The Transient UV Objects Project
Searching for transients in the UV regime

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Introduction

Despite the prevalence of transient-searching facilities operating across most wavelengths, the UV has not been utilised for systematic large-scale searches for serendipitous transients. This gap is noteworthy because the UV can provide valuable information about many types of transients, including flares, dwarf novae, novae, supernovae, tidal disruption events, and kilonovae (see Sagiv 2014). Discovering transients in the UV can provide key insight about the early UV emission as well as how they evolve. Therefore, such studies could help to understand the physics responsible for many transient phenomena, and could reveal new behaviour. Since systematic, large-scale, blind UV transient searches have not been undertaken, **such studies would also have the potential to discover completely new types of sources!**

Radio   Visual   Gamma-ray

TUVOpipe

Even without dedicated UV transient-searching facilities, we can use available UV telescopes to look for transients. The UVOT aboard *Swift* is well-suited to the task, as it has observed many fields repeatedly, and all its data are public and accessible a few hours after observations.

> **We developed a custom pipeline to automatically search for UV transients in all UVOT data in real-time, allowing for follow-up observations of new, highly interesting sources while they are still active.**

The pipeline consists of:
- Downloading all new UVOT data
- Searching for transients using **difference image analysis**
- Creating lightcurves using UVOT data
- Querying online catalogs for previously known information about each transient
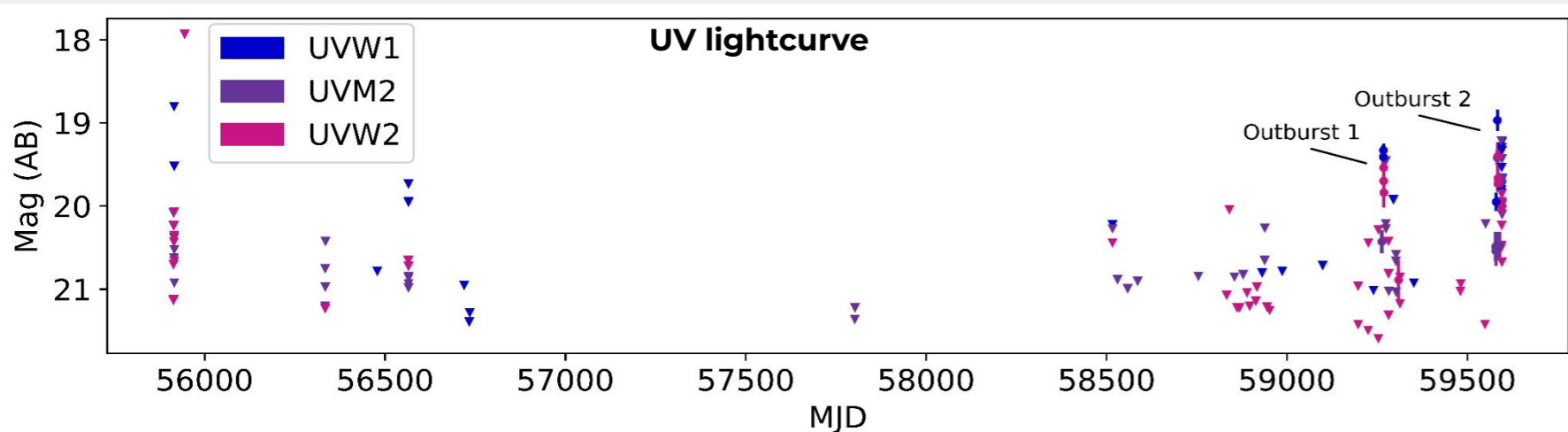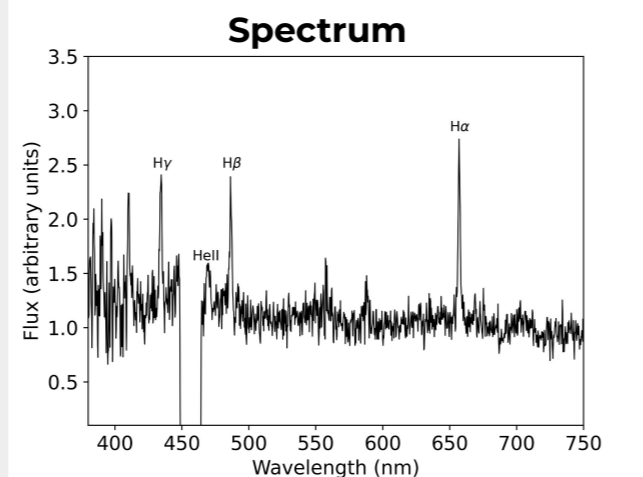
Every day, the pipeline presents users with images, lightcurves, and catalog information for each candidate transient detected in the recent UVOT observations.

