

ZTF ML: Status & Plans

	PCEB				RRab				EA_UP				ELL				Cep II				RRd			
	1.00 0.00 0.98 0.01				1.00 0.00 0.99 0.01				1.00 0.00 1.00 0.00				1.00 0.00 1.00 0.00				1.00 0.00 1.00 0.00				1.00 0.00 1.00 0.00			
	0.99 0.01 0.98 0.02				0.99 0.04 0.97 0.03				0.98 0.02 0.64 0.86				1.00 0.00 1.00 0.00				0.90 0.10 0.90 0.10				0.65 0.94 0.67 0.93			
	30569 - 85 serv_1std				30569 - 2420 residual_br_fa_ratio add mod				30593 - 108 residual_br_fa_ratio				30593 - 142 residual_br_fa_ratio				30593 - 124 mod				30569 - 500 residual_br_fa_ratio bet_1std rms slopes_10per			
RS CVn	0.99 0.01 0.98 0.04				0.95 0.15 0.89 0.18				1.00 0.00 0.98 0.02				0.98 0.02 0.93 0.07				0.99 0.01 0.93 0.07				0.95 0.05 0.80 0.10			
	0.95 0.15 0.90 0.20				0.09 0.94 0.10 0.90				0.04 0.95 0.15 0.85				0.66 0.46 0.72 0.25				0.51 0.49 0.58 0.42				0.18 0.82 0.26 0.74			
	1514 - 86 slopes_10per				1514 - 2420 station_1 mod				1514 - 108 tp20				1514 - 142 slopes_10per				1514 - 124 station_1				1514 - 500 station_1 station_1			
beta Lyrac	0.95 0.05 0.97 0.08				0.95 0.14 0.87 0.19				0.92 0.08 0.93 0.07				0.96 0.06 0.93 0.05				0.95 0.05 0.92 0.08				0.93 0.07 0.64 0.06			
	0.18 0.82 0.28 0.72				0.00 1.00 0.01 0.99				0.10 0.90 0.10 0.80				0.07 0.98 0.12 0.88				0.11 0.89 0.14 0.86				0.01 0.99 0.03 0.97			
	279 - 85 bet_1std residual_br_fa_ratio				279 - 2420 bet_1std residual_br_fa_ratio mod				279 - 153 station_K residual_br_fa_ratio				279 - 142 bet_1std residual_br_fa_ratio				279 - 124 bet_1std				279 - 500 residual_br_fa_ratio bet_1std ss			
RRc	1.00 0.00 1.00 0.00				0.91 0.09 0.88 0.12				1.00 0.00 1.00 0.00				0.99 0.01 0.96 0.01				1.00 0.00 0.93 0.03				0.99 0.01 0.93 0.07			
	0.91 0.09 0.94 0.16				0.25 0.75 0.45 0.55				0.08 0.97 0.09 0.91				0.64 0.06 0.93 0.05				0.84 0.16 0.80 0.20				0.75 0.24 0.63 0.07			
	5433 - 85 station_1 rms				5433 - 2420 station_1				5433 - 153 tp65				5433 - 142 station_1 mod				5433 - 124 station_1				5433 - 500 slopes_10per			
PCEB	0.00 1.00 0.00 1.00				0.09 0.91 0.10 0.90				0.93 0.07 0.87 0.13				0.57 0.43 0.57 0.43				0.82 0.58 0.88 0.39				0.87 0.33 0.84 0.38			
	0.00 1.00 0.00 1.00				0.00 1.00 0.03 0.97				0.06 0.95 0.04 0.86				0.08 0.92 0.14 0.86				0.11 0.89 0.16 0.84				0.03 0.97 0.06 0.94			
	85 - 47075 residual_br_fa_ratio				85 - 2420 mod				85 - 103 residual_br_fa_ratio				85 - 142 station_1 slopes_10per tp65				85 - 124 station_1 tp80 slopes_10per				85 - 500 station_1			

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



ZTF_RB_Project

[ABOUT](#) [CLASSIFY](#) [TALK](#) [COLLECT](#) [RECENTS](#) [LAB](#) [ZTF HOME](#)  [ZTF IPAC](#) 

Real bogus identification of transients

[Learn more](#)

[Get started](#)

This project has been built using the Zooniverse Project Builder but is not yet an official Zooniverse project. Queries and issues relating to this project directed at the Zooniverse Team may not receive any response.



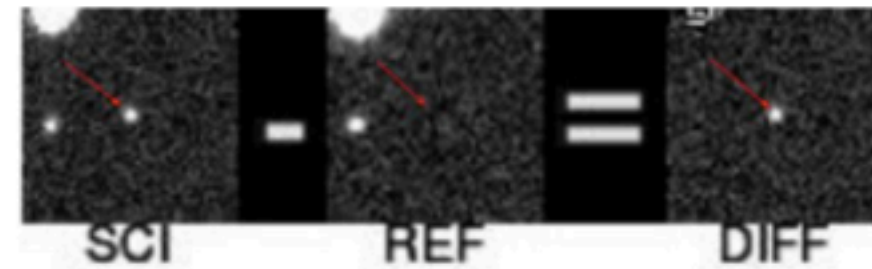
1 person is talking about

Start with the tutorial

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!



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

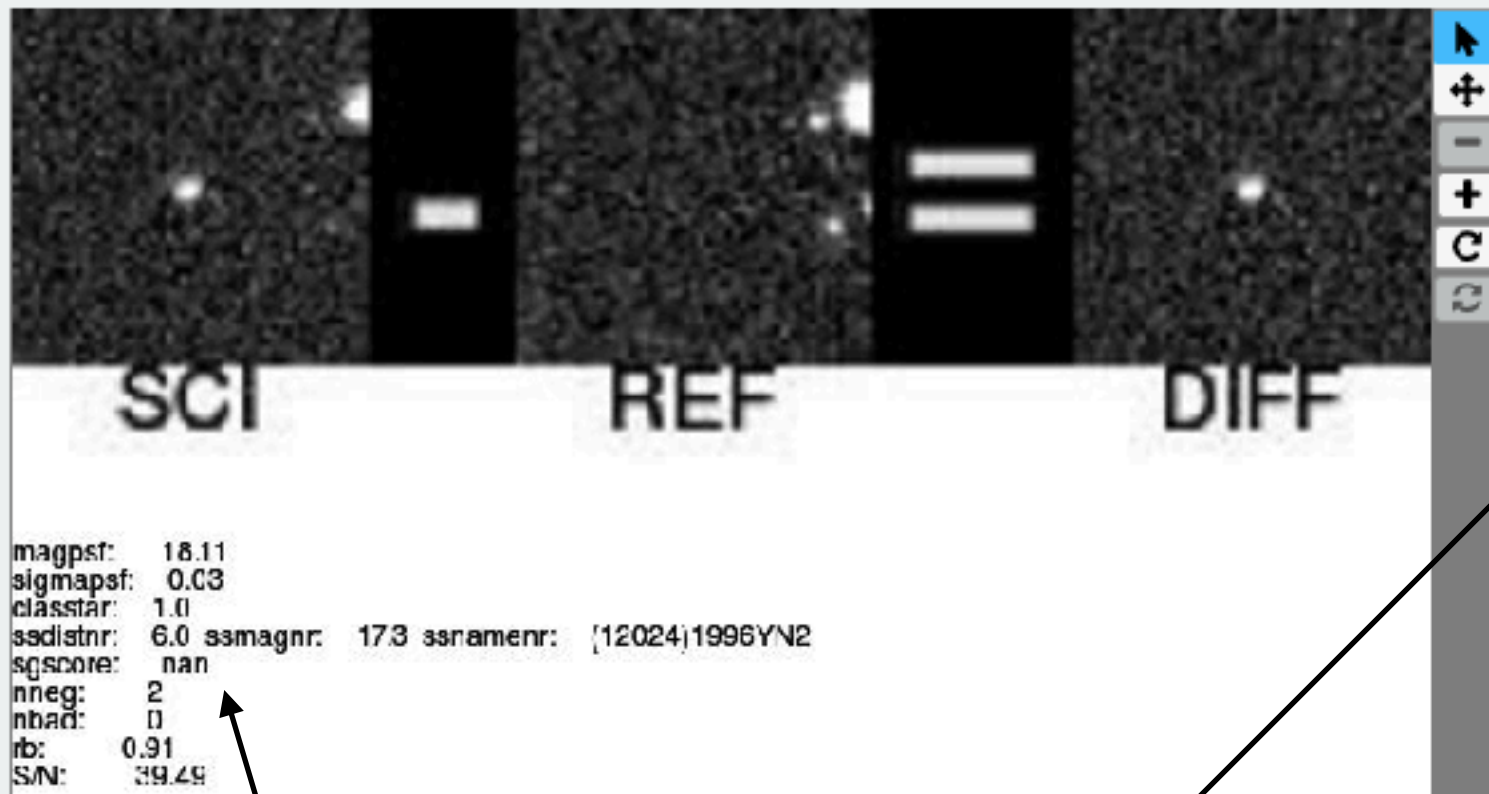
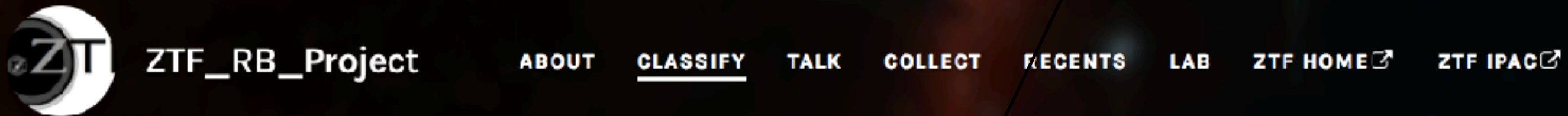


