Multiwavelength Cross-Correlations and Flaring Activity in Bright Blazars

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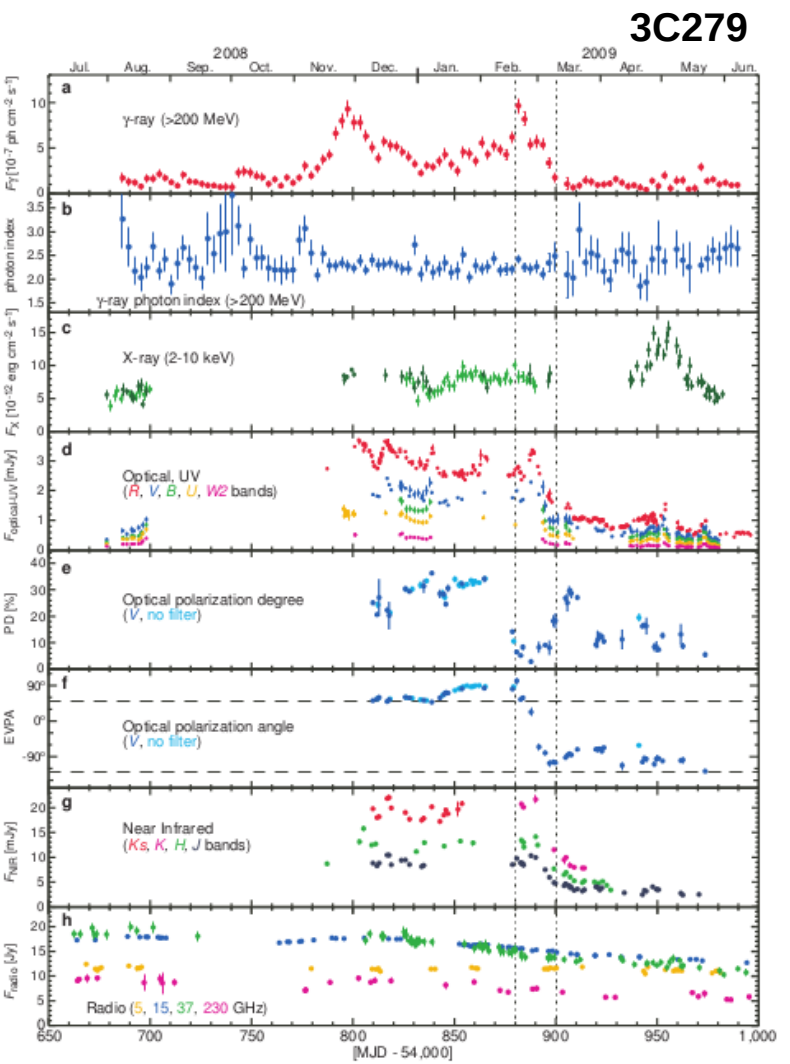
Half Century of Blazars and Beyond
Turin 2018

Introduction

What's the relation between different emission regions?

How do the flaring properties of one wavelength relate to another?

Where and how are γ-rays produced in blazars jets?



Abdo et al. 2009

Sample

0.76-m Katzman Automatic Imaging Telescope (**KAIT**)

