ZTF ML: Status & Plans

Ashish Mahabal

ZTF Team Meeting

2018-03-20

Outline

- Overview (current and plans)
- Real-Bogus - Umaa Rebbapragada (part II)
- Real-Bogus using Deep Learning - Brian Bue (part III)

Many contributions

- **Richard Walters: Zooniverse setup and campaigns** **UW**
- **Frank: Access to ZTF products**
- **Nadia: TNS comparisons**
- **Ragnhild: Connection to Transient marshal** **AMPEL**
- **Umaa/Brian: R-B classification**

Students:
- **Tiara Hung**
- **Yutaro Tachibana**
- **Charlotte Ward**

- **Adam Miller: Star-galaxy separation**
- **Quan-Zhi Ye: streaking asteroids**

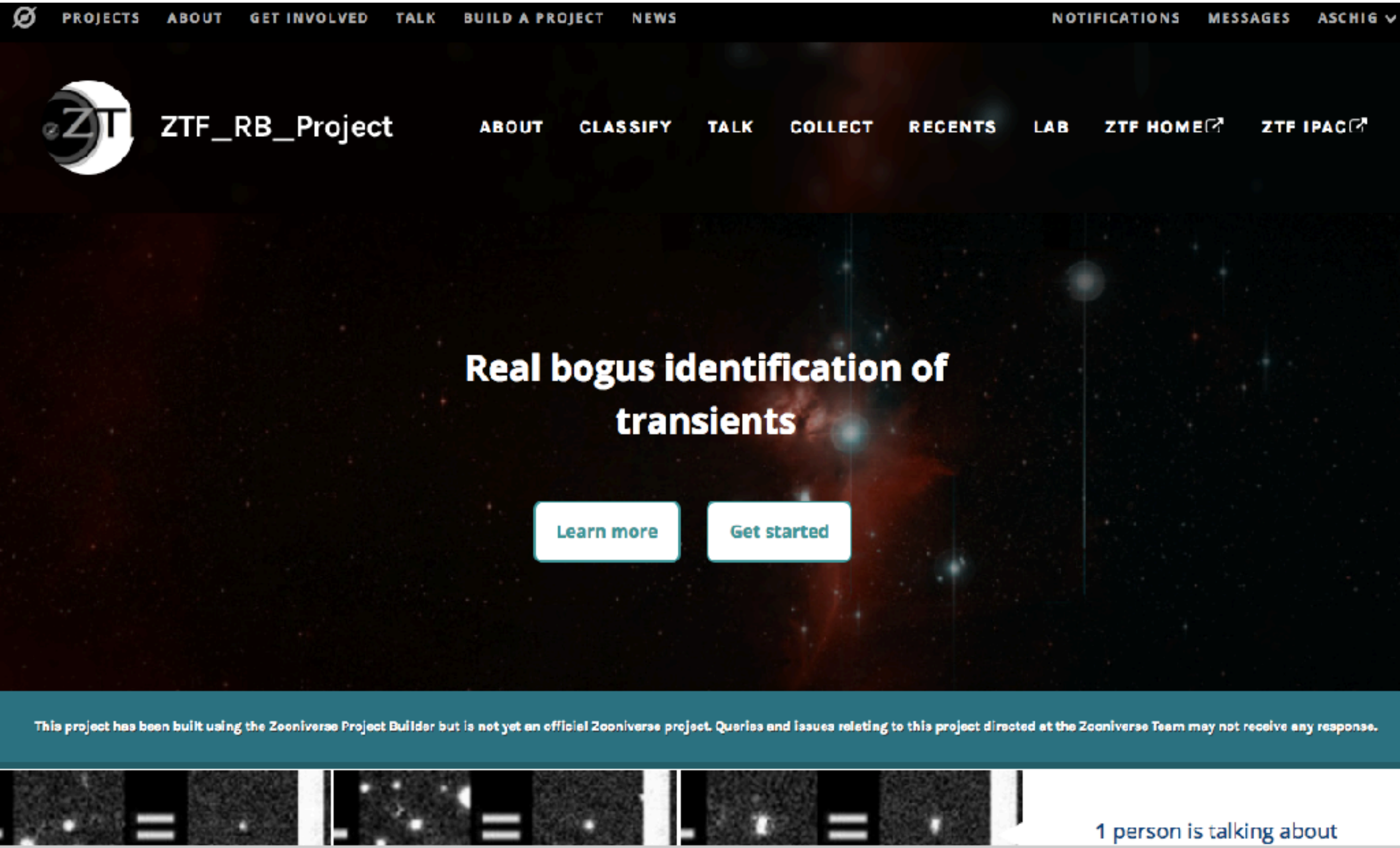
Enabling some activities:
- **Shri**
- **Dmitry Duev**
- **Suvi**
- **Matthew Graham**
- **Mansi**
- **Tom Prince**
- **…**

I am sure I have missed some names

Help Wanted

Join ZTF ML mailing list
meetings: alternate Wednesdays (9 AM), Thursdays (2 PM)
http://noir.caltech.edu/twiki_ptf/bin/viewauth/ZTF/MachineLearning

Zooniverse Starting Screen



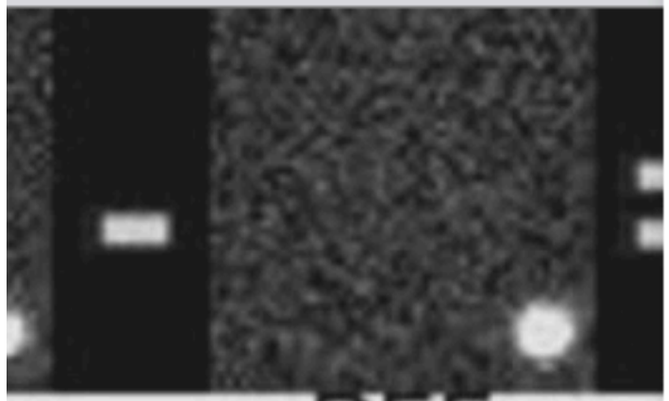
1 person is talking about

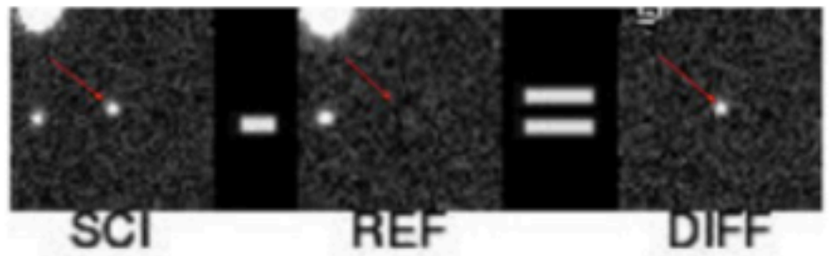
Start with the tutorial

_RB_Project

ABOU

LAB





magpsf: 19.04
sigmapsf: 0.04
classtar: 0.98
ssdistnr: -999
sgscore: nan
nneg: 3
nbad: 0
rb: 1.0
S/N: 29.36

The subtraction above is an example of a real transient and should be classified as such. The transient appears at the center of the image.

Continue

real or bogus

Done & Talk

ct tutorial

: null

Metadata Definitions

- magpsf = Magnitude of object in science image
- sigmapsf = Error of magnitude in science image
- classtar = Likelihood of object being a star with 1 being highest and 0 the lowest (source Sextractor)
- ssdistnr = Distance to nearest solar system object
- sgscore = Star galaxy score (Not automated yet)
- nneg =
- nbad =
- rb = Real bogus score (Not automated yet)
- S/N = Signal to noise of science object

Let's go!

