

# Measuring the Polarization of Gamma Radiation



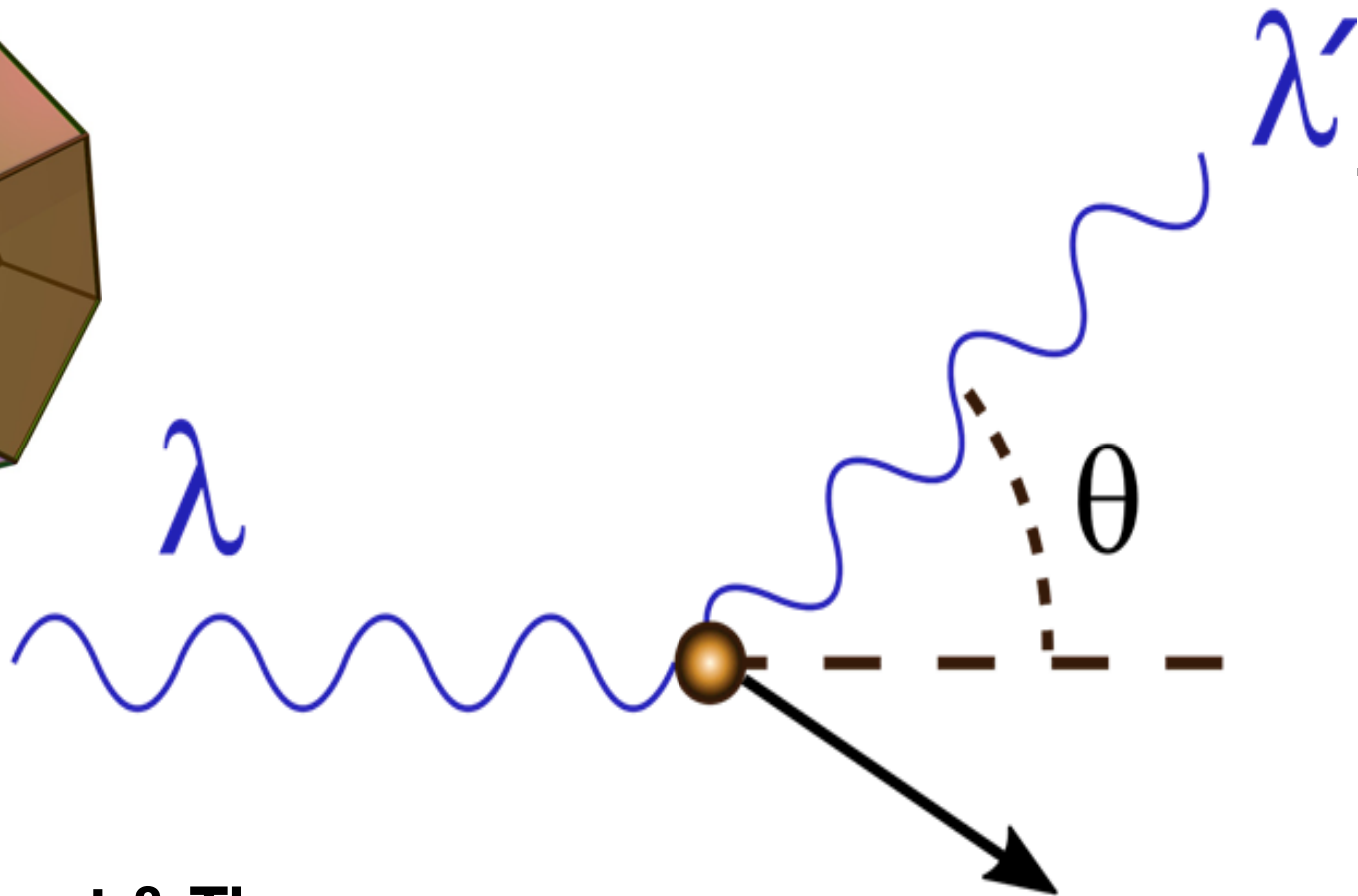
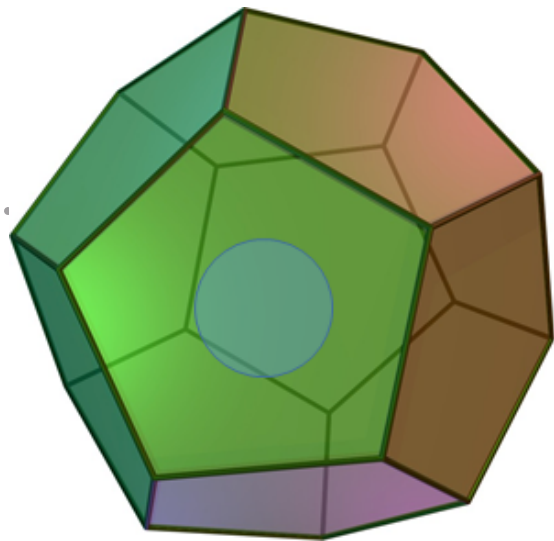
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2015 - 2016

