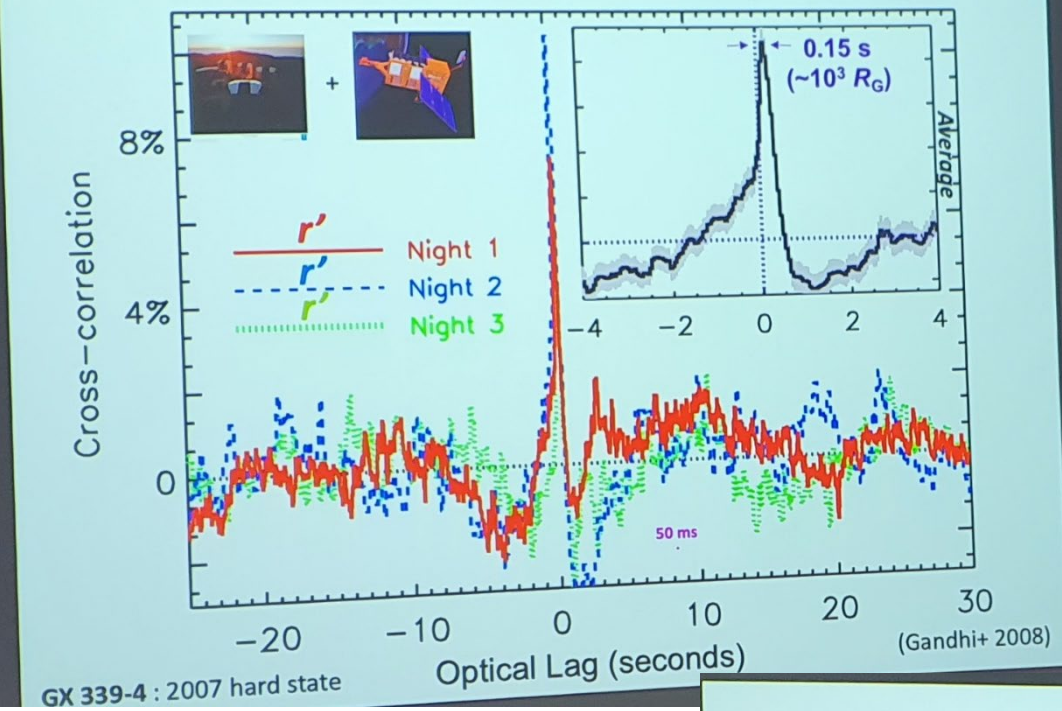
30th Texas Symposium

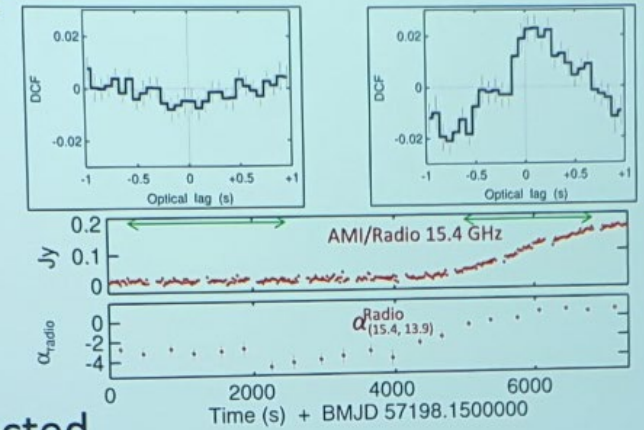
Sub-second X-O Cross Correlation Function (CCF)



GX 339-4 : 2007 hard state

Origin of sub-second delays?

- ~~Reprocessing?~~
  No. Too short.
  Too red.
- Jet?
- ~~Hot flow?~~
  No radio expected.



No opt./X anti-correlation. No QPOs.

Answering the Open Questions

1) What are the physical conditions associated with jet formation and launching in XRBs?

⟹ *B field ~ 10^4 G. Inner jet zone size ~0.1 light-second, but variable (what does it depend on?)*

2) Can we see the accretion-ejection connection in *real* time?