Individual classification pages

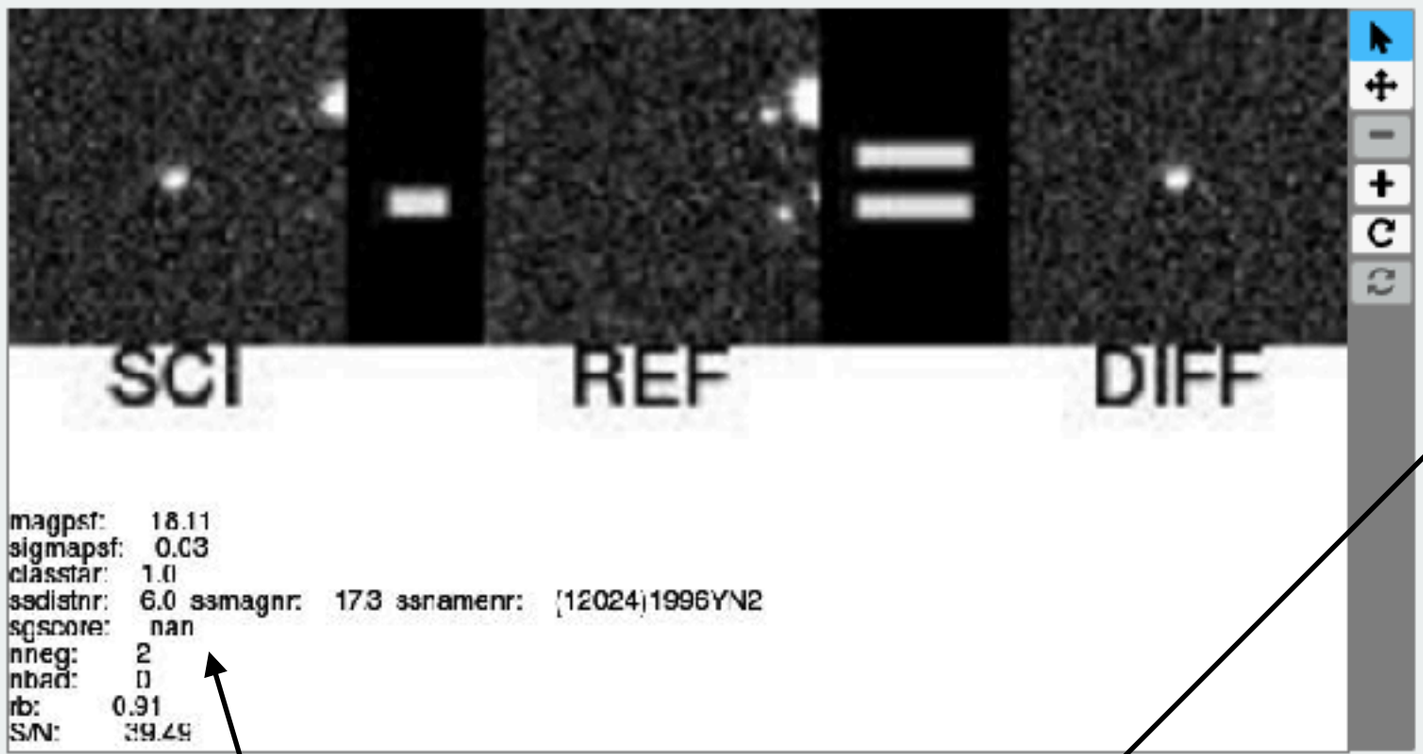
Classify

Talk

zoom++

ZTF_RB_Project

ABOUT | CLASSIFY | TALK | COLLECT | RECENTS | LAB | ZTF HOME | ZTF IPAC



Is the transient real or bogus?

- Real
- Bogus
- Skip

Back | Done & Talk | Done

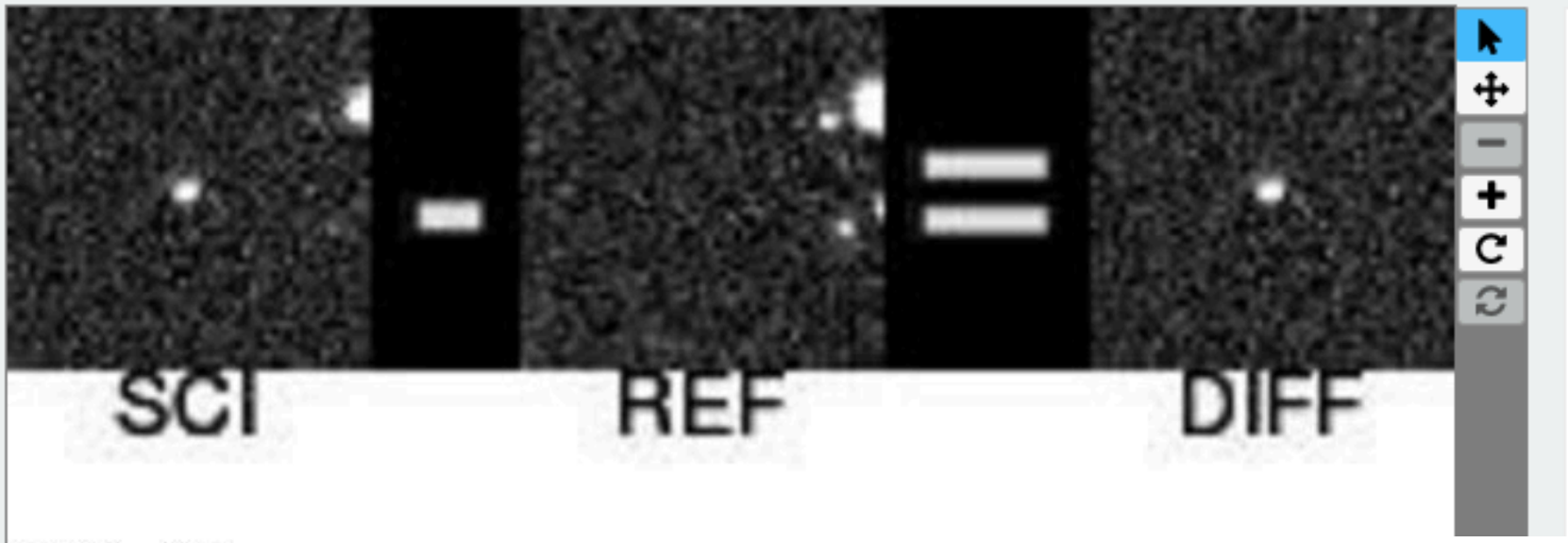
Show the project tutorial

Metadata

Options

Tutorial

Discuss



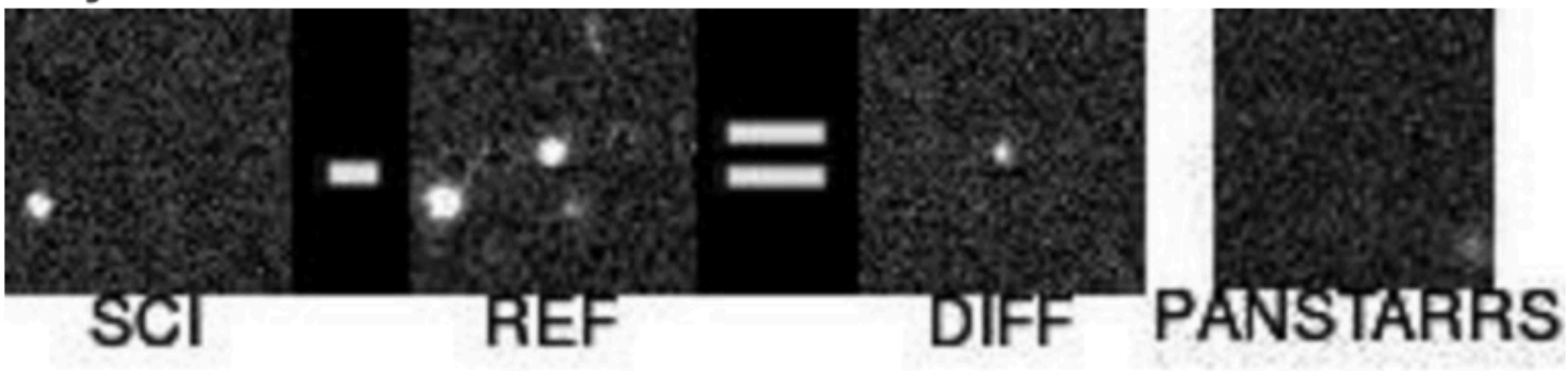
magpsf: 18.11
sigmapsf: 0.03
classtar: 1.0
ssdistnr: 6.0 ssmagnr: 17.3 ssnamenr: (12024)1996YN2
sgscore: nan
nneg: 2
nbad: 0
rb: 0.91
S/N: 39.49

- **magpsf**
- **rb (real-bogus)**
- **sgscore**
- **ssdistnr**

Metadata Definitions

- magpsf = Magnitude of object in science image
- sigmapsf = Error of magnitude in science image
- classtar = Likelihood of object being a star with 1 being highest and 0 the lowest (source Sextractor)
- ssdistnr = Distance to nearest solar system object
- sgscore = Star galaxy score (Not automated yet)
- nneg =
- nbad =
- rb = Real bogus score (Not automated yet)
- S/N = Signal to noise of science object

Subject 19734239



magpsf: 18.08
sigmapsf: 0.05
classtar: 0.98
ssdistnr: -999.0 ssmagnr: -999.0
sgscore: 0.0
nneg: 3
nbad: 0
rb: 0.71
S/N: 21.98

Comments:

ifdiffpos keyword

sjoert
@sjoert

March 15th 2018, 9:28 am

Yes that happens when isdiffpos parameter of the ZTF package is equal to 0 or 'f'. For these cases in the DIFF image we are actually looking at REF-SCI.

