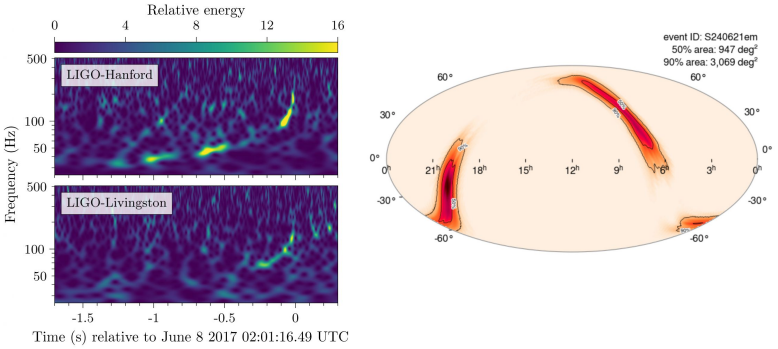
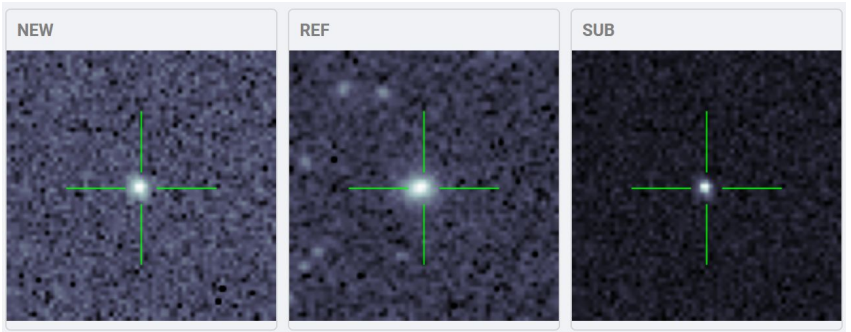
Postbac Update !