Individual classification pages

Classify

Talk

zoom++



magpsf:	18.11
sigmapsf:	0.03
classtar:	1.0
ssdistnr:	6.0
ssmagnt:	17.3
ssnament:	{12024 1996YN2
sgscore:	nan
nneg:	2
nbad:	0
rb:	0.91
S/N:	39.49

Is the transient real or bogus?

☐ Real

☐ Bogus

☐ Skip

Back

Done &
Talk

Done

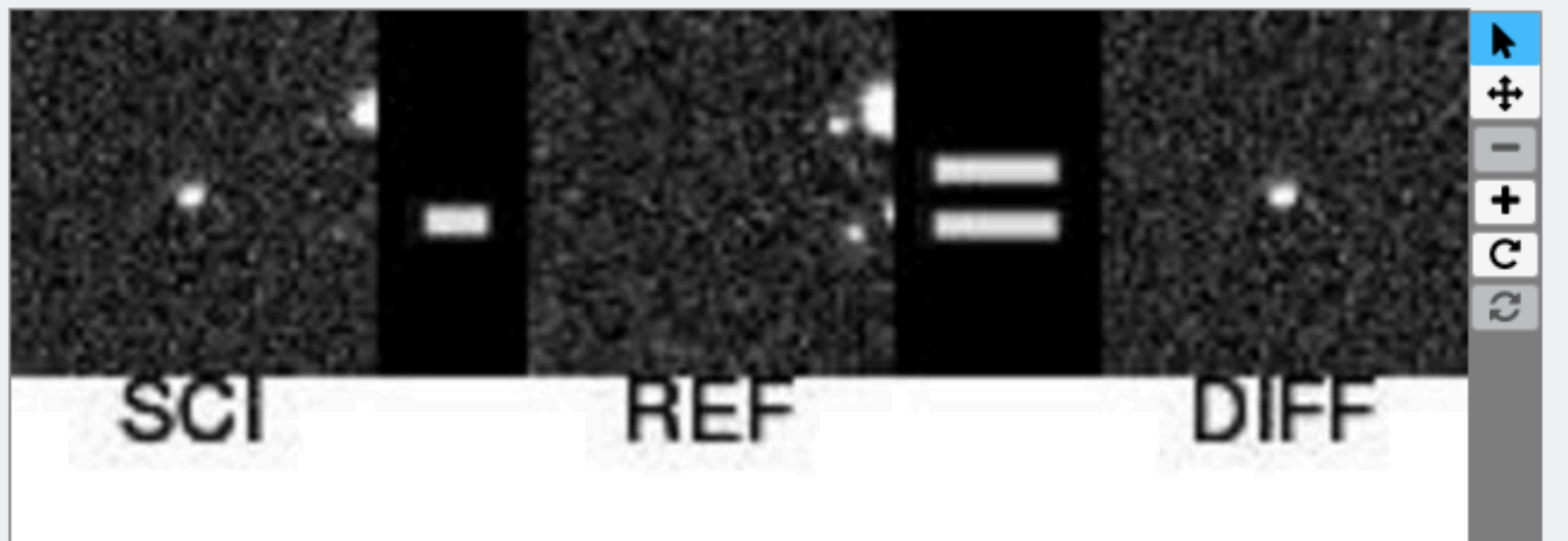
Show the project tutorial

Metadata

Options

Tutorial

Discuss



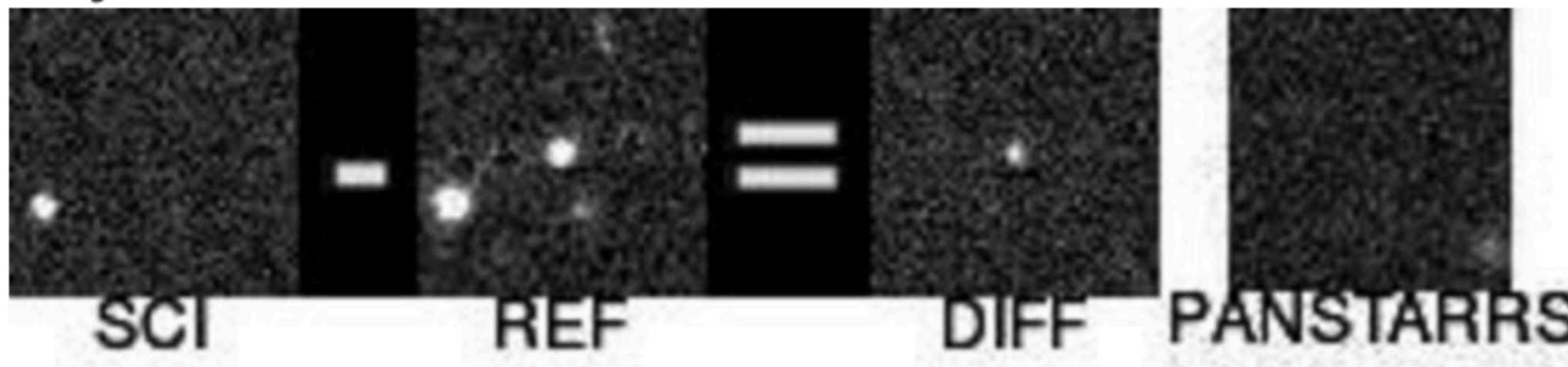
magpsf: 18.11
sigmapsf: 0.03
classtar: 1.0
ssdistnr: 6.0 ssmagnr: 17.3 ssnamenr: (12024)1996YN2
sgscore: nan
nneg: 2
nbad: 0
rb: 0.91
S/N: 39.49

Metadata Definitions

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- nbad =
- rb = Real bogus score (Not automated yet)
- S/N = Signal to noise of science object

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

Subject 19734239



Comments:

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



[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 Zooniverse 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](#)