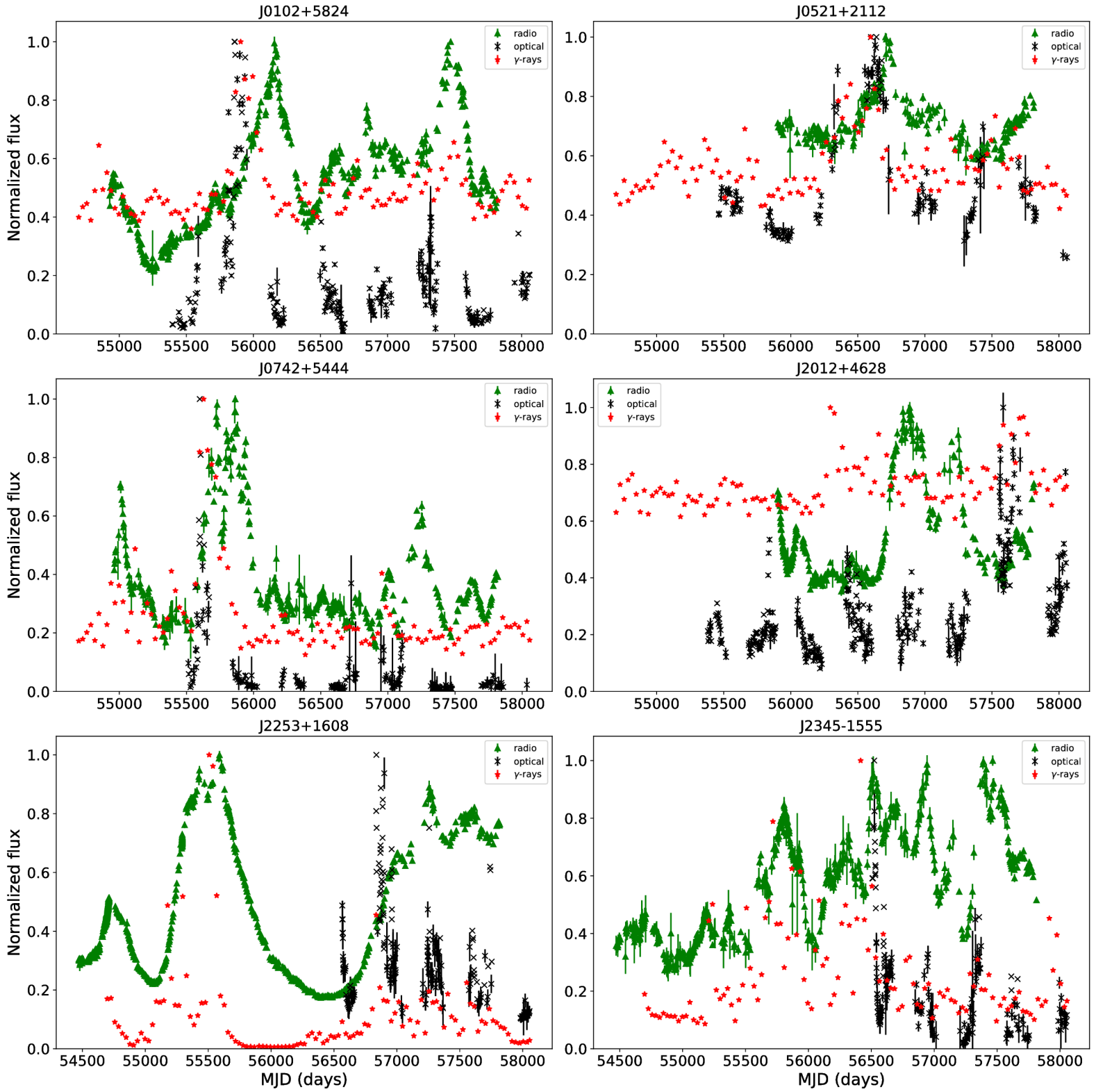
40-m Owens Valley radio observatory at 15 GHz (**OVRO**)

Fermi γ-ray space telescope 30-d binned light curves

~8 year long light curves

145 blazars: 93 BL Lacs, 45 FSRQs, 5 Unclassified

(75 LSPs, 28 ISPs, 24 HSPs, 18 No Info.)

