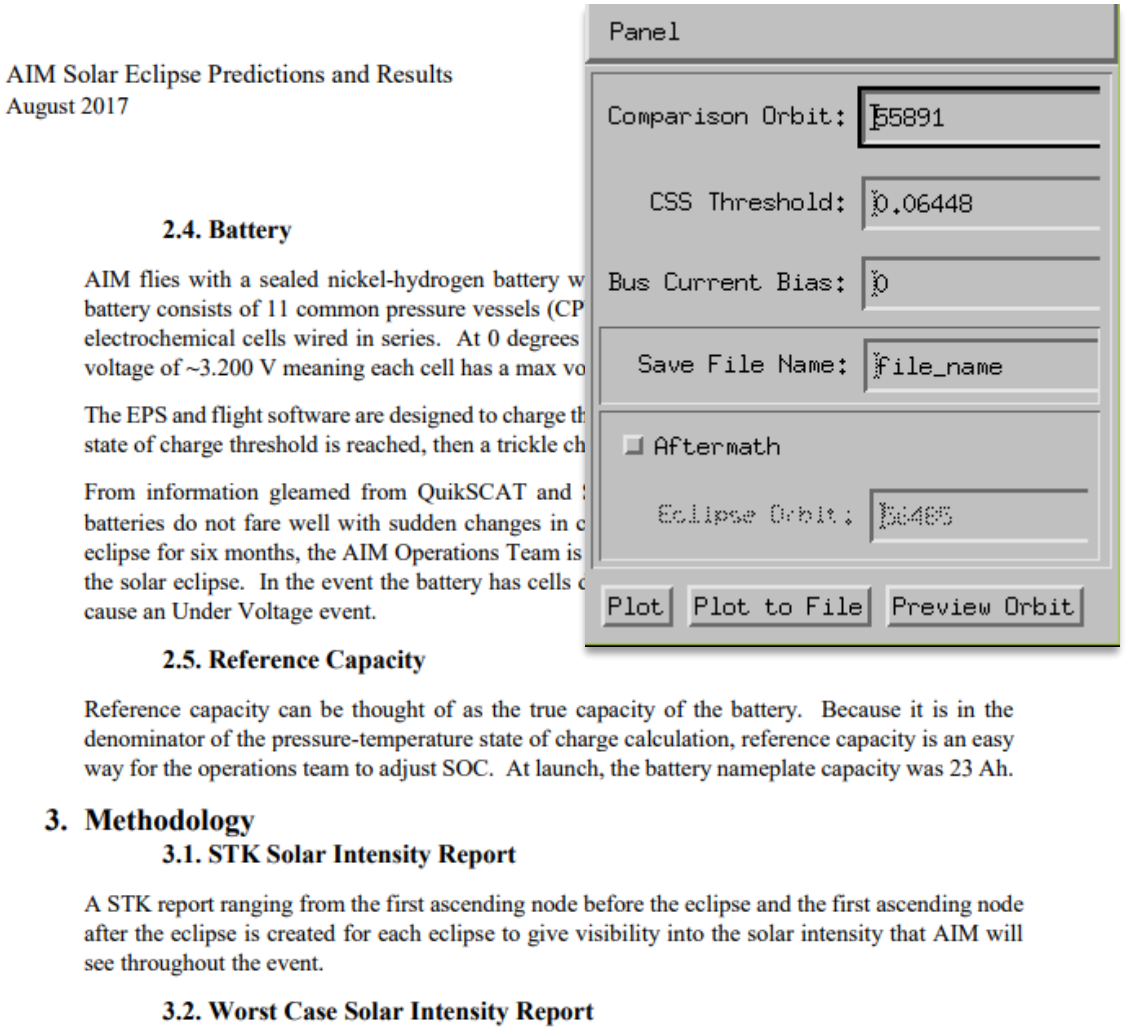
Early Projects

Lunar Eclipse Prediction Tool

- Created IDL GUI to greatly simplify lunar eclipse predictions and analysis
- Generated MANY analysis tools along with this project
- Created documentation with the tool

August 2017 Lunar Eclipse Predictions

- Made efforts to predict AIM's behavior during event
- Generated recommendations based on findings
- Performed exhaustive analysis
- Created SER to document process and findings

