

# Spectra for Transient Classification

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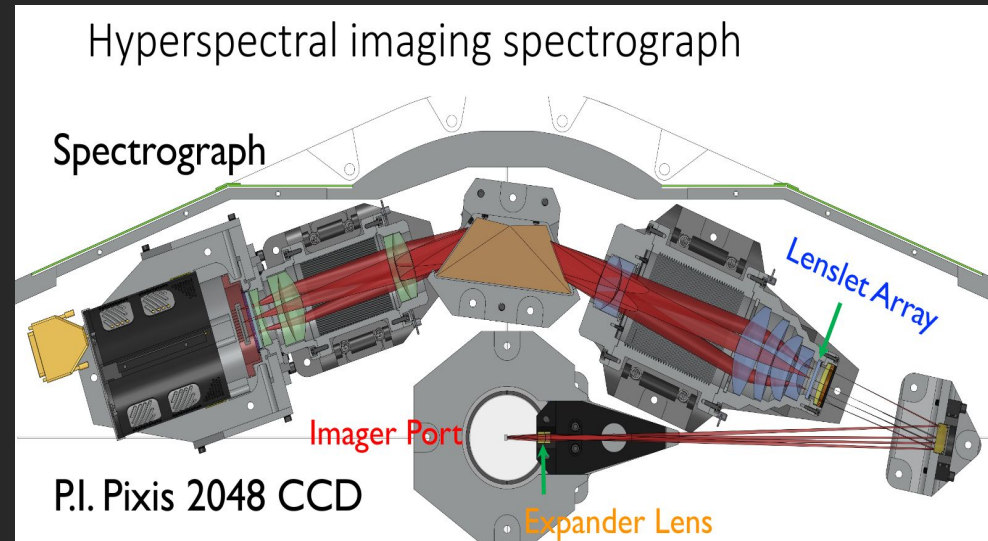
On behalf of the AppleCiDEr and ZTF summer school