Difference image analysis


Science   Template

Difference   Zoom
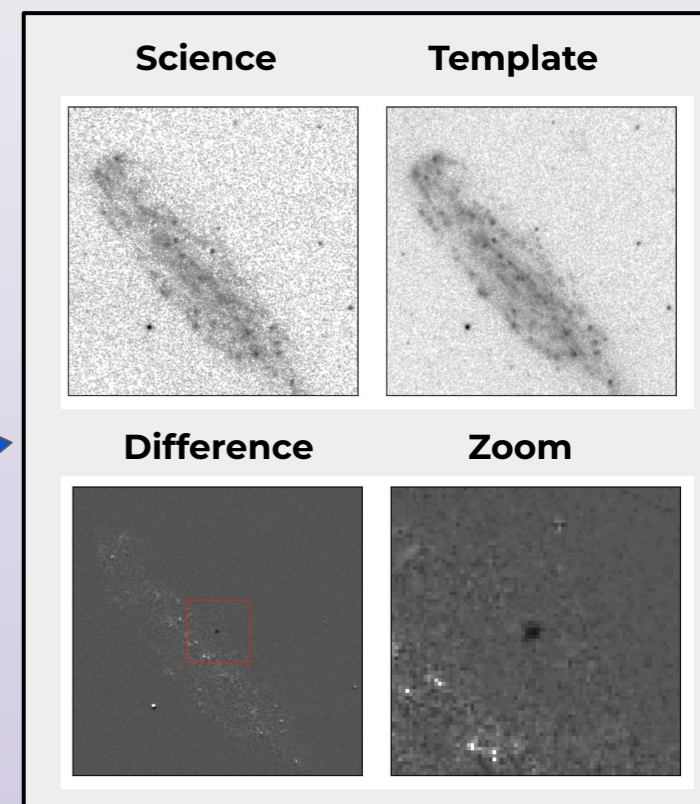
Example study: *TUVO-21acq*

We discovered two bright (>4 mag) UV outbursts from an unclassified source. The properties of the outburst were indicative of a dwarf nova (DN). We obtained an optical spectrum, with which we confirmed its CV nature. UV data of DNe is important to study accretion processes in CVs (see Modiano 2022).

Spectrum

Hγ, Hβ, HeII, Hα

Flux (arbitrary units) vs Wavelength (nm)

UV lightcurve

UVW1, UVM2, UVW2

Outburst 1, Outburst 2

Mag (AB) vs MJD

Results

With TUVOpipe we have analysed over 100,000 UVOT images. We detect a few to a few tens of real UV transients every day, and most are variable stars and outbursts from cataclysmic variables (CVs). The majority are previously known, but, we have also discovered many new UV transients with no known classification. For these highly interesting sources, we undertake follow-up observations to determine their nature and characterise their behaviour.