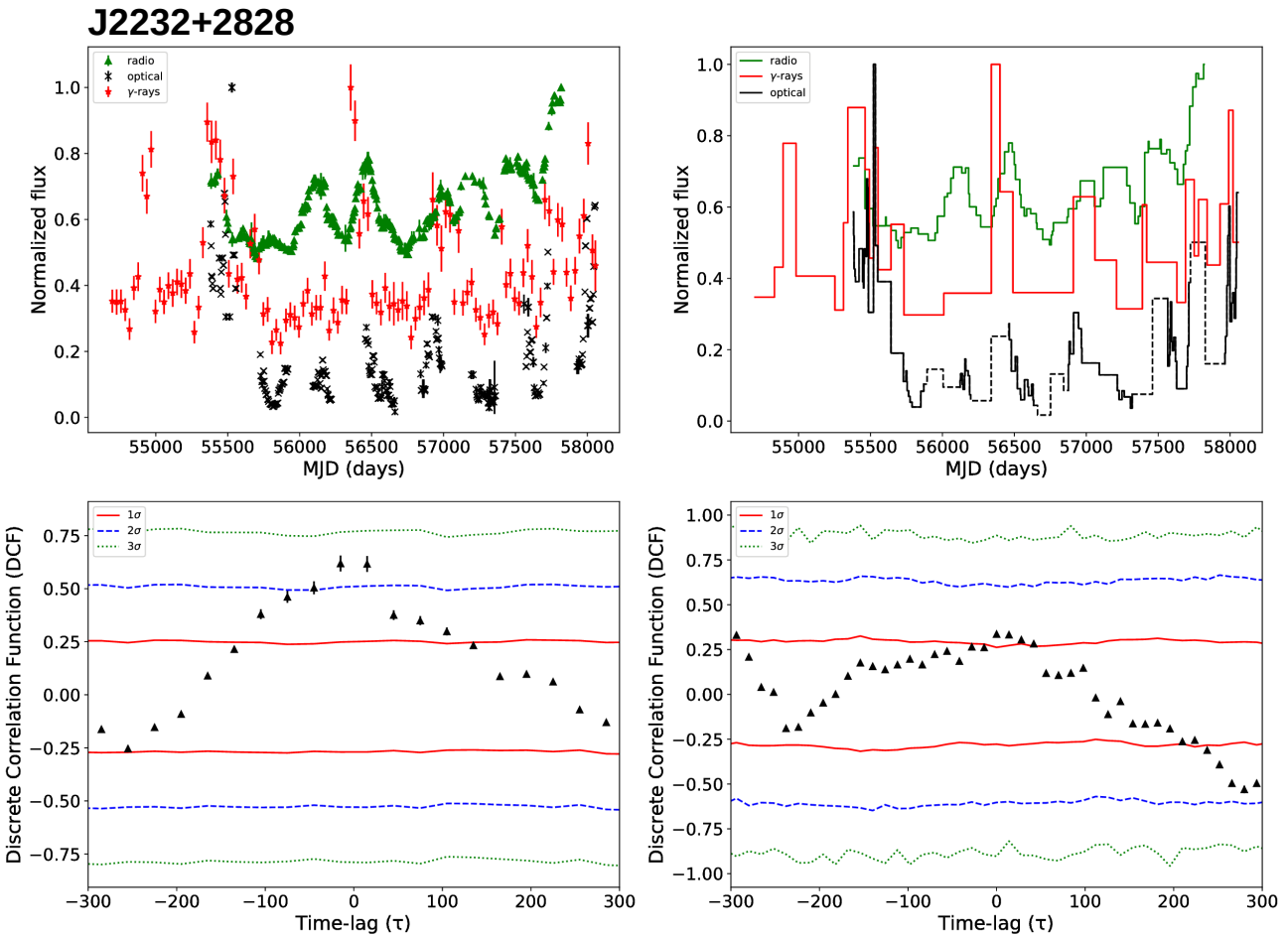

J0102+5824
J0521+2112
J0742+5444
J2012+4628
J2253+1608
J2345-1555
radio
optical
γ-rays
Normalized flux
MJD (days)

Tools

Time-lags: Discrete correlation function (DCF, Edelson & Krolic 1988)

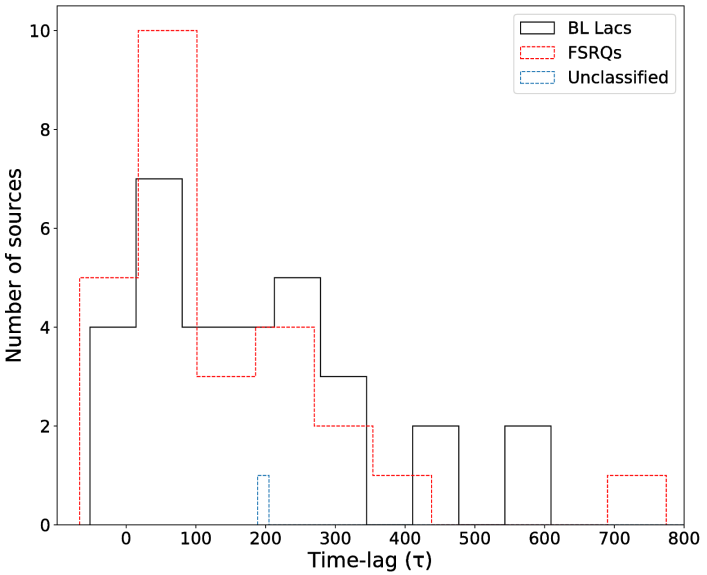
Significance of DCF: Source randomization method (Cohen et al. 2014)

Flare identification: Bayesian blocks (Scargle et al 2013)