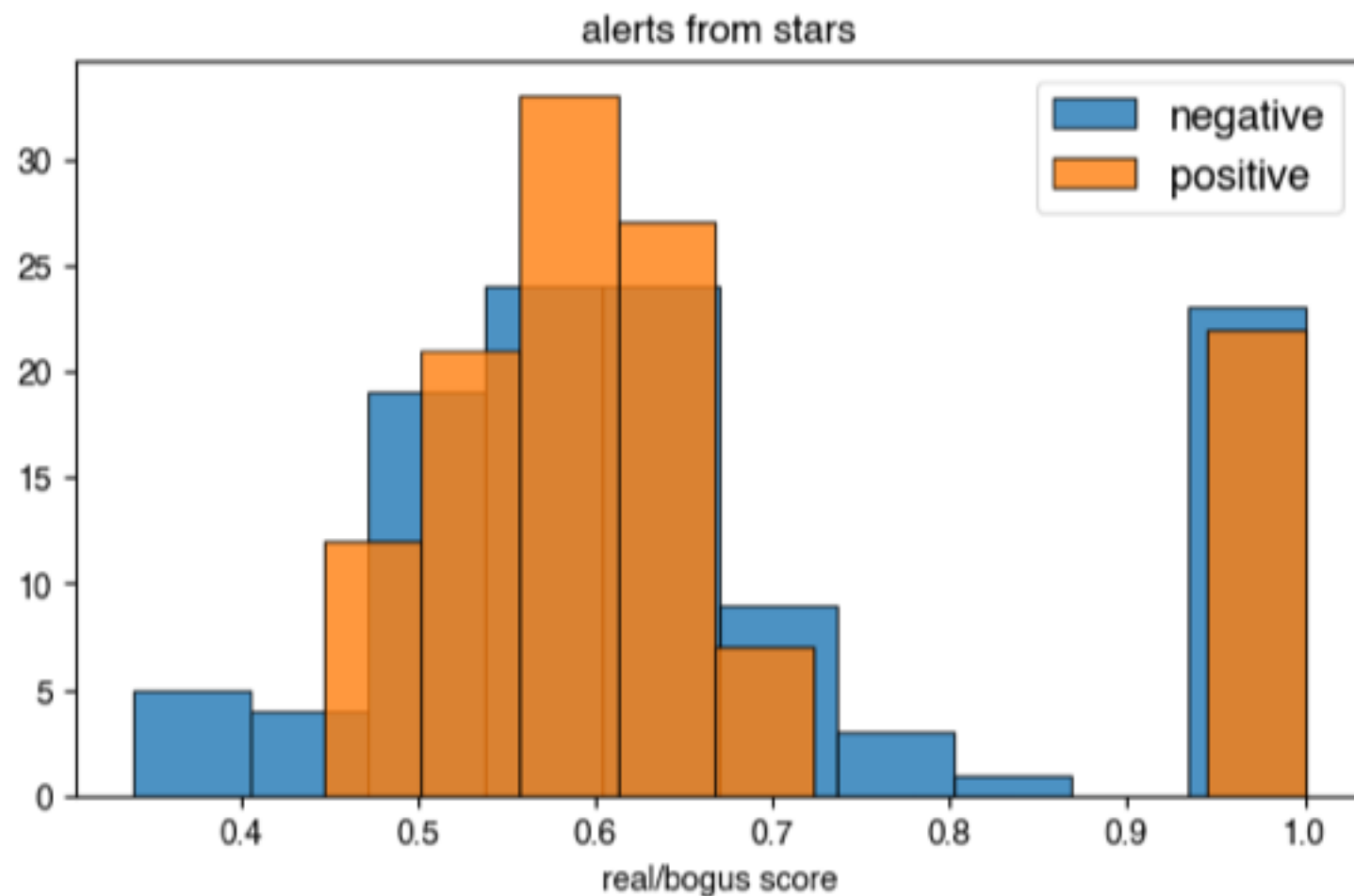
[sjoert](#)
@sjoert

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](#)

