PHOTOMETRY OF CELESTIAL FIREBALLS

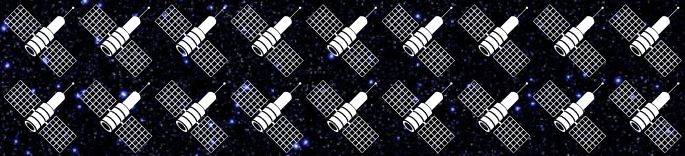
Luke Galbraith Russell • Willamette University

SATELLITES ENTERING ORBIT

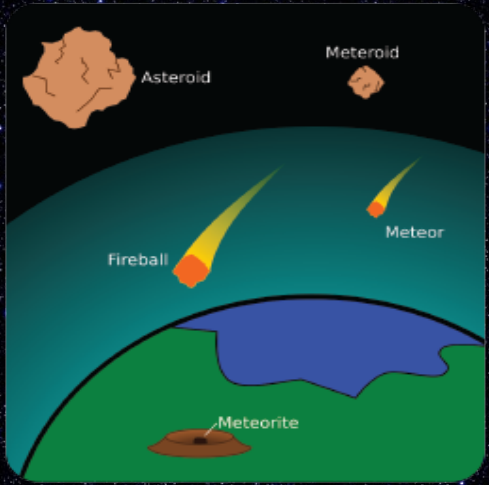
2006

2017

2022



NEAR-EARTH OBJECTS



large rock in orbit

small rock in orbit

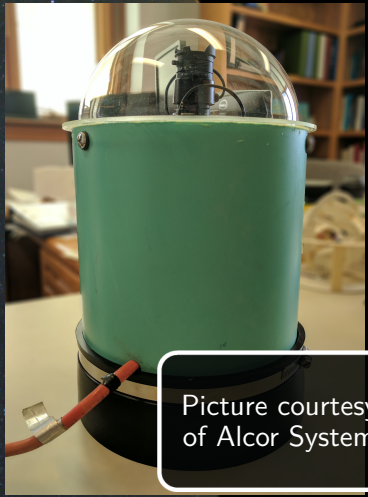
small rock
entering atmosphere