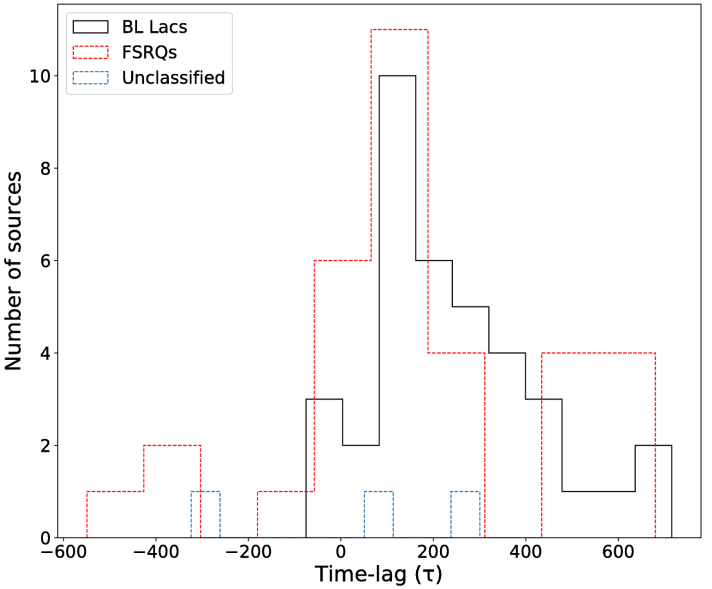


DCF results

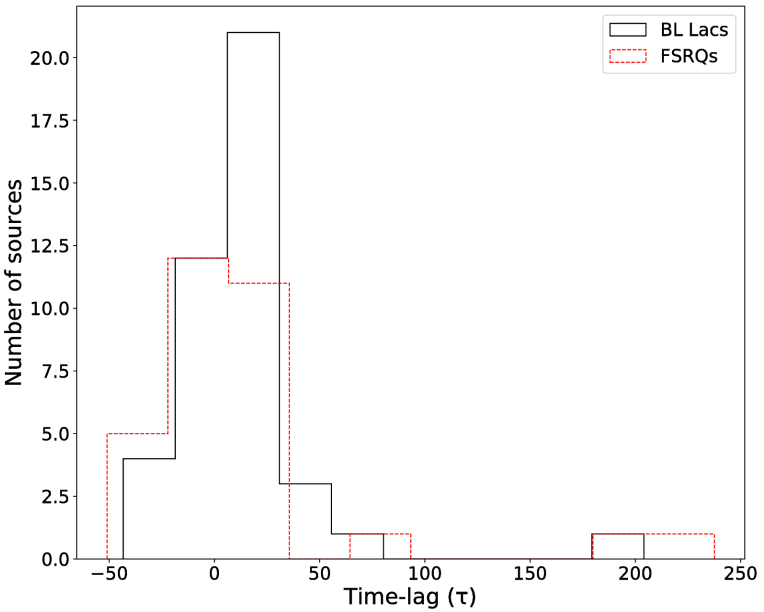
Optical-Radio



γ-rays-Radio



Optical-γ-rays



Flaring statistics

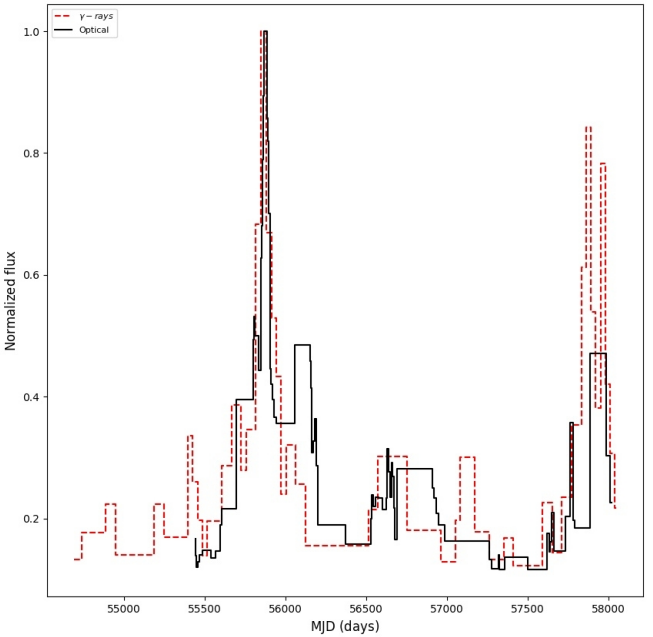
For the optical—γ-ray and optical—radio correlated sources 78% of radio and 86% of γ-ray flares are associated with an optical counterpart.