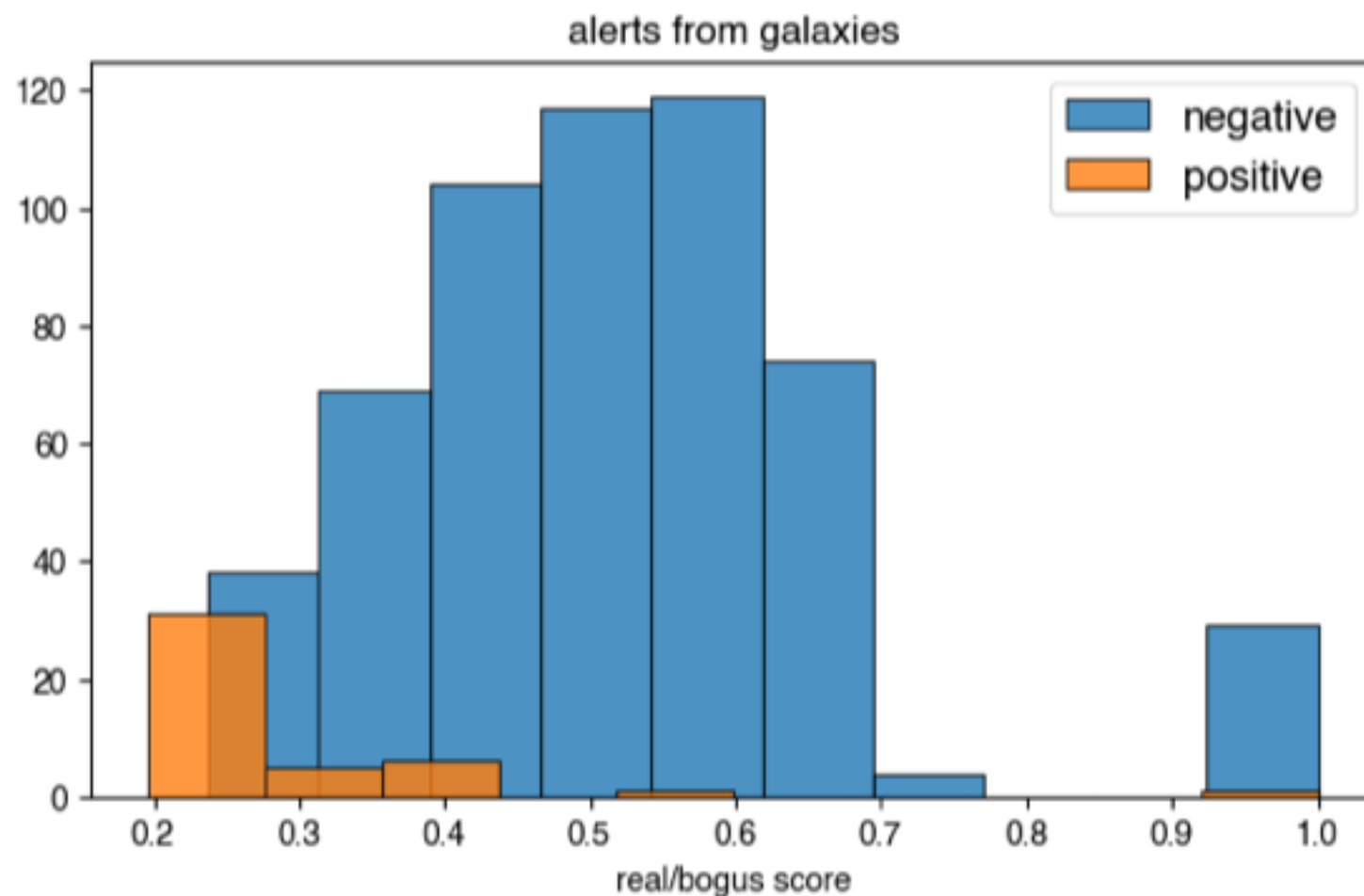
ifdiffpos keyword



Slides from Sjoert

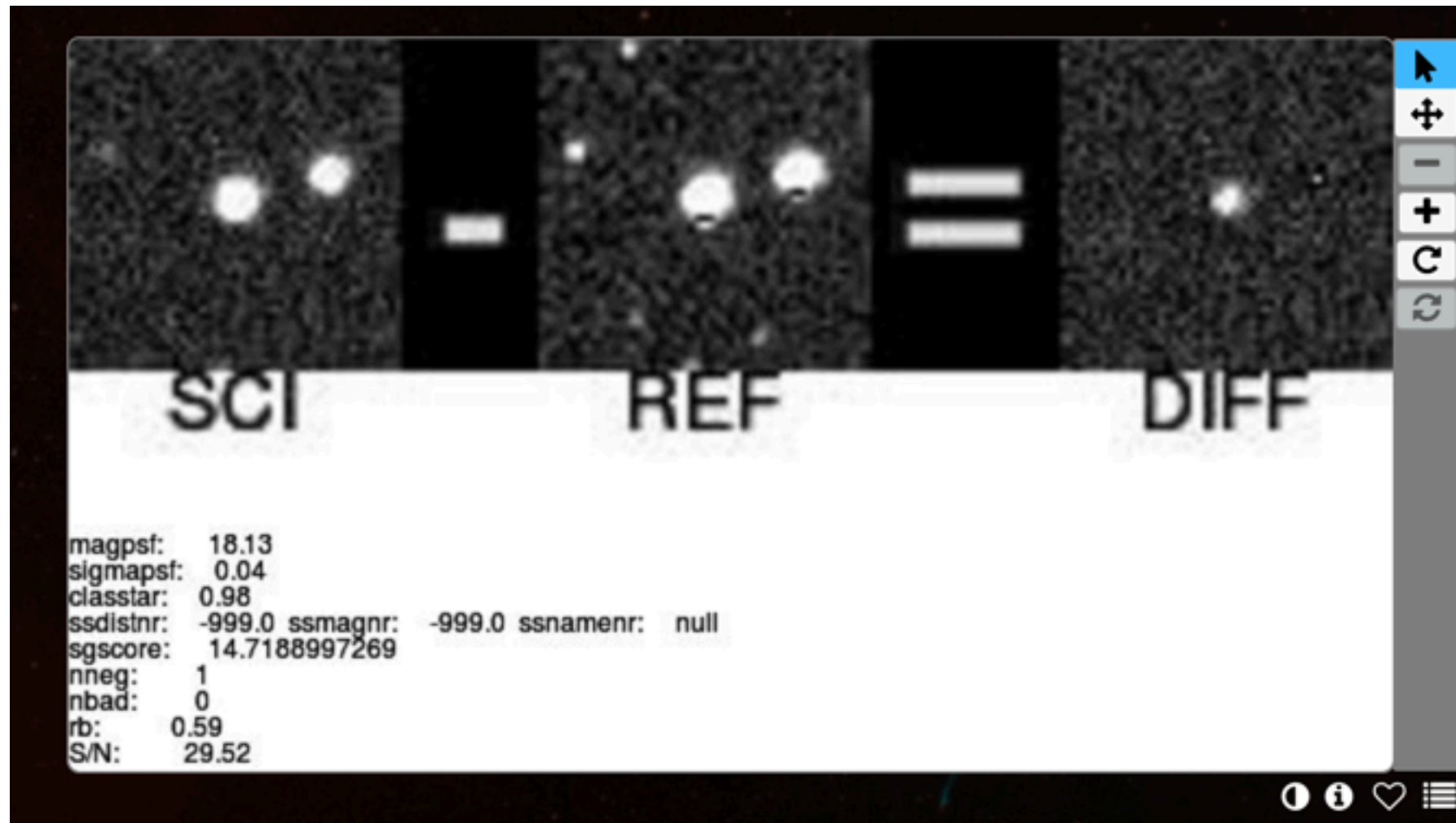
Positive: ifdiffpos = 1
Negative: ifdiffpos = 0

**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

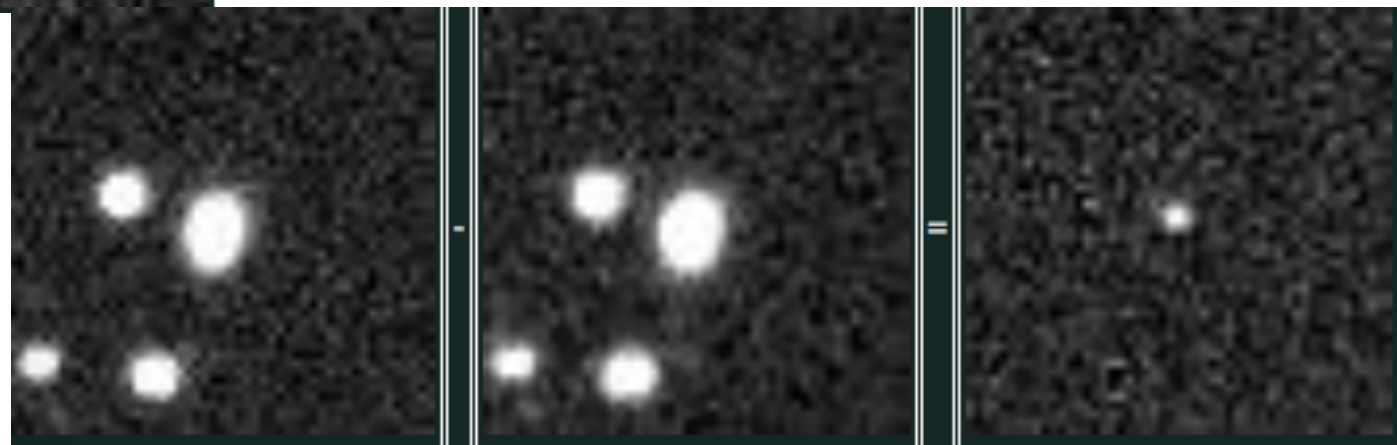
- High SNR selection: Are we losing good sources?
- Can be checked with known asteroids of fainter mags
- Also sources detected by other surveys
- Separability of real-bogus may be linked



Sci

Ref

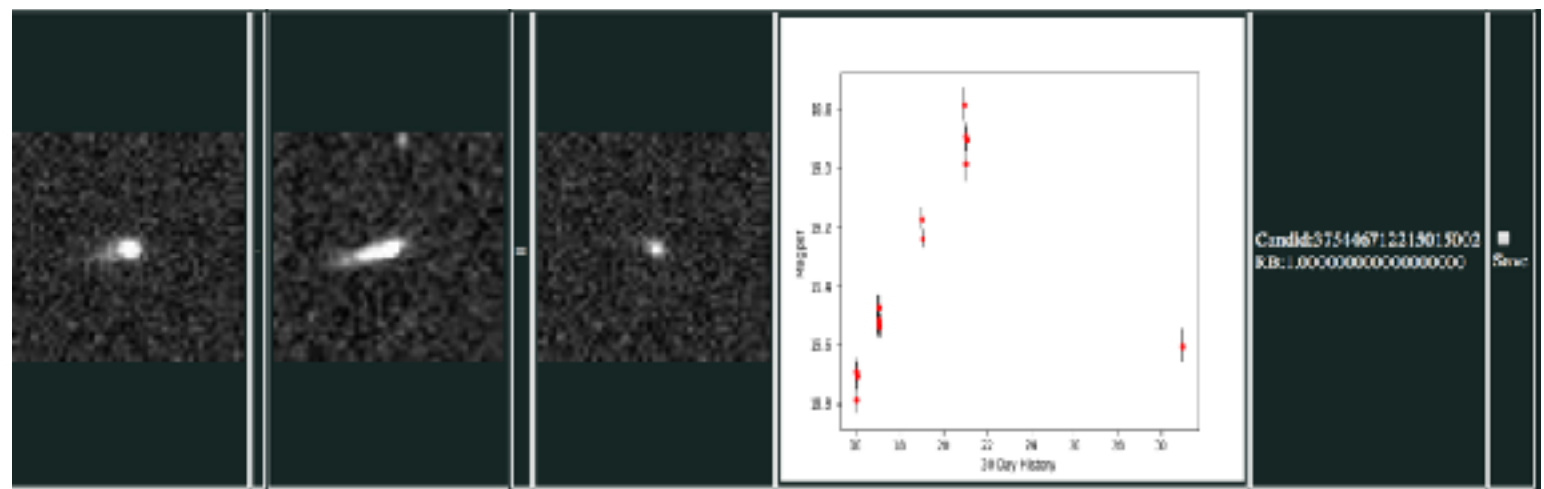
Diff



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 $15 < \text{mag} < 20$
 - 38 no reference images before the ZTF observations
 - 13 missed (investigation ongoing... object in reference, other...)



