Photometry of Celestial Fireballs

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Introduction

To protect space endeavors, more information is needed about meteoroid population distribution. We created a portable all-sky camera system that can potentially increase the amount of meteor data astronomers can collect. The first step is showing that our photometric data is just as accurate as other systems.

Objectives

- Create a program that can analyze photometric data from meteor video
- Test program against events with previously established light curves to test its validity
- Run program on events captured by our all-sky camera.

Our All-Sky Camera

Mathematical Methods

The photometric data we can extract from our camera is its pixel values, an uncalibrated measure of **intensity**. We use Equation 1 to turn that into an uncalibrated **magnitude**. We also apply Equation 1 on a star in that sky with a known magnitude in order to calibrate our camera.
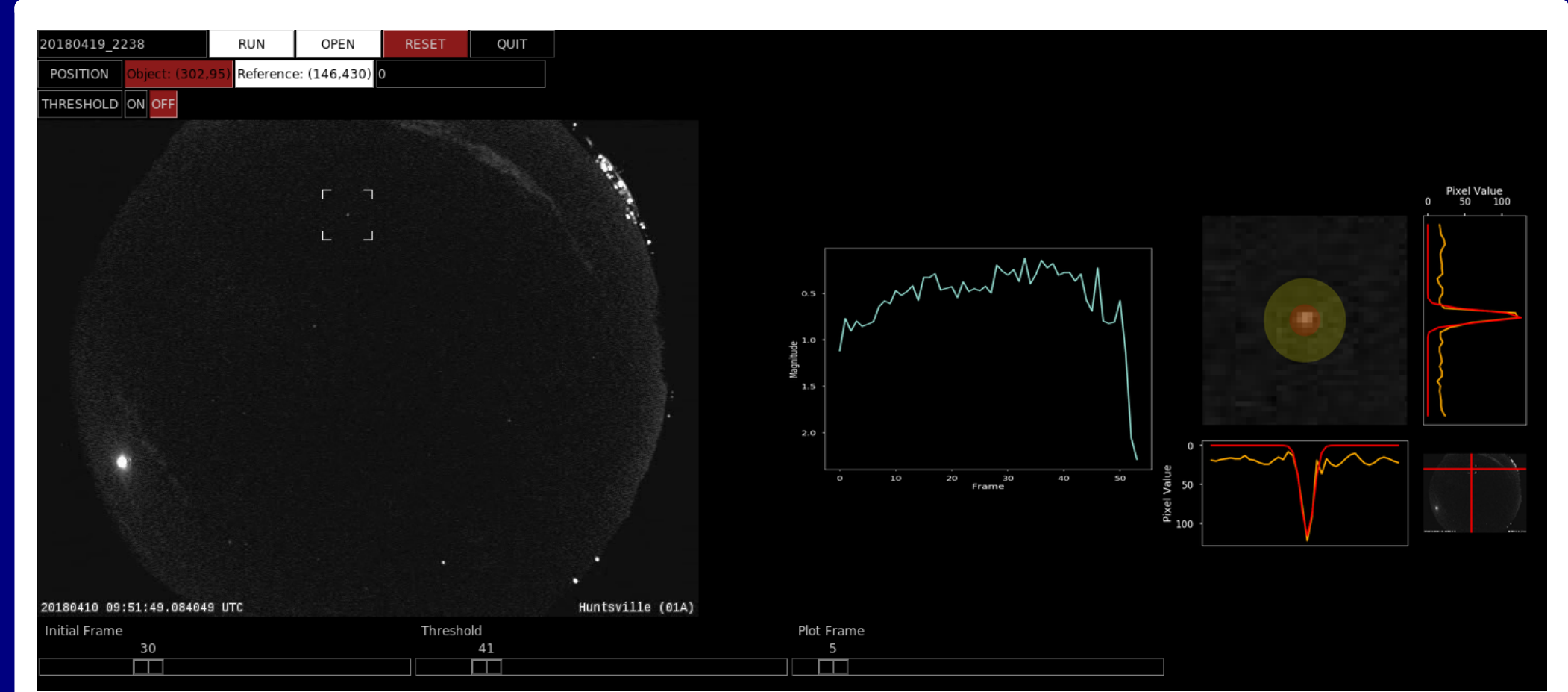
$$m = -2.5\log(I) \tag{1}$$

