Blazar multi-wavelength studies with Rubin and the CTAO

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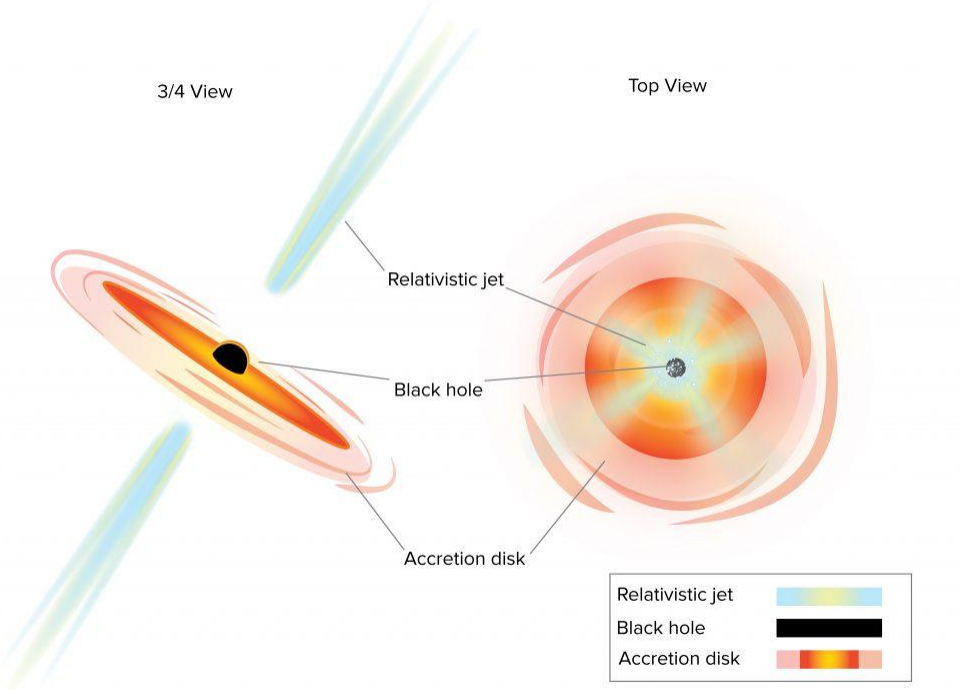
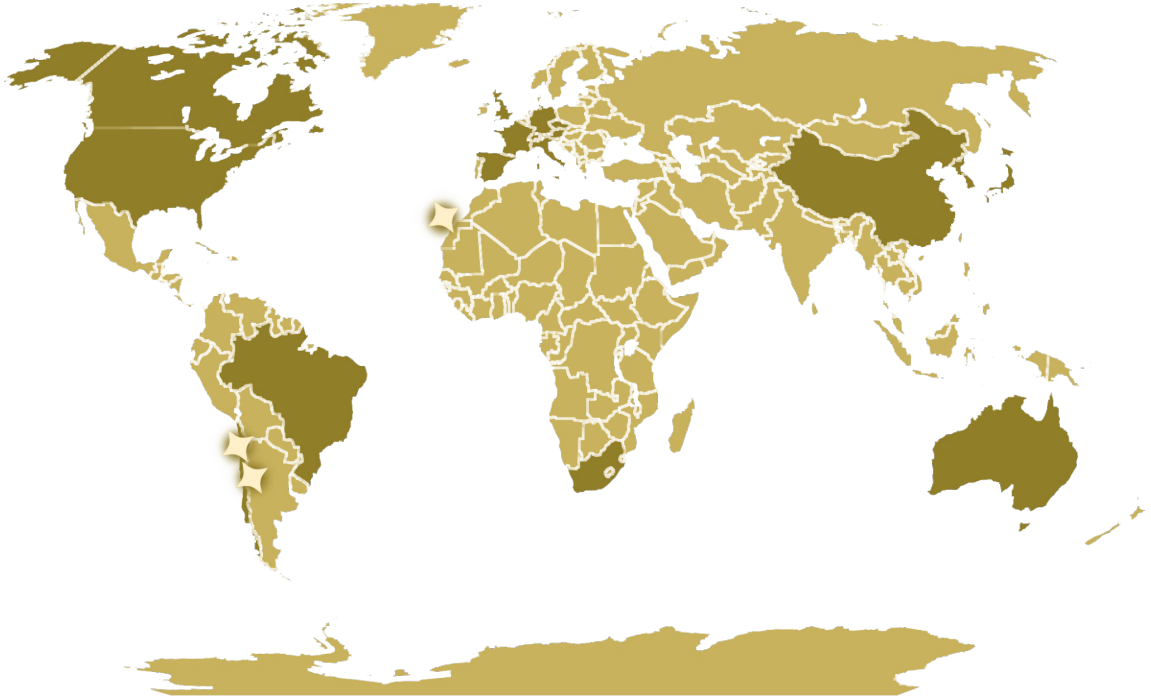
From AGNs to blazars