RB Campaign Planning

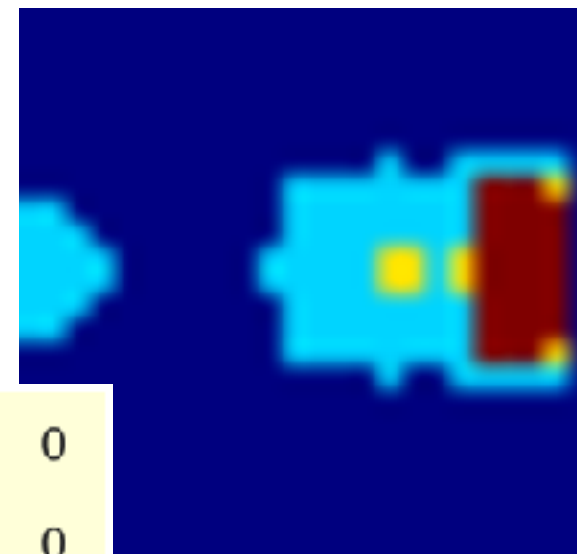
- $\text{delta-t} > 30 \text{ mins}$; $\text{ndet} \geq 2$
- In the past:
 - just i-band
 - $0.2 < \text{RB}$; $0.4 < \text{RB} < 0.6$; $\text{RB} > 0.9$
- Planning further campaigns
 - e.g. By science goal; by CCD; by x and y
 - Thu. 9 AM, Cahill #370

Real-Real classification

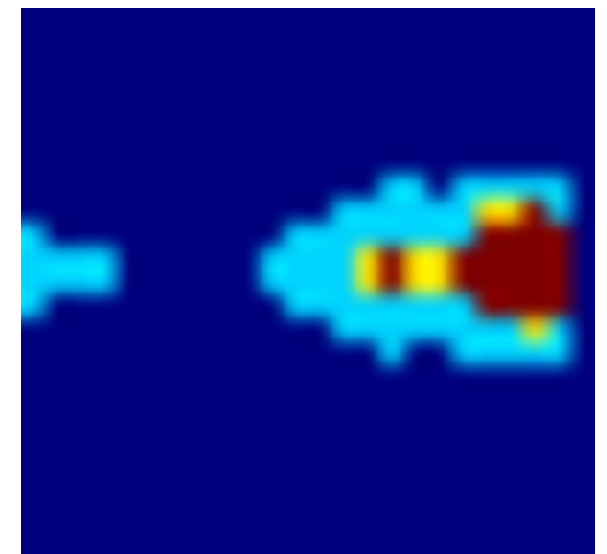
- Move away from explosions-only mode
 - Current reals may be biased away from extragalactic
 - Need 'Archive Marshal' volunteers to mark reals too
- Random Forests (true/trusted)
- Deep learning (with images)

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

True Class	1	94	2	0	2	0	0	0
	2	18	81	0	0	0	0	0
	4	32	0	53	14	0	0	0
	5	32	0	1	65	0	0	0
	6	26	0	5	66	0	1	0
	8	78	0	0	4	0	13	0
	13	1	1	5	1	2	3	83
		1	2	4	5	6	8	13
		Prediction						