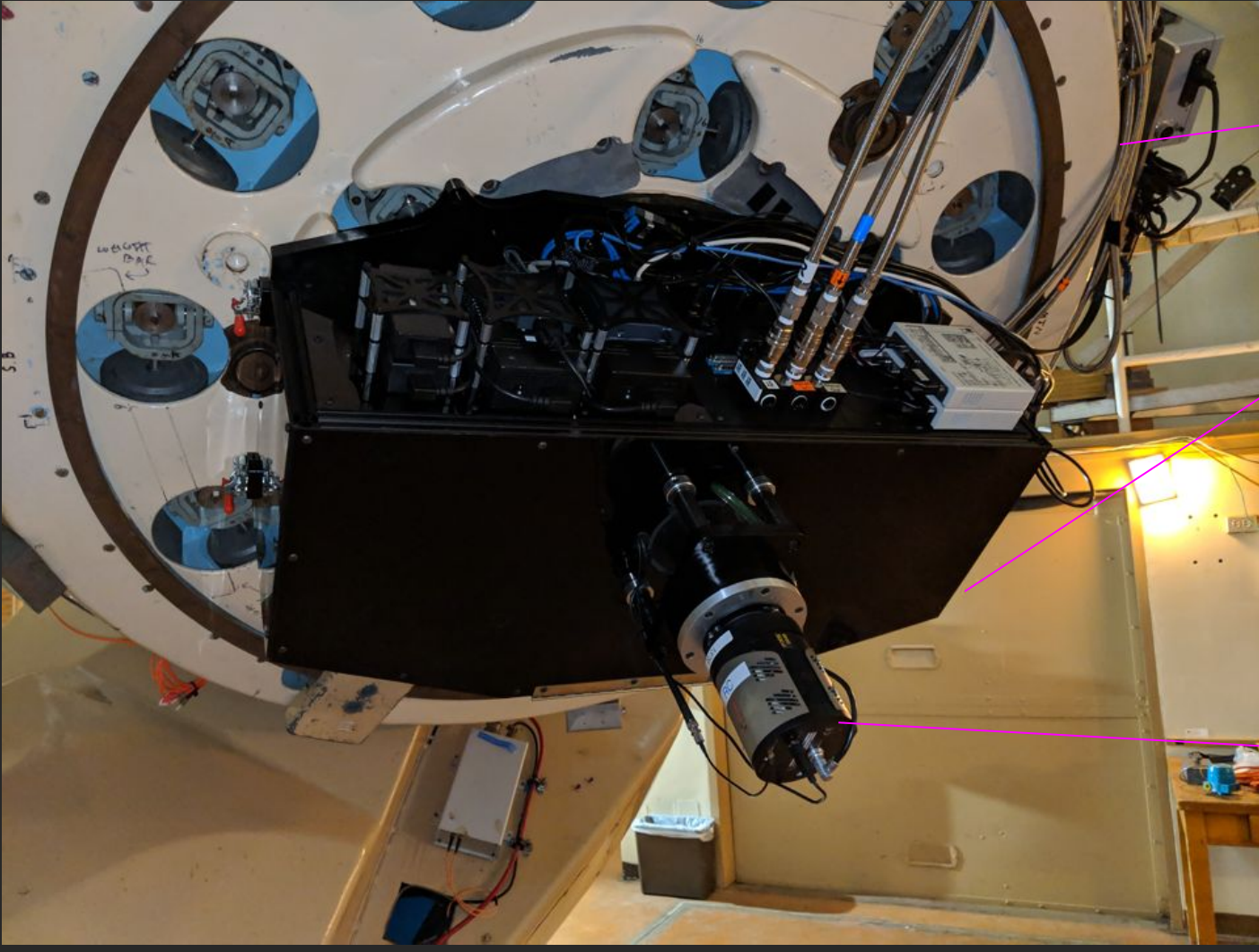


# Spectroscopy: Introduction

- Light decomposition into wavelength components
- Reveals composition, velocity, redshift, temperature
- Type Ia: Si II absorption, no H