- Radio-loud jetted AGN, visible for far away (up to z~5)
- Jet pointing the line of sight
- Extremely bright compared to the host galaxy (up to 10-100 times)
- Extremely variable (~min to years) → hard to predict



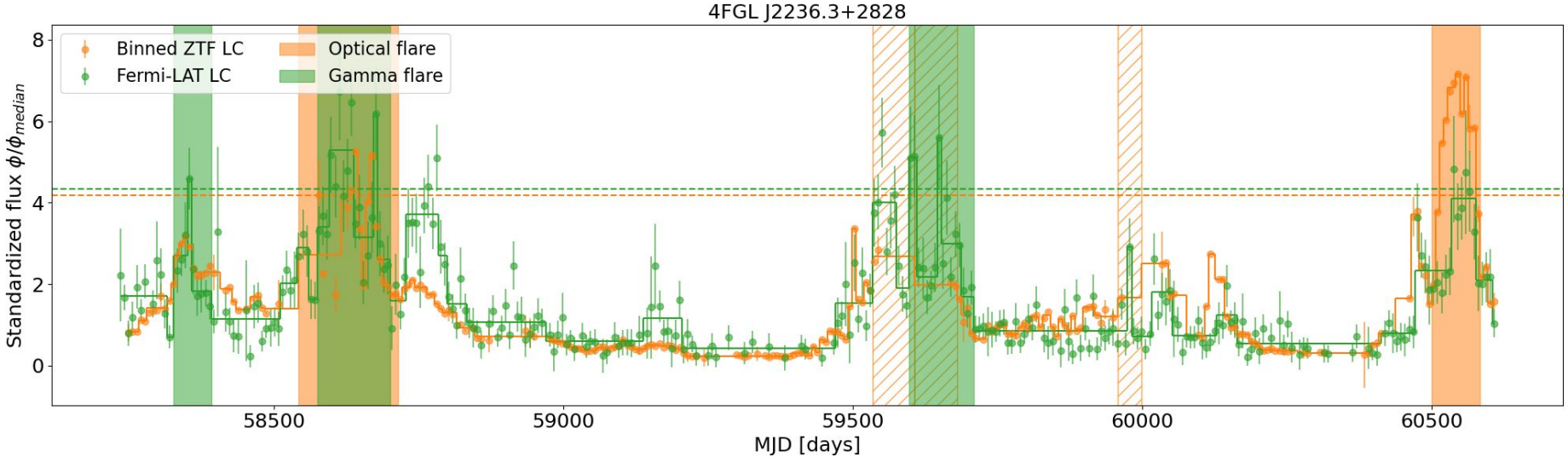
The new generation observatories



Credits: Gabriel Pérez Diaz

Credits: NOIRLab/NSF/AURA