I think this is a variable star or moving object that happened to enter the reference image.

For Zooinverse vetting it might be better to remove isdiffpos==0 sources.

View the discussion

aschig
@aschig
RESEARCHER

March 14th 2018, 2:42 pm

Indeed, it does seem like a negative subtraction. But in the diff it seems positive!

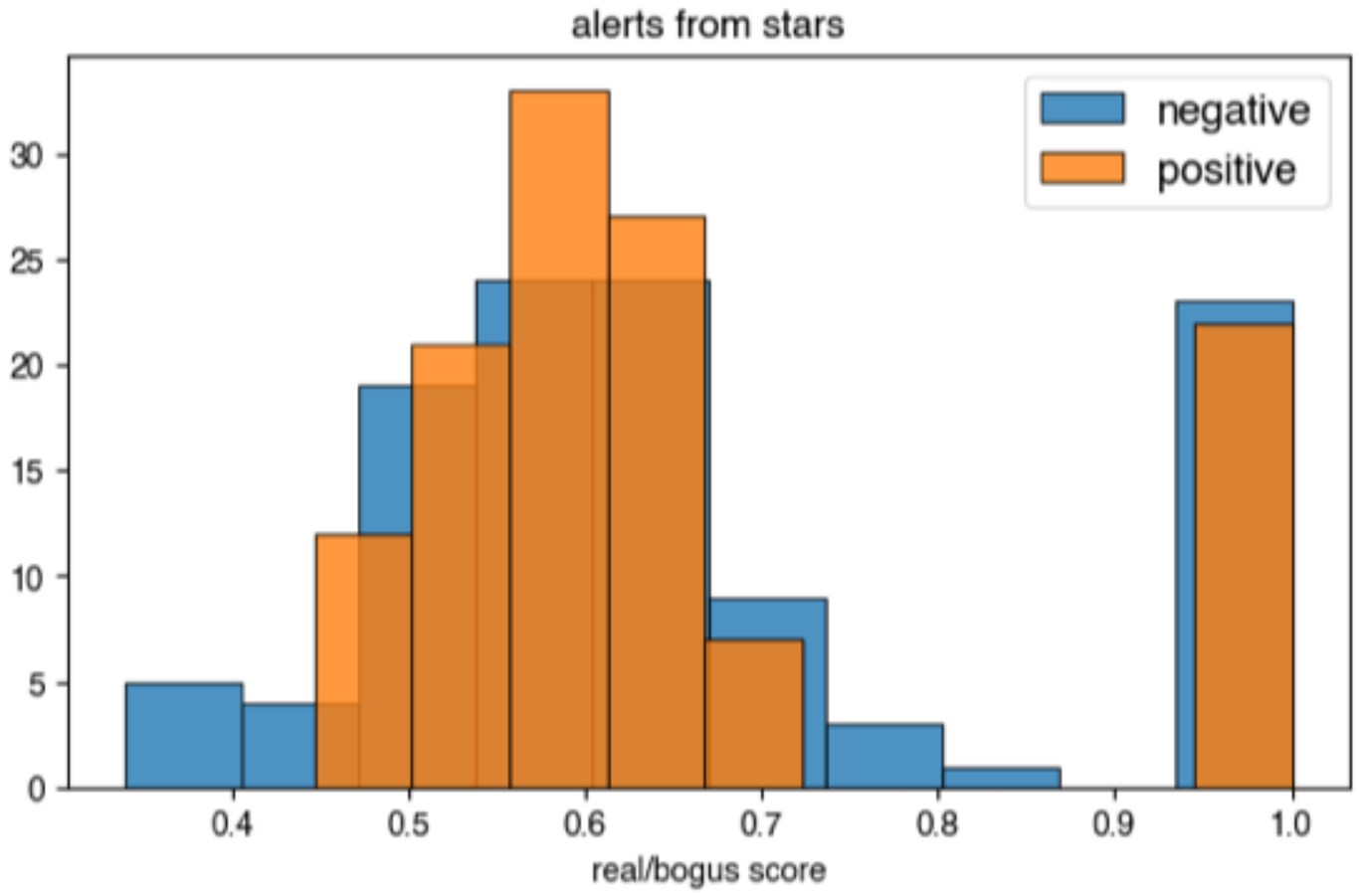
View the discussion

sjoert
@sjoert

March 8th 2018, 3:30 pm

another negative subtraction? For non-expert users this could be confusing? perhaps selected only source with isdiffpos=1?

