ASTR 1040 Recitation: Active Galactic Nucleii

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April 14 & 16, 2014

- Night Observing: Monday April 14 (8:30 pm)
- Midterm III: Thursday April 17 (9:30 am)
- Review Session: Wednesday April 16 (5:00 pm G125)

• Heliostat Observing: Friday April 18 (2:30 - 4:30 pm)

Today's Schedule

• Past/Current Homework or Lecture Questions?

Redshift

Quasars

Active Galactic Nucleii

• Faster Then Light Travel?



•
$$1 + z = \lambda_{\rm obs} / \lambda_0$$

Cosmological Redshift



How Do We Observe Cosmological Redshift?



Active Galactic Nucleii

- 1960s: observes newly discovered radio sources with visible light
- Typically look like normal galaxies
- 3C 273: looks like blue star, strong emission lines that did not seem to correspond to any known element
- After a few months, H emission at $z \approx 0.17$



Maarten Schmidt

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- Soon find many more objects with even larger redshifts
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- Given name Quasars: "QUAsi-StellAr Radio Sources"

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- Of all galaxies we observe, only 1% are "active"

What Powers A Quasar? Part I

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 yrs

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Only 1% of galaxies are "active" for 100% of their life

$$ullet \, \Rightarrow t_{
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m universe} pprox 10^{10} \, \, {
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- We measure L, which gives us $\dot{M} \approx 1~M_{\odot}/$ yr
- Can estimate their mass: $10^8 10^{10} M_{\odot}$

What Powers A Quasar? Part II

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- Look at "surface blemishes"
- Fastest possible variation gives a time scale
- Turn the time scale into a distance scale through propagation speed



What Powers A Quasar? Part II

What about their size?

- ullet Pretty short timescales: \sim seconds hours
- Gives size of a few light-minutes to light-hours
- \bullet Distance from Sun to Earth is \sim 8 light-minutes
- \bullet Distance from Sun to Saturn is ~ 45 light-minutes
- \bullet Distance from Sun to Pluto is ~ 5.5 light-hours
- \Rightarrow Black Hole!!

Quasar Characteristics



R. Orvedahl (CU Boulder)

AGN & Quasars

Quasar Characteristics

- Jets
- Broad Line Region
- Narrow Line Region
- Obscuring Torus



- Accretion disc is very hot, mainly plasma
- Magnetic field becomes trapped in plasma (Frozen-In)
- Field becomes wrapped around rotation axis



Figure 4.11 (a), (b), (c) The winding up of the solar magnetic field due to differential rotation of the Sun.

Frozen-In Condition



- Measure jet on sky (use VLBI for best resolution)
- Wait some time, measure it again
- Spatial & time difference give speeds of 6c??



Superluminal Jets Explained



Superluminal Jets Explained



We measure $\beta_T \equiv \frac{v_T}{c} = \frac{\beta \sin \theta}{1 - \beta \cos \theta}$

 $\beta_T^{\max} = \beta \gamma > 1$