From intensity, we can extrapolate out to get the object's total **luminosity**. We can then relate the luminosity of the event to its total **kinetic energy** to find its **mass** through integration of its light curve,
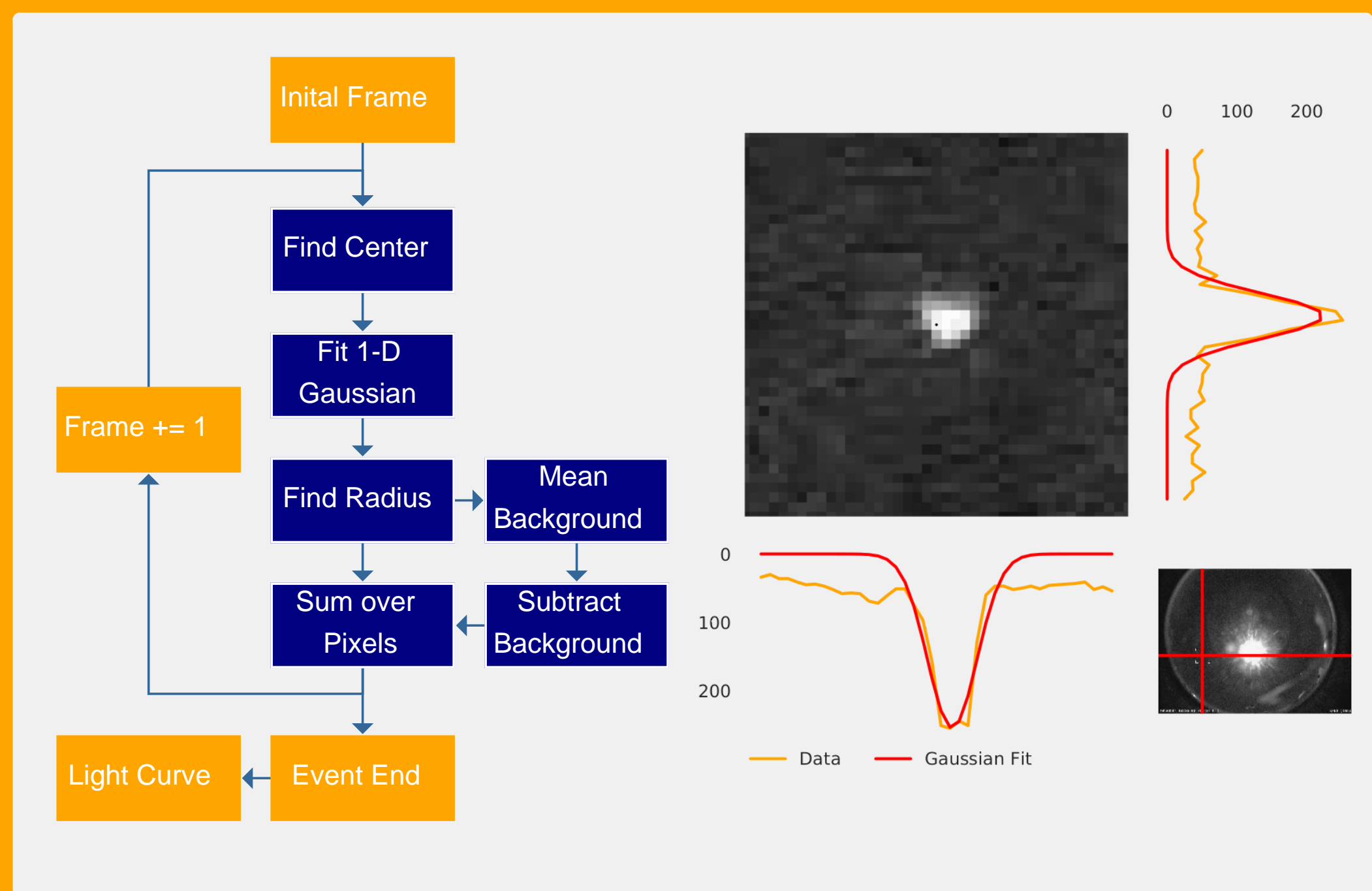
$$L = \tau \frac{v^1}{2} \frac{dM}{dt} \tag{2}$$

