Notes from the Workshop

Dave Thompson's Notes from the Workshop - These are largely unedited notes. I was not always able to identify the speaker. Please send corrections or additions to David.J.Thompson@nasa.gov

Svetlana Jorstad

Good example – Bl Lac. Cannot do this for every source. GASP group contributed.

1730-130 – normal – little X-ray, some optical

Emission line observations 1510-089. SMARTS + Paul Smith. Also polarization. Some correlation gamma-ray/polarization

Line variability only in gamma-ray-loud?

3C454.3 and 3C279 most spectacular gamma-ray outbursts. Unusual jet activity before the flare.

3C279 ejection in 2010, then optical raised to higher level plateau. Maybe same with 0836 recently.

When have bright knot ejected, should watch. Theorists pay attention.

Alan Marscher

Best case when have monitoring programs.

X-rays: Swift monitors blazars, but mostly observes flares. ASTROSAT may help, but may concentrate on monitoring for short periods.

Not good IR coverage.

Missing observations on non-prominent objects.

Theoretical models have not kept up with observational data. Need things beyond one-zone models.

Needs

More VLBI – mostly done for well-known objects. Maybe follow new TeV sources.

Wavelength-dependent optical polarization to test turbulence, reconnection models

ROBOPOL complements Arizona observations, but hard to add sources to list.

Kanata is not so constrained on sources.

Better X-ray, UV, IR coverage:

Monitoring of emission-line profiles: follow-up of Isler et al, Leon-Tavares results

Paul Smith does about 2 dozen regularly. SMARTS does some, too.

Really short on human resources.

Long enough data train to do power spectra. Need care in analysis. More data and imaginative analysis. Sort out order from noise.

Demos - any universal properties, like width of flare vs. wavelength? Not all the same.

Time scale of

Alan - Not all the same. Study the ones with best data, not systematically.

Standard analyses needed. Connections have not been searched systematically.

Demos = need small number of parameters.

Vovk: Monitor slightly misaligned sources?

Alan – don't gain much with misaligned jets. Practical limitations on some of these.

Stefano – GAIA database may be useful. Complement VLBI for reference frame.

SJ/AM – Kepler monitoring some blazars. 2018 observe 3C279. 3C273 next summer. Maybe combine with long looks with XMM

Wagner – we tend to do what we can do. Maybe be more systematic, with different scales for different sources. But then find only things with that have those cadences, as MOJAVE and BU programs do.

AM – optical groups have little coordination. GASP does some, F-GAMMA does some, but we could do better. No data depository. No optical polarization database, for example. Fear of being scooped, but lots of data.

EA - ROBOPOL planning general data release.

Problem is people power. Collect, analyze, publish, then make public.

ML – issue in Chicago workshop. One thing that came out – can use Matt's list of who observing what. Maybe publish schedule. Easiest way is to have each group list past schedule as text file on their Web site. Then Matt could access it. Matt will send out suggested format.

Matt Lister - demographics

tinyurl.com/agndemographics

Very broad range of observations. See biased subsets, not broad-band observations. Fermi has wide energy band, so can spot wide range of synchrotron peak objects.

To convert to demographics, need to know ranges of parameters.

Luminosity functions – all related. Like to know unbeamed function.

Unidentified – how many are blazars? Can we predict SEDs at lower energies based on Fermi data?

Fundamental properties? Which are most useful?

Stars – mass is the key parameter. Something similar for blazars? Maybe too many?

Classification systems now are complicated.

Justin – things have been done in radio, gamma-ray, others? Would it make sense to try to connect the various ones?

ML – 2MASS. Cross-identification by position (except for Fermi). Obscuration effects, accretion disk swamping jet, so not quite as clean in optical and X-ray bands.

BL – dependence on luminosity/synchrotron peak/ photon index - driven by different flavors of BL Lacs. FSRQs show no patterns. Almost all low-peaked.

ML – BL Lacs. Large range of Compton dominance makes it hard to find patterns. If SSC, then easier for two peaks to track each other.

JF – why are FSRQs all low-peaked? Seems to be a key question

SJ – are quasars special?

ML – non blazars hard to detect by Fermi. Statistics not good enough for patterns. Hard to test unified models.

SJ - include low-luminosity AGNs.

ML – target low-redshift AGN to see if can be detected?

SJ – need very compelling science case

ML – need good prediction of what could expect. If understood SED well enough, could predict gamma rays. But don't even have good information about synchrotron peak, no IR for example. AGNS not popular with those facilities.

DT – ALMA calibrator sources data are public.

SW – are population studies coupled to long-term variability. 0528 was bright throughout EGRET, now hard to see. Synchrotron peak has not changed.

ML – part of problem is we know most from a few objects.

SW – what could we do to track down long-term trends?

ML – delve down into less famous sources. Sense of looking for keys under streetlight. If went down a little could study a population that might be just as extreme. Could be useful to study the ranges. How variable are quantities in blazars? How often do sources change categories.