large rock
entering atmosphere

NEAR-EARTH OBJECTS

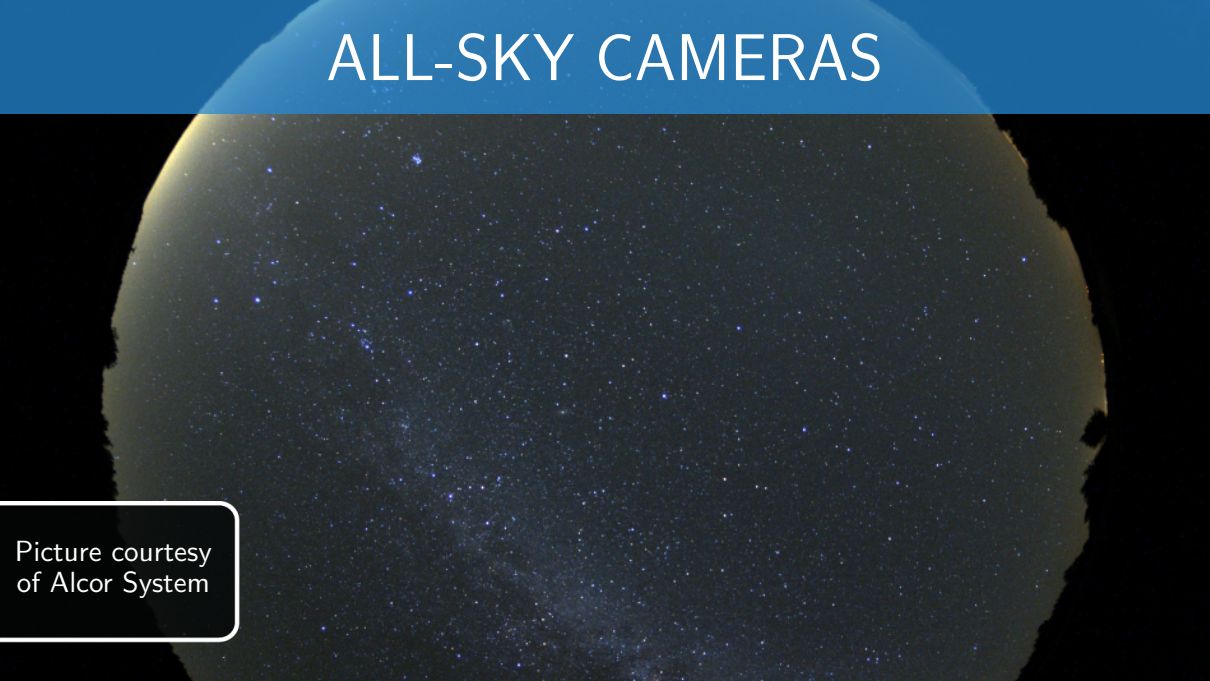
Picture courtesy of ESA

ALL-SKY CAMERAS



Picture courtesy of Alcor System

ALL-SKY CAMERAS



Picture courtesy of Alcor System

FROM BRIGHTNESS TO MASS

$$m = -2.5 \log(I)$$

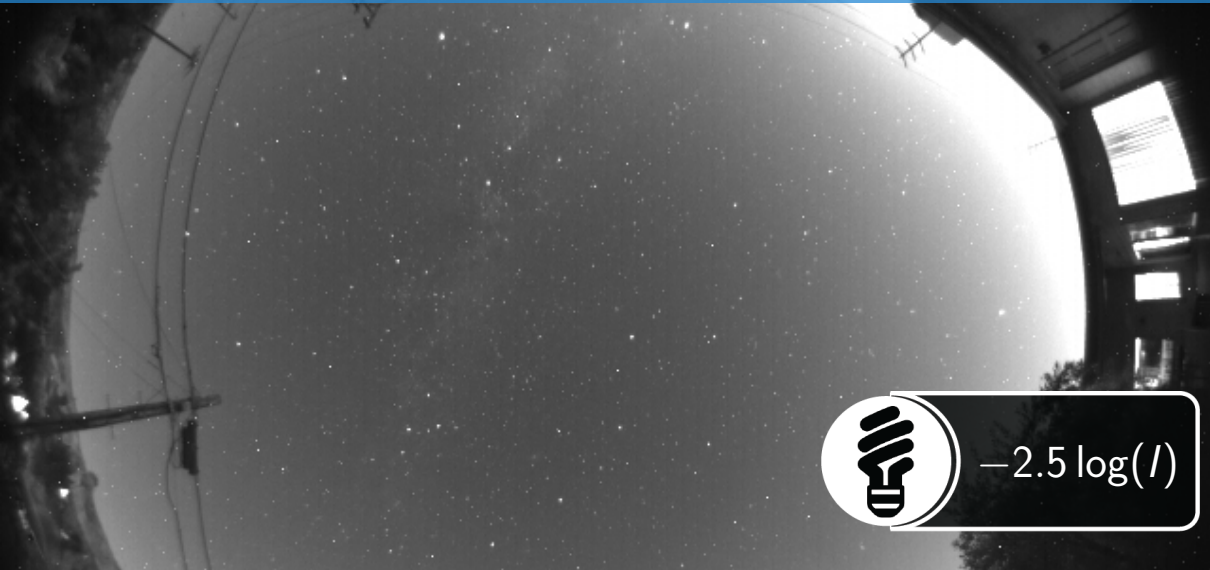
m = magnitude
I = sum of object's pixel values

