The global properties of all variety of AGN

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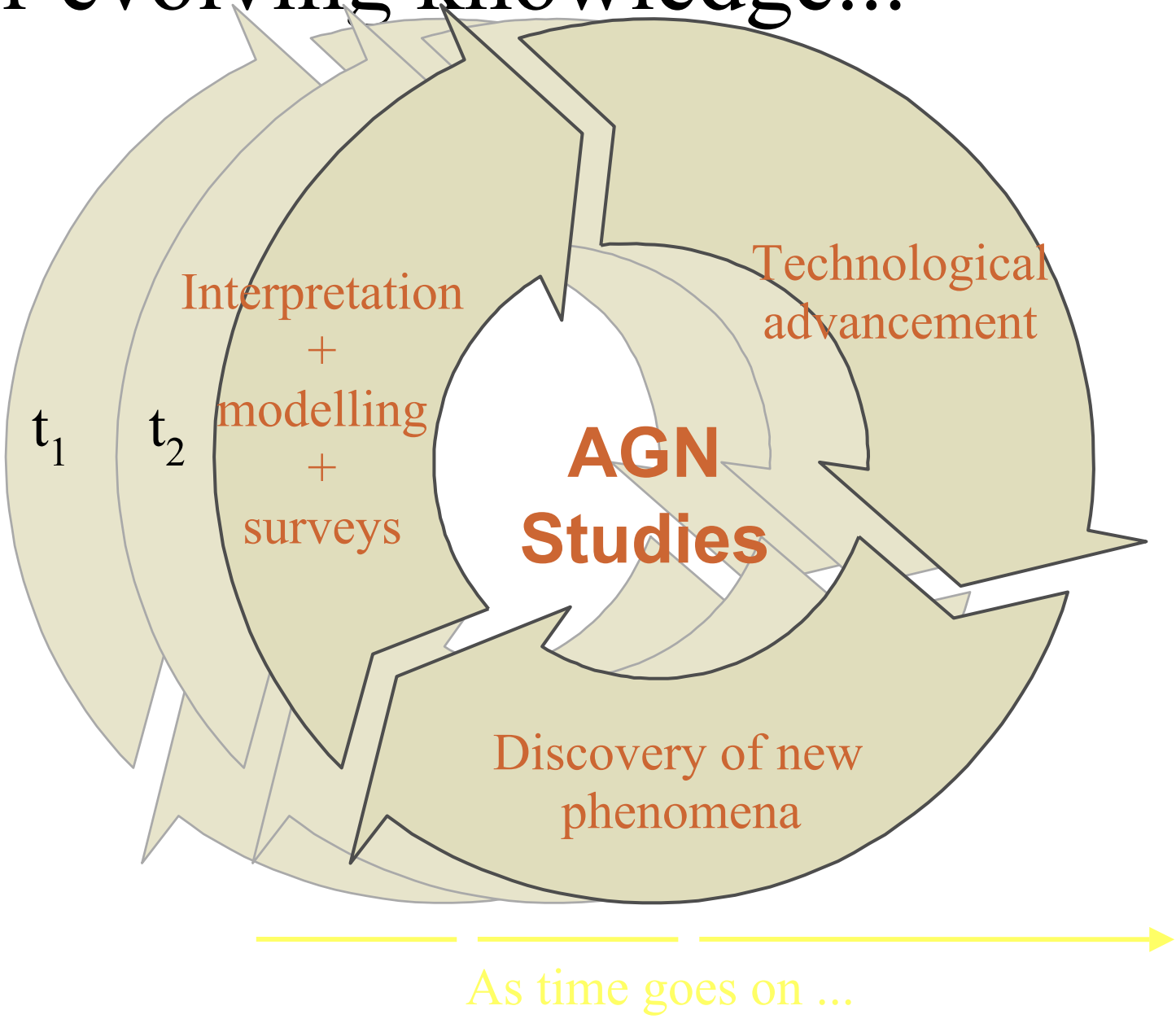
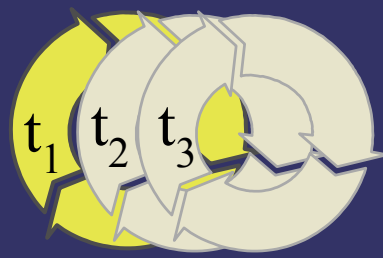
This talk