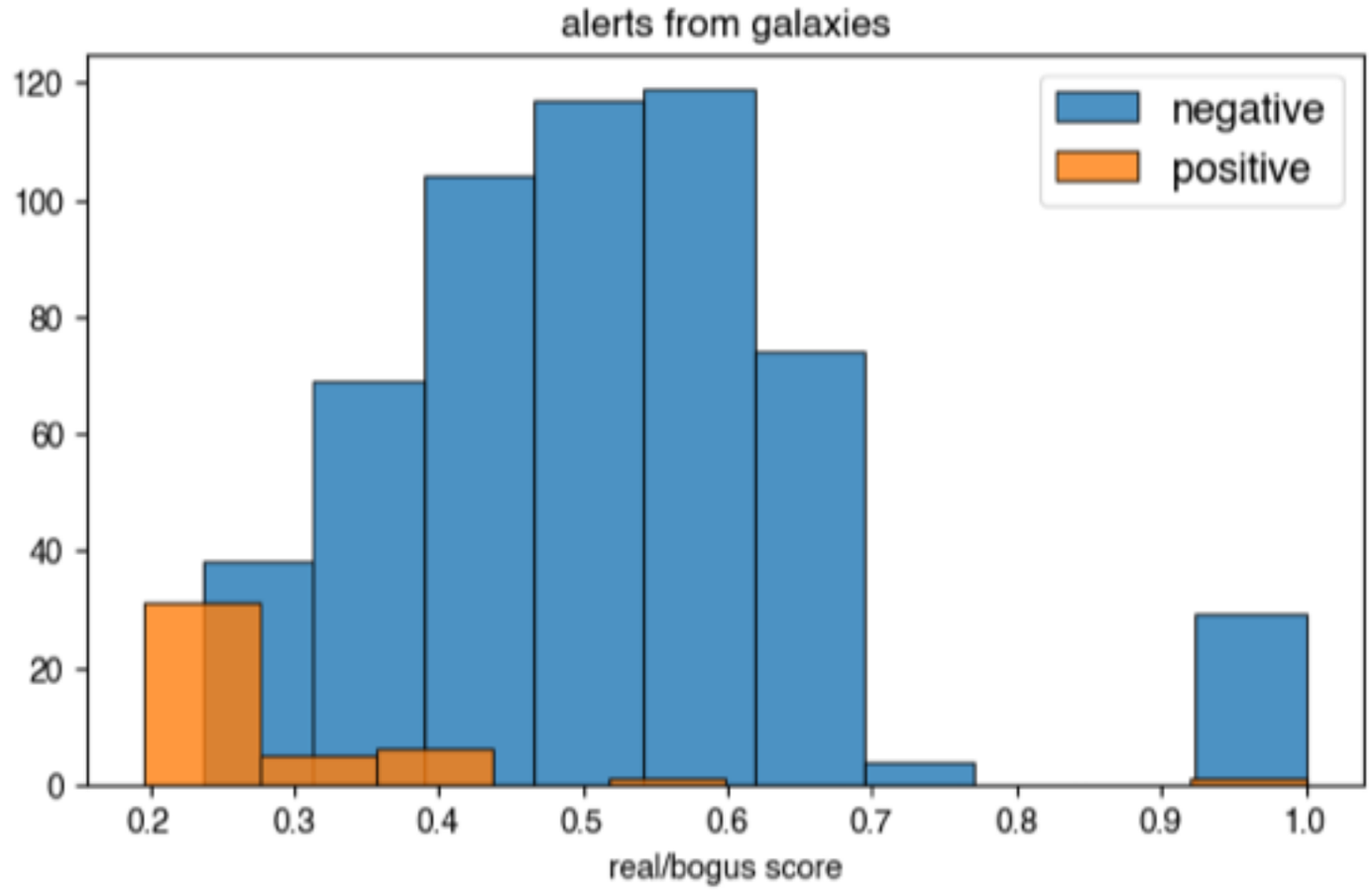
View the discussion



Slides from Sjoert

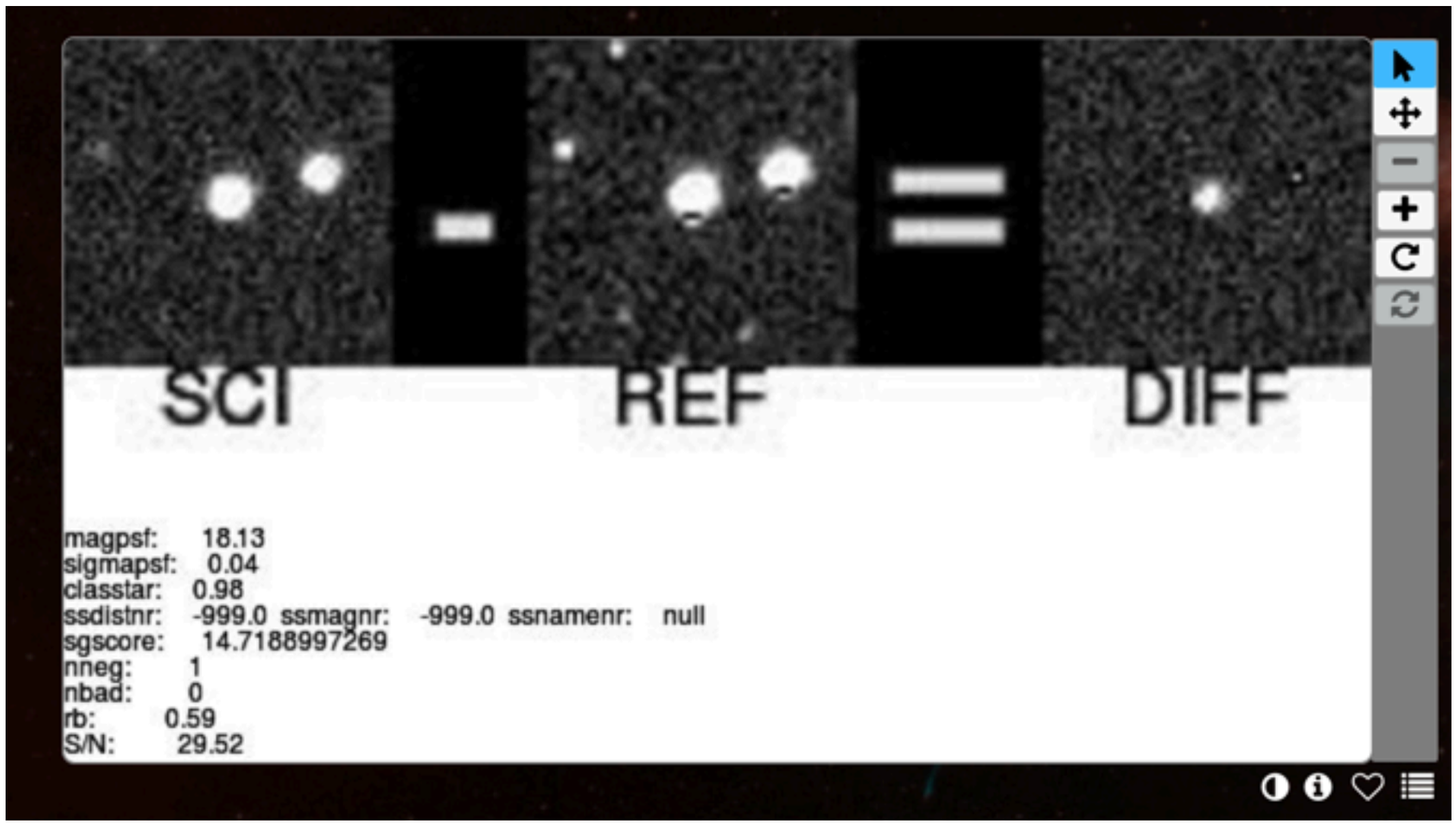
Positive: ifdiffpos = 1
Negative: ifdiffpos = 0

Suggested option:
select only ifdiffpos = 1
sources for now



Other suggestions

Nadia

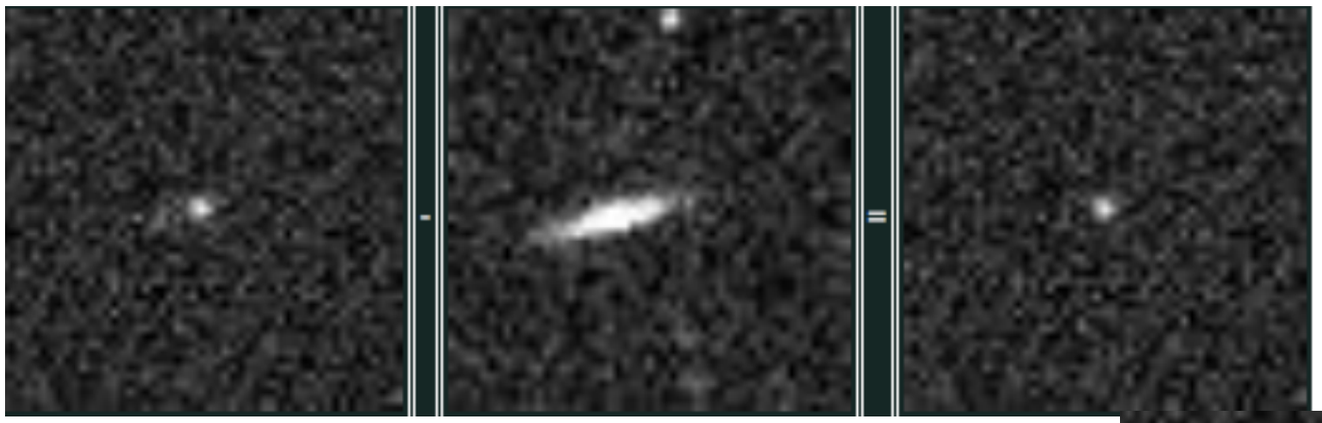


Point out bad Ref images
Can be done in “Talk”

+other, mainly for reals. To be taken up later.