~60% of radio and γ-ray flares are associated for sources with a radio—γ-ray correlation.

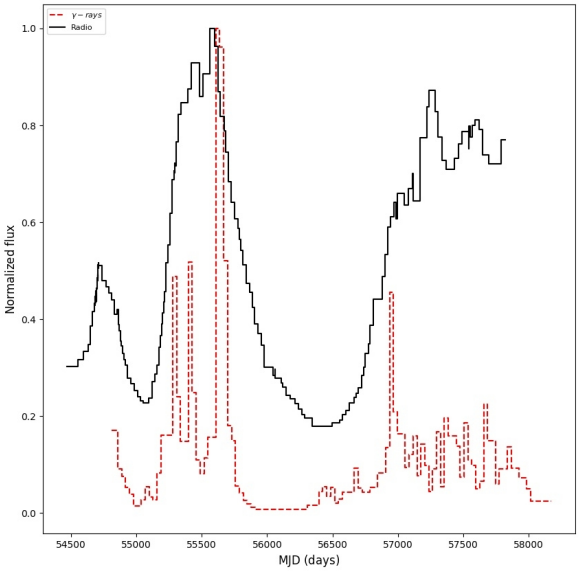
Associated flares have higher amplitudes than orphan flares for the optical—γ-ray and optical—radio correlated sources

No difference in associated and orphan flares in γ-ray for the radio—γ-ray correlated sources.