Kira Nolan

Matthew Graham

Multi-messenger + transient astronomy





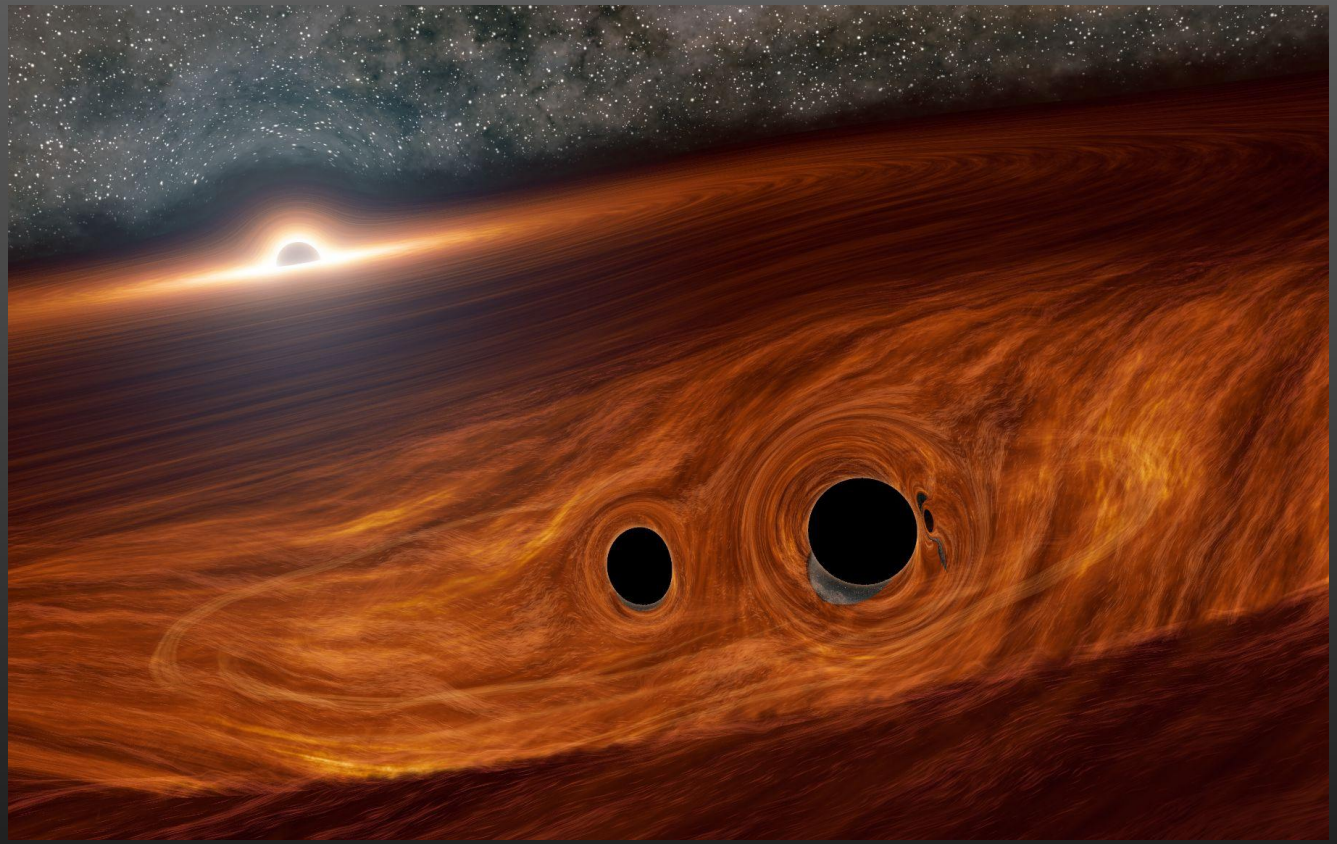
Overview

1. Project 1: Optical follow-up of Binary Black Hole merger gravitational wave detections

2. Project 2: Analysis of science-motivated filtering on large volume of astronomical data from the Zwicky Transient Facility

3. Other things I’m doing…

Why chase Binary Black Hole (BBH) merger flares?



Binary black holes in AGN (active galactic nucleus) disk / Image credit: Caltech/R. Hurt (IPAC)

As few as ***ten*** confirmed flares can accurately measure the Hubble constant

Selecting high mass mergers in real-time

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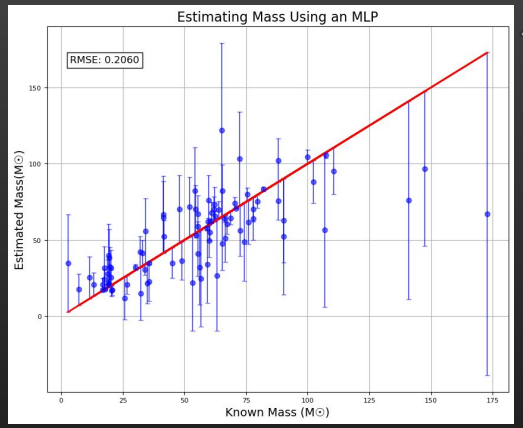
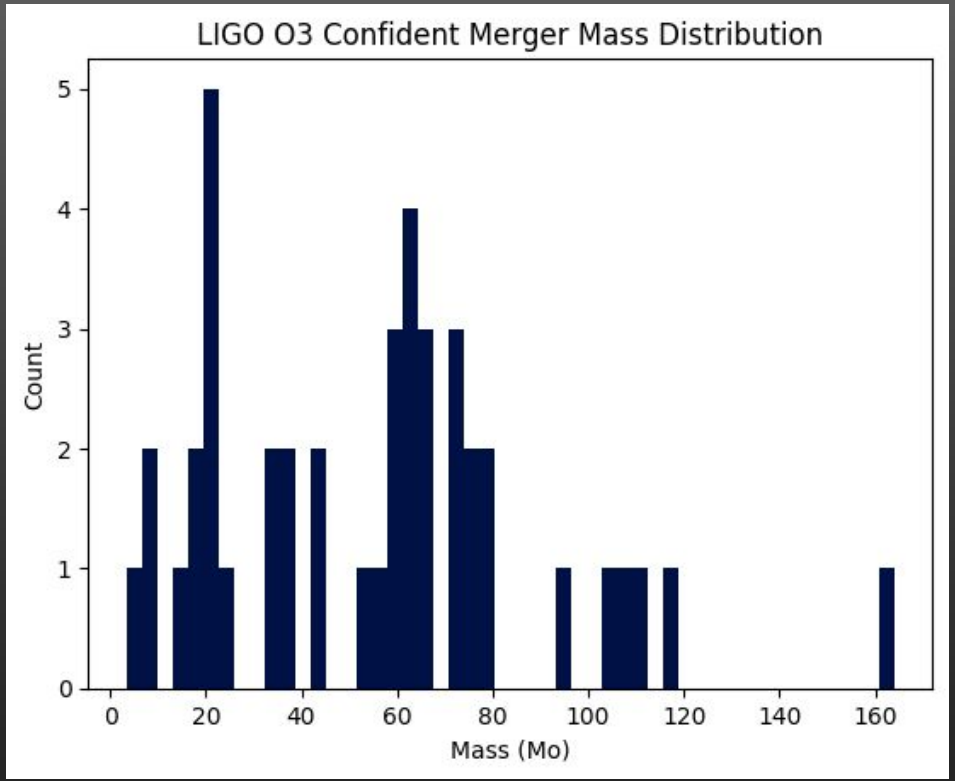
Event ID	Possible Source (Probability)	Significant	UTC	GCN	Location	FAR
S240507p	BBH (>99%)	Yes	May 7, 2024 04:16:32 UTC	GCN Circular Query Notices | VOE		1 per 50.02 years