$$L = \tau \frac{v^2}{2} \frac{dM}{dt}$$

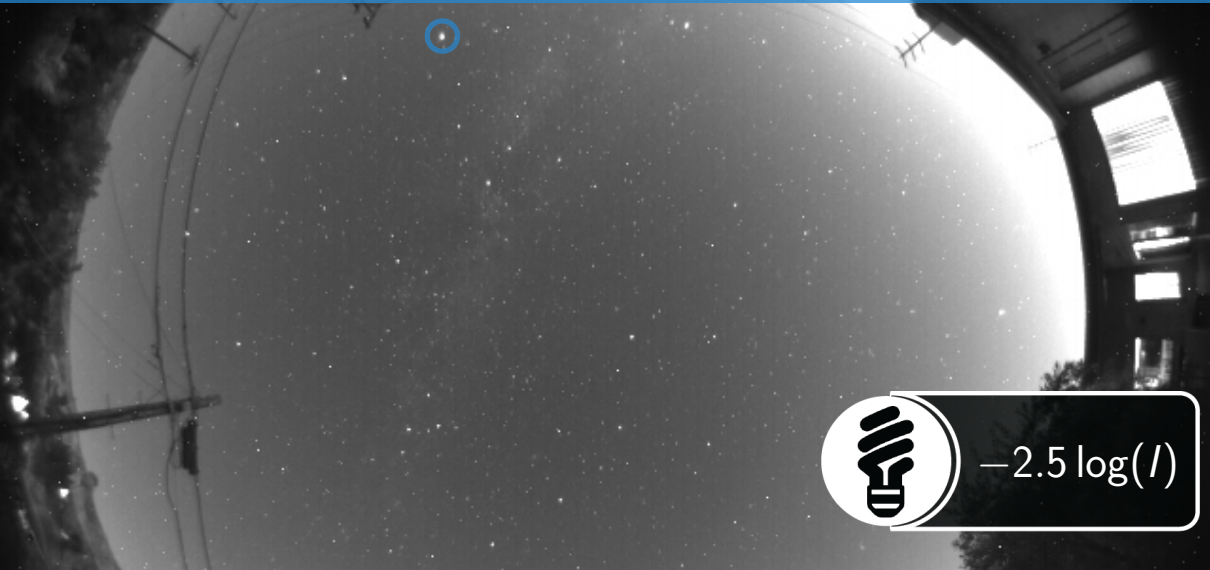
L = luminosity
v = velocity
M = mass
τ = luminous efficiency
t = time