# RockSat-C '16 Launch



| Event                      | Count-Rate<br>(phot/cm <sup>2</sup> /s) | Duration<br>(seconds) | Rate           |
|----------------------------|---|-----------------------|----------------|
| Solar Typical              | 0.1                                     | 100                   | 10/day         |
| Flare Big                  | 100                                     | 300                   | 1/year         |
| TERRESTRIAL<br>X-RAY FLASH | 10000                                   | 0.003                 | 50/day         |
| X-RAY Typical              | 1                                       | 30                    | 3/day          |
| BURST Big                  | 100                                     | 30                    | 1/month        |
| X-RAY<br>BACKGROUND        | 10                                      | $\infty$              | Always Present |

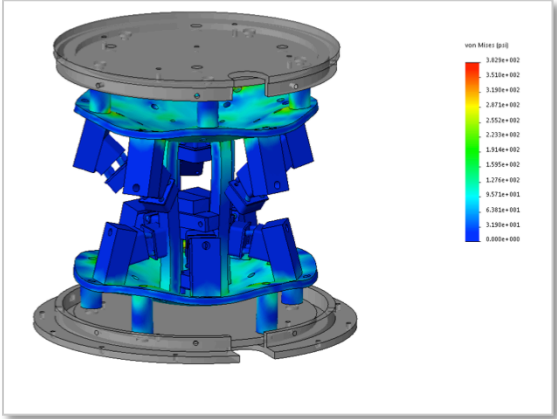
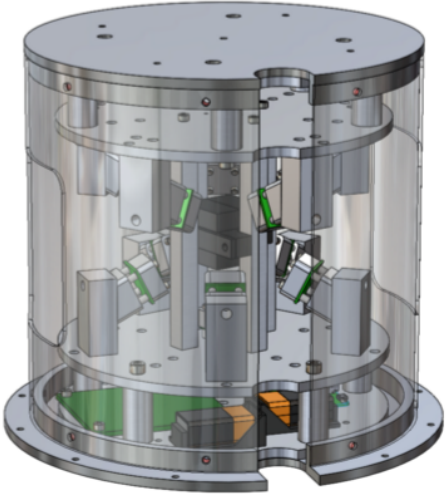
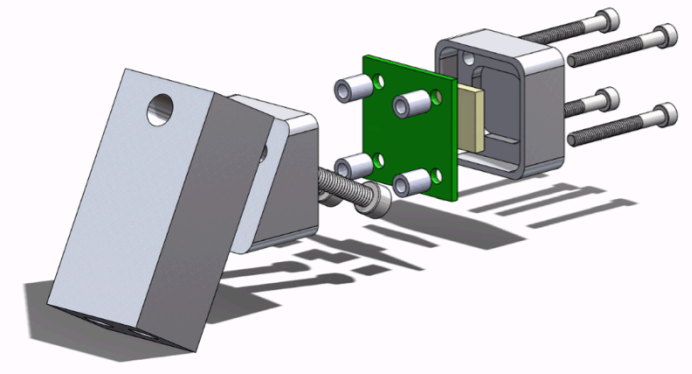
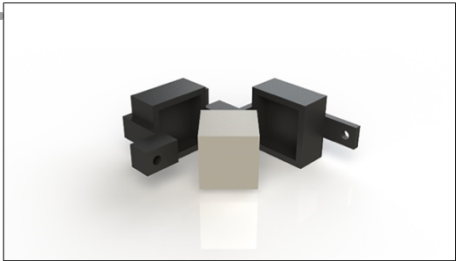