J0237+2848

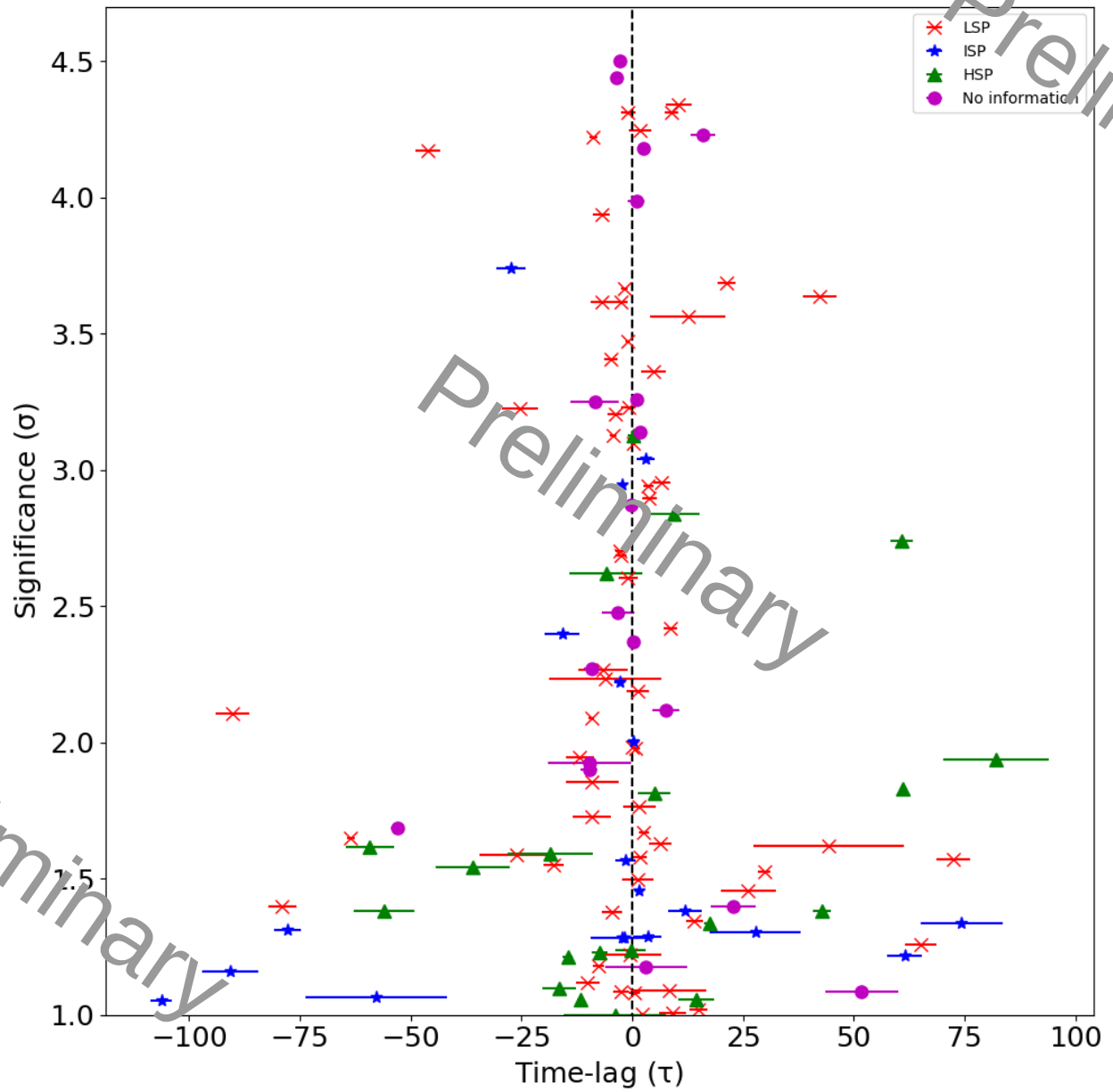


J2253+1608



Probing the optical to γ-ray correlation

All sources from KAIT +Steward observatory + SMARTS
+3-day,10-day binned γ-ray light curves



Summary

Explored the time-lags between optical—radio—γ-rays for a large number of sources

Radio is typically lagging both optical and γ-rays, exceptions exist!

There is a strong connection between optical and γ-rays suggesting IC scattering as the dominant mechanism

Associated flares tend to have higher amplitudes than orphan flares.