- Type II: Strong H lines
- TDEs: He, H, blue continuum
- AGN: Broad lines, Fe II

“How we collect them?”  
Example of SEDM





Palomar 60-inch  
(1.5 meter) mirror

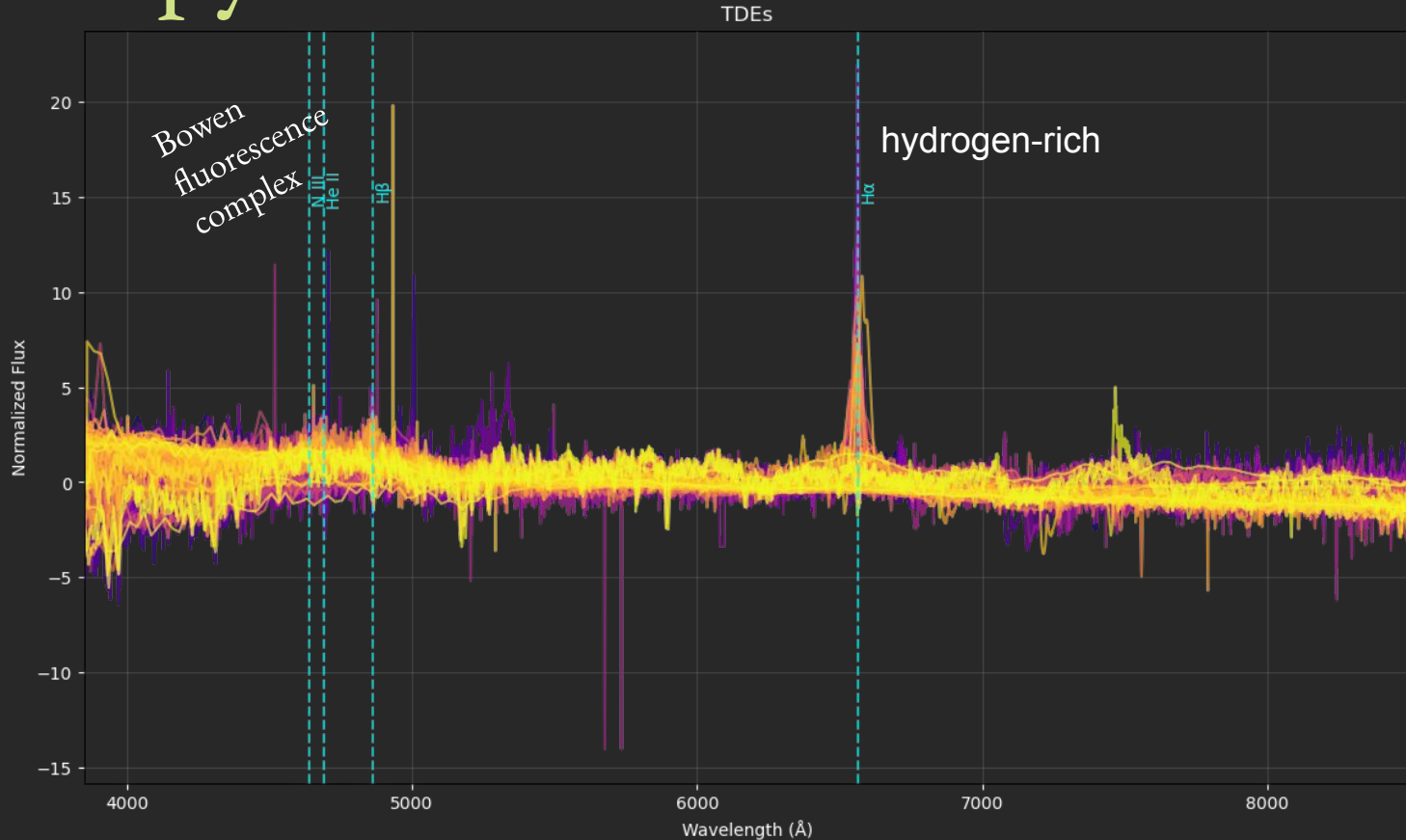
Spectrograph (IFU)