**Concept & Theory**

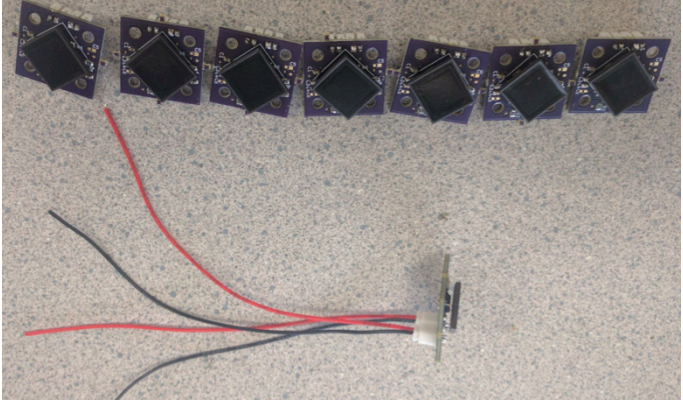
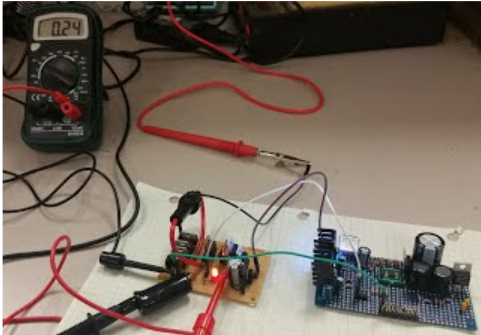
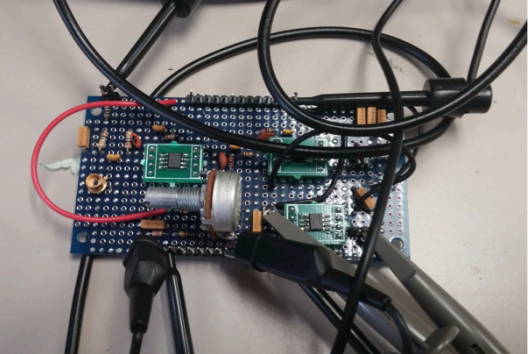
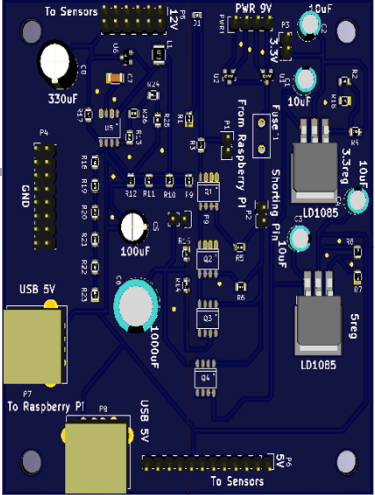
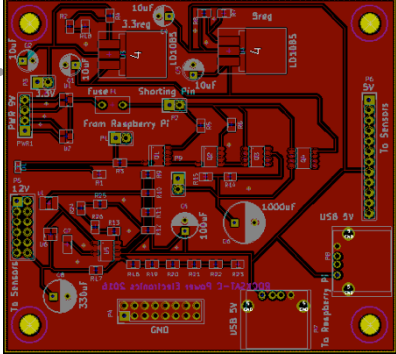
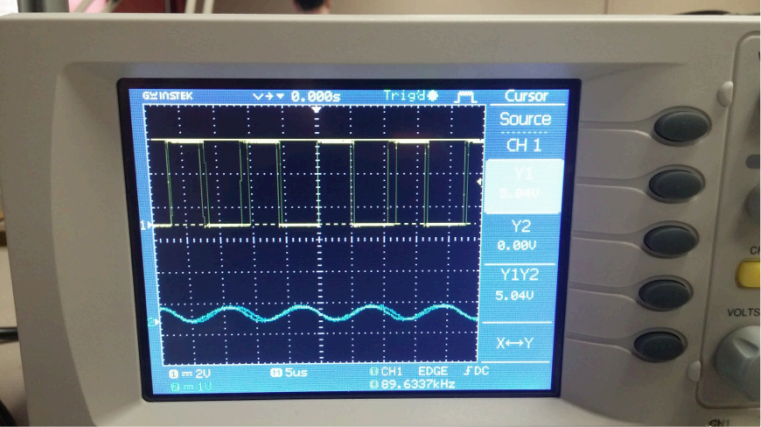