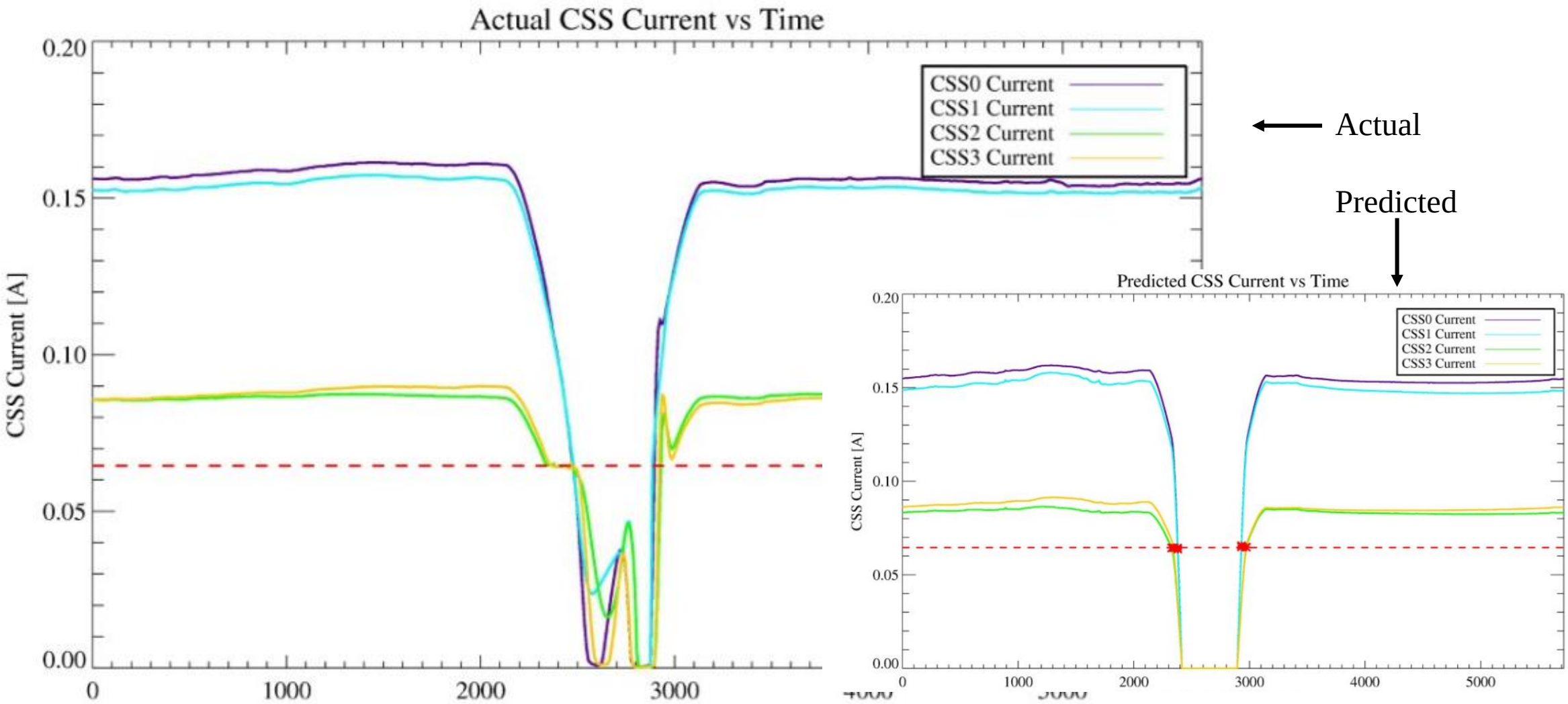


Early Projects

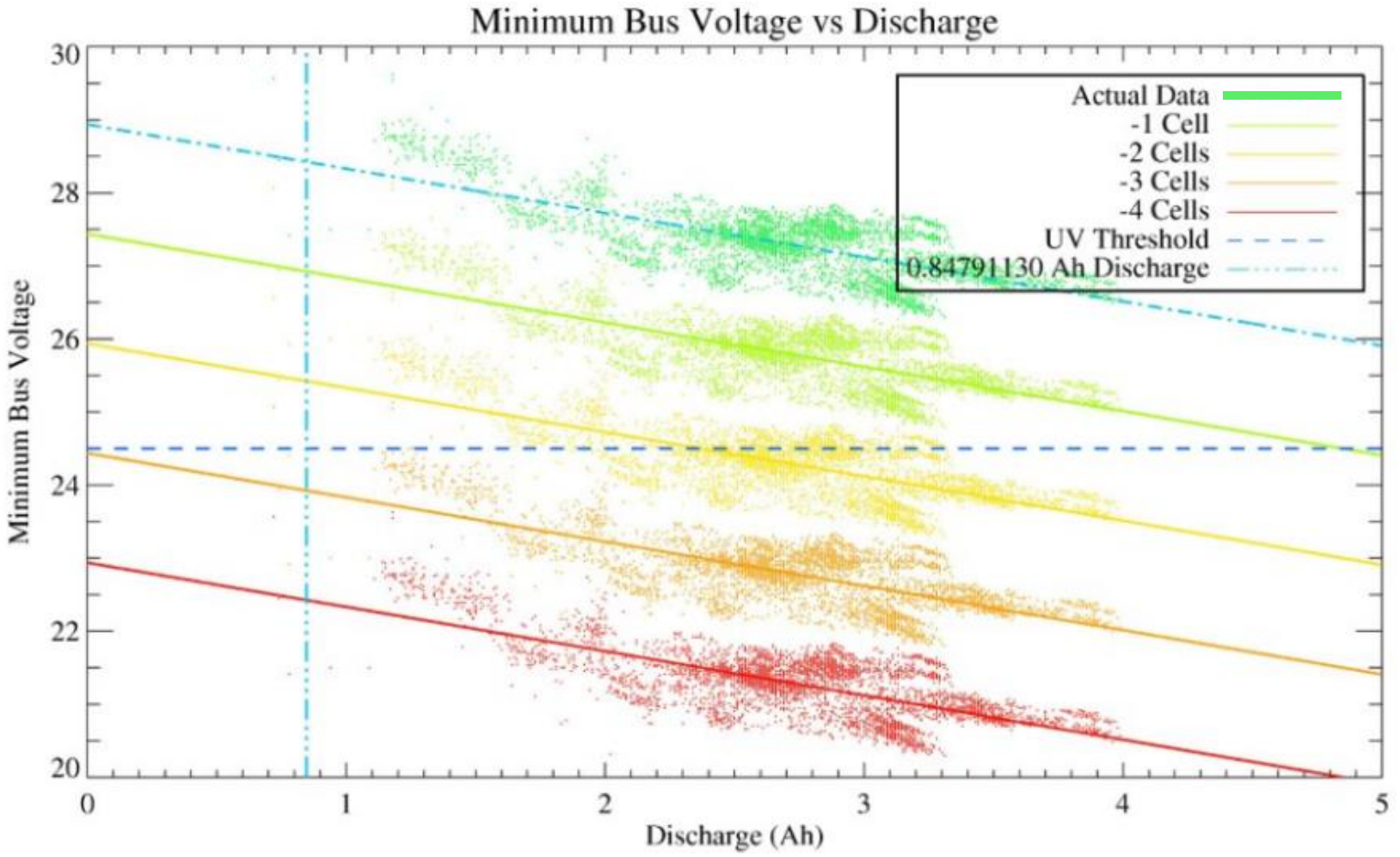
```
STK File Used: /data/var/aim/work/subsystem_reports/eps/eclipse/matts_prediction_code/STK_files/Aug_21_2017/new_spoof_2.txt
Bus Current Bias: 0.00000
Comparison Orbit: 55891
-------------------------------------------------
Eclipse Enter:    Aug 21, 2017-19:50:08.000
Eclipse Exit:     Aug 21, 2017-20:06:57.000
Eclipse Duration: 16 minutes
-------------------------------------------------


-------------------------------------------------
Minimum Intensity:       0.0000000%
Minimum Array Current:   0.0000000 A
Minimum Intensity Time: Aug 21, 2017-19:54:48.000
-------------------------------------------------


-------------------------------------------------
CSS Below Threshold
     CSS0: Aug 21, 2017-19:54:12.000
           40.006873% intensity
     CSS1: Aug 21, 2017-19:54:10.000
           42.133630% intensity
     CSS2: Aug 21, 2017-19:53:18.000
           77.723142% intensity
     CSS3: Aug 21, 2017-19:53:32.000
           73.069424% intensity
-------------------------------------------------


-------------------------------------------------
CSS Above Threshold
     CSS0: Aug 21, 2017-20:03:22.000
           41.263882% intensity
     CSS1: Aug 21, 2017-20:03:23.000
           42.337431% intensity
     CSS2: Aug 21, 2017-20:04:05.000
           75.817923% intensity
     CSS3: Aug 21, 2017-20:04:03.000
           74.934750% intensity
-------------------------------------------------

