

Impressions of the Workshop

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Most Disturbing Talk of the Workshop

First talk, which was about

JET observations and how the multi-waveband LAG is caused by

The DELAY OF FLIGHT TRAVEL of disturbances between the emission regions at different frequencies

+ The speaker suffered from time dilation caused by acceleration

from $v \ll c$ to $v = 0.98c$ ($\Gamma = 5$) so that 1 minute of speaker time = 5

5 minutes of audience time at the end of the talk

Some Impressive Advances in Understanding

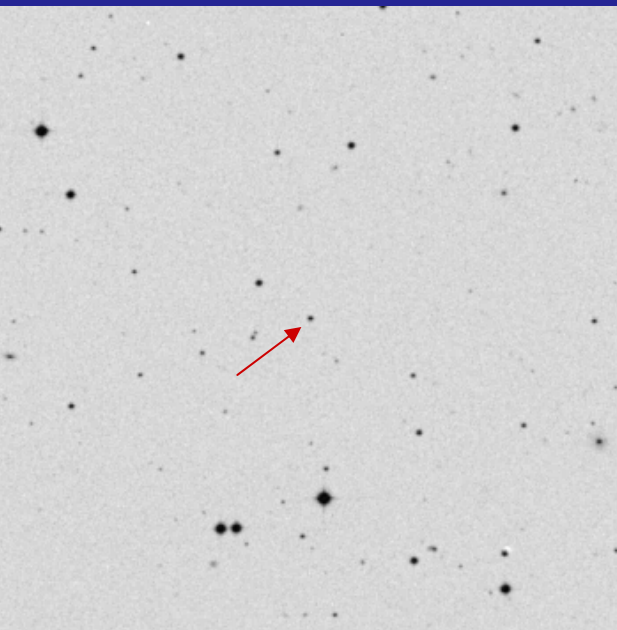
- Bob Becker: Able to measure properties of undetected sources
- QSO host galaxies are giant ellipticals, radio loud or quiet
- IR interferometry can image pc-scale in nearby AGNs
- Extended jets produce X-rays
- We have some understanding of how BHs/disks makes jets
- Multi-waveband variability is revealing where high-E emission occurs and likely processes that produces it
- IR/X-ray flares in the Galactic Center inform us on processes very close to a massive black hole
- Jets appear to produce X-rays near BH in some (all?) XRBs
- Polarization studies support possibility of helical B fields in jets
- IR/submm observations reveal properties of AGNs in early universe (lots of dust already)
- High-z quasars are being studied with radio & X-ray imaging

Have we made progress?

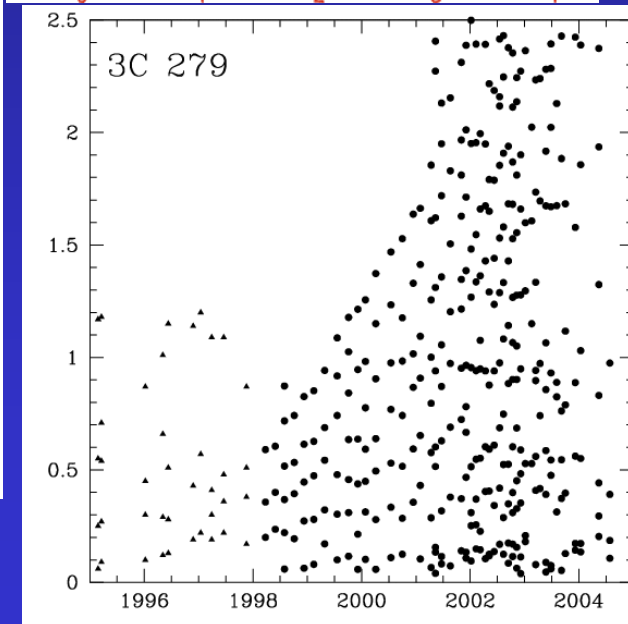
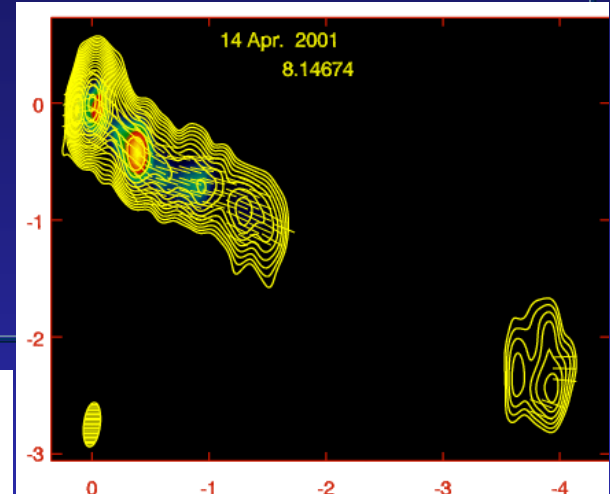
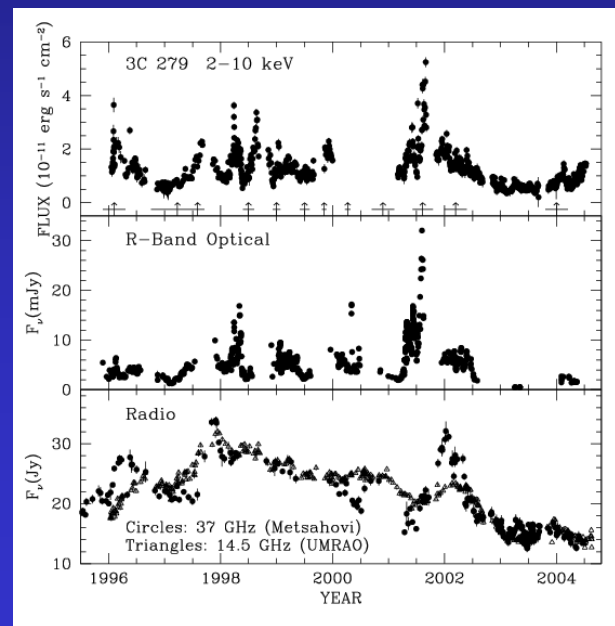
Certainly the data are much richer