Initial LIGO alerts do not contain masses.

Building on ML mass estimation work done by Ceci Ochoa:

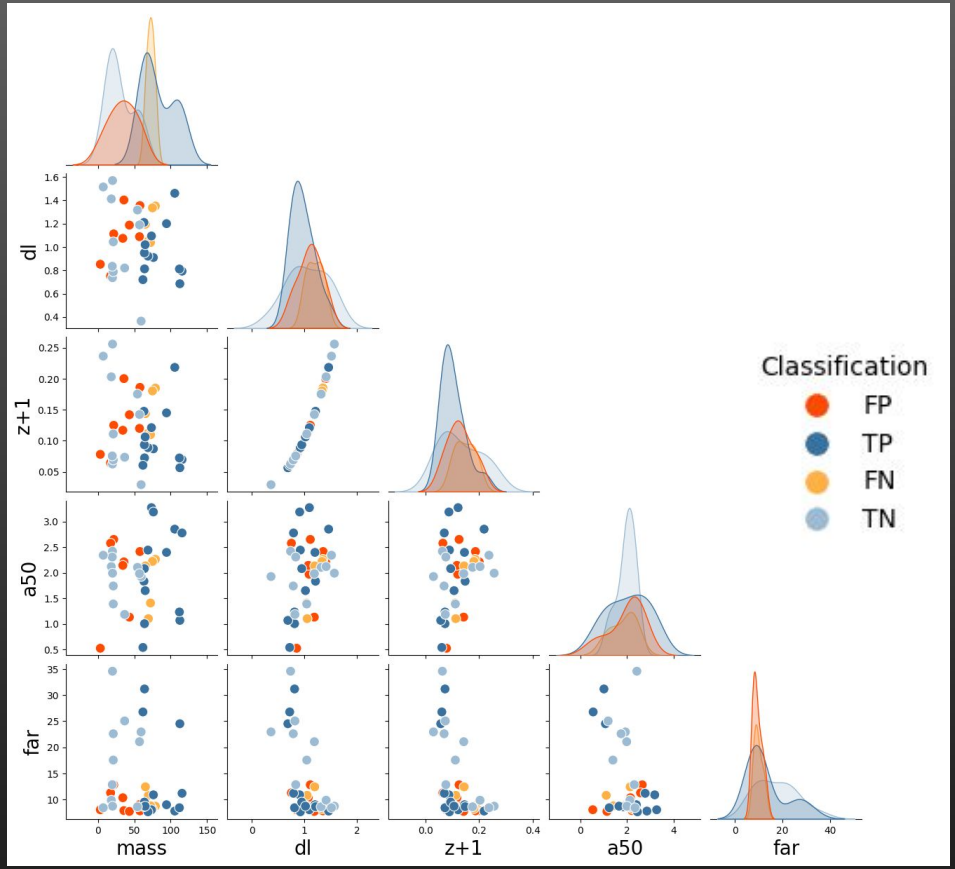




Performance of classifier with 60 $M_\odot$ division:

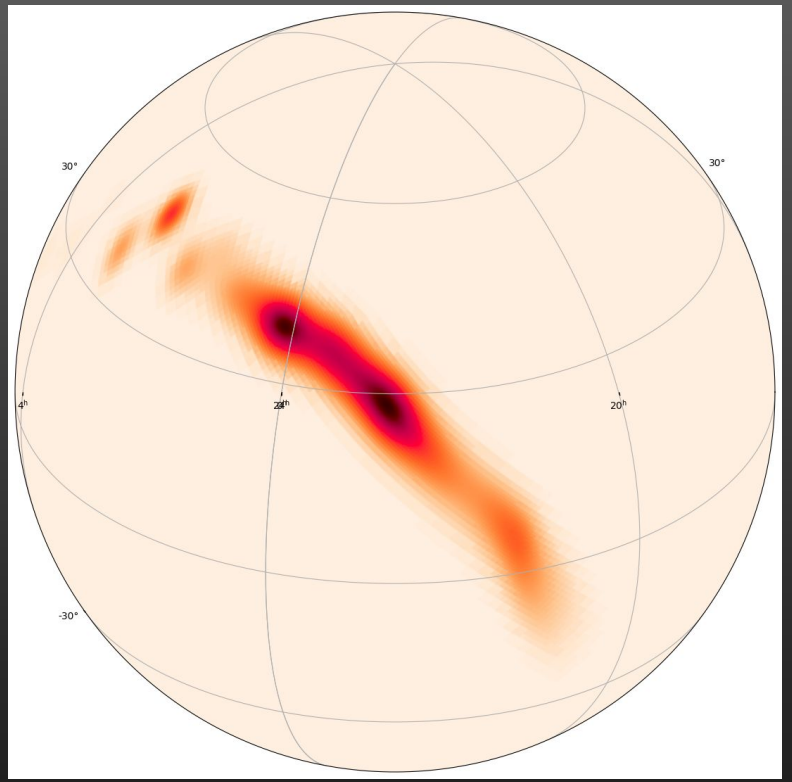
Model: MLP Classifier

Training data: luminosity distance, redshift, 50% probability area, false alarm rate

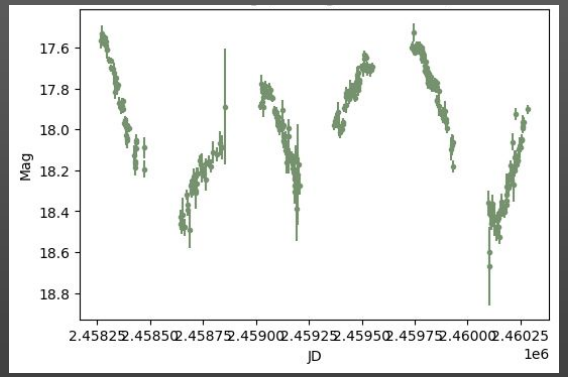


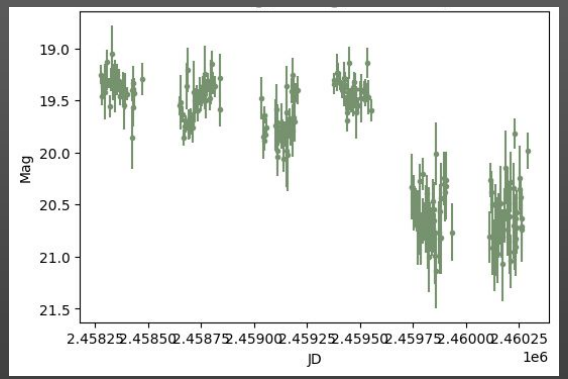
Identifying AGN in the LIGO localization map

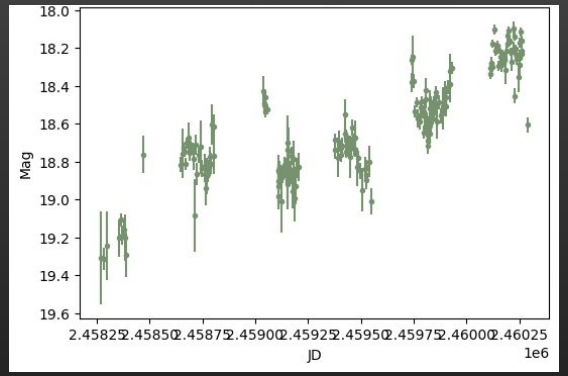
Crossmatch LIGO skymap
with catalog of AGN, Quaia