BL – variability decreases with synchrotron peak frequency increase. Huge changes. Difference from EGRET sources that were bright.

JF – Fermi not a problem. Other bands a bigger problem. Hard to get time for non-exciting sources.

SW – seeing details of changes with Fermi can be difficult on short time scales. More coordination with ground-based instruments?

SJ – Only Mkn 421 501 have really detailed SEDs

SW – more joint exercises. 2155 example – not easy to explain, so dropped. Not an extraordinary flare.

BL – using archival data. Some are old. Hard to have confidence in correlations.

ML – How can more Fermi observations contribute? Series of suggestions.

BL – long term variation of Fermi energy index. Could be done.

ML – alerts when spectrum changes.

Sara – recently have focused on index changes. Do see smaller flares, but do not spam community. Could make more information available.

ML – key MW. Better synchrotron peak coverage. Maybe lower threshold for announcing flaring from unid sources.

Discussion of flare advocates work

ML – open questions

Finding associations – better ways?

BL – open to suggestions

ML – list contacts for topics on Fermi pages?

Dearth of ISPs. Wavelength coverage or obscuration?

Justin Finke – SED modeling

Is there something that the Fermi LAT Collaboration can do?

Faster alerts – really would like these!

Distinguish leptonic/hadronic models?

AM – hadronic requires higher power. Could look at radio.

JF – still seem viable for HSPs, but not for others

ML - correlations for hadronic models?

JF – not sure

ML – also relates to variability properties. How change during a flare?

EA – anything with polarization?

JF – yes, different prediction for leptonic/hadronic models? Not sure whether affects regions that can measure polarization. Really applies to Compton component.

Any predictions for synchrotron peak?

JF – not really. Neutrinos can make the distinction, however.

Emerging trends? Blazar sequence. But selection effects (Giommi). Also ISPs have filled in.

SJ – positions can change

Reshmi – TeV sources do show this. Peaks move when flaring.

IV – should we expect trends if have multiple components?

BL – SEDs are long-term averages. Can find counter-examples in single flares. General trends are not the whole story. Compton dominance can change.

IV – What is long term? Sources are not stable.

BL – good point. Average flux, but do see correlations.

ML – another way – look at large-scale radio power (as Meyer did).

SJ – Doppler factor

JF – TeV blazar bulk Lorentz factor crisis: measured values disagree with what is needed in models. Decelerating jet? Spine/sheath? Any way to distinghuish?

EA – polarization test?

Possibly

What about M87?

JF – difficult case.

AM – maybe jet has large Lorentz factor, but smooth.

SJ – or hard to see movement?

JF – how to tell shocks from reconnection acceleration?

AM – polarization. Shocks should produce different wavelength dependence from reconnection. Not necessarily seen, but should be able to rule out extreme reconnection event. Paul Smith is starting to do that.

JF – are multi-zone models viable? Too many free parameters?

How do we reduce the number of free parameters?

AM – have to pick physical model. If not, have too many. But have huge number of observations with many characteristics to measure, so may need more parameters.

AM – are single-zone models viable? Probably not.

JF – Can SED modeling constrain the location of the gamma-ray emitting region?

IV – What is real physical model?

AM – very little progress in SED modeling. Maybe time-varying SED modeling.

JF – maybe sometimes.

Stefan Wagner – Observing Strategies

Few sources well vs. many as good as possible? Smart cadence? Coordination?

Paolo – 3C454.3 – optical tends to undersample.

SW – match cadence to flux level. Go for the biggest flares – but does that bias the results?

If Few, then which ones?

Critical parameters? Everyone limited by dynamic range

Span range of luminosities (redshifts)?

Span range of Doppler factors?

Span range in thermal photon fields?

Span range in IC peaks, gamma_min…?

If many, must be sparse, how often? Coordinate?

PC – many optical orphan flares

ML – have few with lower Doppler factors, but biased against those in MOJAVE.

SW we all choose by what is easiest to observe

AM – have to do that, or end up with lousy data. Live with the biases. Might not have much choice.

SJ – only 30% of flaring gamma-ray sources have optical coverage. Cadence is important.

SW – how to be selective/smart wrt observables

What kind of data? Observe weak sources?

Pepa – TACs complain if don't get results

SW – produces biases. At least be aware of them.

Have we used optical color indices? Same question for polarimetry.

JF – can do cross-correlations?

Sara – use for modeling.

EA – Kanata has used multi-band polarimetry, ROBOPOL does not.

SW Can we agree on a few must-do's?

Flares – any? Specific sources? Flux level?

Paolo – If Fermi has to integrate for a week, it's pointless. Go for the big flares.

SW Plans in communities?

RM – optical triggers are important for TeV flares.

Pepa – also high-energy photons from Fermi

ML – will circulate memo about information sharing. Consider database for future.

University of Utah – Web page for MAGIC/VERITAS/HAWC Might post other information there.