We know much more about AGNs than was even dreamed of in the early 1960s

Our confusion is at a much more sophisticated level than ever before!

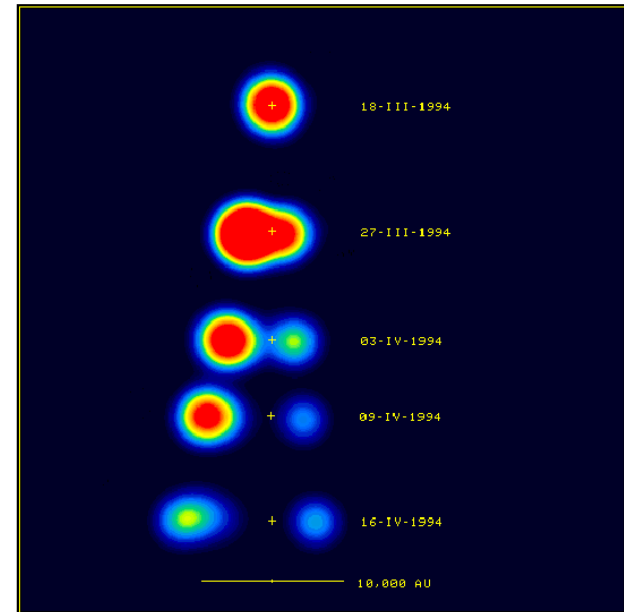
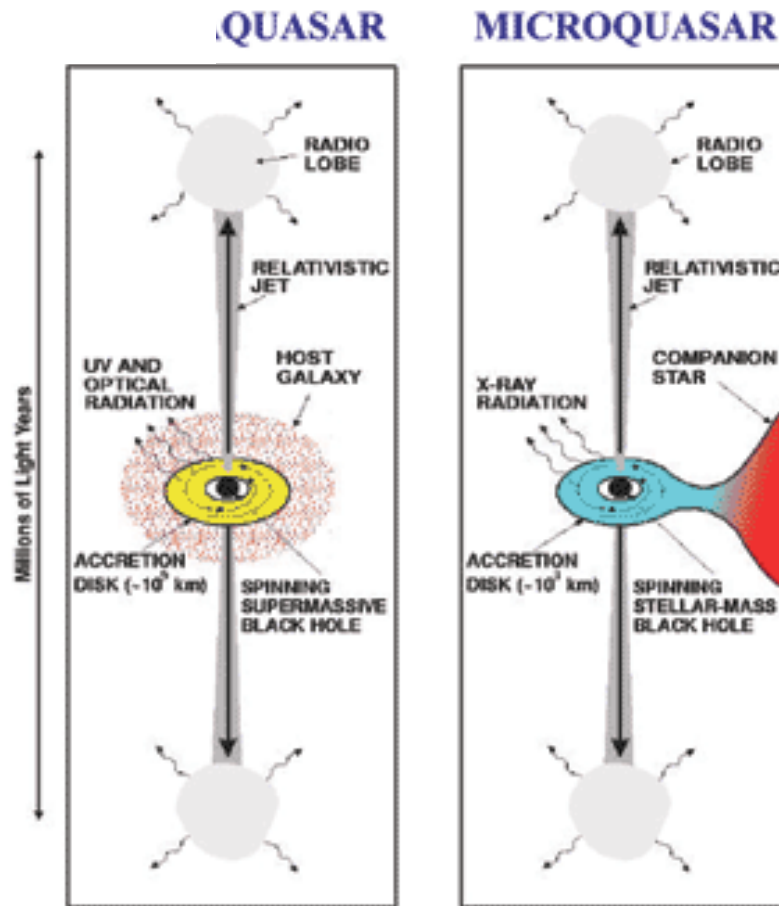