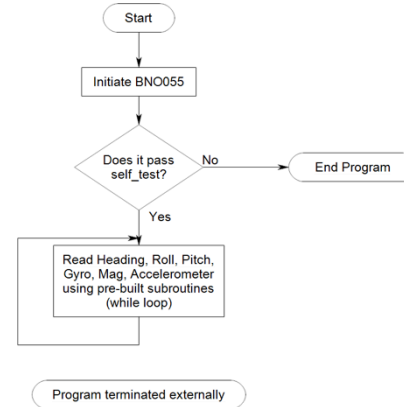
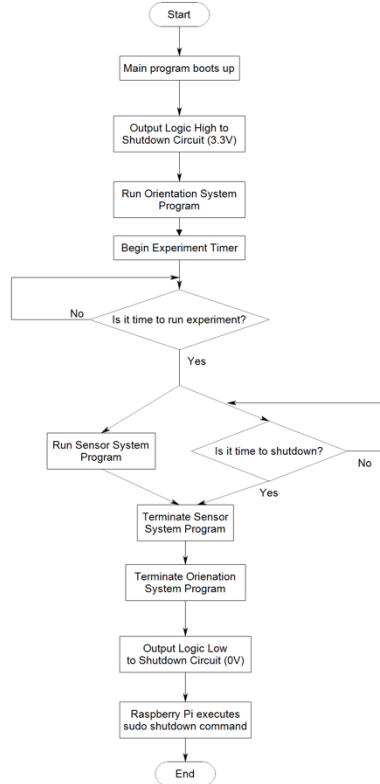
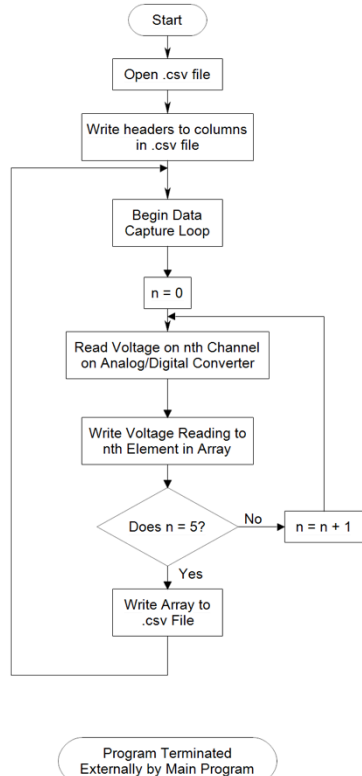
# Mechanical Design Elements



# Electrical Design Elements

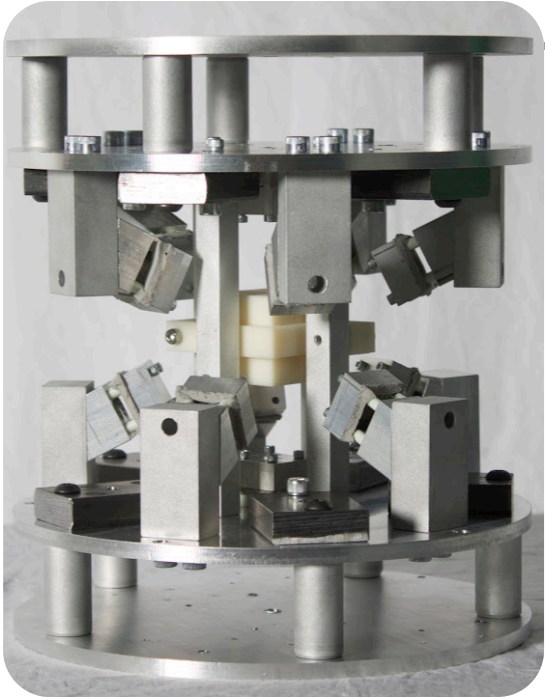
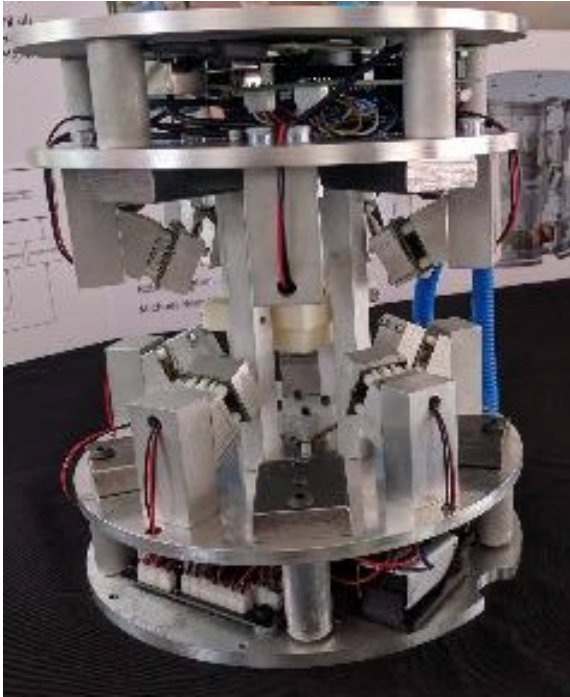