$$M = \int \frac{2L}{\tau v^2} \, dt$$

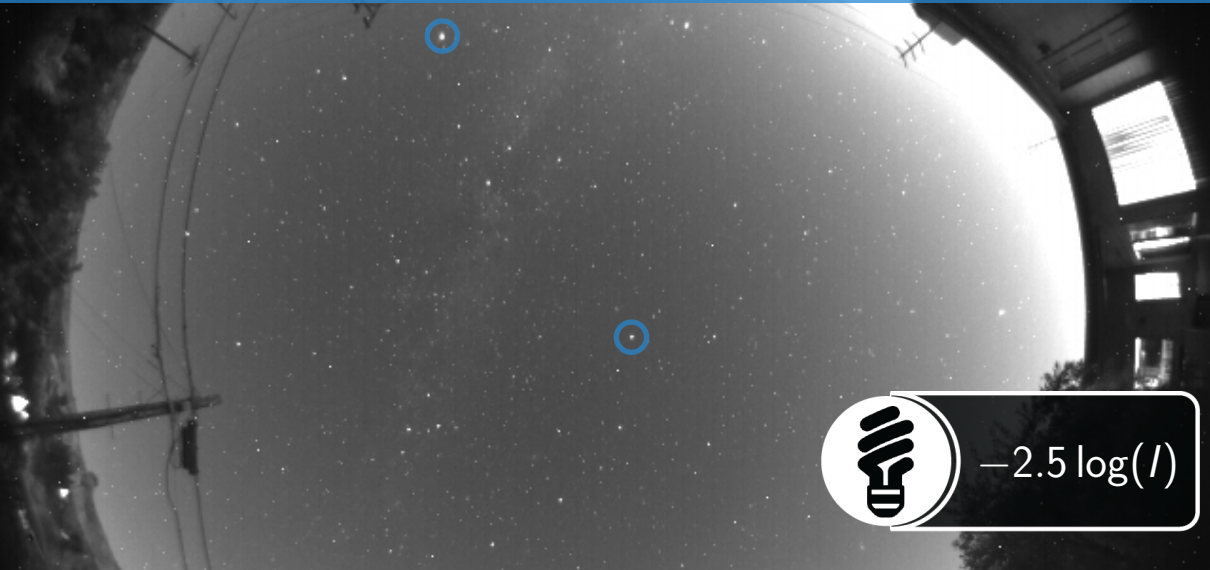
DETERMINING MAGNITUDE



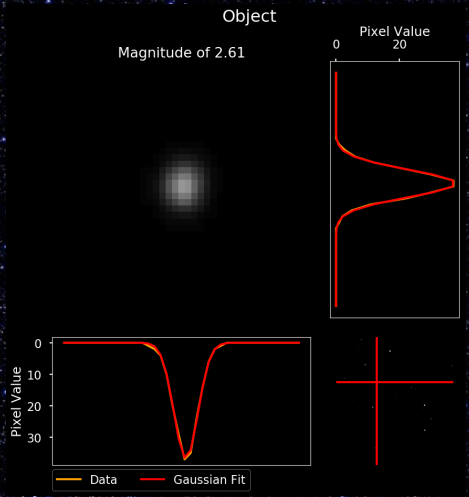
DETERMINING MAGNITUDE

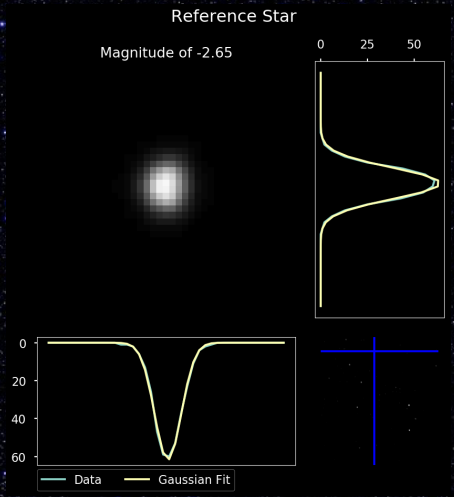


DETERMINING MAGNITUDE

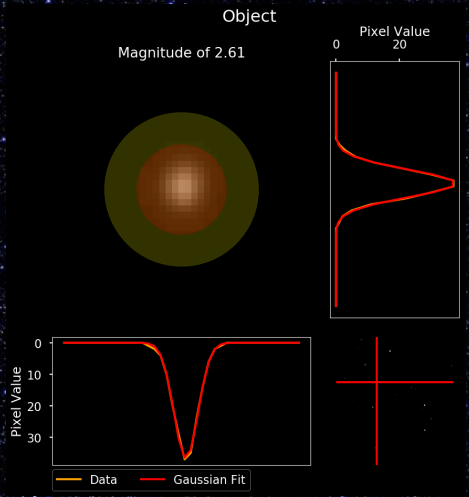


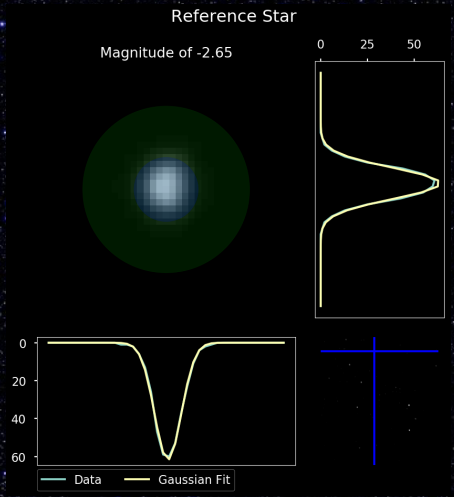
RAW DATA


Object
Magnitude of 2.61
Pixel Value
0
20
0
10
20
30
Pixel Value
Data
Gaussian Fit