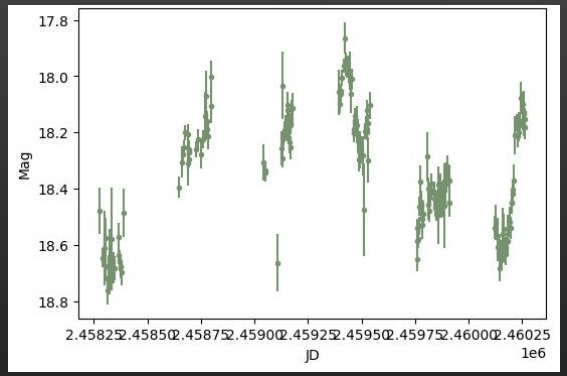


A computationally cheap heuristic for anomaly detection:





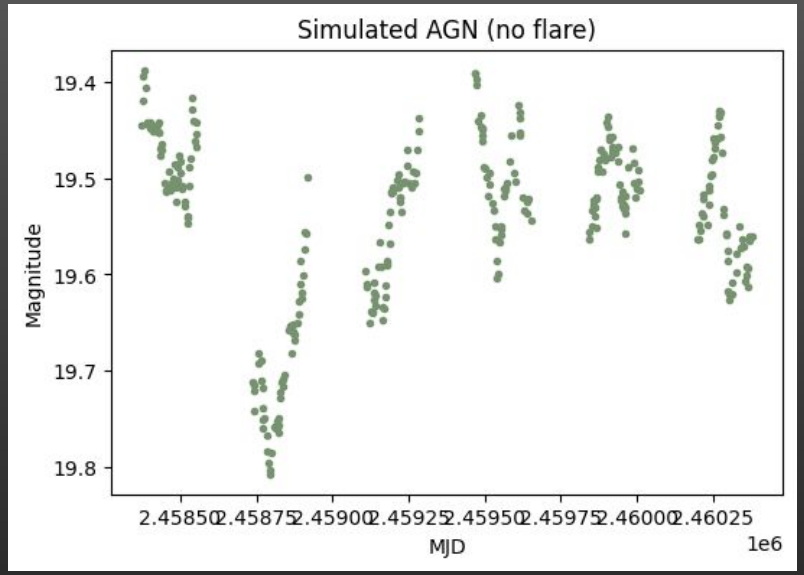


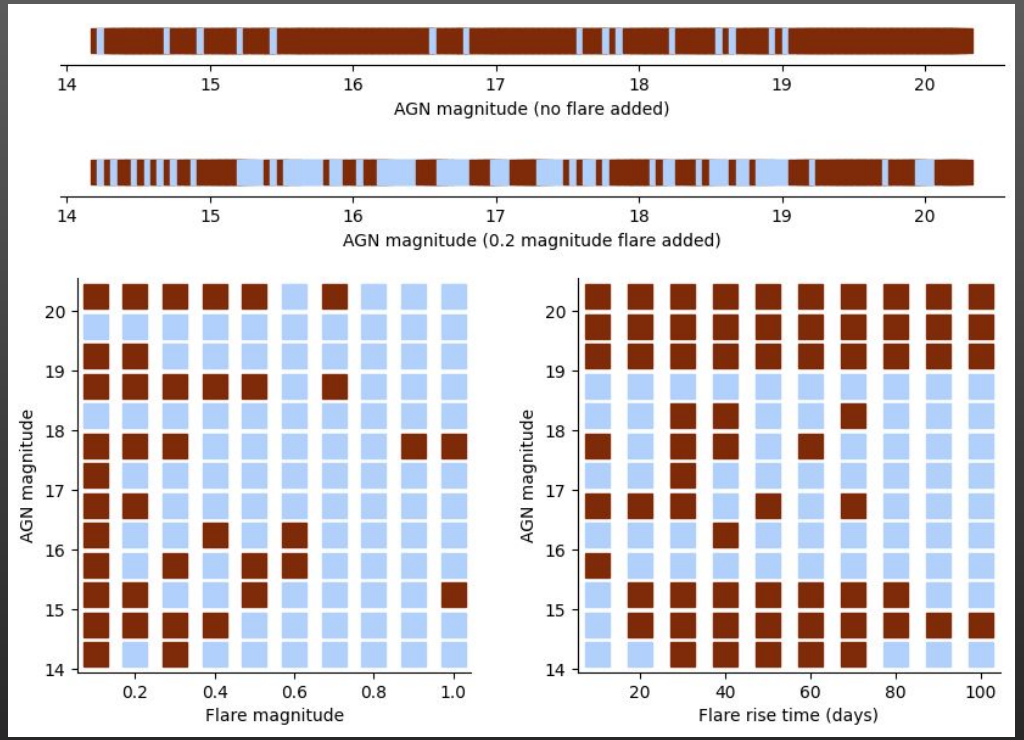


Goal:

Select flaring lightcurves with rolling window statistics (ie medians, median absolute deviations, slopes)

Testing heuristic on simulated lightcurves