~19 mag in ~2700  
seconds

Rainbow camera  
(For imaging,  
acquisition and  
guiding)

# Spectroscopy: Introduction

**Evolving line profiles** - TDEs change dramatically over months/years



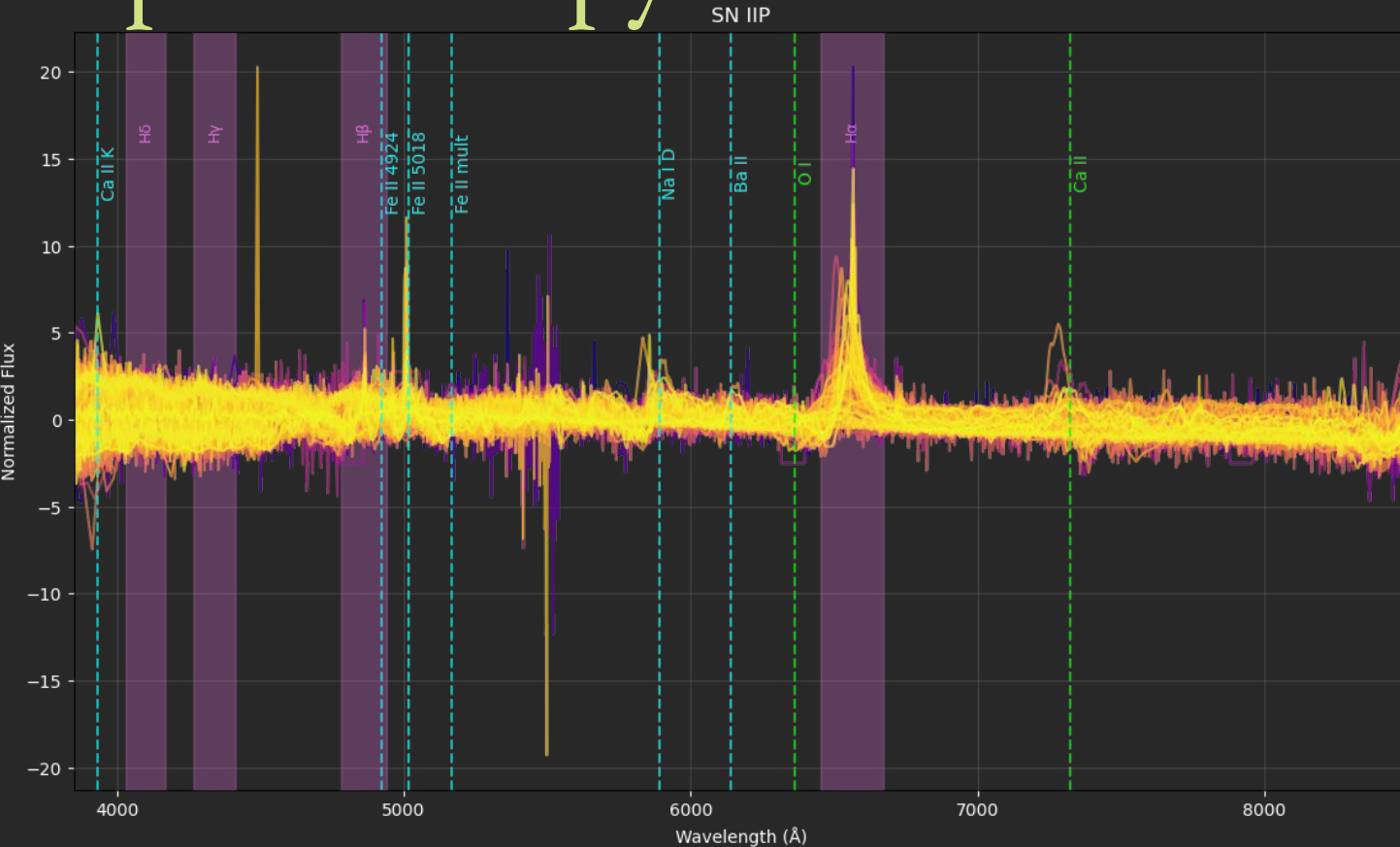
# Spectroscopy: Introduction

AGN



**Forbidden lines** -  
very AGN  
characteristic

# Spectroscopy: Introduction



Hydrogen Balmer  
series (broad due to  
expansion)

**Forbidden lines** - later  
phase

# Spectroscopy: Why time matters?

- **Early spectra** (minutes to days after explosion) show features related to the progenitor envelope or shock breakout.
- **Later spectra** (weeks to months) reflect the expanding ejecta, nucleosynthesis products, and interaction with circumstellar material (CSM).
- Transients evolve: spectra change over hours, days, weeks
- Multi-epoch data improves classification and physical interpretation
- Critical for: Element identification, Velocity measurements, Detecting short-lived features
- Essential for understanding origin, environment, and explosion physics

# Spectroscopy: Why time matters?

- Example 1: Type II supernova evolves from strong hydrogen lines to forbidden lines of O, Ca, and Fe in the nebular phase.
- Example 2: Some transients look similar at one epoch but diverge later. E.g., early spectra of Type Ib and Type Ic SNe may be hard to distinguish — but helium lines in Type Ib emerge later.
- Example 3: FBOs, kilonovae, or shock breakout flashes evolve on very short timescales (hours–days)
- Important spectral features (e.g., r-process lines in kilonovae) may be briefly visible and vanish quickly.



# Spectroscopy: Challenges

- Too many transients, limited telescope time
- Faint or distant sources
- Weather and host contamination