# Software Design Elements



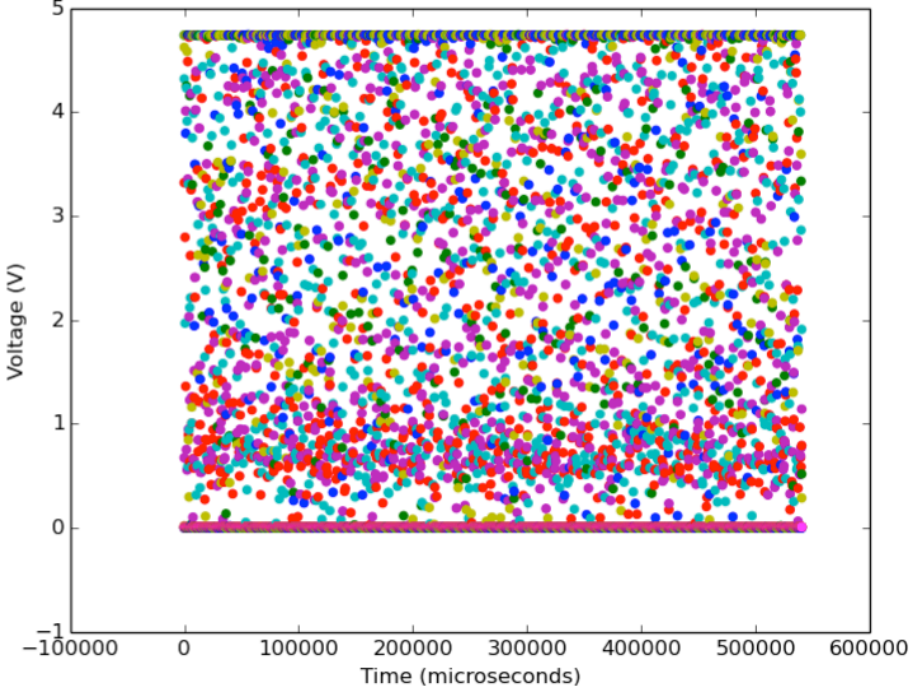
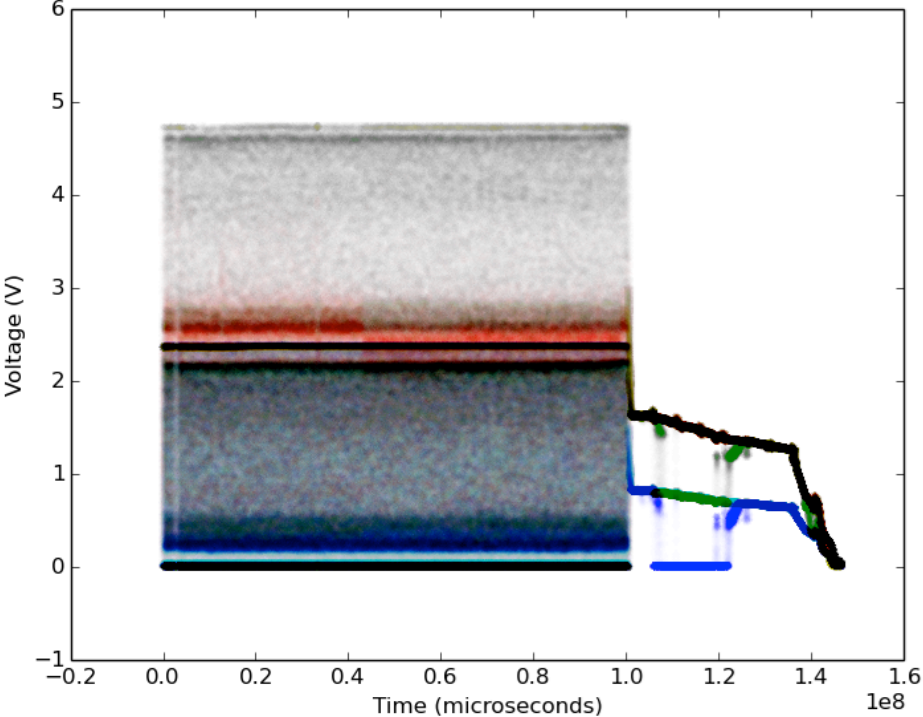
| Test#   | Roll    | Pitch    | Accel (X)        | Accel (Y)        | Accel (Z)        | Mag (X)  | Mag (Y)  | Mag (Z)  | Gyr (X)      | Gyr (Y)      | Gyr (Z)      | System Time       |                 |
|---------|---------|----------|------------------|------------------|------------------|----------|----------|----------|--------------|--------------|--------------|-------------------|-----------------|
| Degrees | Degrees | Degrees  | m/s <sup>2</sup> | m/s <sup>2</sup> | m/s <sup>2</sup> | m-Testes | m-Testes | m-Testes | degrees/s    | degrees/s    | degrees/s    | H M S             |                 |
| 0       | 0       | 0        | 5.67             | 7.55             | 1.9              | -45.875  | -28      | 8.925    | -0.054444444 | 0            | 0            | 0 12:35:25.231152 |                 |
| 0       | 32.875  | -74.8125 | 5.98             | 7.58             | 1.98             | -45.9625 | -26.875  | 8.9625   | 0.002222222  | 0.002222222  | -0.003333333 | 12:35:25.562504   |                 |
| 0       | 32.875  | -74.8125 | 5.98             | 7.58             | 2.01             | -46.9625 | -26.5    | 8.9625   | 0.002222222  | 0.002222222  | 0            | 12:35:26.884991   |                 |
| 0       | 32.875  | -74.8125 | 5.98             | 7.58             | 2.1              | -45.875  | -26.625  | 8.9625   | 0.001111111  | -0.002222222 | 0.001111111  | 12:35:26.193484   |                 |
| 0       | 32.875  | -74.8125 | 5.33             | 7.94             | 2.05             | -45.5    | -26.5    | 8.9625   | 0.001111111  | -0.003333333 | 0.001111111  | 12:35:26.512140   |                 |
| 0       | 32.875  | -74.8125 | 5.33             | 7.94             | 2.12             | -44.75   | -26.875  | 7.6875   | 0.002222222  | 0            | -0.003333333 | 12:35:26.829470   |                 |
| 0       | 32.875  | -74.8125 | 5.33             | 7.94             | 2.18             | -45.5    | -26.5    | 6.875    | 0.001111111  | 0.001111111  | 0.001111111  | 12:35:27.145789   |                 |
| 0       | 32.875  | -74.8125 | 5.33             | 7.94             | 2.12             | -44.75   | -27.25   | 6.875    | 0.001111111  | -0.002222222 | 0.001111111  | 12:35:27.780033   |                 |