EW

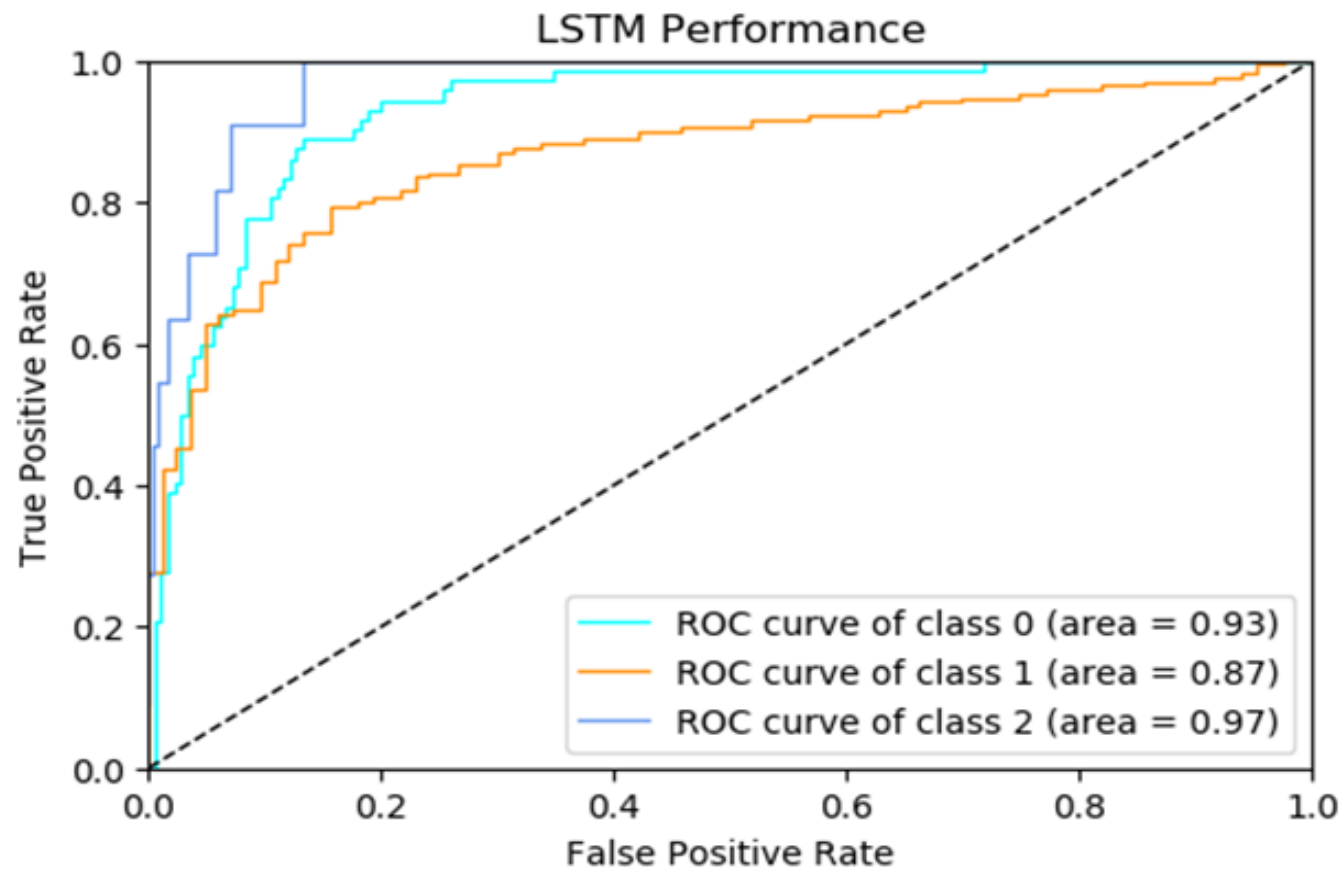


RS CVn

Deep Learning
with dmdt

Mahabal et al. 2017

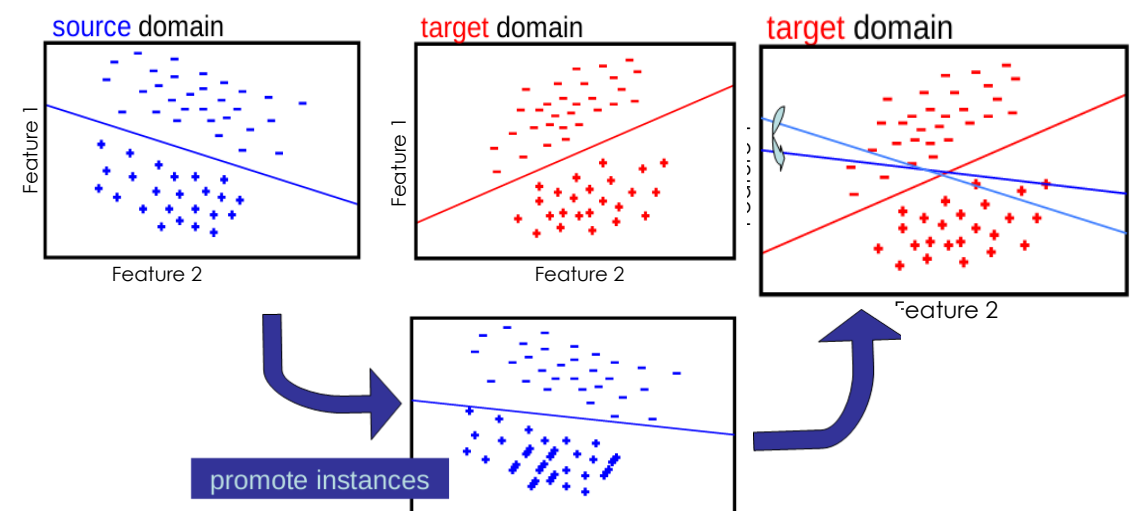
Real Real with Light Curves



CRTS transients
With Sreyasee Das, VIFI

Using light curves (with mag err)

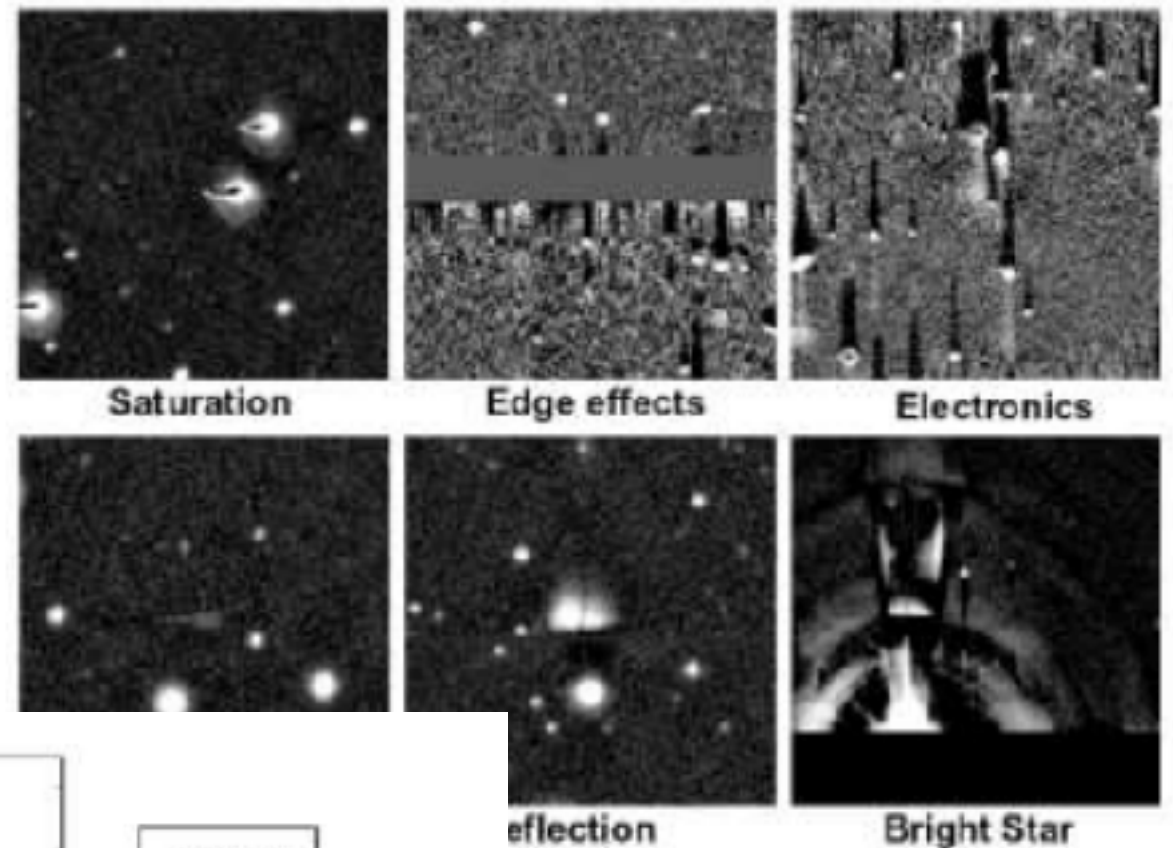
Domain adaptation



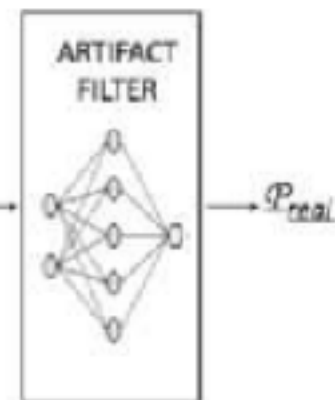
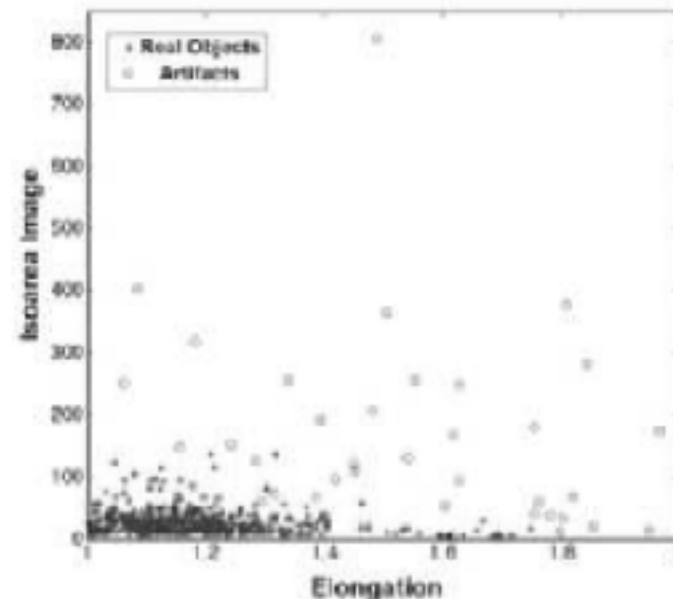
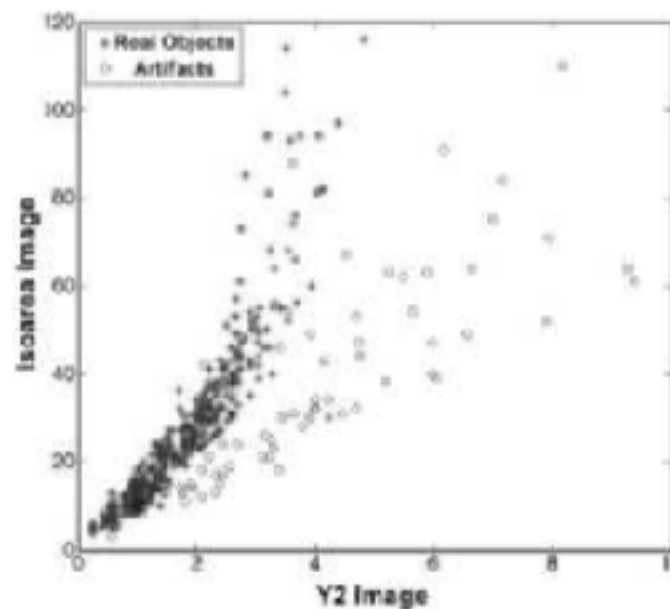
CRTS, PTF -> ZTF

