First AI-assisted discovery of a comet

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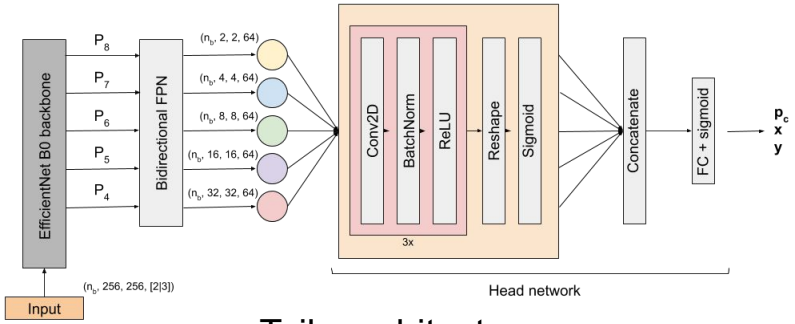
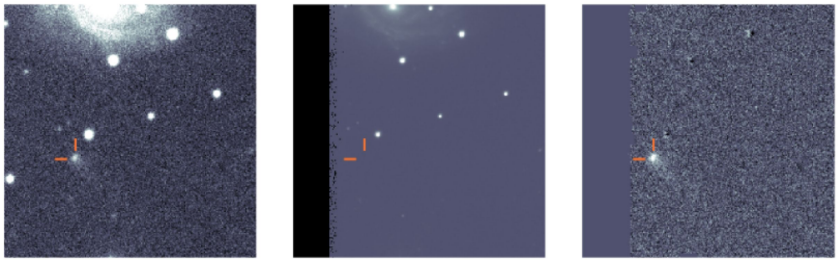
Tails: DL-assisted discovery of comets (in ZTF)

- Custom state-of-the-art EfficientDet-based architecture
- Large, diverse training dataset; active learning
- [SCI, REF] or [SCI, REF, DIFF], 256x256px, no diff image required
- >99% label prediction accuracy
- 1-2 pix median positional RMSE w.r.t. JPL Horizons nucleus positions
- Production service running on Twilight data since 8/2020 in GCP
- ~10-20 nightly candidates



Tails architecture



2I/Borisov from October 15, 2019

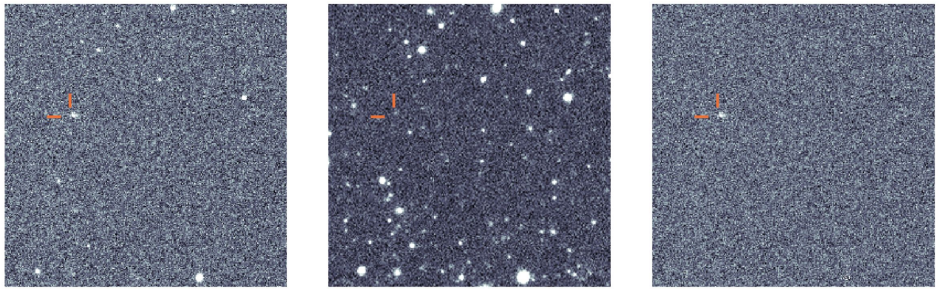
Duev+ (in prep.)

Tails: the first AI-assisted comet discovery

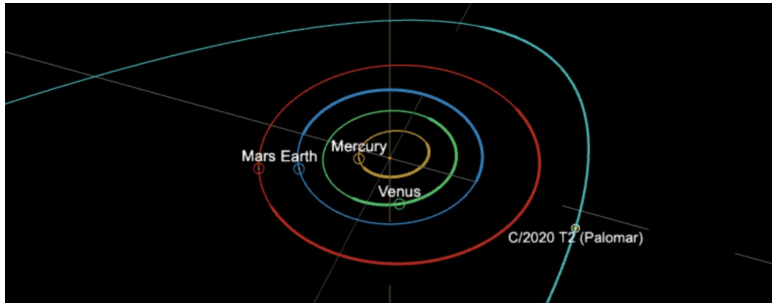
- **C/2020 T2**
- Discovered on Oct 7, 2020 in Twilight Survey data
- 19.3 mag in ztfr
- ~2”.5 FWHM vs ~2” nearby *
- Score: 0.96
- Typical long-period comet