UVOT images processed by TUVOpipe

Number of images per field
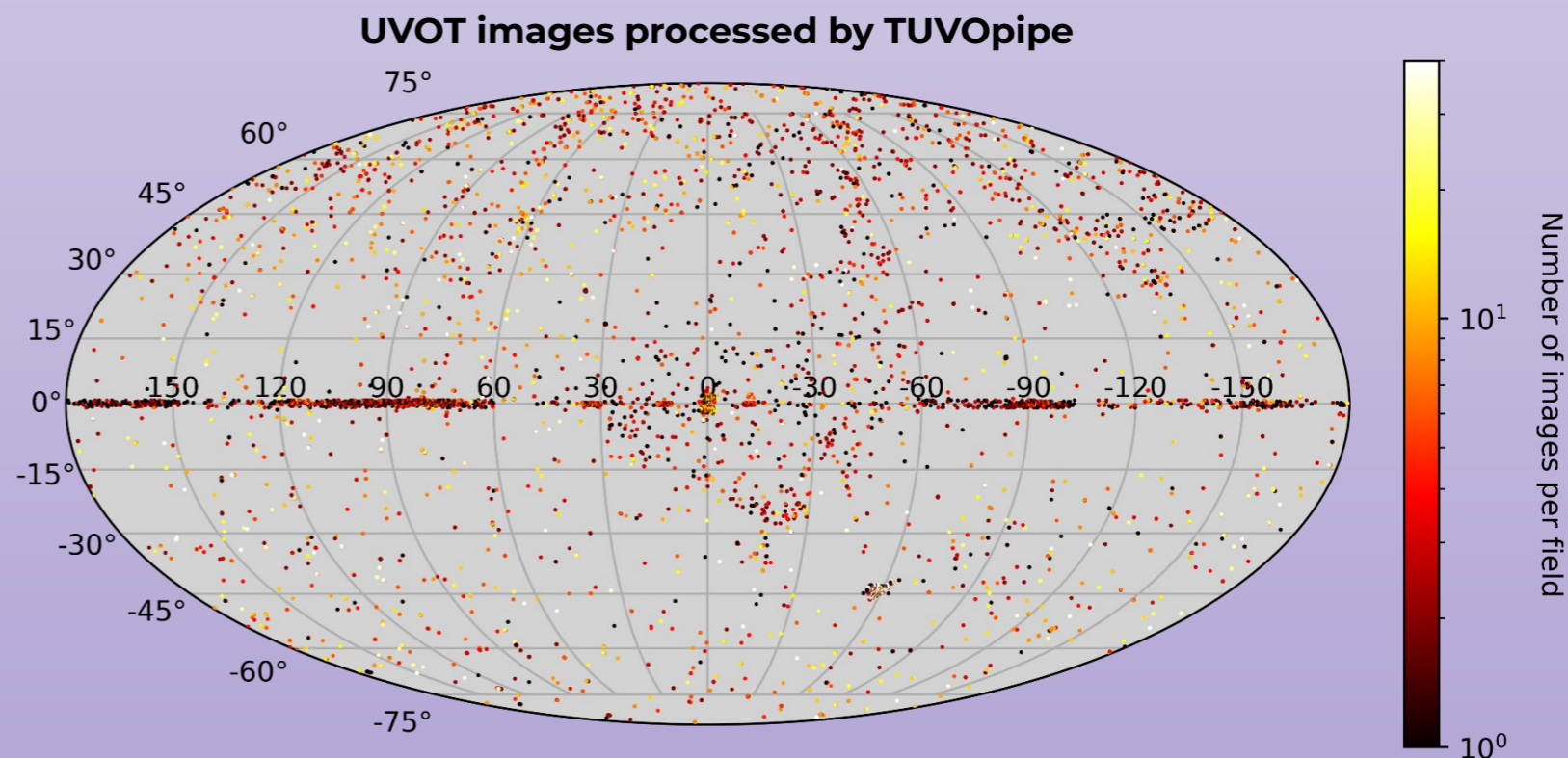
References: Modiano et al., 2022, submitted to A&A; Modiano et al., 2022, in prep; Sagiv et al.,2014, AJ, 147, 79