```

Text Output of Program

Early Projects



Early Projects



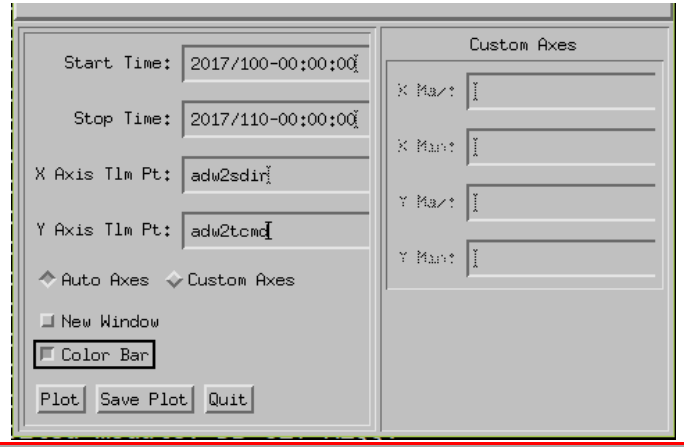
Early Projects

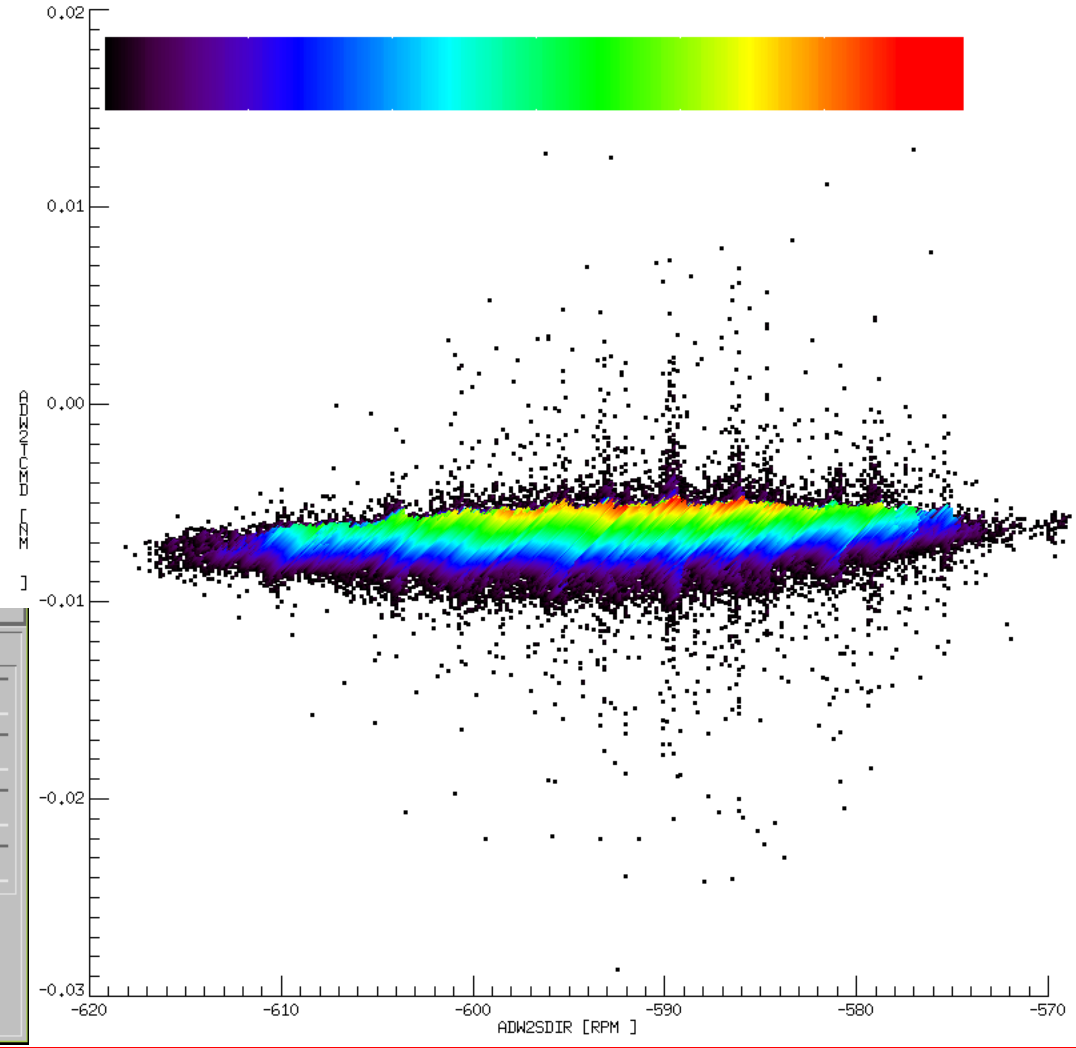
Other

Early Projects

Histogram Plotter

- Created “binning” plotting tool to investigate correlations between telemetry points
- Allows to see intensity of correlations using colors



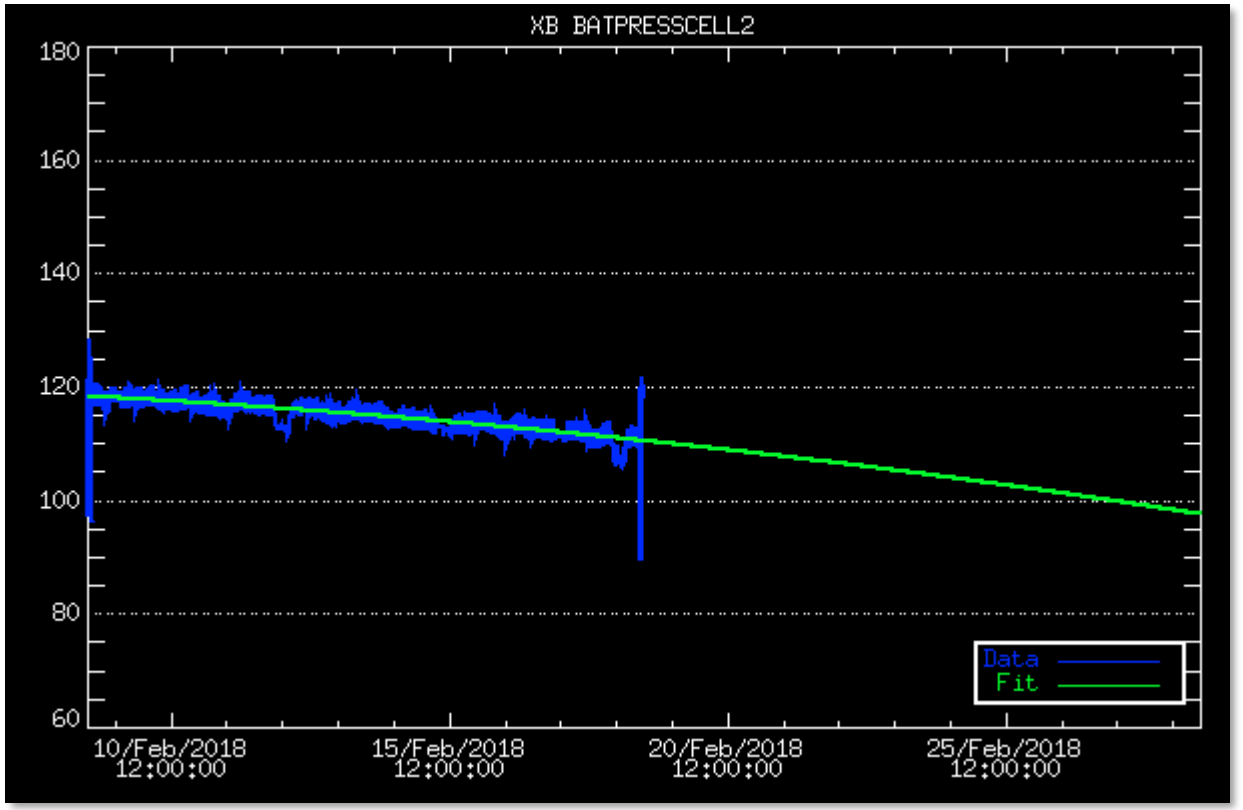


Early Projects

Telemetry Regression and Extrapolation

- Allows users to fit data with different functions
- Allows for extrapolation forward or backwards in time