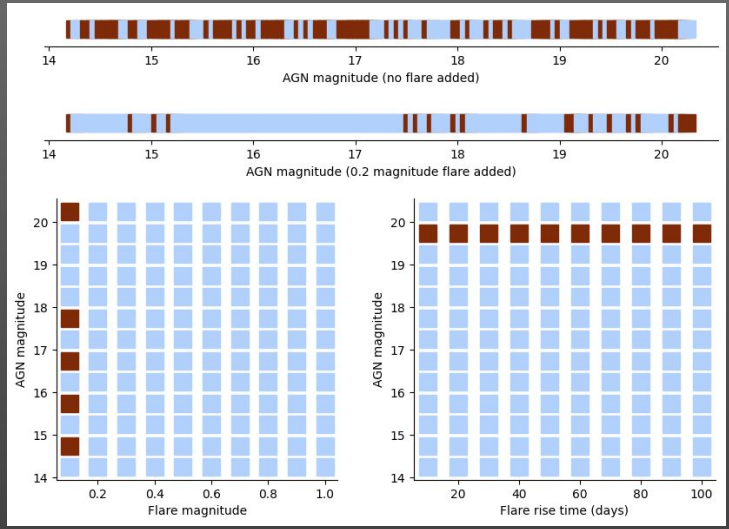


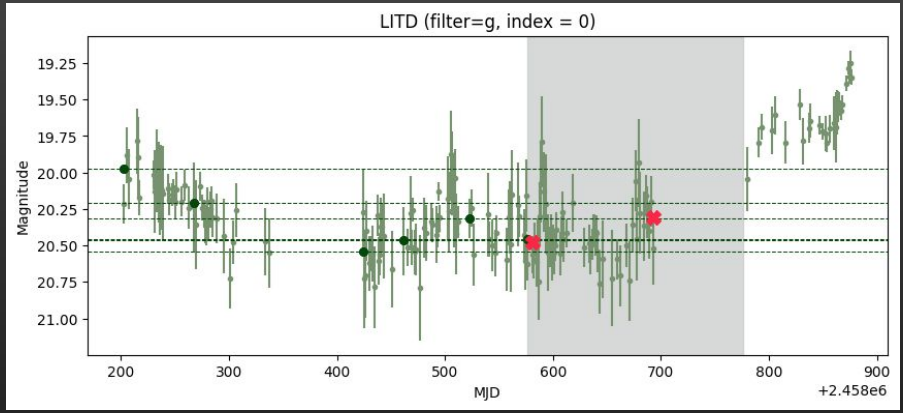
Results:

The best performing filter:

Rolling window of 100 days pre gw, 25 days post gw

Require brightest median post gw to be brighter than 3*MAD of 60% medians pre gw

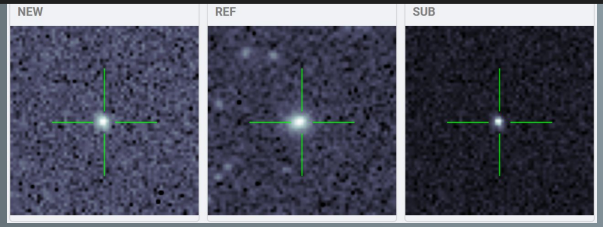




An AGN from “A Light in the Dark…” (Graham et. al 2023)