Bogus Bogus

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

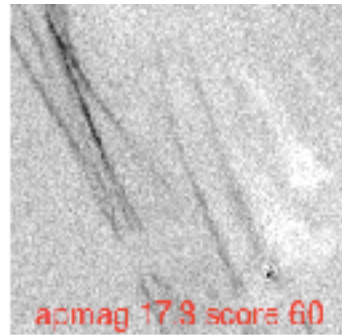
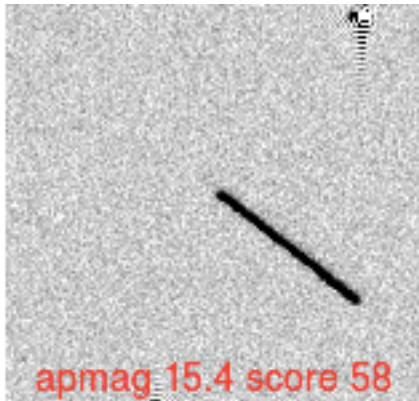


Donalek et al. 2008



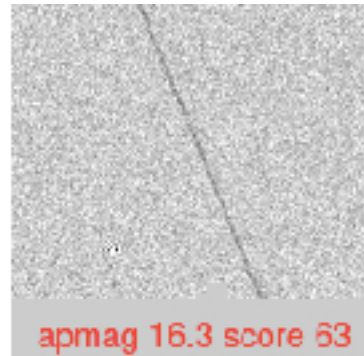
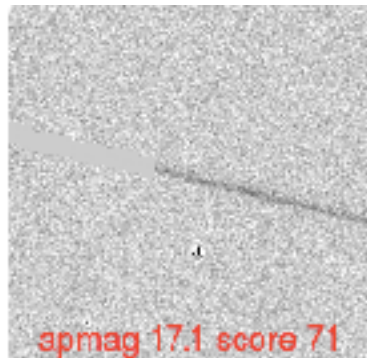
Palomar Quest data

Deep Learning with AStreaks



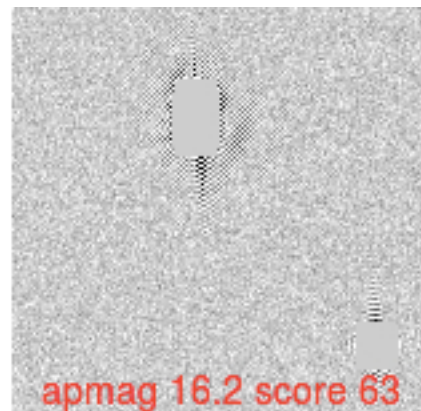
These are ghosts and dementors

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

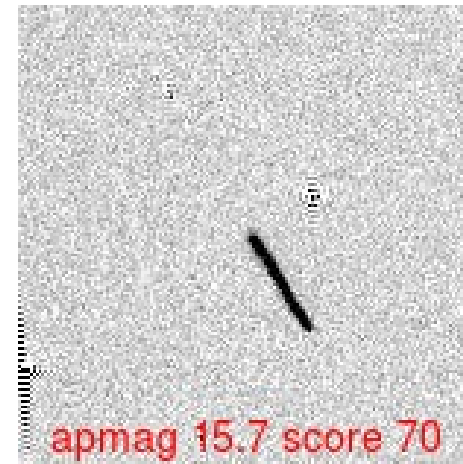


Show the project tutorial

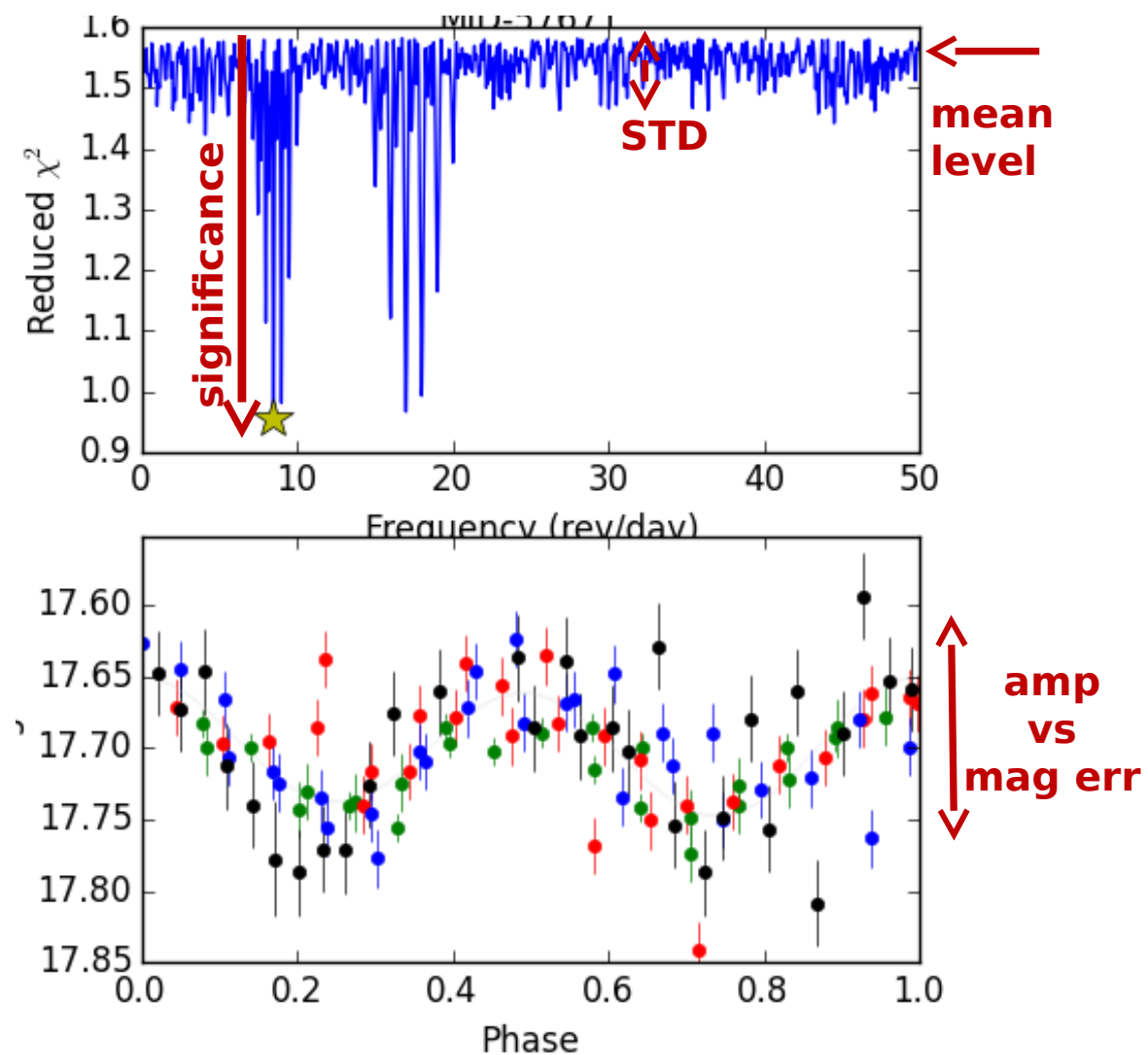
ML effort in solar system science

- **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 tuning the parameters in order to pick out the most interesting cases