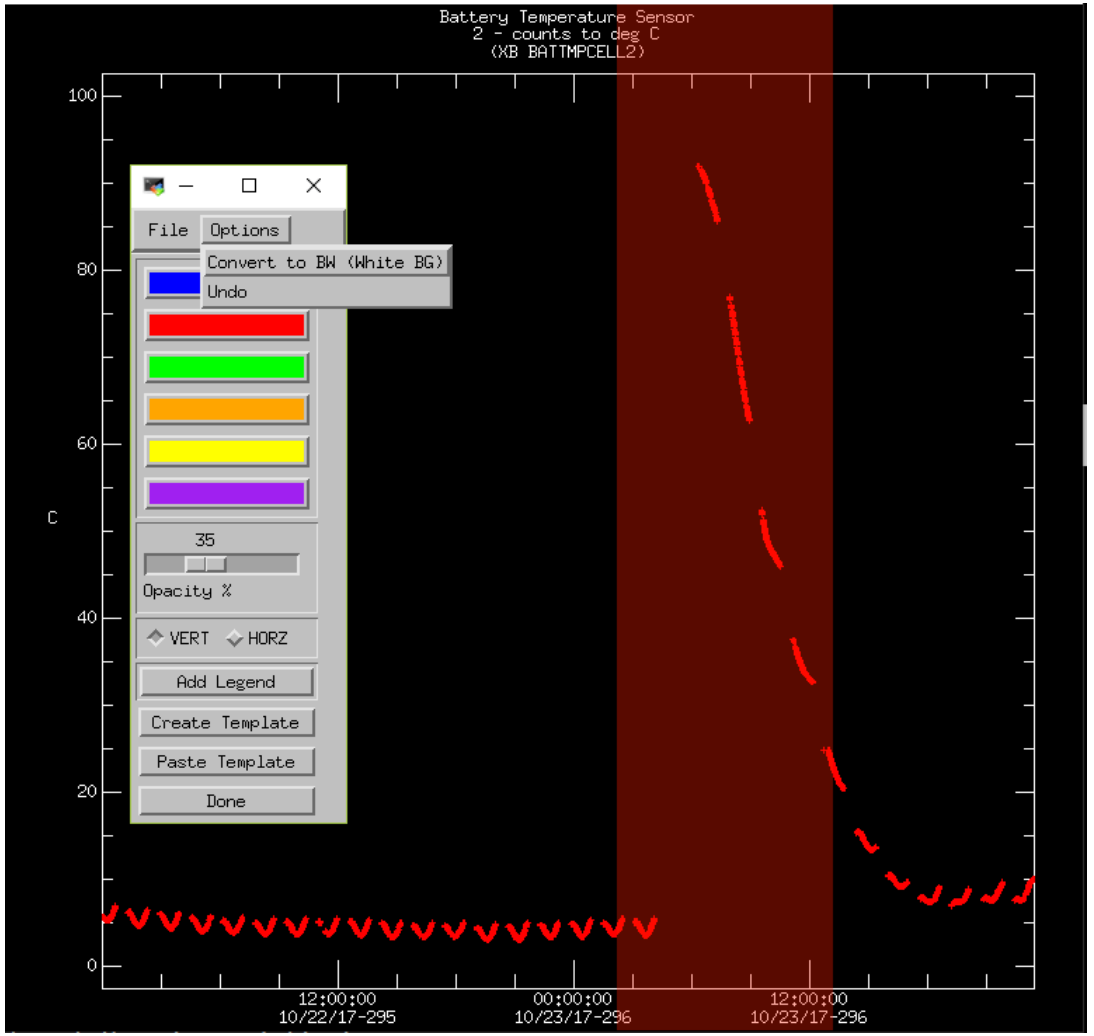
```
;       OPTIONAL PARAMETERS:
;       ***CURRENTLY ONLY ONE FIT METHOD AT A TIME IS SUPPORTED***
;       /linear - perform a linear fit
;       /quad - perform a quadratic fit
;       /cube - perform a cubic fit
;       /exp - exponential fit
;       /power - power law fit
;       /sat - saturation growth fit
;       threshold = value - used to predict crossings of a threshold
;       sm = value  used to smooth data.
;       /no_sigma - won't plot sigma lines
;       future - YDNHMS array to get data past fitting data
;       past - YDNHMS array to get data before the fit
;
;       NOTE:
;       Better fits come from using a physical model.  Be wary
;       when chosing which model you want to use.  Some of the
;       models will give very bad results if applied to data
;       that is not in the correct form.
;       Polynomials tend to be awful at predicting trends.
;
```



Early Projects

IDL Plot Highlighting GUI

- Add transparent color bars to plots (saves highlighters and paper!)
- Multiple color options
- Adjustable transparency
- Ability to add a custom legend for each color
- Make templates of colors to be copied and pasted on multiple plots
- Easily convert the plot to black and white before highlighting (makes it easier to print)
- Save as many different formats
- Highlight with vertical or horizontal bars