- *Review that emphasises the evolving nature of AGN studies.*
- *It hopes to present acquired knowledge about the properties of AGN but also to discuss how they are affected by technical capabilities and selection effects.*
  - *Two examples to illustrate this connection will be discussed.*
- *It will end with a preview of the properties we are still to understand and discover.*

Ever evolving knowledge...



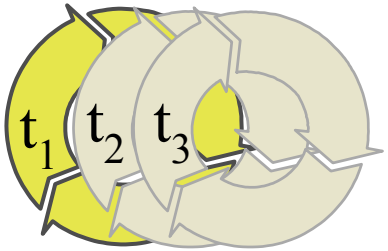
What is an AGN?



- ***C. Seyfert (1940's) studies galaxies with peculiar strong nuclei and broad emission lines***
- ***Radio astronomy (1950's) discloses galaxies with extended structures***
  - The optical identification of radio sources leads to

Sources with extra activity across electromagnetic spectrum

Ingredients of an AGN *(1/2)*

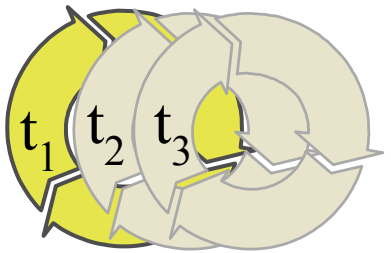


- ***Supermassive black hole***

+

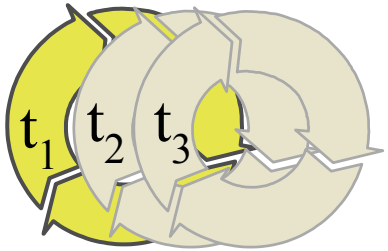
- ***Accretion disc***

Ingredients of an AGN *(2/2)*