- **Additional analysis is underway!**
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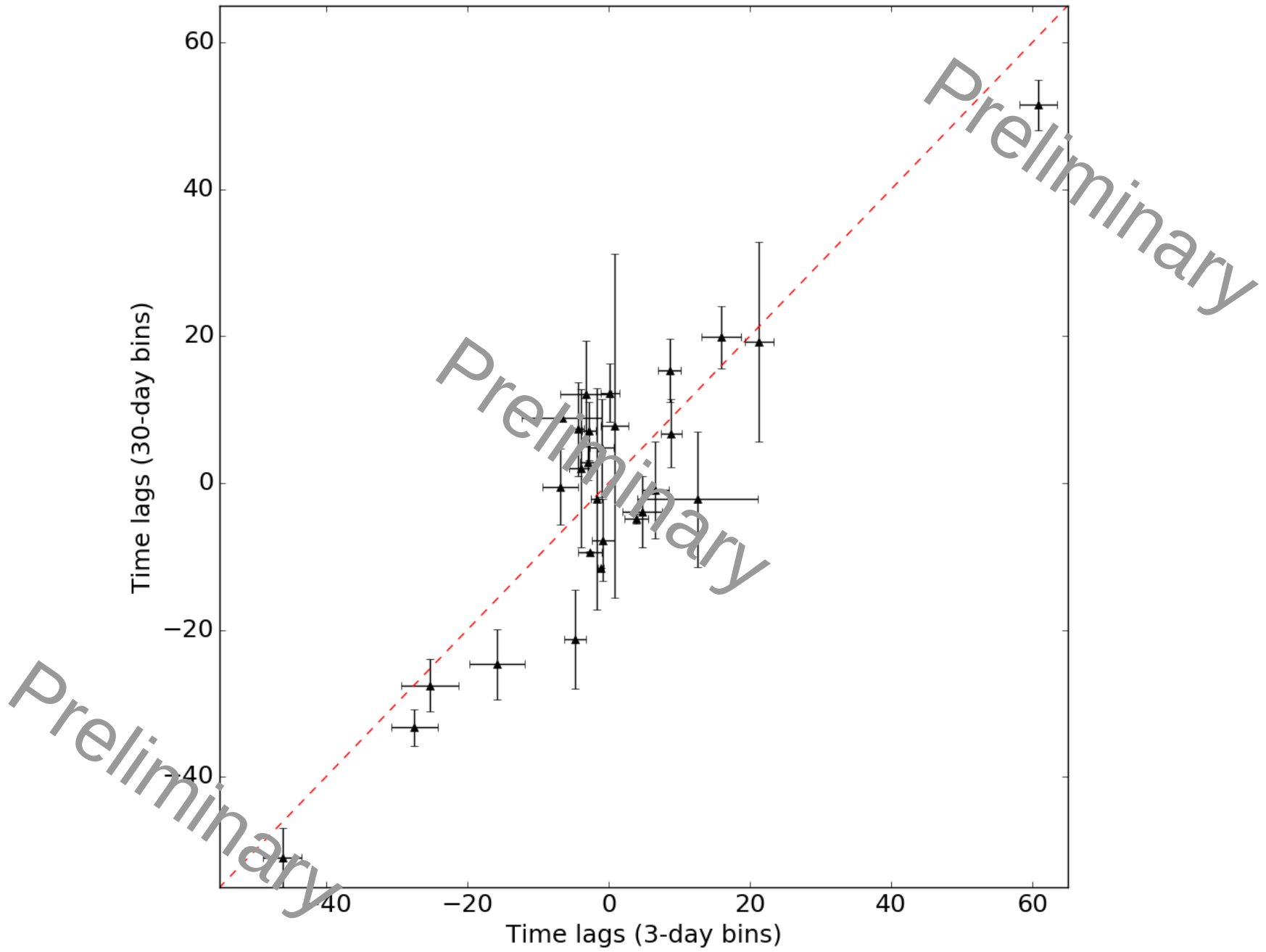
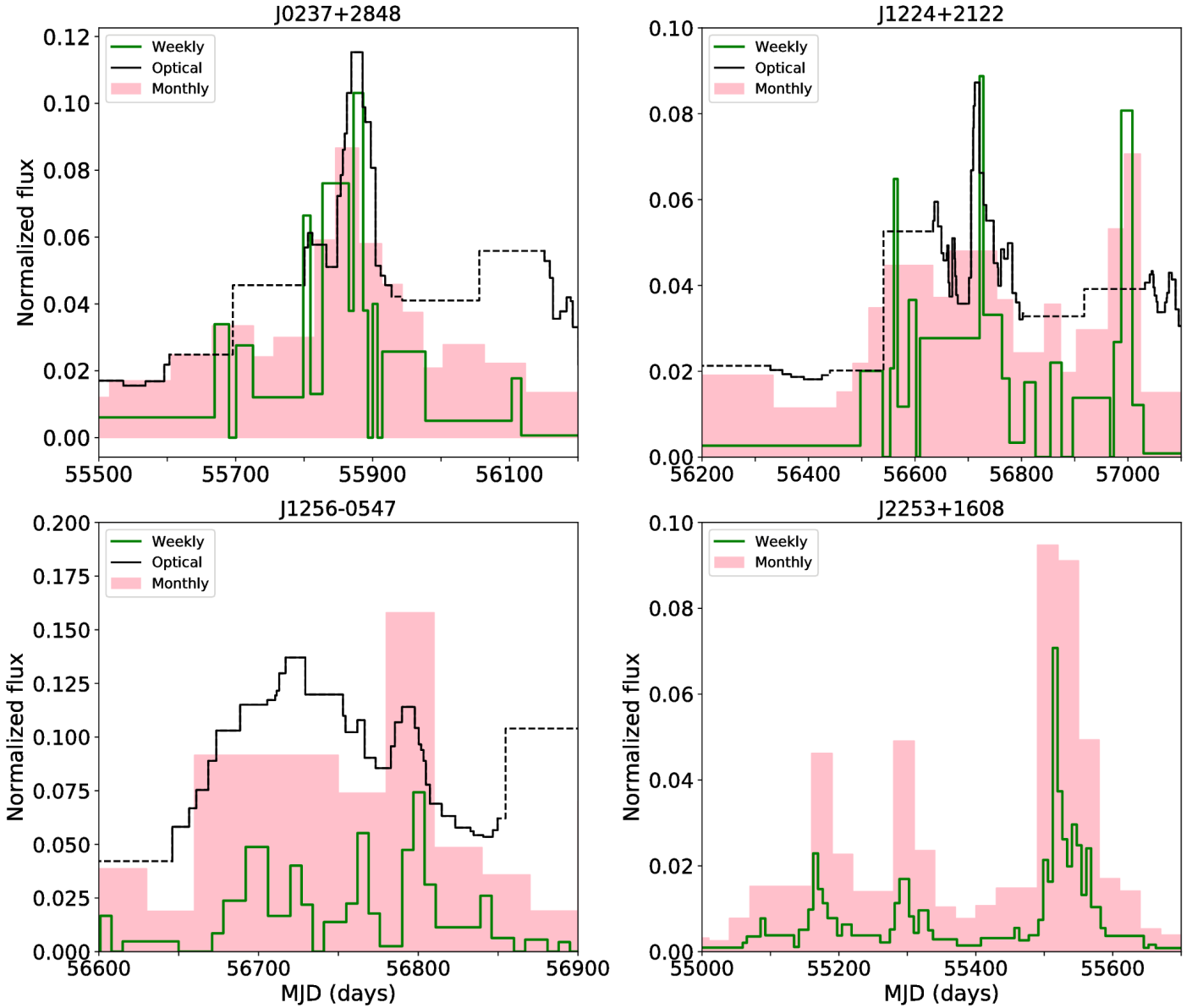
Thank you!