Recent Projects

Recent Projects

SIM Monthly Process Revamp

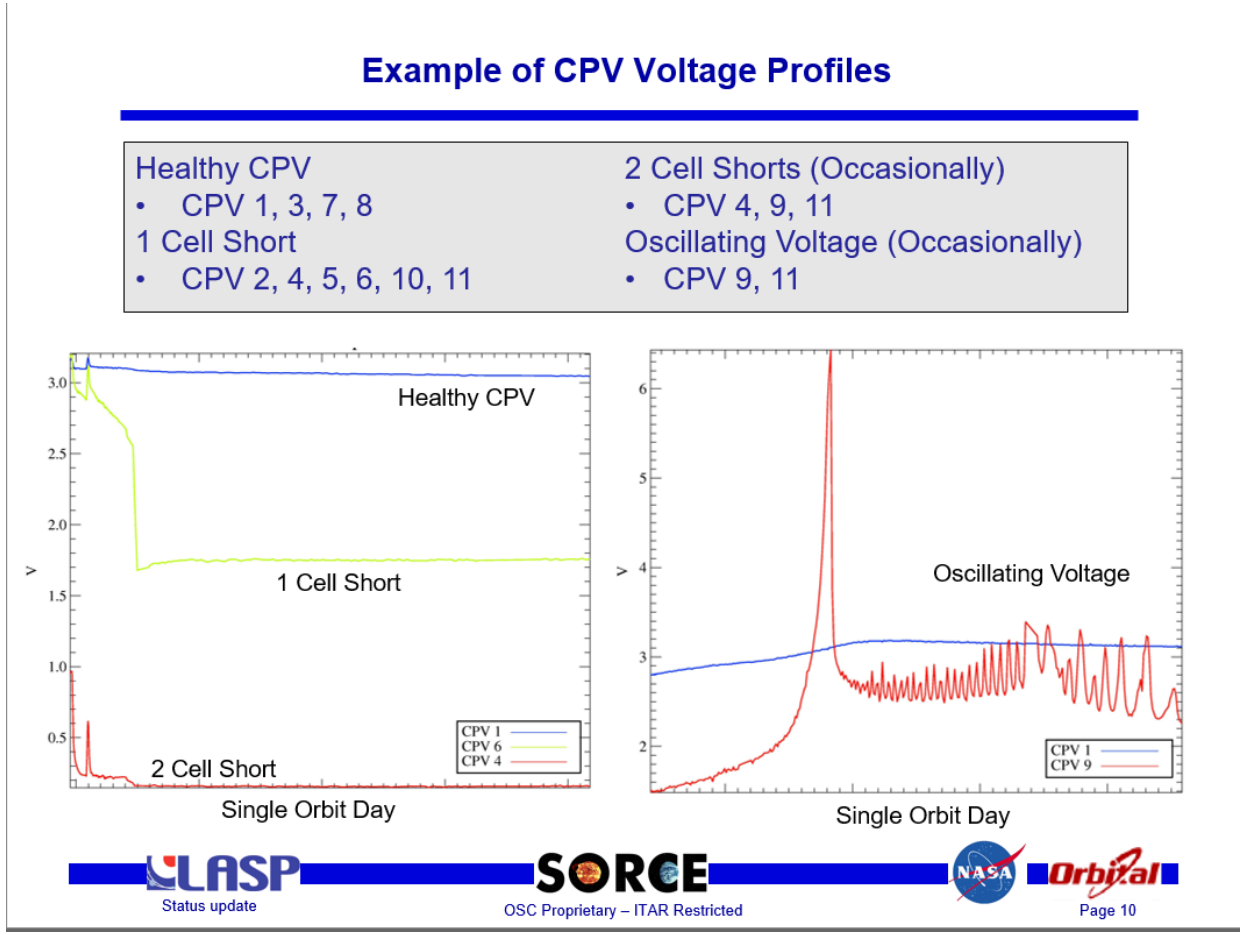
- Made significant updates to the processes and code involved in making the monthly
- Made use of databases to store science statistics for fast retrieval
- Created a logical file structure to make linking in presentations possible
- Rewrote many of the science scripts to be modular, easy to read, and easy to edit
- The monthlies pretty much make themselves now.

scanname	schedstart	emstart	success	stepssuccess	numsteps	failreason
Filter	Filter	Filter	Filter	Filter	Filter	Filter
SolarESRMode8	15-Oct-201...	2017/288-02...	1	42,43,44,45,4...	10	
SolarESRMode10a	15-Oct-201...	2017/288-05...	1	55,56,57,58,5...	6	
SolarESRMode7	15-Oct-201...	2017/288-21...	1	36,37,38,39,4...	8	
SolarESRMode10	16-Oct-201...	2017/289-08...	1	50,51,52,53,5...	7	
SolarESRMode9	16-Oct-201...	2017/289-10...	1	48,49,50,51,5...	9	
SolarESRMode8	07-Oct-201...	2017/280-05...	1	47,48,49,50,5...	13	
SolarESRMode8a	07-Oct-201...		0		0	No RTS St...
SolarESRMode7	07-Oct-201...	2017/280-21...	1	42,43,44,45,4...	13	
SolarESRMode2	08-Oct-201...	2017/281-00...	1	7,8,9,10,11,12,	6	
SolarESRMode1	08-Oct-201...	2017/281-07...	1	0,1,2,3,4,5,6,...	13	
SolarESRMode3	09-Oct-201...	2017/282-01...	1	14,15,16,17,1...	8	
SolarESRMode4	09-Oct-201...	2017/282-07...	1	21,22,23,24,2...	8	
SolarESRMode8a	09-Oct-201...	2017/282-15...	1	55,56,57,58,5...	6	

Recent Projects

Zimmerman Presentation

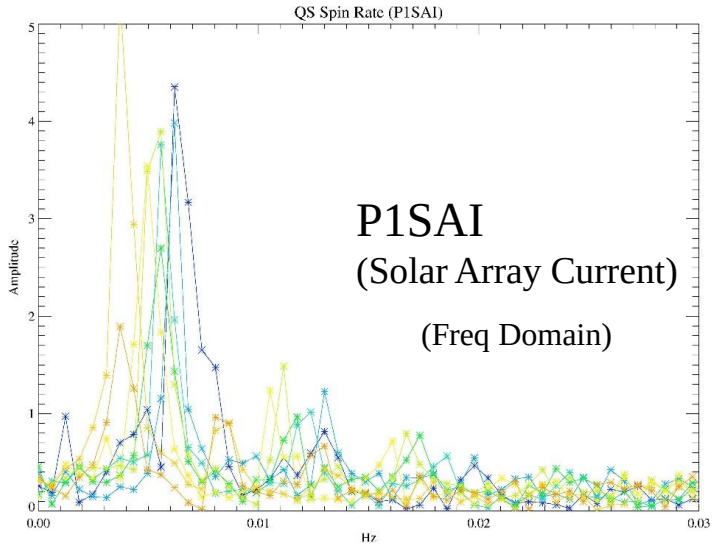
- Worked with Emily to create a presentation with recent behaviors of SORCE's battery
- Presented to Dr. Zimmerman and other professionals



Recent Projects

Analyzed Spin of QS During EM

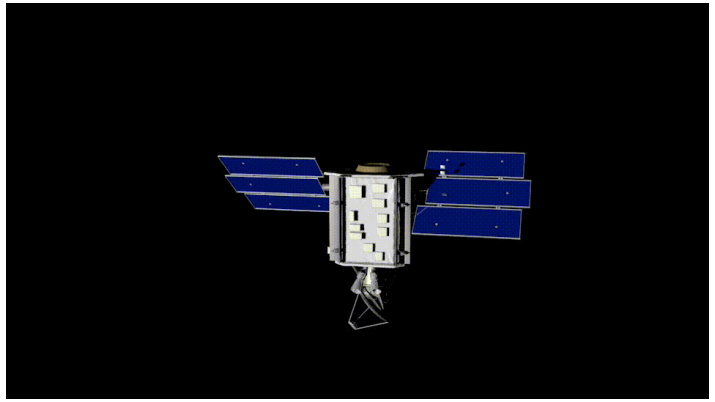
- Used a Fourier Transform to find the spin rate of QS based on periodic telemetry point
- Attempted (and failed) to model QS's spin axis using a graphics software

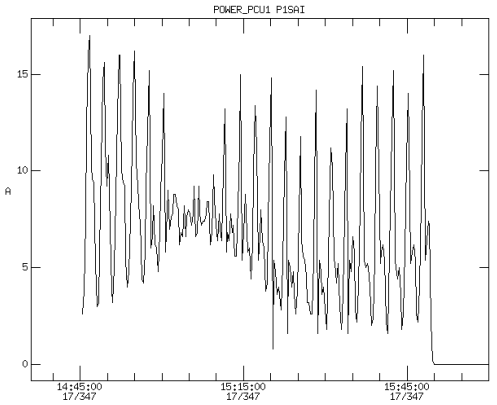


P1SAI
(Solar Array Current)

(Freq Domain)