Flare detection



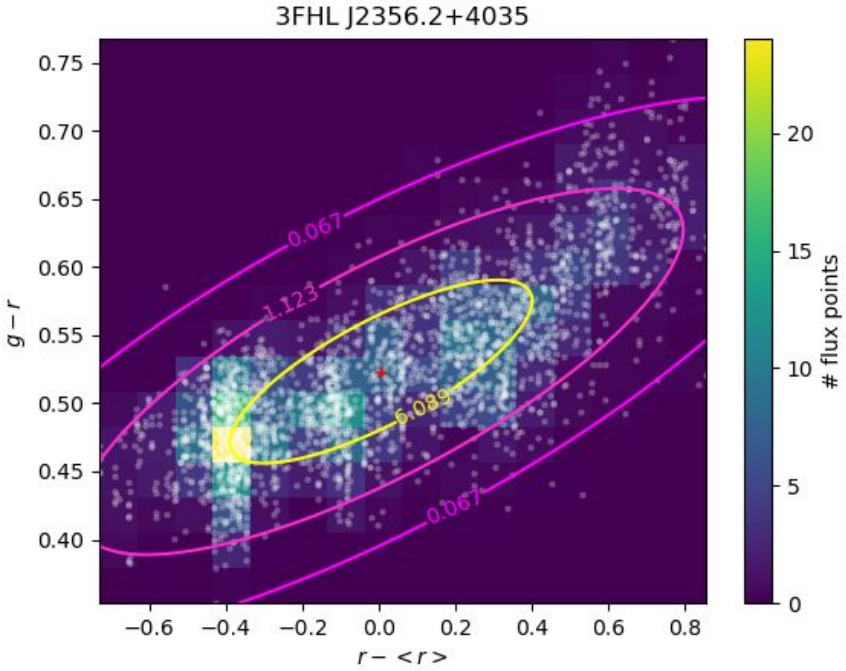
Independent detection of flare states:

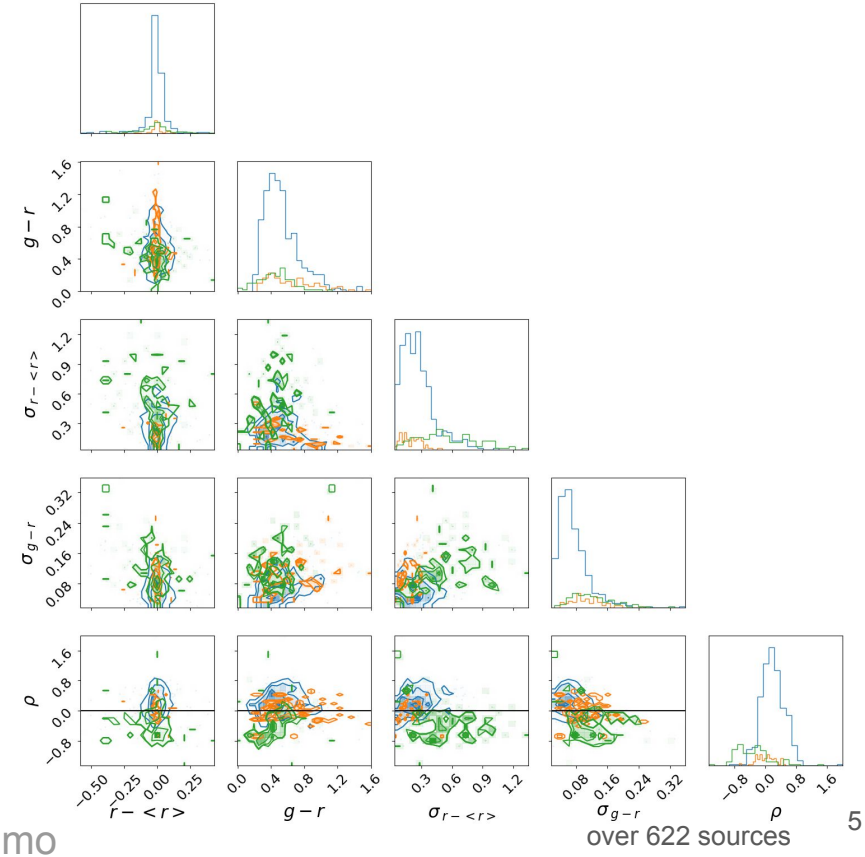
- Steady flux porudction state
- Detection of extreme state from CDF reconstruction

Multi wavelength behaviour:

- Only gamma flare → IC
- Only optical flare → synchrotron
- Cross bands flare → EC or SSC