| 0       | 32.875  | -74.8125 | 5.33             | 7.94             | 2.15             | -45.9625 | -26.875  | 6.5      | -0.001111111 | -0.003333333 | -0.006666667 | 12:35:28.413455   |                 |
| 0       | 32.875  | -74.8125 | 5.33             | 7.95             | 2.09             | -45.9625 | -27.25   | 7.6875   | -0.003333333 | 0            | 0            | 0.004444444       | 12:35:28.413455 |
| 0       | 32.875  | -74.8125 | 5.32             | 7.94             | 2.13             | -45.875  | -27.5625 | 7.25     | -0.001111111 | 0            | 0            | 0.004444444       | 12:35:28.729716 |
| 0       | 32.875  | -74.8125 | 5.31             | 7.94             | 2.17             | -44.75   | -26.875  | 6.9625   | 0            | 0.001111111  | 0.002222222  | 12:35:28.948667   |                 |
| 0       | 32.875  | -74.8125 | 5.31             | 7.94             | 2.17             | -44.75   | -26.875  | 6.9625   | -0.003333333 | -0.003333333 | 0.004444444  | 12:35:29.426757   |                 |
| 0       | 32.875  | -74.8125 | 5.32             | 7.94             | 2.1              | -45.9625 | -27.25   | 7.25     | 0.002222222  | 0.002222222  | 0            | 0.002222222       | 12:35:29.362030 |
| 0       | 32.875  | -74.8125 | 5.34             | 7.96             | 2.09             | -45.875  | -26.875  | 6.6625   | 0.001111111  | 0            | 0.002222222  | 12:35:29.312291   |                 |
| 0       | 32.875  | -74.8125 | 5.32             | 7.94             | 2.08             | -45.25   | -26.875  | 7.6875   | 0.001111111  | 0            | 0.001111111  | 12:35:30.402857   |                 |
| 0       | 32.875  | -74.8125 | 5.31             | 7.95             | 2.08             | -45.5    | -26.5    | 6.875    | 0            | 0.002222222  | 0.001111111  | 12:35:30.946745   |                 |
| 0       | 32.875  | -74.8125 | 5.33             | 7.94             | 2.15             | -45.875  | -26.875  | 7.6875   | 0            | 0.001111111  | 0.017777778  | 12:35:31.262357   |                 |
| 0       | 32.875  | -74.8125 | 5.33             | 7.94             | 2.09             | -46.25   | -27.25   | 6.5      | 0            | 0.001111111  | 0.003333333  | 12:35:31.679794   |                 |