Quasar 3C 279
in the optical in 1960s



Cartoon of Quasar vs. Microquasar

QUASAR-MICROQUASAR ANALOGY



Are active galactic nuclei scaled-up microquasars?

Scaling Laws

If X-ray dips in 3C 120 are related to those in microquasar GRS1915+105, timescales follow linear scaling with black-hole mass within a factor of a few

Conflicting scaling laws:

Size scale $\propto R_s \rightarrow$ scales linearly with M_{BH} and L_{edd}

But emission line region size depends on ionization, so $R_{\text{BLR}} \propto L_{\text{UV}}^{0.5}$

Reverberation mapping gets the result $R_{\text{BLR}} \propto L_{\text{UV}}^{0.7}$

--- “Exercise for students” to explain why then emission line properties do not depend strongly on luminosity

--- Another exercise for students: Determine how the size scale of a jet should vary with M_{BH} & L

What Does Not Scale with Size?

Why we cannot simply scale microquasars up to AGNs

Ratio of cooling time to dynamical time decreases with size scale

Similarly, ratio of cooling time to acceleration/collimation time of jet also decreases with size scale

→ Inner accretion disk of an AGN is cooler than that of a microquasar

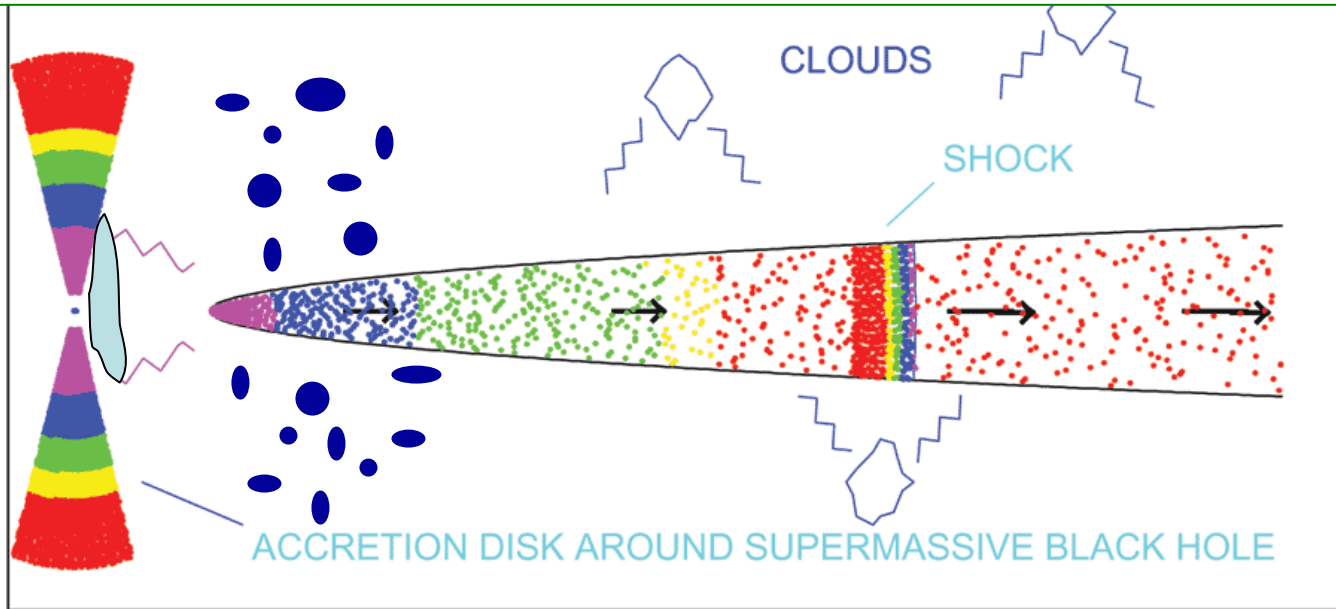
→ If X-rays come mainly from inner jet, might expect X-ray emission region to be more distributed relative to inner disk in microquasars than in AGNs

