A First Look at the TESS-\textit{Fermi} Blazars

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Active Galactic Nuclei

- Accretion Disk
- Relativistic jet
- Dusty torus
- Accretion Disk

NASA
Blazars

In blazars, we are staring “down the barrel” of a relativistic jet.

- Detailed probes of microphysics due to Doppler boosting.
- Simultaneous multiband monitoring -> the origin of the high energy emission.
Blazars

An AGN in which the optical emission (and variability) comes from the relativistic jet.

The Kepler Blazar W2R 1926+42

-Flake asymmetries indicating possible acceleration / dissipation timescales

-Emission region sizes $\sim 10^{15}$ cm (or about 70 AU).

Edelson et al. (2013), Mohan et al. (2015)
An AGN in which the optical emission (and variability) comes from the relativistic jet.

The Kepler Blazar W2R 1926+42

- Flare asymmetries indicating possible acceleration / dissipation timescales
- Emission region sizes \( \sim 10^{15} \text{ cm} \) (or about 70 AU).

Li et al. (2018)
TESS and the *Fermi* Blazars

Simultaneous radio, optical, UV, X-ray, and $\gamma$-ray light curves:

- Location of flaring activity
- Origin of the high energy ($\gamma$-ray) emission

Ongoing *Swift* program in northern hemisphere!

- 3.5 day cadence
- 1 year baseline
TESS and the Fermi Blazars

Spectral Energy Distribution of 3C 66A: Optical to $\gamma$-ray

Low-energy peak: synchrotron emission

High-energy peak: ???

Multiband: watch entire SED vary!
What is the origin of the high energy emission?

**Leptonic:** Synchrotron
Self-Compton or External Compton scattering

**Hadronic:** photo-pion production → $\pi^0$ decay photons

**TESS and the *Fermi* Blazars**

**Swift-monitored:** Four blazars in each polar viewing zone.

<table>
<thead>
<tr>
<th>South</th>
<th>North</th>
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<tbody>
<tr>
<td>PKS 0506-61</td>
<td>4C +56.27</td>
</tr>
<tr>
<td>1RXS J0543-55</td>
<td>S4 1749+70</td>
</tr>
<tr>
<td>PKS 0637-75</td>
<td>S5 1803+784</td>
</tr>
<tr>
<td>PMN J0730-6602</td>
<td>3C 371</td>
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**Fermi + TESS only:** Five so far across the sky, and counting!

*Only five??*
TESS and the *Fermi* Blazars

PMN 0730-6602

![Graphs showing data from TESS, Swift, Fermi, and X-ray hardness over time.](image)
TESS and the *Fermi* Blazars

1RXS J0543-55

![Graphs showing data from TESS, Swift, Fermi, and X-ray hardness over MJD range.](image-url)
TESS and the *Fermi* Blazars

PKS 0208-512

![Graph showing TESS and Fermi observations of PKS 0208-512 over MJD 58360 to 58400.](image-url)
TESS and the *Fermi* Blazars

PKS 0346-27
Lots of questions!

Why do X-ray bright blazars show weaker gamma / optical correlation?

Time-dependent SED modelling + radio data

Quantification of lags and leads: Bayesian block analysis, Gaussian processes…

Lots of challenges!

Careful decorrelation and decomposition required.

Classification of UFOs (unidentified Fermi objects)?

Lots to look forward to!
TESS and AGN: What’s next?

Classify unknown Fermi targets?

Radio-loud vs radio-quiet AGN: jet production and accretion disks

Optical quasiperiods (QPOs): probes of black hole mass

…and on and on!
Types of AGN

Classification depends on viewing angle!

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<thead>
<tr>
<th>Time (rest frame days)</th>
<th>Flux (counts per second)</th>
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KIC 6932990

KIC 12208602

KIC 2694186

K.L. Smith et al. 2018a