See separate talks by
Quan-Zhi Ye and
Rex Chang



2018 CL

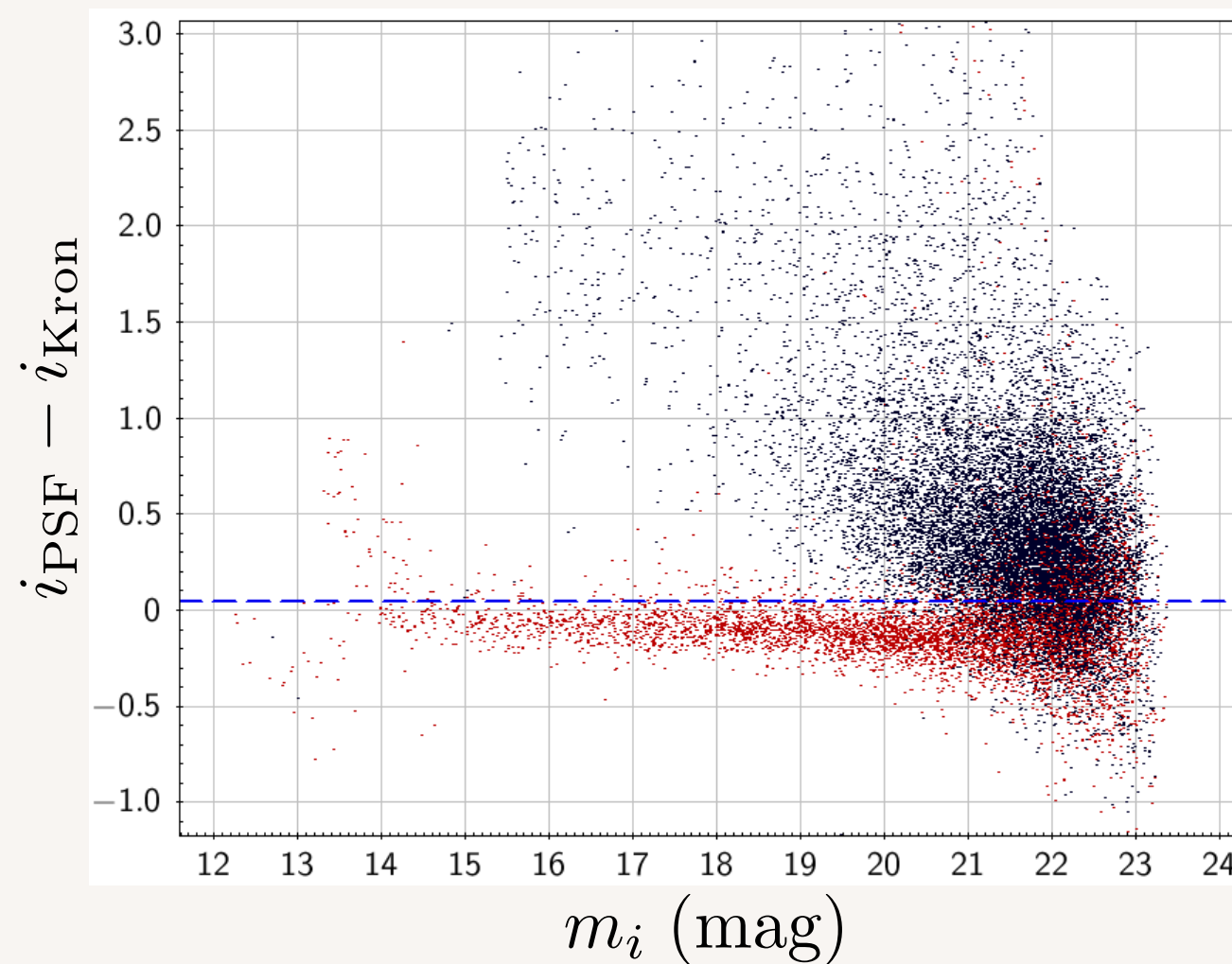


Star-Galaxy Model

Adam Miller

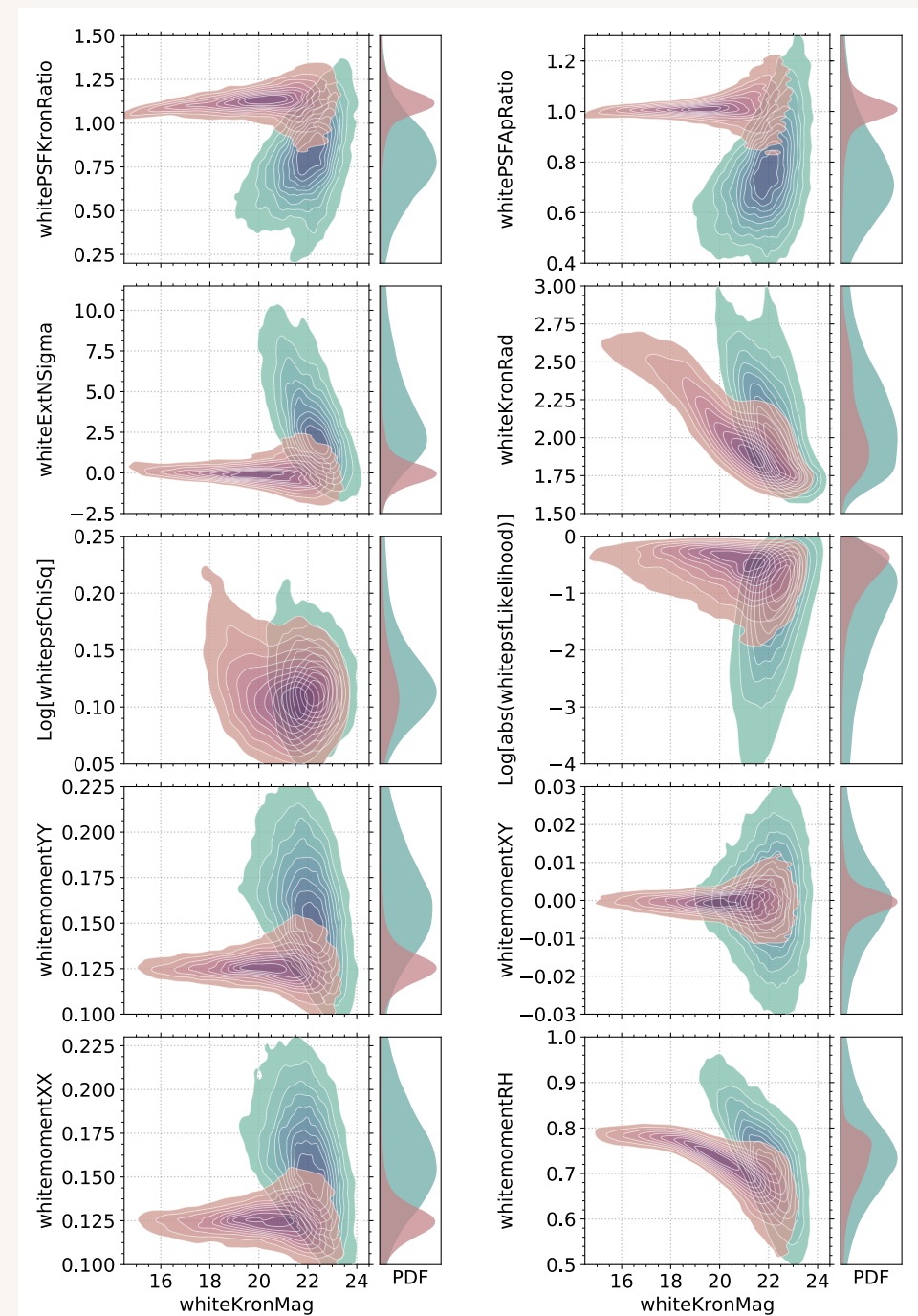
See separate talk
for details

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**