⟹ *Yes. Sub-second multiwavelength lags explained by internal shocks.*

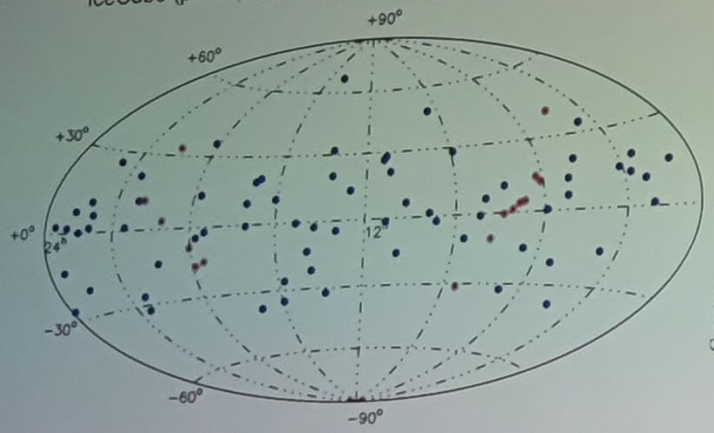
3) Can we tie models (MHD) with observational constraints (radiation)?

⟹ *Evidence for a universal standing shock at ~10^3 R_G. Does this apply to AGN?*

6) Evidence of neutrinos from blazars ... growing

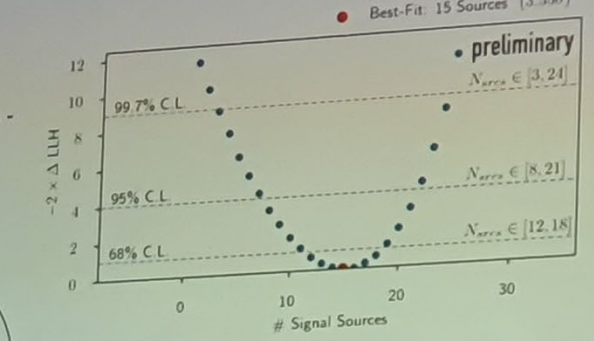
P. Giommi, T. Glauch, P. Padovani, E. R., A. Turcati, Y.L. Chang Dissecting the regions around IceCube high-energy neutrinos: growing evidence for the blazar connection,
submitted to MNRAS

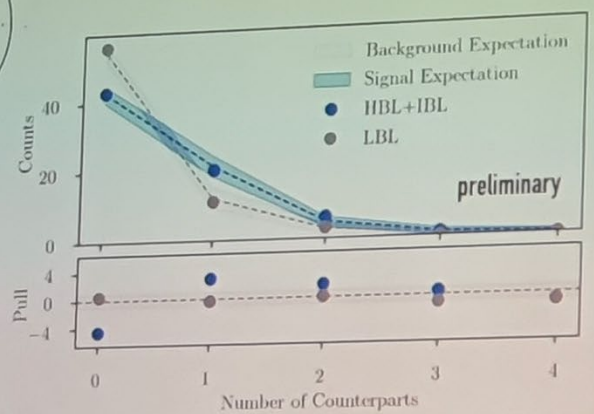
IceCube (public) high energy tracks in equatorial coordinates -



Low Galactic latitude in red (not used in the search for counterparts).