Filter gap analysis:

objectId	candid	candidate.jd
ZTF18acnaufm	2611136954015010007	2.460366e+06

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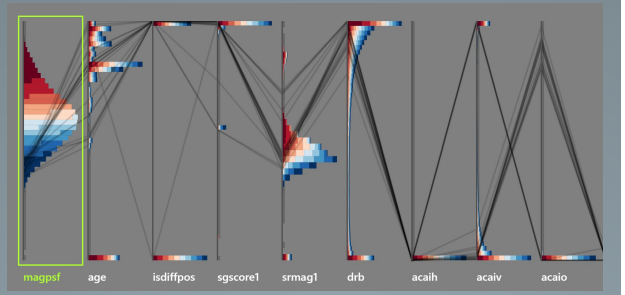
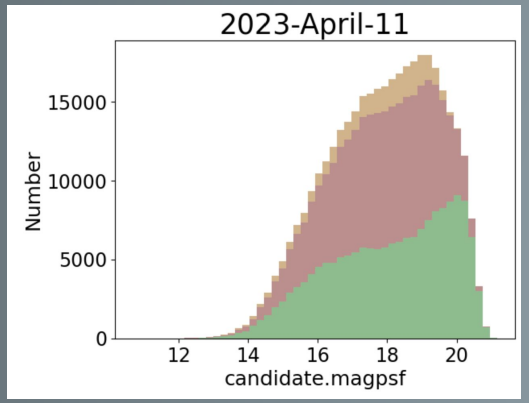
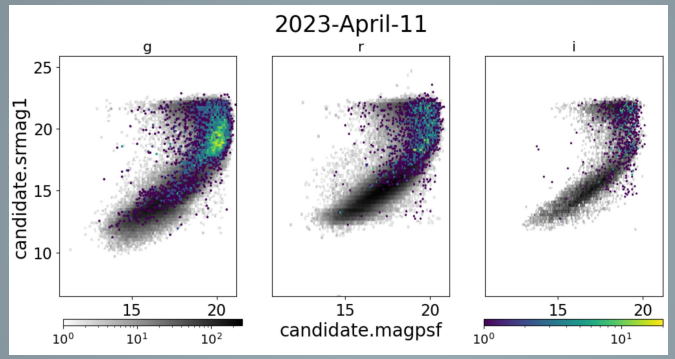
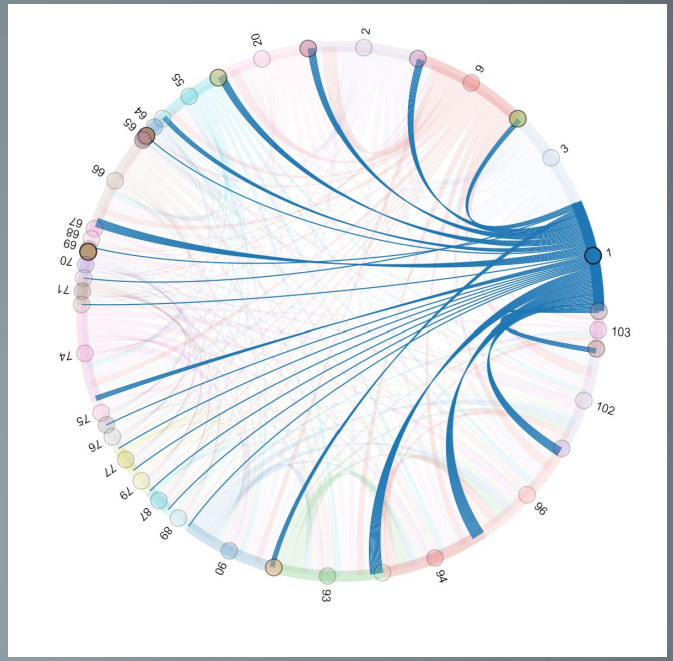
      "$cond": {
        "if": {
          "$gt": [
            "$candidate.simag1",
            0
          ]
        },
        "then": "$candidate.simag1",
        "else": 99
      }
    },
    {
      "$cond": {
        "if": {