Question of Completeness

- High SNR selection: Are we losing good sources?
- Can be checked with known asteroids of fainter mags
- Also sources detected by other surveys
- Separability of real-bogus may be linked

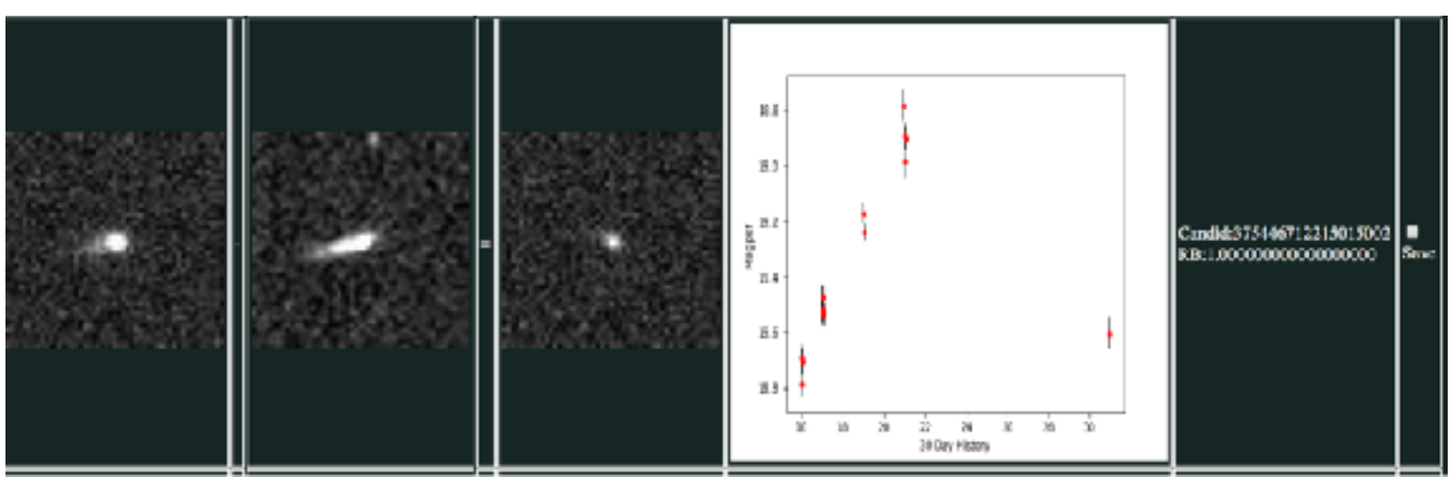


Sci **Ref** **Diff**

TNS Verification

Nadia Blagorodnova

- Cross-match of **TNS** reported transients **with ZTF alerts**
  - 59 TNS objects identified in ZTF alerts (467 alerts with repeats)
- Search for **TNS objects not in ZTF alerts**
  - 802 TNS objects in fields observed by ZTF without identification in ZTF
  - 78 observed in ZTF at epochs +/- 2 days of the discovery date
  - 51 have, at discovery 15 < mag < 20
  - 38 no reference images before the ZTF observations
  - 13 missed (investigation ongoing… object in reference, other…)



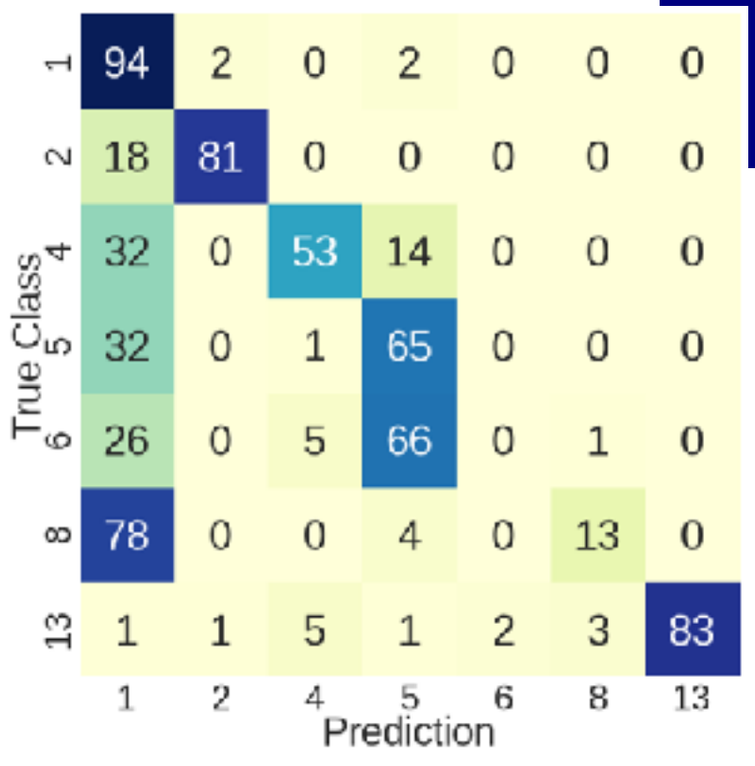
RB Campaign Planning

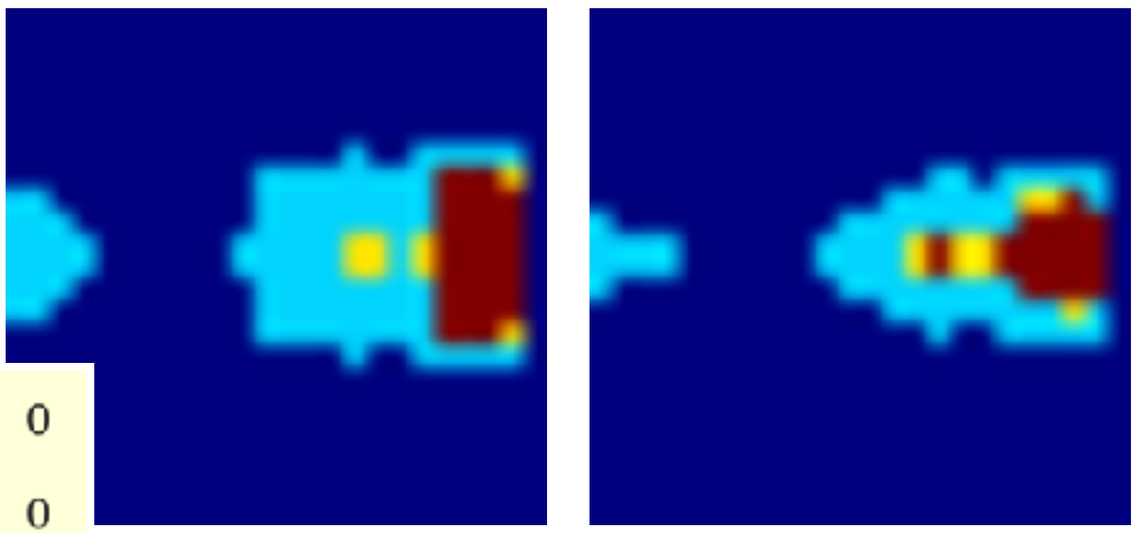
- delta-t > 30 mins; ndet >= 2
- In the past:
    - just i-band
    - 0.2 < RB; 0.4 < RB < 0.6; RB >0.9
- Planning further campaigns
    - e.g. By science goal; by CCD; by x and y
    - Thu. 9 AM, Cahill #370

Real-Real classification

- Move away from explosions-only mode
  - Current reals may be biased away from extragalactic
  - Need ‘Archive Marshal’ volunteers to mark reals too
- Random Forests (true/trusted)
- Deep learning (with images)