FFT ↑

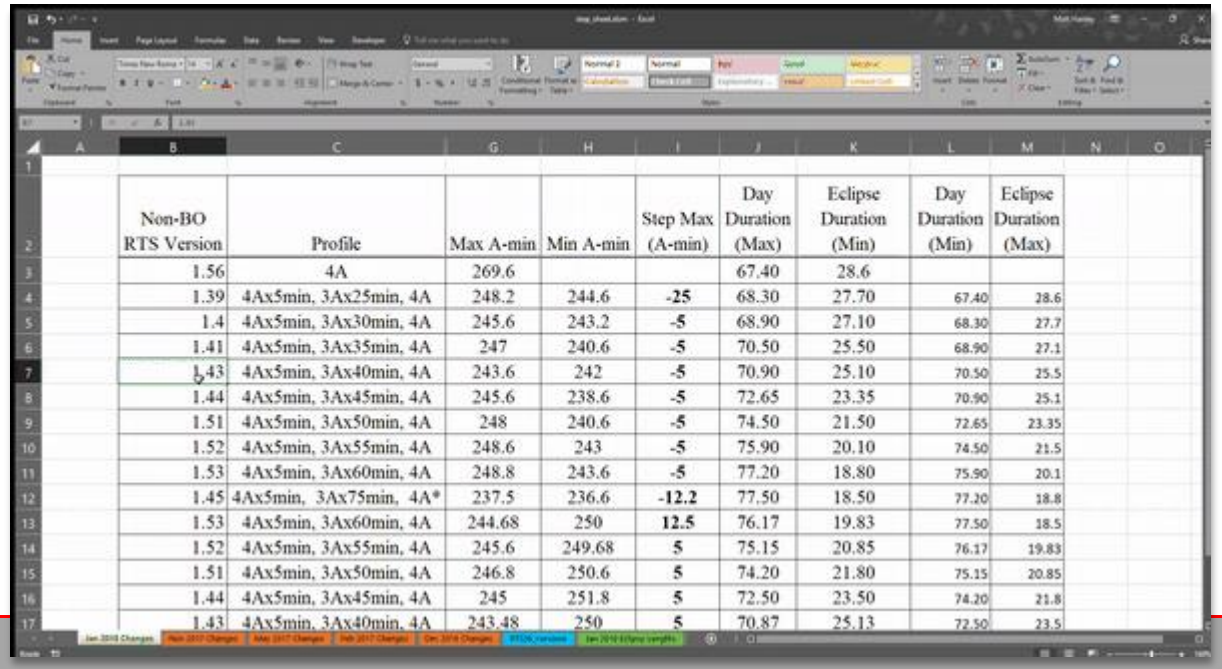




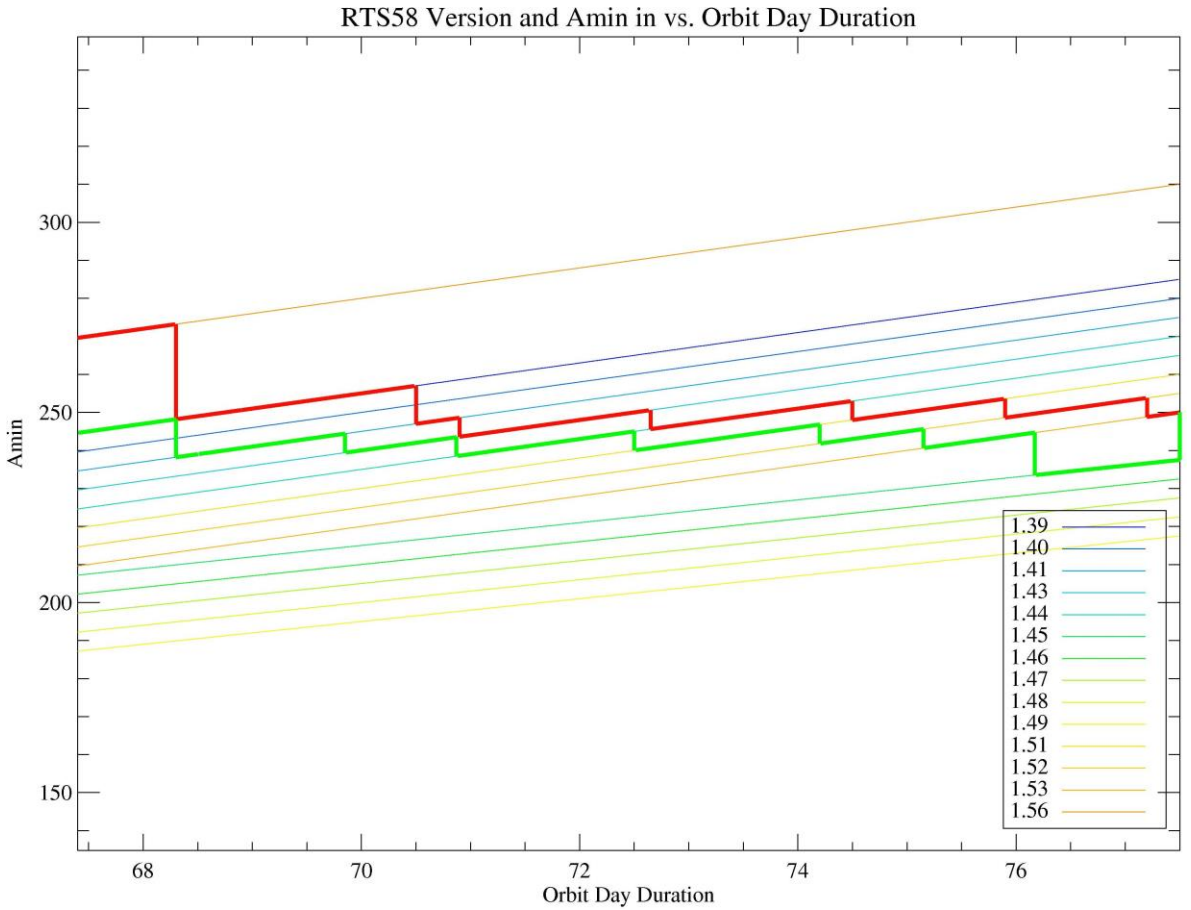
Recent Projects

Mini Eclipse Charge Change Analysis

- Analyzed historic charge changes to determine if methodology for determining changes needs adjusting