More than 70 gamma-ray emitting blazars found in spatial coincidence

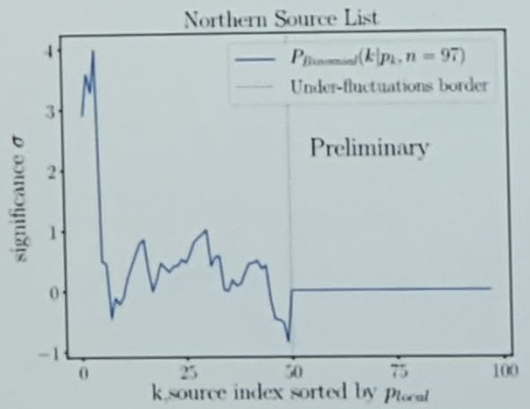


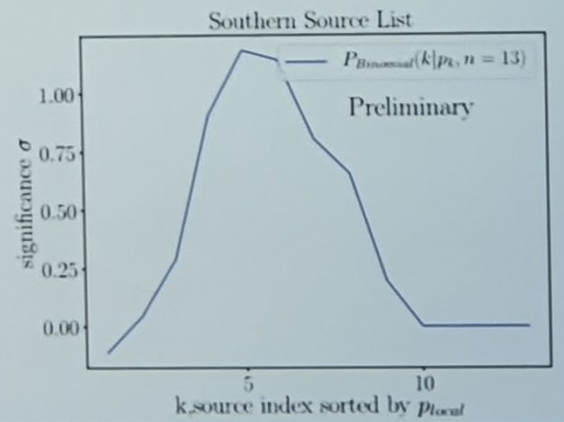


Source Population Results

Search for excess of hotspots → A significant p-value demonstrates inconsistency with background-only for entire catalog.

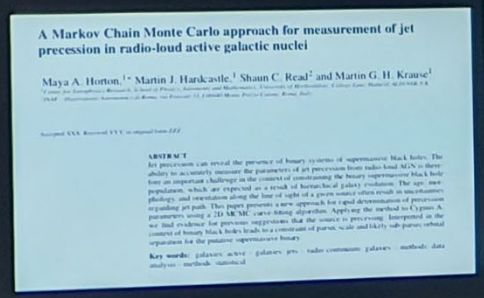
- Probability of k or more sources passing a threshold out of a catalog of N.
- 4σ pre-trial where k=4 in Northern Catalog.
  → 3.3σ post-trial. (2.25σ w/o TXS 0506+056) to account for N other possible excesses
- Includes NGC 1068, TXS 0506+056, PKS 1424+240,GB6 J1542+6129





MCMC SIMULATIONS

* Parameter searches on single and multiple jets
* Good constraints on precession period, phase, cone opening and position angle



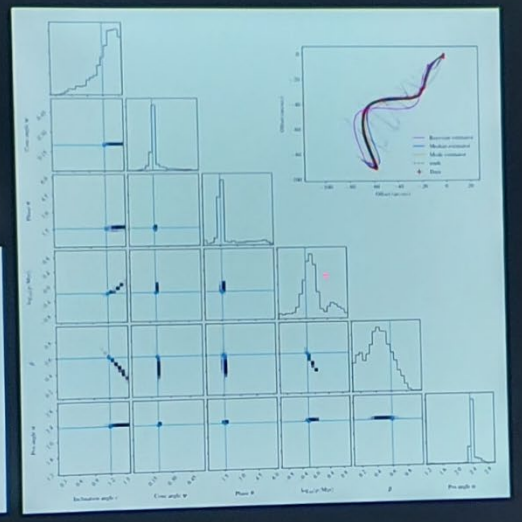
A Markov Chain Monte Carlo approach for measurement of jet precession in radio-loud active galactic nuclei

Maya A. Horton,[1]* Martin J. Hardcastle,[1] Shaun C. Read[2] and Martin G. H. Krause[1]

ABSTRACT

Jet precession can reveal the presence of binary systems of supermassive black holes. The ability to accurately measure the parameters of jet precession from radio-loud AGN is therefore an important challenge in the context of constraining the binary supermassive black hole population, which are expected as a result of hierarchical galaxy evolution. The age, morphology, and orientation along the line of sight of a given source often result in uncertainties regarding jet path. This paper presents a new approach for rapid determination of precession parameters using a 2D MCMC curve-fitting algorithm. Applying the method to Cygnus A, we find evidence for previous suggestions that the source is precessing. Interpreted in the context of binary black holes leads to a constraint of parsec scale and likely sub-parsec orbital separation for the putative supermassive binary.

Key words: galaxies: active – galaxies: jets – radio continuum: galaxies – methods: data analysis – methods: statistical



CYGNUS A

Real universe example

Cygnus A: large well-studied radio source showing precession characteristics and multiple visible knots in jet and counterjet