1	EW/EB
2	EA
4	RRab
5	RRc
6	RRd
8	RS CVn
13	LPV



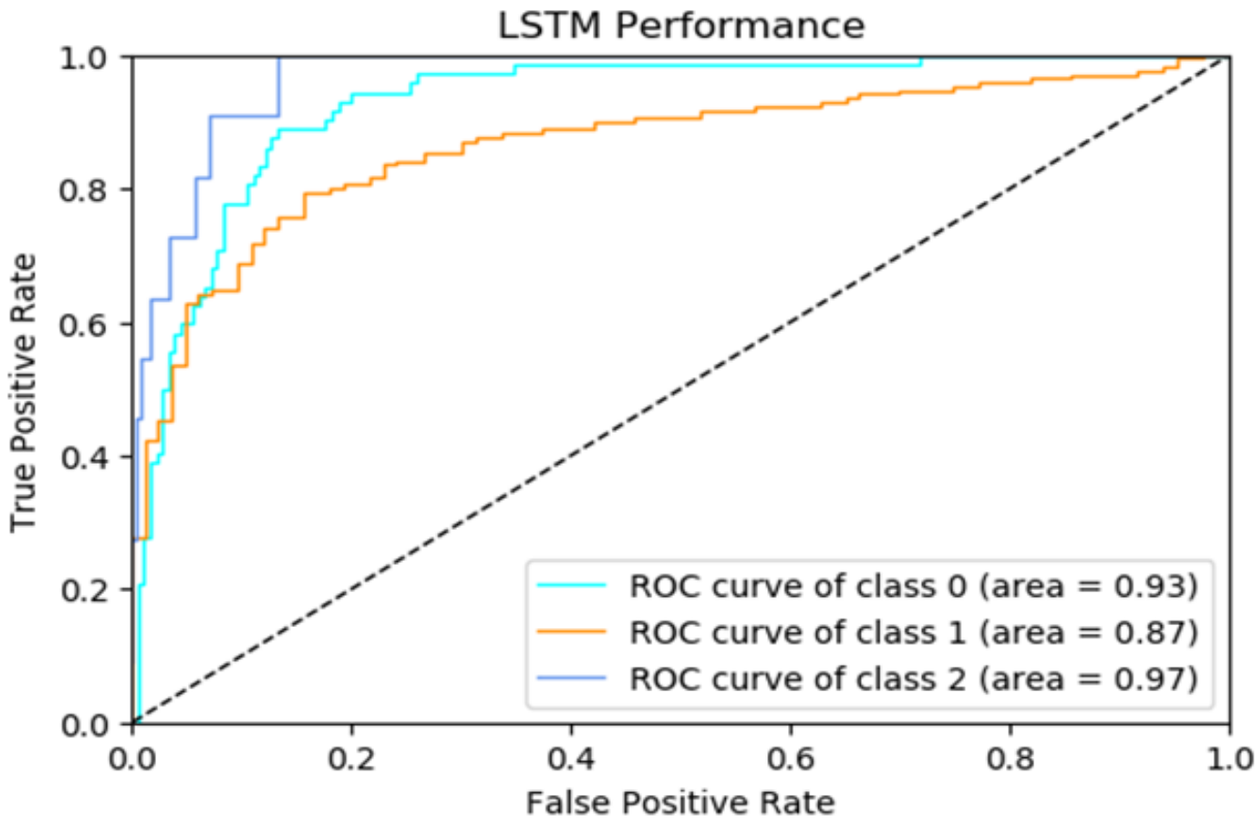


EW **RS CVn**

Deep Learning with dmdt

Mahabal et al. 2017

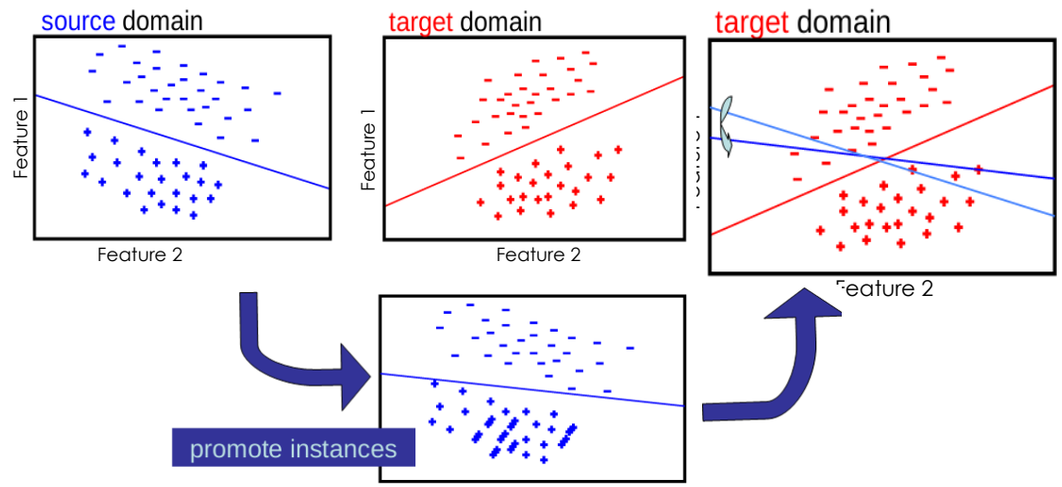
Real Real with Light Curves



CRTS transients
With Sreyasee Das, VIFI

Using light curves (with mag err)

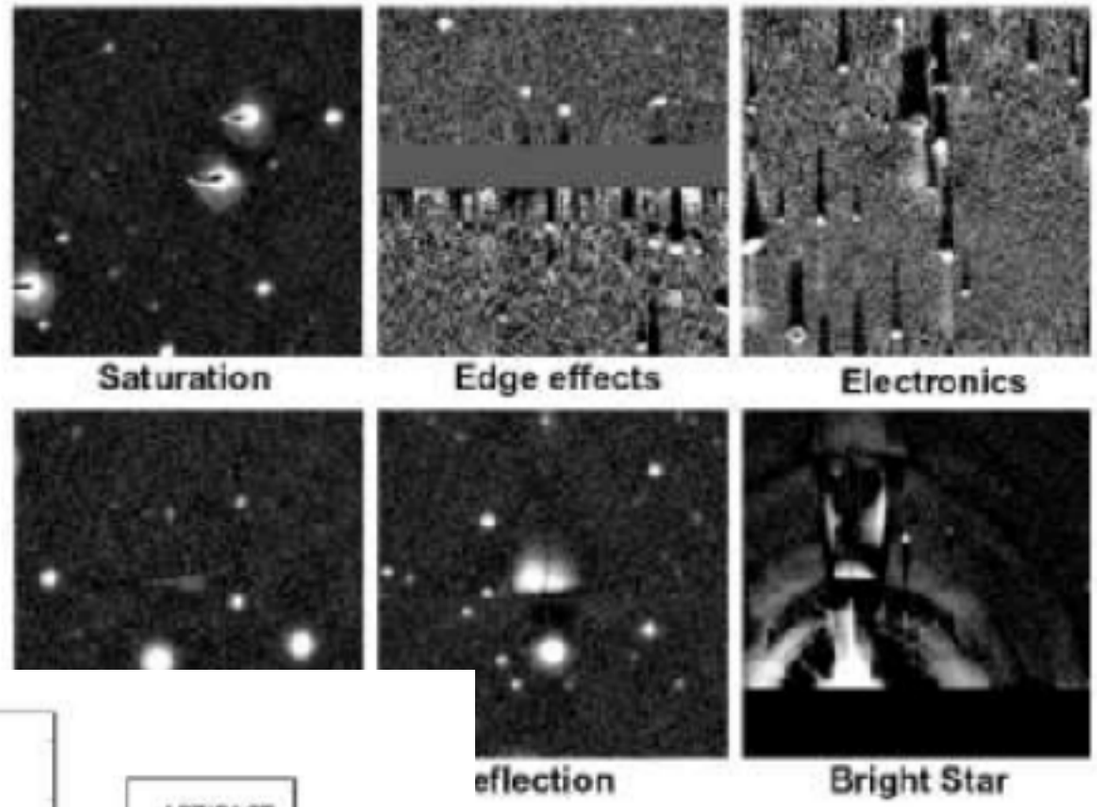
Domain adaptation



CRTS, PTF -> ZTF

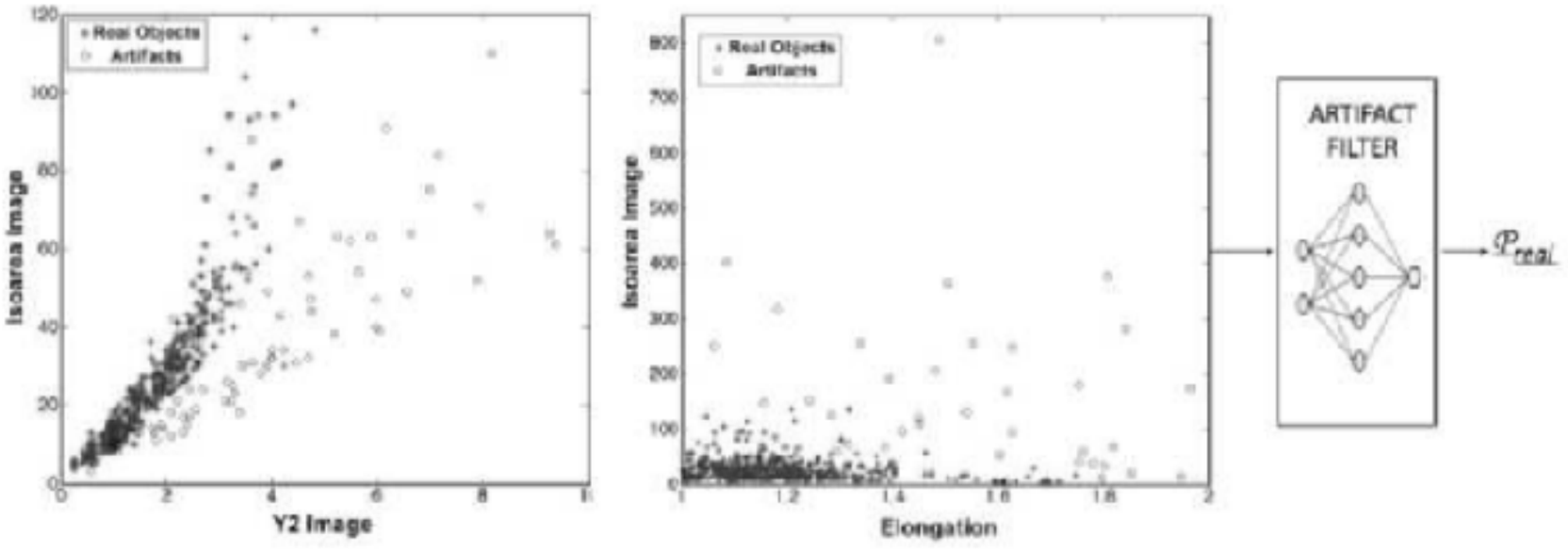
Bogus Bogus

- Will help us understand our contaminants better
- Somewhat lower priority (i.e. not at the expense of science)
- Use of Zooniverse + ML