          "$gt": [
            "$candidate.sgmag1",
            0
          ]
        },
        "then": "$candidate.sgmag1",
        "else": 99
```

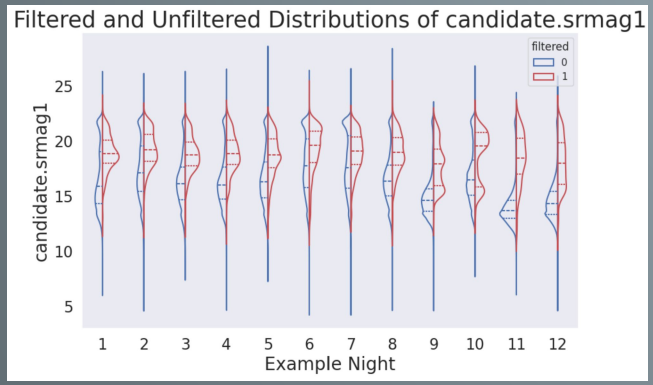
Data visualization !

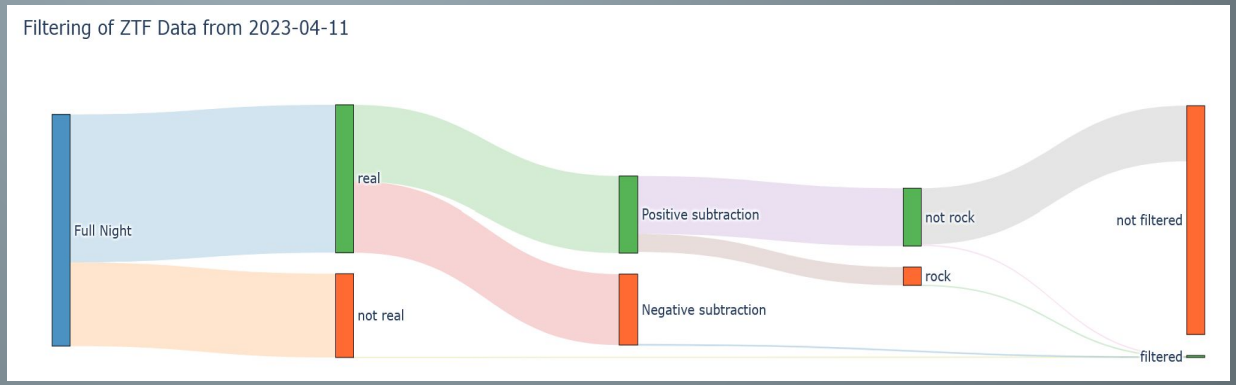






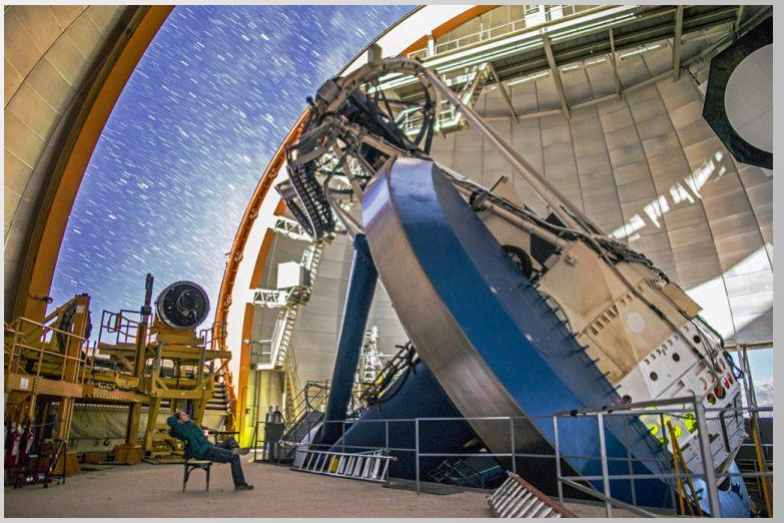






Other things

- Gave a talk at a conference in May
- Training to observe on DECam
- Co-mentoring an undergrad summer research student



More other things

- Caltech astronomy outreach
- Techlit club at Caltech
- Livin in fear of summer in Pasadena