Additional slides

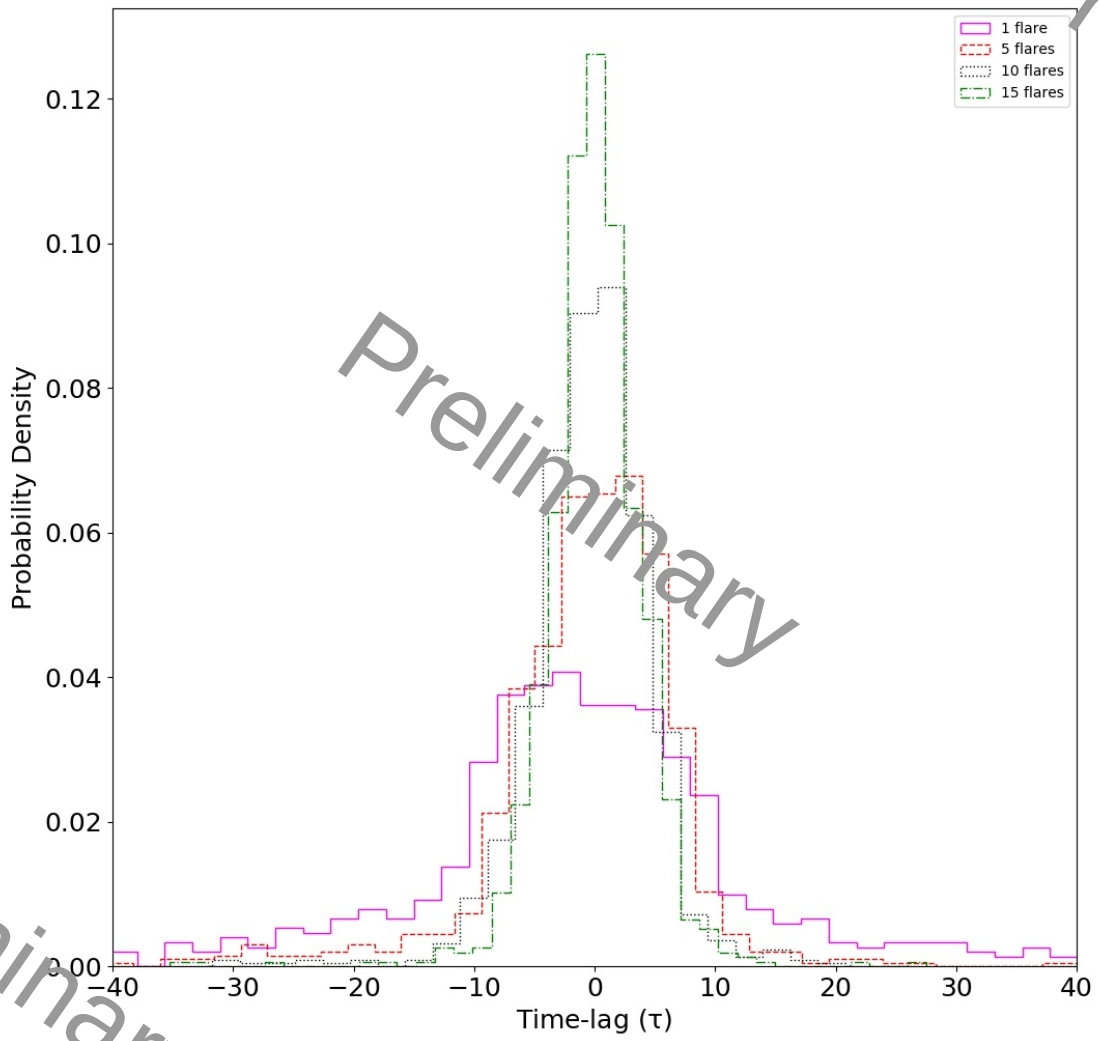
Time-lags: 30d versus 3d light curves



Block analysis: 30d versus 7d light curves



Are non-zero lags really non-zero lags?



Not necessarily!