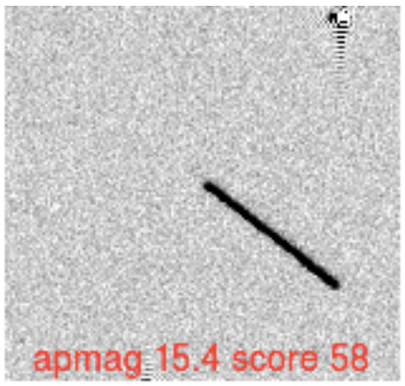


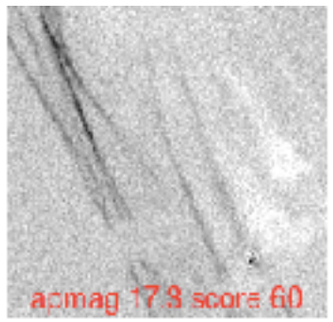
Palomar Quest data

Donalek et al. 2008



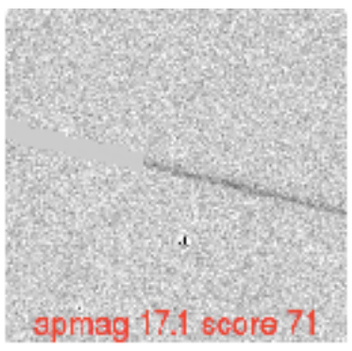
Deep Learning with AStreaks

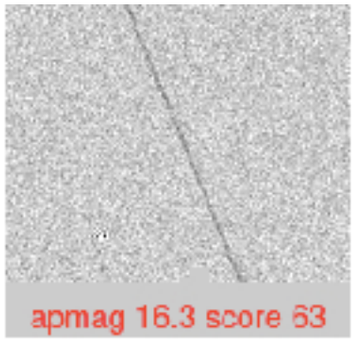




These are ghosts and dementors

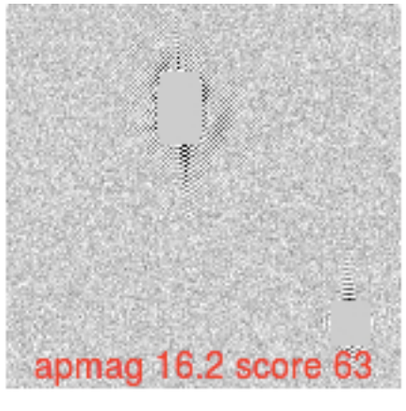
This is how a real asteroid would look. Short streak.





Another satellite trail

A satellite trail. Note that part of it is masked out, and the unmasked trail is longer.



A masked bright star

What kind of streak do you see?

- Asteroid (short streak)
- Satellite (long streak - could be partially masked)
- Masked bright star
- Dementors and ghosts
- Cosmic rays
- Naked stars
- Yin-Yang (multiple badly subtracted stars)
- Skip (Includes 'Not Sure' and seemingly 'Blank Images')

Need some help with this task?

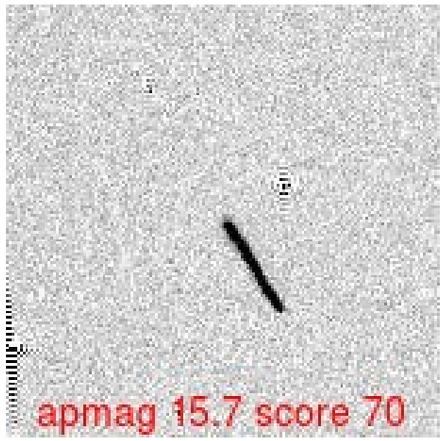
Done

Show the project tutorial

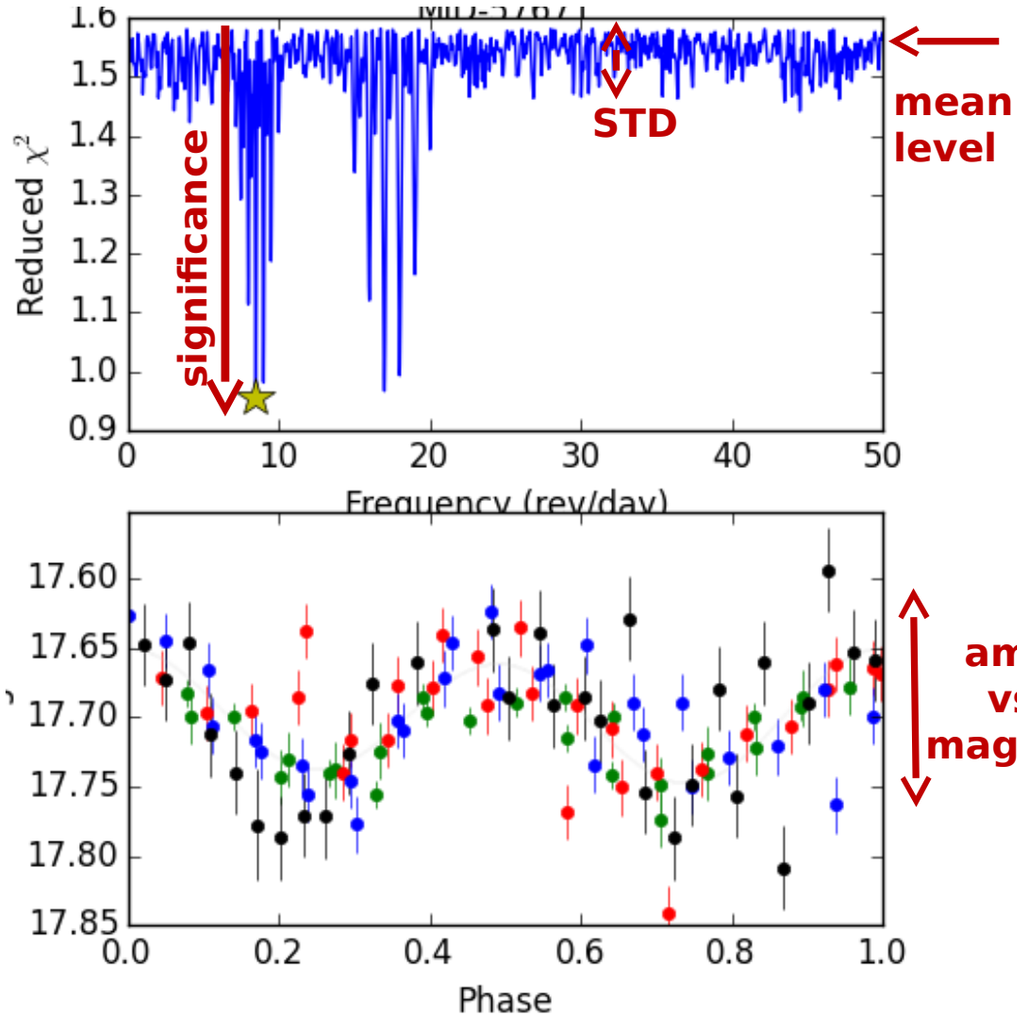
ML effort in solar system science

See separate talks by Quan-Zhi Ye and Rex Chang

- **Streak detection (lead by QZ Ye/Caltech)**
  - Based on Random Forest; using synthetic data + ZTF images as input
  - Several ML model “flavors” exist and under test
  - Working on building a better RB classifier
- **Rotation period determination (lead by Rex Chang/NCU)**
  - Based on Random Forest; using PTF data as input
  - Working on tunning the parameters in order to pick out the most interesting cases