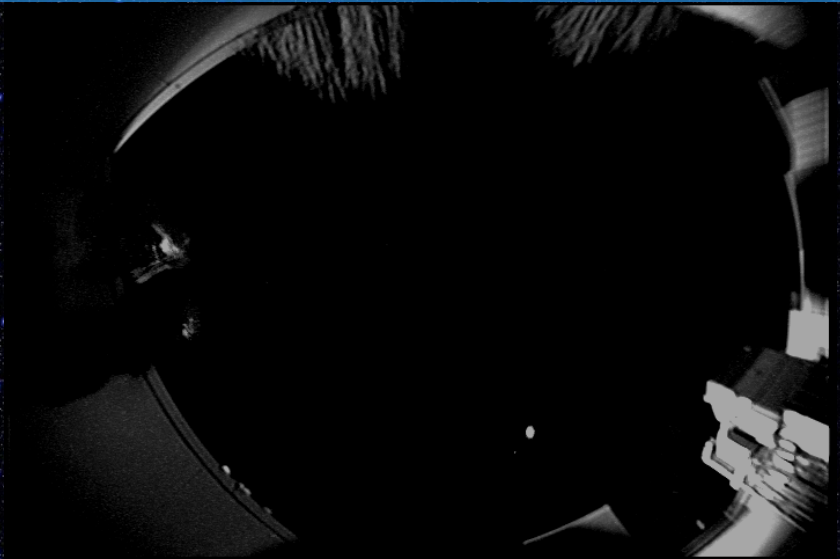

Reference Star
Magnitude of -2.65
0
25
50
0
20
40
60
Data
Gaussian Fit

RAW DATA

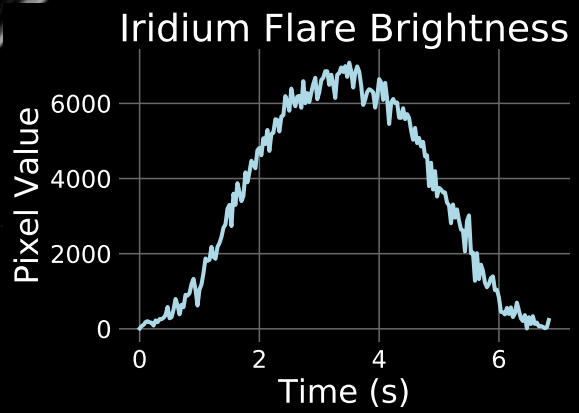

Object
Magnitude of 2.61
Pixel Value
0
20
Pixel Value
0
10
20
30
Data
Gaussian Fit