Scandals

- After many years of trying and many claims, we still don't have complete samples of quasars
- L. Gurvits plans to get VLBI images of 15,000 high-z quasars at fluxes ~ 1 mJy (requires 12-hr observation of each. . .)
- We still cling to single-zone, uniform emission models because they're easy despite knowing that they are wrong
- Jets can accelerate electrons to TeV energies hundreds of kpc from the nucleus, extending our embarrassingly poor understanding of acceleration processes
- Edges in X-ray spectra can be fit by either absorption or emission lines
- We confuse jet and accretion-disk emission
- 3D simulations show that jets get destroyed when perturbed
- Microquasars have periodicities, well-defined states; hard to find AGN analogies to such orderly behavior
- Our own Galactic Center is on a hunger strike

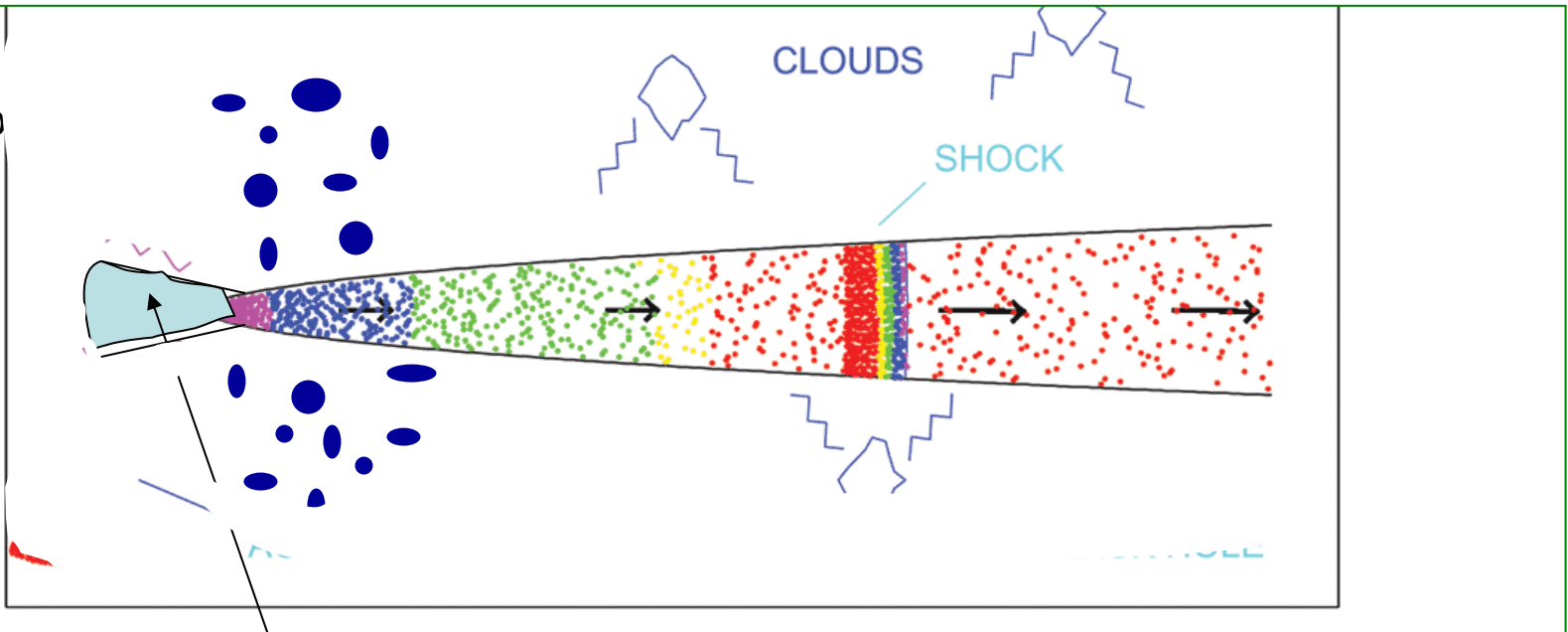
Changing Picture of an AGN

5 years ago



Changing Picture of an AGN as Informed by Microquasars

This workshop



Relativistic electrons in the innermost jet region do the job of the thermal electrons in the accretion disk corona of the old picture

Jet carries away a large fraction of the system's luminosity

ADAFs replace inner accretion disk

Partial covering might explain the broadened Fe X-ray line as well as relativistic effects

WHO NEEDS THE ACCRETION DISK & BLACK HOLE?