Caltech



Northwestern University



JOINT SPACE-SCIENCE INSTITUTE



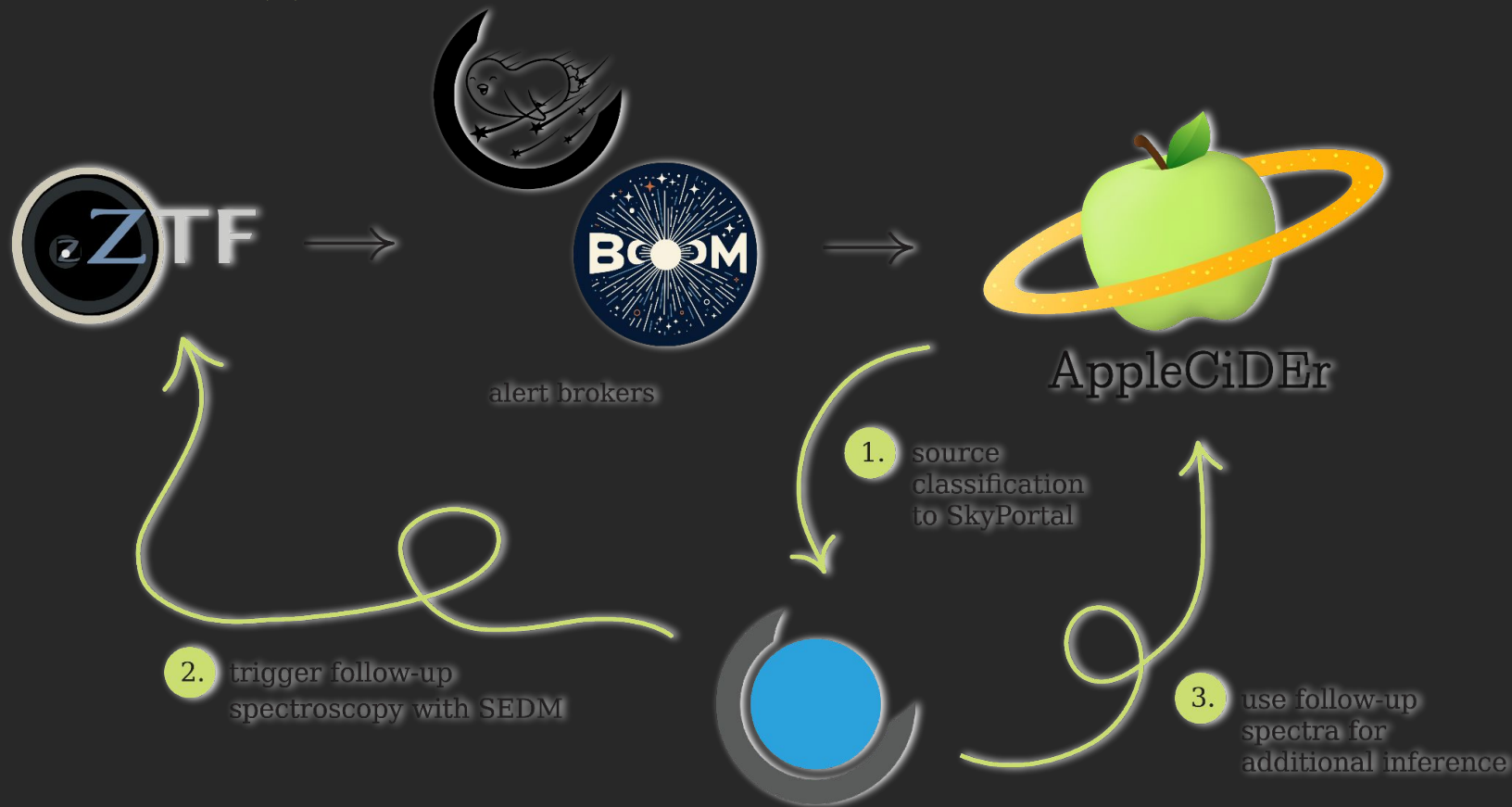
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# Workflow



# How?

## 1. Preprocess

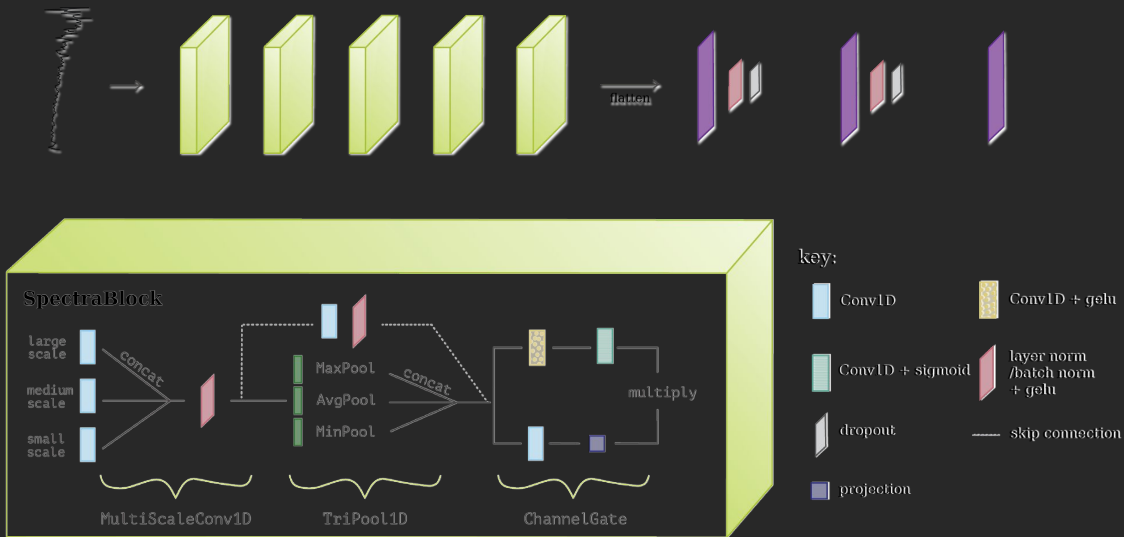
- Handle NaNs: Drop invalid (non-numeric) entries
- Interpolate to fixed length E.g. interpolate to 4096 wavelength points
- Normalize the flux
- Apply redshift correction

# How?

## 1. Preprocess

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## 2. Architecture



# Results with and without spectra