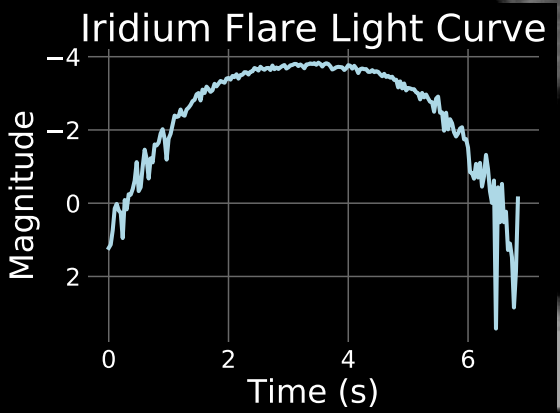

Reference Star
Magnitude of -2.65
0
25
50
0
20
40
60
Data
Gaussian Fit

IRIDIUM FLARES



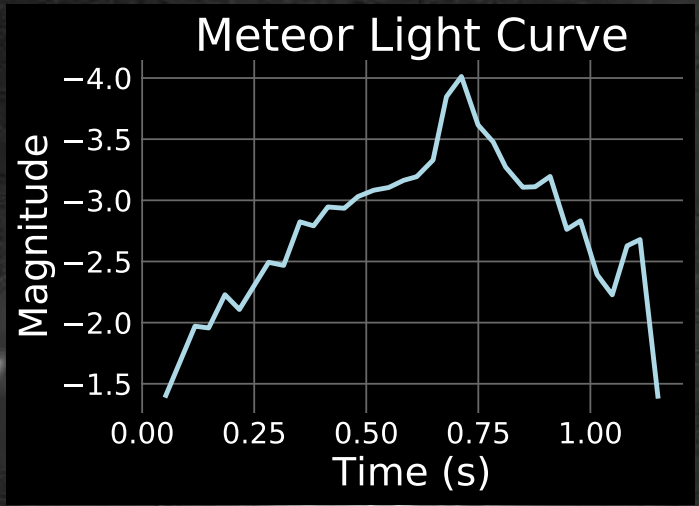
IRIDIUM FLARE: LIGHT CURVE



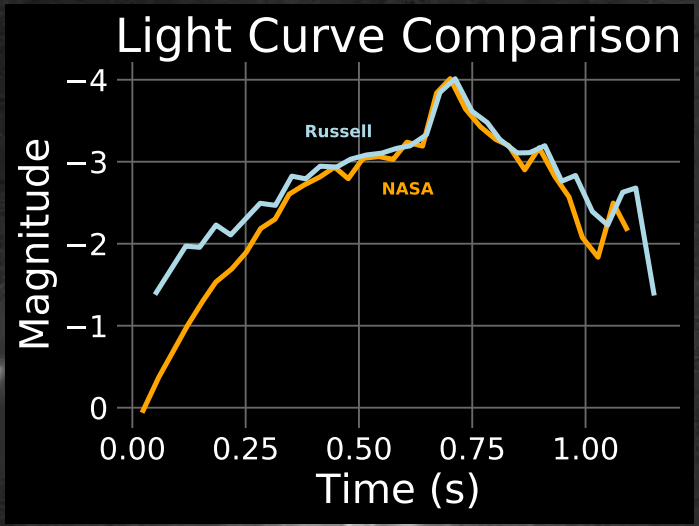


NASA METEORS

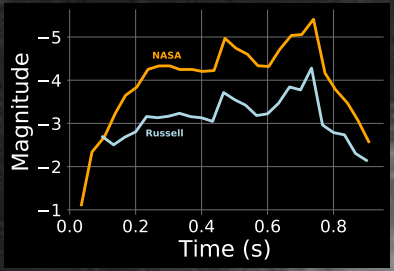
NASA METEOR: LIGHT CURVE

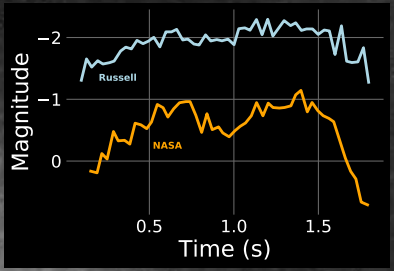


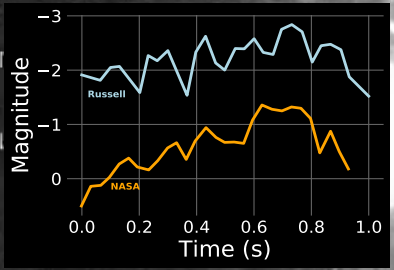
NASA METEOR: LIGHT CURVE

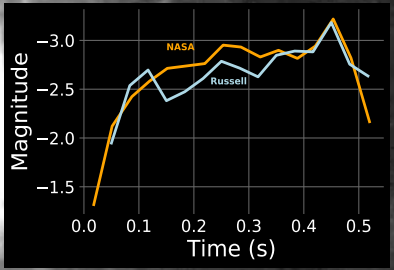


NASA METEORS: LIGHT CURVES



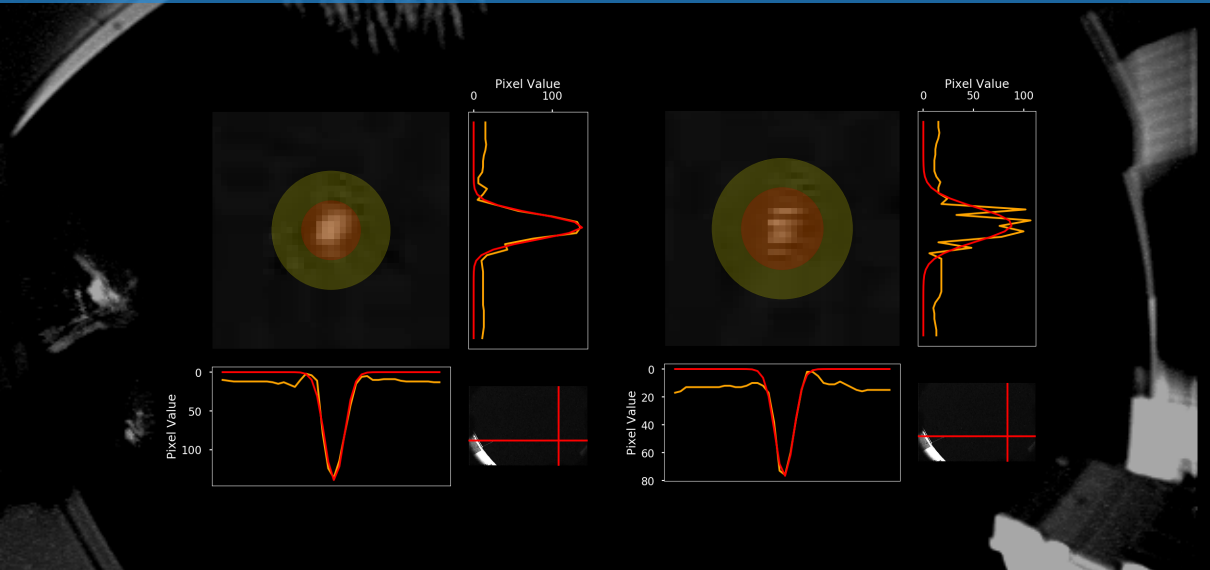