Computational Methods
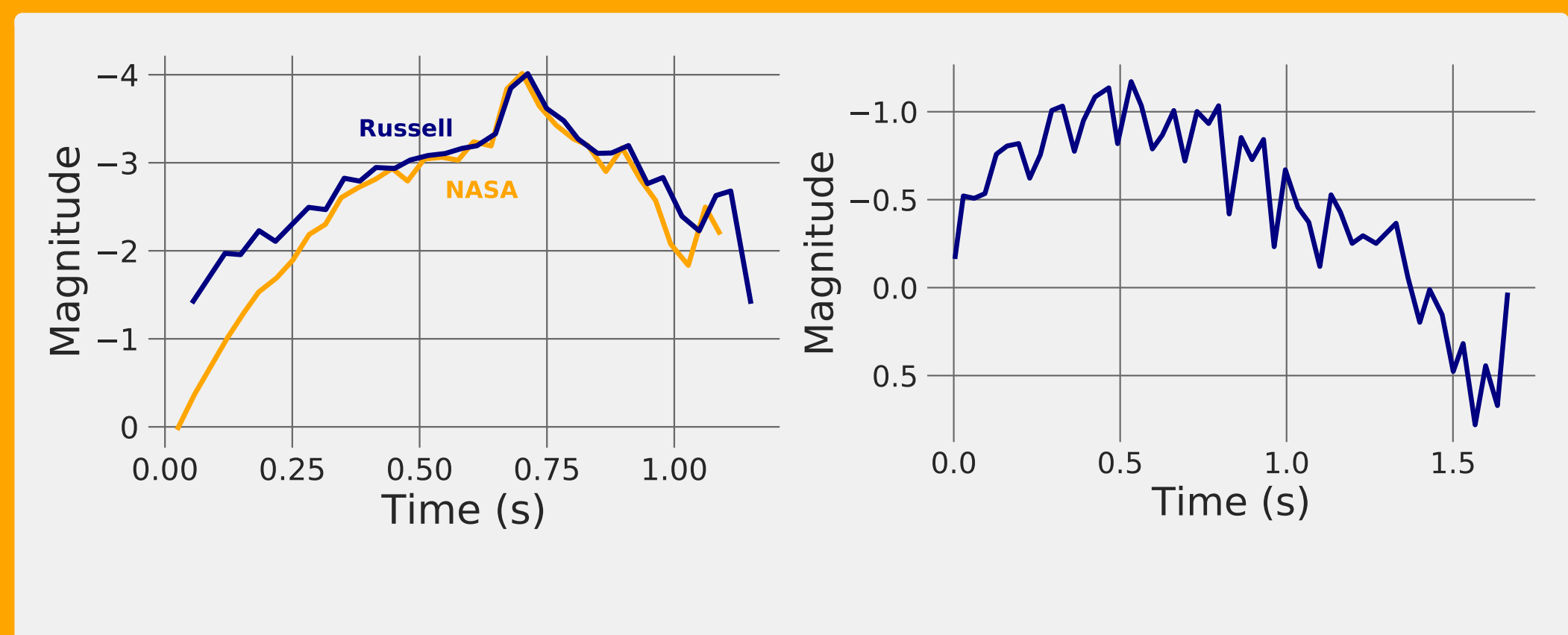
Photometry Program

Frame Data

Results

The program was than ran on meteor events collected on NASA's all-sky network. This was done multiple times, each time providing solid evidence that the program was working correctly. The program was then ran on a fireball our own system detected.

Meteor Data

Conclusion

The photometric program we wrote appears to be successful at finding the calibrated magnitudes of events. There is some fine tweaking and optimization to be done, but after that, it's on to collecting enough data to perform statistical analysis on and create our own population distribution of meteoroids.