Characterisation of blazar classes



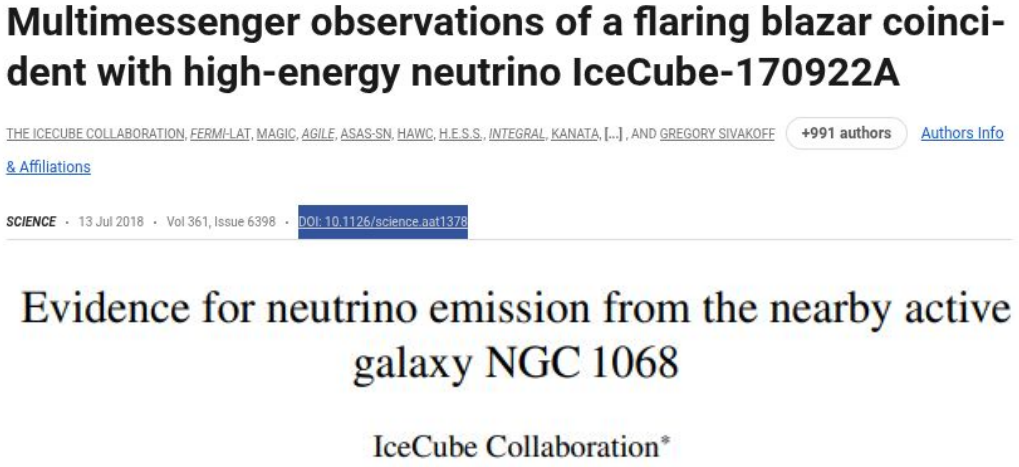


over 622 sources

Neutrino detection in AGNs

Hints of detection of neutrino production in AGNS

- For now: weak population evidences (1 blazar / 1 Seyfert)
- Constraints on emission models



Multimessenger observations of a flaring blazar coincident with high-energy neutrino IceCube-170922A

THE ICECUBE COLLABORATION, *FERMI*-LAT, MAGIC, *AGILE*, ASAS-SN, HAWC, H.E.S.S., *INTEGRAL*, KANATA, [...], AND GREGORY SIVAKOFF +991 authors Authors Info & Affiliations

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Evidence for neutrino emission from the nearby active galaxy NGC 1068

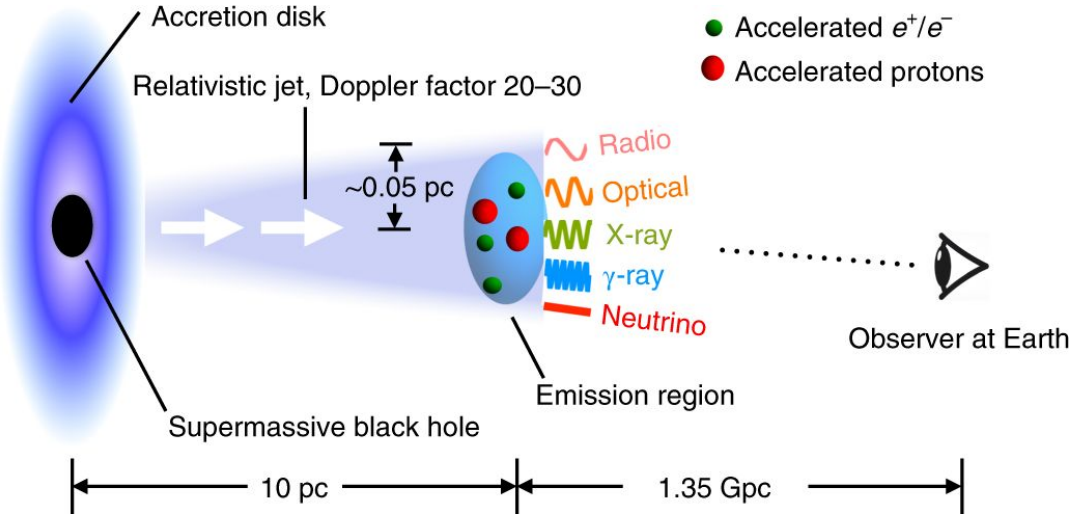
IceCube Collaboration*

Emission processes

Two concurring processes:

- Leptonic processes
  → EM emission
- Hadronic processes
  → EM + ν + cosmic rays

No ν detection: only upper limits on ratio
Now: detection ⇒ constraints on specific processes
→ cosmic ray emission models + flux prediction



Conclusion

Blazars are the most luminous persistent objects: astrophysical emission processes at cosmological distances

Optical characterization → improvement of blazar sample thanks to large scale optical surveys

Flare detection → comparison with neutrino emission for larger sample of blazars

Why that is important?: constraints on model emissions ⇒ understanding of extreme environment (accretion around spuermassive black hole) + part of explanation on origin of cosmic rays