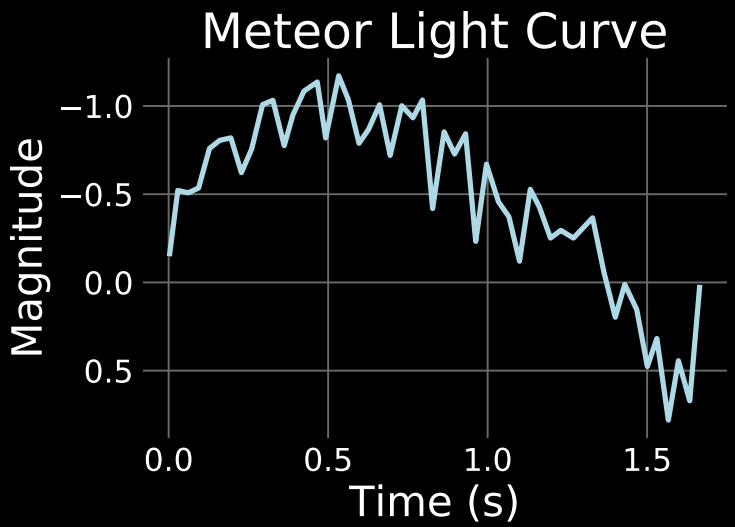


D6 FIREBALLS

D6: PHOTOMETRIC DATA



D6: LIGHT CURVE



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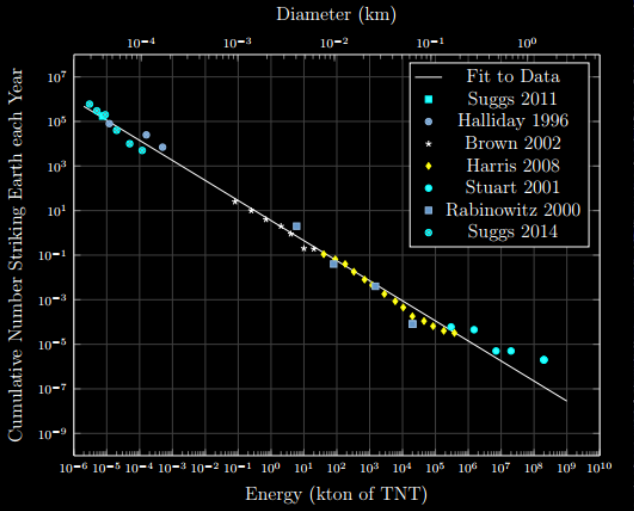
LONG-TERM GOAL



Graph made by
Dr. J. Rembold

REFERENCES

- Background picture 1: alcor-system.com
- Background picture 2: sbig.com
- Whitehead, James. "The North American All-Sky Camera Database." (2009).
- Suggs, Rob M. "The NASA Fireball Network All-Sky Cameras." (2011).
- All icons made by Freepik

QUESTIONS?

FOR MORE:

GITHUB.COM/LUKEGALBRAITHRUSSELL

TO GET SOURCE CODE AND CONTINUOUS UPDATES