2018 CL

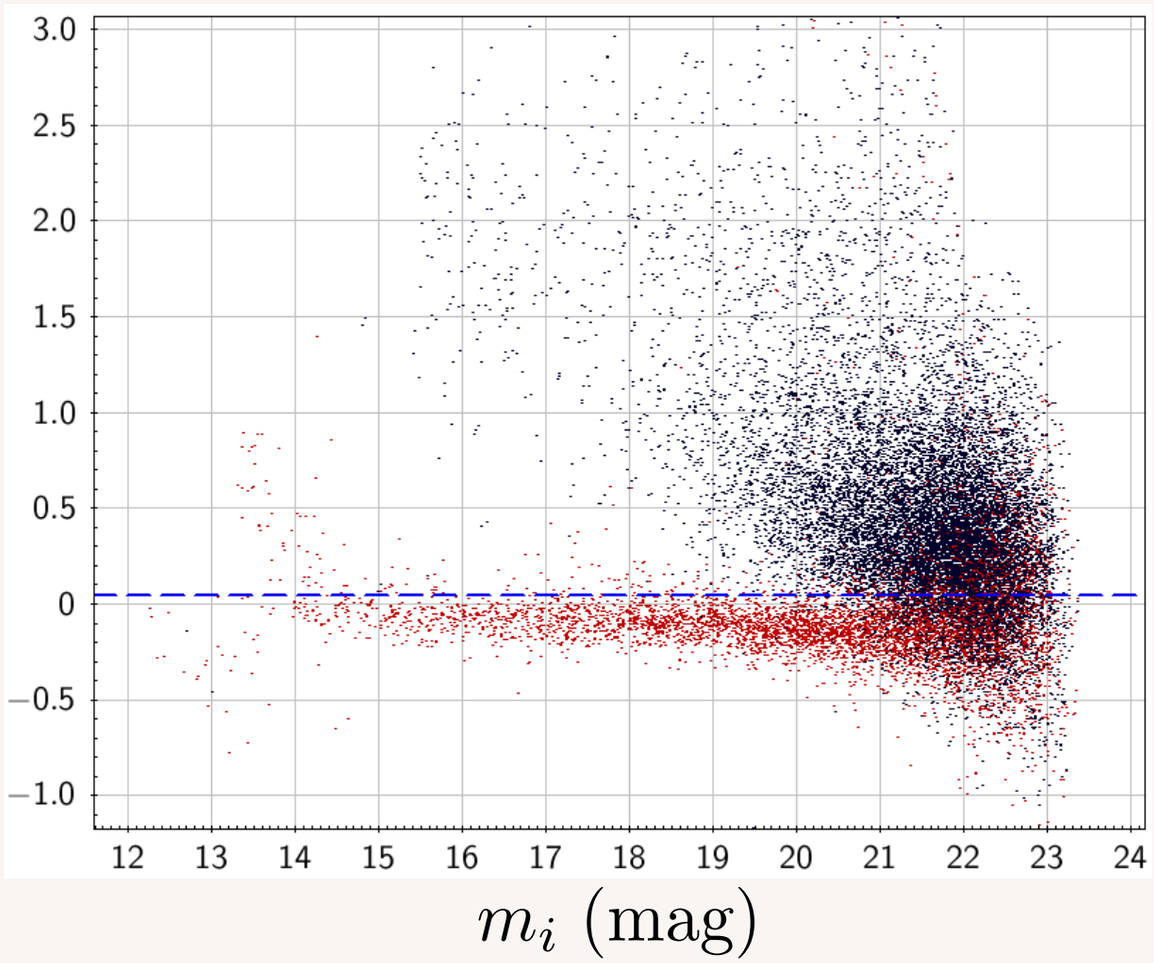


Star-Galaxy Model

Adam Miller

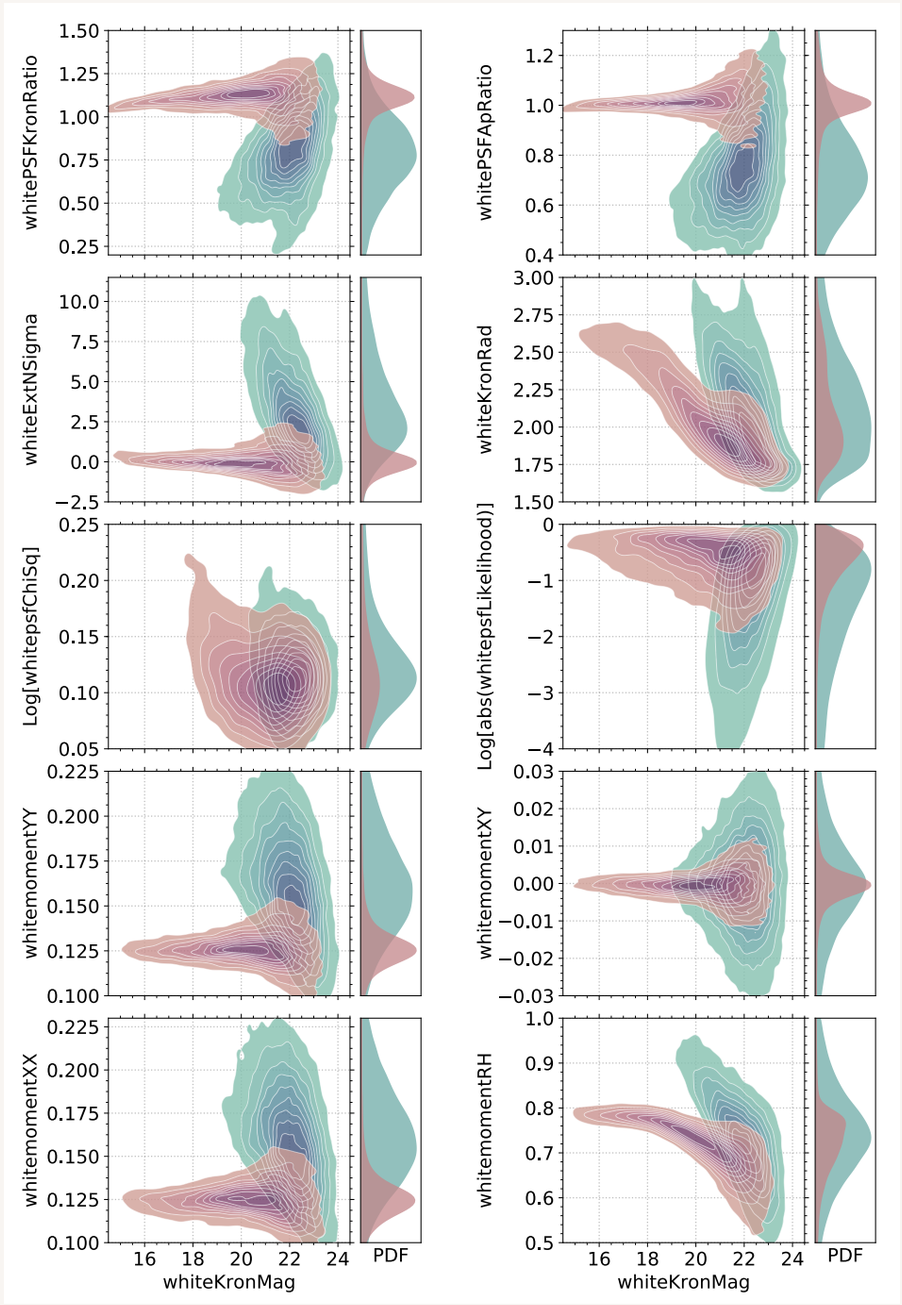
See separate talk for details

This



= BAD

This



= also not good
(but waaaay better)

Connecting with brokers

- ALeRCE
- AMPEL
- Antares

Help Welcome

Hope to see many of you
on Thursday at 9 AM in #370

Join ZTF ML mailing list
meetings: alternate Wednesdays (9 AM), Thursdays (2 PM)
http://noir.caltech.edu/twiki_ptf/bin/viewauth/ZTF/MachineLearning