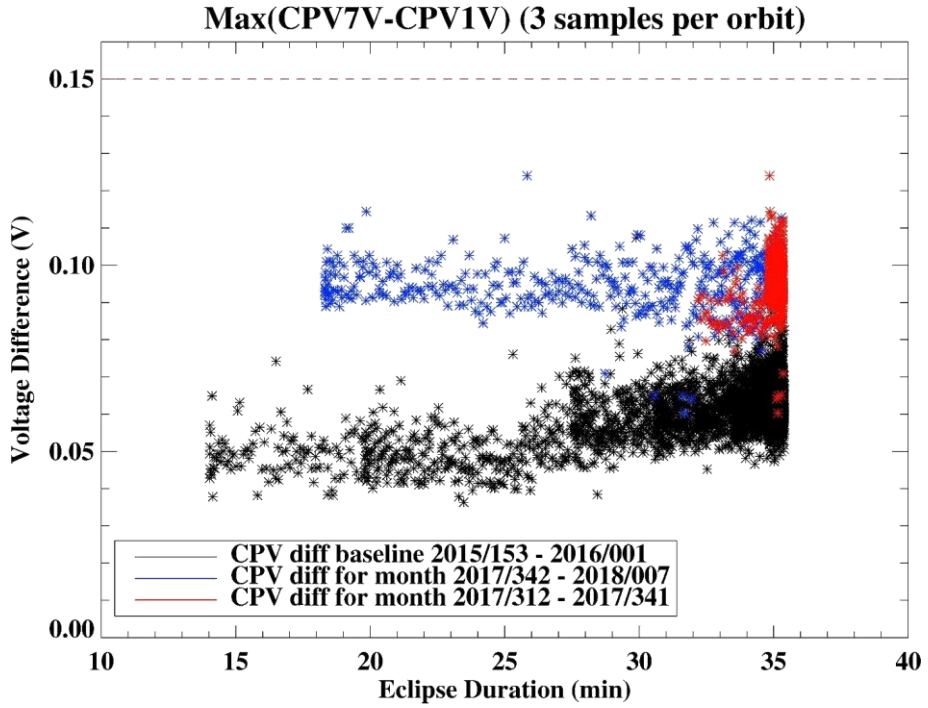


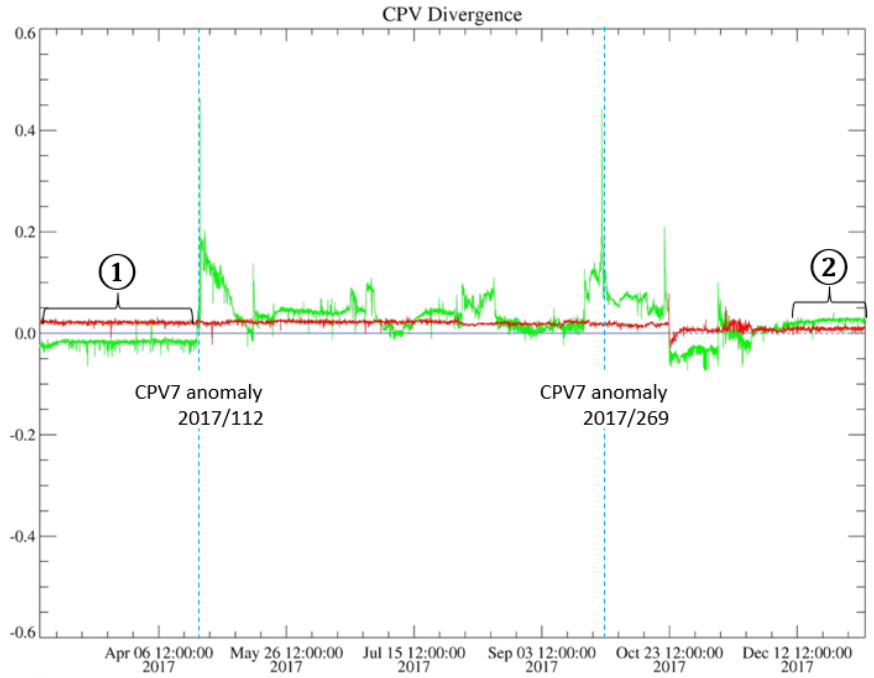
Non-BO RTS Version	Profile	Max A-min	Min A-min	Step Max (A-min)	Day Duration (Max)	Eclipse Duration (Min)	Day Duration (Min)	Eclipse Duration (Max)
1.56	4A	269.6			67.40	28.6		
1.39	4Ax5min, 3Ax25min, 4A	248.2	244.6	-25	68.30	27.70	67.40	28.6
1.4	4Ax5min, 3Ax30min, 4A	245.6	243.2	-5	68.90	27.10	68.30	27.7
1.41	4Ax5min, 3Ax35min, 4A	247	240.6	-5	70.50	25.50	68.90	27.1
1.43	4Ax5min, 3Ax40min, 4A	243.6	242	-5	70.90	25.10	70.50	25.5
1.44	4Ax5min, 3Ax45min, 4A	245.6	238.6	-5	72.65	23.35	70.90	25.1
1.51	4Ax5min, 3Ax50min, 4A	248	240.6	-5	74.50	21.50	72.65	23.35
1.52	4Ax5min, 3Ax55min, 4A	248.6	243	-5	75.90	20.10	74.50	21.5
1.53	4Ax5min, 3Ax60min, 4A	248.8	243.6	-5	77.20	18.80	75.90	20.1
1.45	4Ax5min, 3Ax75min, 4A*	237.5	236.6	-12.2	77.50	18.50	77.20	18.8
1.53	4Ax5min, 3Ax60min, 4A	244.68	250	12.5	76.17	19.83	77.50	18.5
1.52	4Ax5min, 3Ax55min, 4A	245.6	249.68	5	75.15	20.85	76.17	19.83
1.51	4Ax5min, 3Ax50min, 4A	246.8	250.6	5	74.20	21.80	75.15	20.85
1.44	4Ax5min, 3Ax45min, 4A	245	251.8	5	72.50	23.50	74.20	21.8
1.43	4Ax5min, 3Ax40min, 4A	243.48	250	5	70.87	25.13	72.50	23.5