| 0       | 32.875  | -74.8125 | 5.31             | 7.95             | 2.1              | -45.5    | -26.375  | 7.6875   | 0.002222222  | 0.002222222  | 0.001111111  | 12:35:31.979794   |                 |
| 0       | 32.875  | -74.8125 | 5.31             | 7.95             | 2.17             | -45.875  | -26.875  | 8.9625   | 0.002222222  | 0.002222222  | 0.001111111  | 12:35:32.273210   |                 |
| 0       | 32.875  | -74.8125 | 5.31             | 7.95             | 2.1              | -45.5    | -26.375  | 7.6875   | 0.002222222  | 0.002222222  | 0.001111111  | 12:35:32.566626   |                 |
| 359     | 68.75   | 39.3125  | 74.4375          | 5.33             | 7.94             | 2.14     | 26.875   | 13.875   | 9.25         | -0.133333333 | -0.100000000 | 12:35:32.860042   |                 |
| 346     | 62.5    | 36.25    | 57.0625          | 7.9              | 7.87             | 4.19     | 30.25    | 15.9625  | 1.25         | 0.000000000  | 0.000000000  | 12:35:33.153460   |                 |
| 356     | 93.75   | -9.875   | 0.875            | -0.24            | -7.12            | 5.97     | 0.3625   | 20.375   | -0.002222222 | 0.001111111  | 0.000000000  | 12:35:33.446876   |                 |
| 8       | 1.25    | -1.3125  | 45.3125          | -0.35            | -4.33            | 7.45     | 4        | 24.875   | 21.1475      | 0.000000000  | 0.000000000  | 12:35:33.740292   |                 |
| 8       | 96.25   | 0.3125   | 44.9625          | -0.19            | -4.45            | 1.77     | 8.1875   | 20.375   | -0.000000000 | -0.000000000 | 0.000000000  | 12:35:34.033708   |                 |
| 9       | 98.75   | 1.5      | 42.5625          | 0.48             | -4.4             | 0.91     | 20.1875  | 20.1875  | -0.000000000 | -0.000000000 | 0.001111111  | 12:35:34.327124   |                 |

# Finished Design





# Final Results





# Lessons Learned

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- Always plan for things taking much longer than expected
- Get spares for every part
- Ask for help when you need it
- Trust yourself and your team
- Trust, but verify
- Be patient with yourself and your team
- Be forgiving when mistakes happen
- Don't be afraid to ask questions
- Above all, have fun





SPACE





Thank You!