ztf_20201007514745_000622_zr_c14_o_q4_0

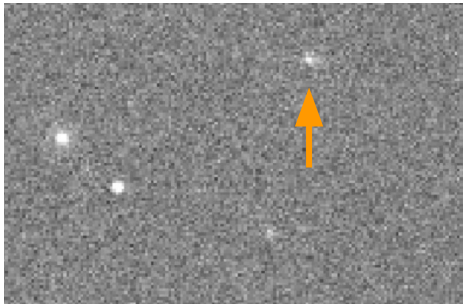
index	id	ni	jd	datestr	p	x	y	ra	dec	radecstr	tails_v	inspected	label
0	ztf_20201007514745_000622_zr_c14_o_q4	0	2.459130e+06	2020 10 7.514745370370370	0.961563	1474.802422	2041.471573	167.651024	28.432082	11h10m36.2458s +28d25m55.4959s	../nb/checkpoints-loc-l1-loss-5/tails	True	comet



MPChecker query results:
No Solar system object found with MPChecker



e: 0.993654
i: 27.873
Peri: 150.3685
Node: 83.0529
q: 2.054805
T: 2459406.6173



Tails: the first AI-assisted comet discovery

	index	id	ni	jd	datestr	p	x	y	ra	dec	radecstr	tails_v	inspected	la
0	0	ztf_20201019522419_000623_zr_c11_o_q2	0	2.459142e+06	2020 10 19.522418981481483	0.999351	1955.746399	1558.977722	171.90899	27.54309	11h27m38.1577s +27d32m35.1235s	../nb/checkpoints-loc-l1-loss-5/tails	False	bo

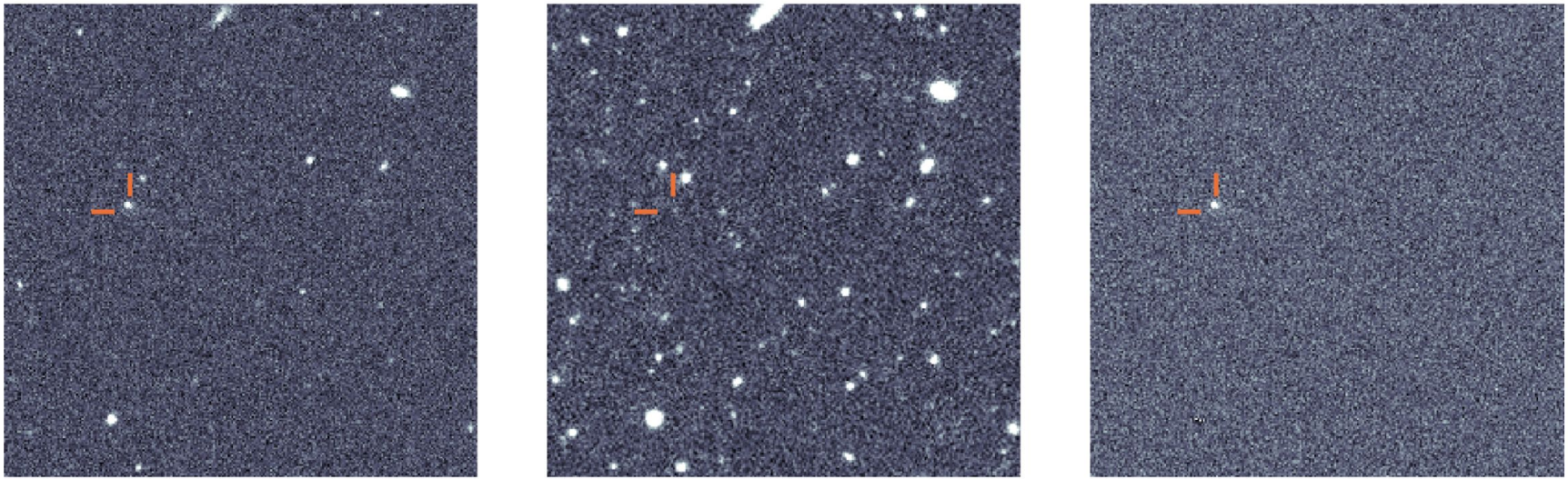


Image of **C/2020 T2** from October 19, 2020 -- clearly a comet