Analyzed SORCE CPV Divergence

- Looked at individual CPV data to characterize sources of divergence





① vs. ②:
Divergence can be seen in times of stable, no brownout operations

This plot shows deviations away from CPV1

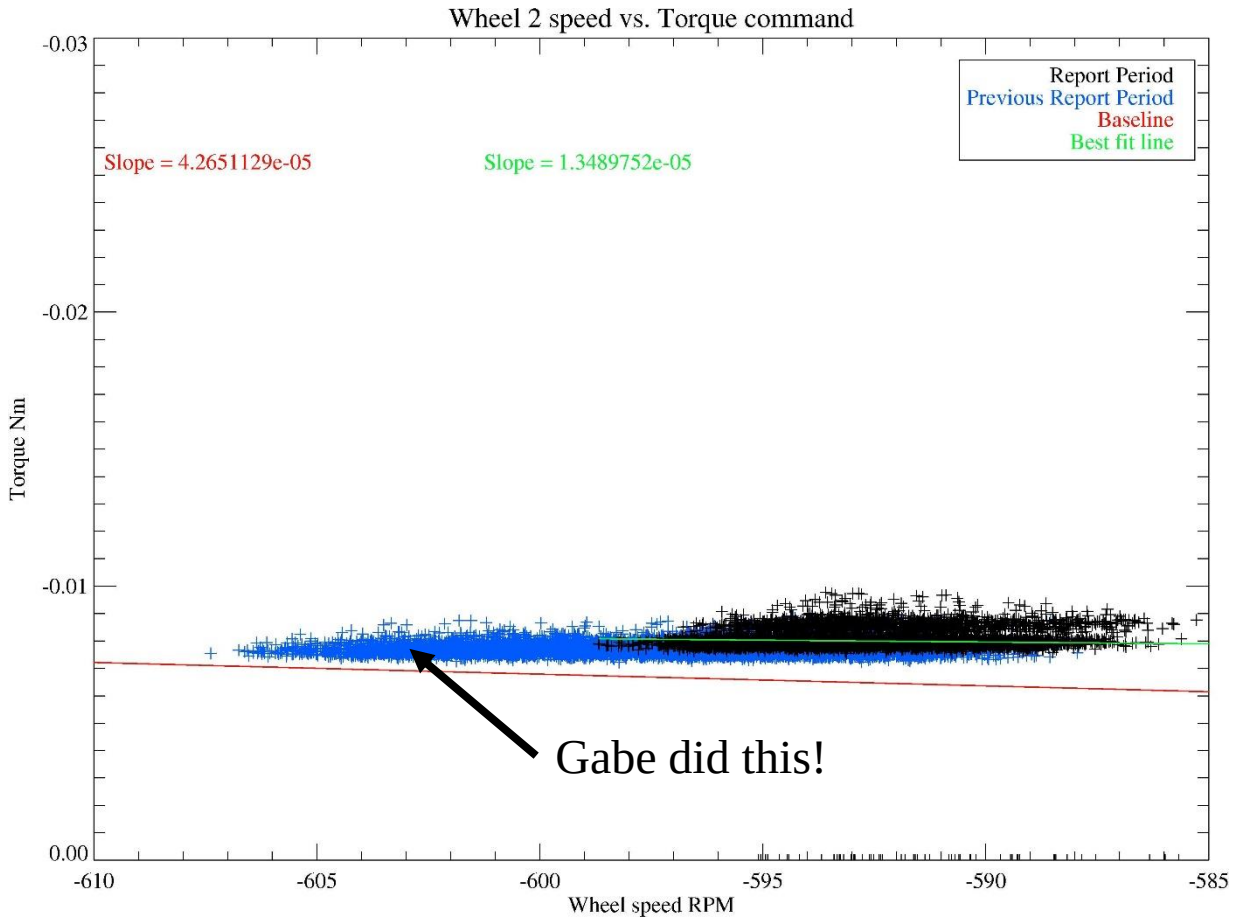
$$V_{CPVX} - V_{CPV1}$$

Other Projects and Tasks Worth Noting

- VBA macros to expedite quarterly highlight delete/paste
- Updated training presentations (SIM, QS ADCS, SORCE EPS)
- Internal Proc Viewer (passed to ops-sw)
- Plot Check website overhaul (nothing came of it)
- Rewrote mission_contacts (nothing came of it)
- TSIS TVAC
- Interactive IDL plotting tutorial
- AIM battery pressure and temperature predictions
- Second Sunrise Analysis
- Mini-eclipse predicts/spreadsheet revamp
- SORCE lunar occultation predictions
- NUC testing
- SORCE Brownout trending documentation
- SORCE Power Analysis (backflips, discharge
- MMS check_products
- Weeklies, Monthlies, Quarterlies – Oh my!

Projects I Oversaw

- Filter RW Friction Plots – Gabe
- Add color to RW Friction Plots – Gabe
- Rewrite SIM Quick Scan code to combine scans – Gabe
- FLAWS – Ginger, Ben S.
- RTS Visualizer – Trevor
- SORCE EPS Quarterly – Ben S.

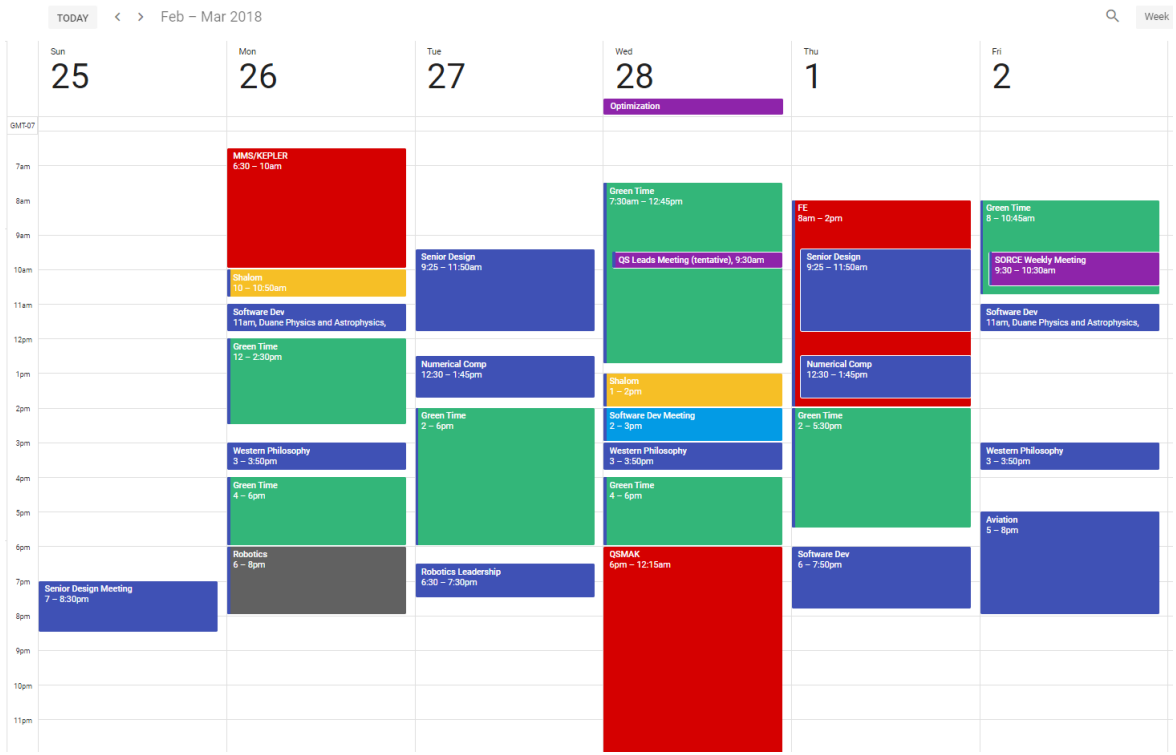


Performance Issues

- Missed QS load
  - Fall 2016
  - Didn’t read notification email of which pass we were loading on and forgot to check mission_contacts
  - Stayed after all hands to listen to JPL reps talk
- Late to Kepler Contact
  - Fall 2016
  - Got caught up in homework and left my house late
  - Arrived after BOT -20 minutes
- QSCAT page
  - Forgot `8 return` before dayproc termination
- Kepler shift confusion
  - Put my name on the wrong day for a schedule swap
  - Neither CC showed up for a VV contact

Performance Issues

- Mitigations
  - I now make sure to check all my emails when I get into work
  - I started to use Google Calendars religiously to help manage time
  - I have been making efforts to give more attention where attention is needed



Future at LASP

- Improve data visualization methods
  - Data visualization is key to understanding data
  - Improving visualization will help find trends and potentially catch anomalies before they happen
- Continue developing tools
  - I enjoy creating tools to help reduce people's time spent on tasks
  - I'd like to create more tools to help analyze data
- Teaching good coding practices to new hires

Future After LASP

- Travel
- Pursue a career in automated systems
- Continue to learn