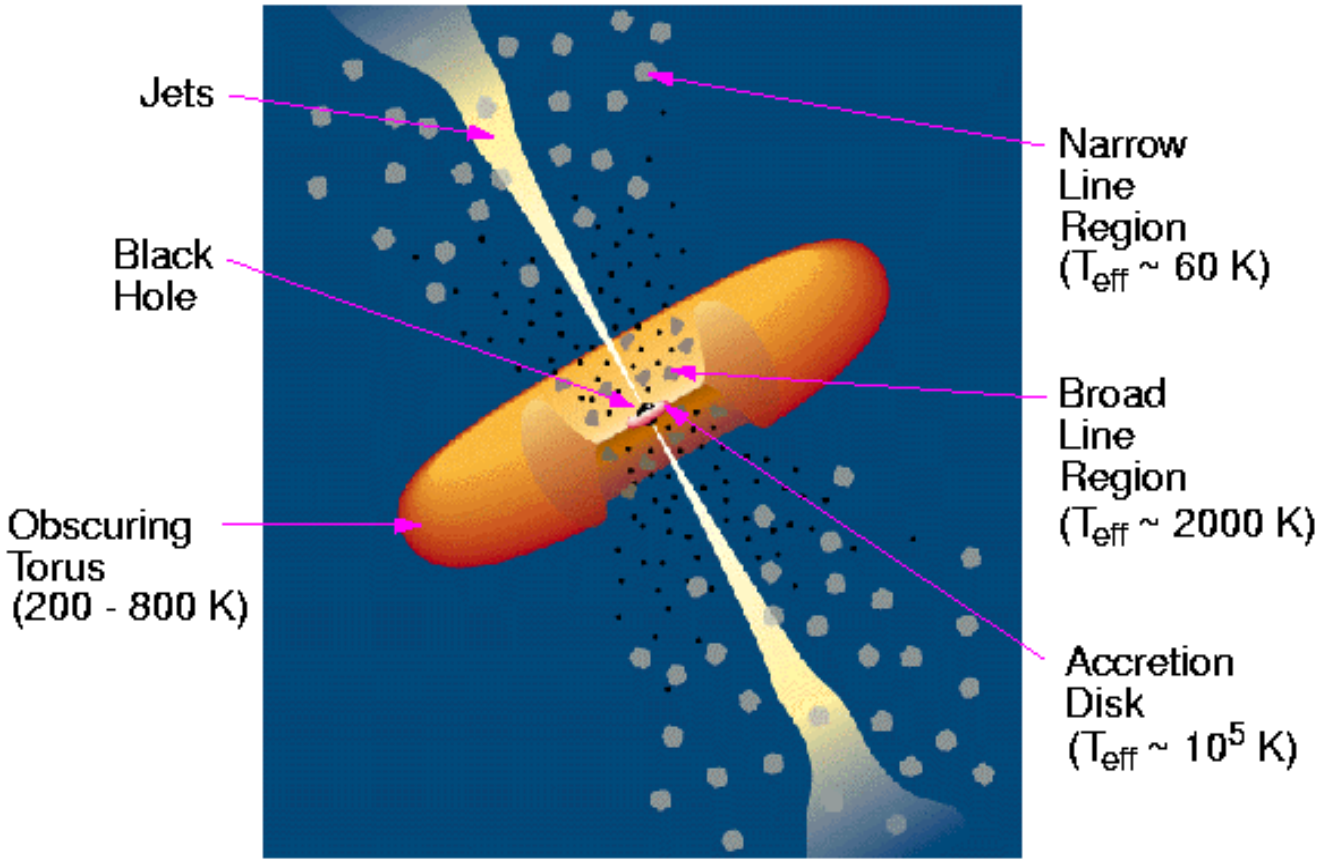
- *Broad line region*
- *Narrow line region*
- *Obscuring 'torus'*
- *Radio jets and lobes*
- *Variability*

Putting the pieces together



AGN Unification

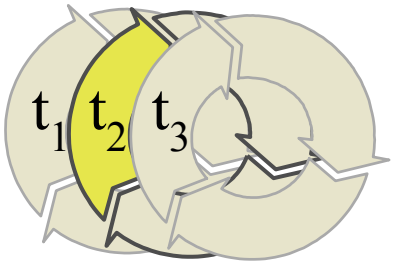
(Diagram from Urry & Padovani 1995)



But much remains to be done...

- ***How important is the lack of spherical symmetry?***
  - ***The same object will look differently depending on projection, relativistic beaming and obscuration.***
- ***What drives the different combinations of the same 'basic' ingredients?***

And another iteration starts ...



- *Classifying AGN (still...)*
  - *How does classification affect knowledge?*
- *Understanding relationships*
  - *How do the different components evolve?*
- *Understanding selection effects*

Classifying AGN (1/2)

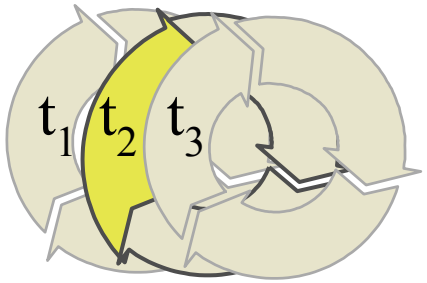
Classification depends on current knowledge and is arbitrary. Following Urry&Padovani, 1995:

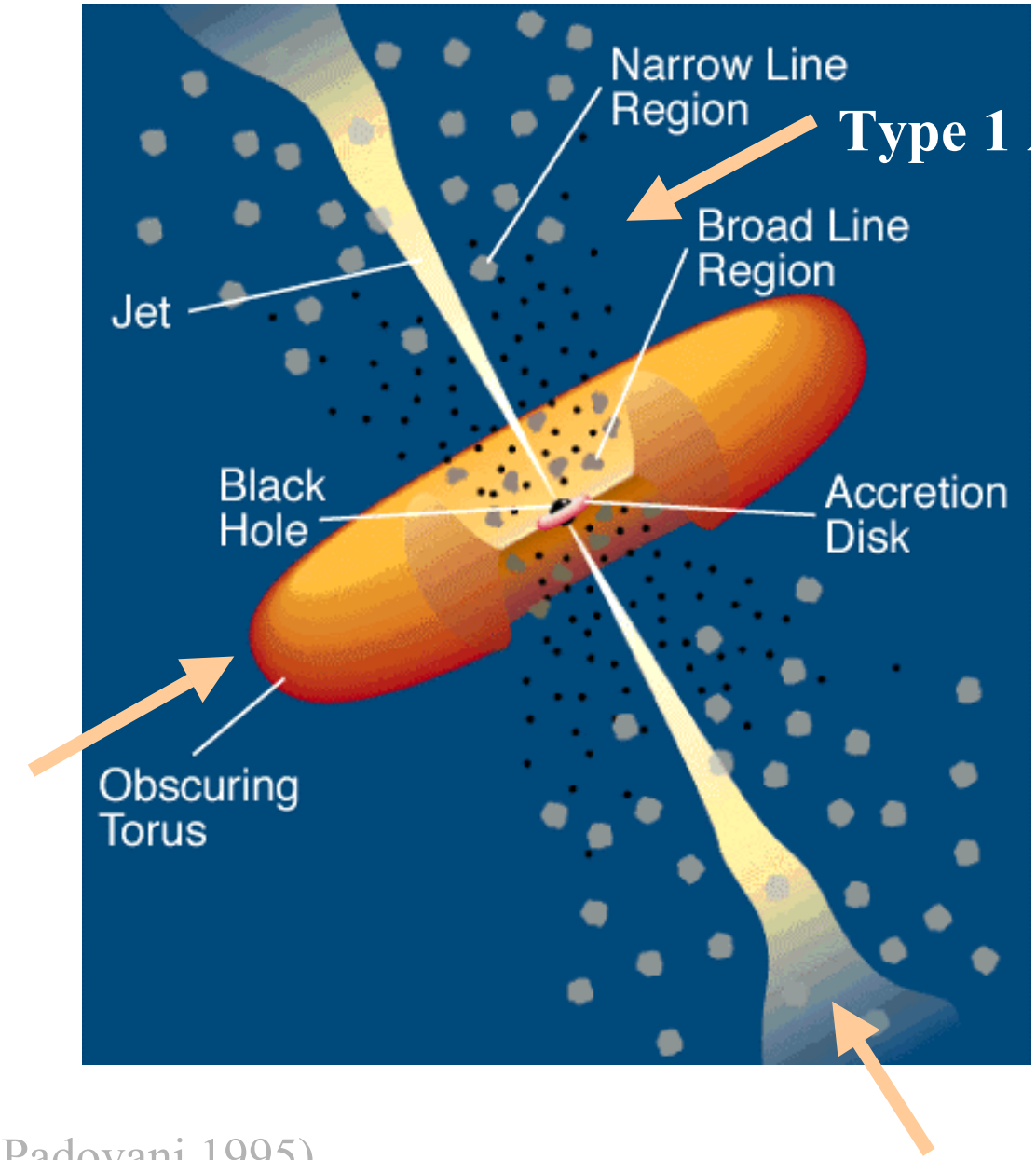
- ***Type 1 – sources with bright continuum and broad emission lines. These include the Quasars, Sy1 and BLRGs.***

- ***Type 2 – sources with weak continuum and narrow emission lines. These include the Sy2, NLRGs.***

- ***Type 0 – sources lacking strong emission or absorption features, or extremely polarised and/or***

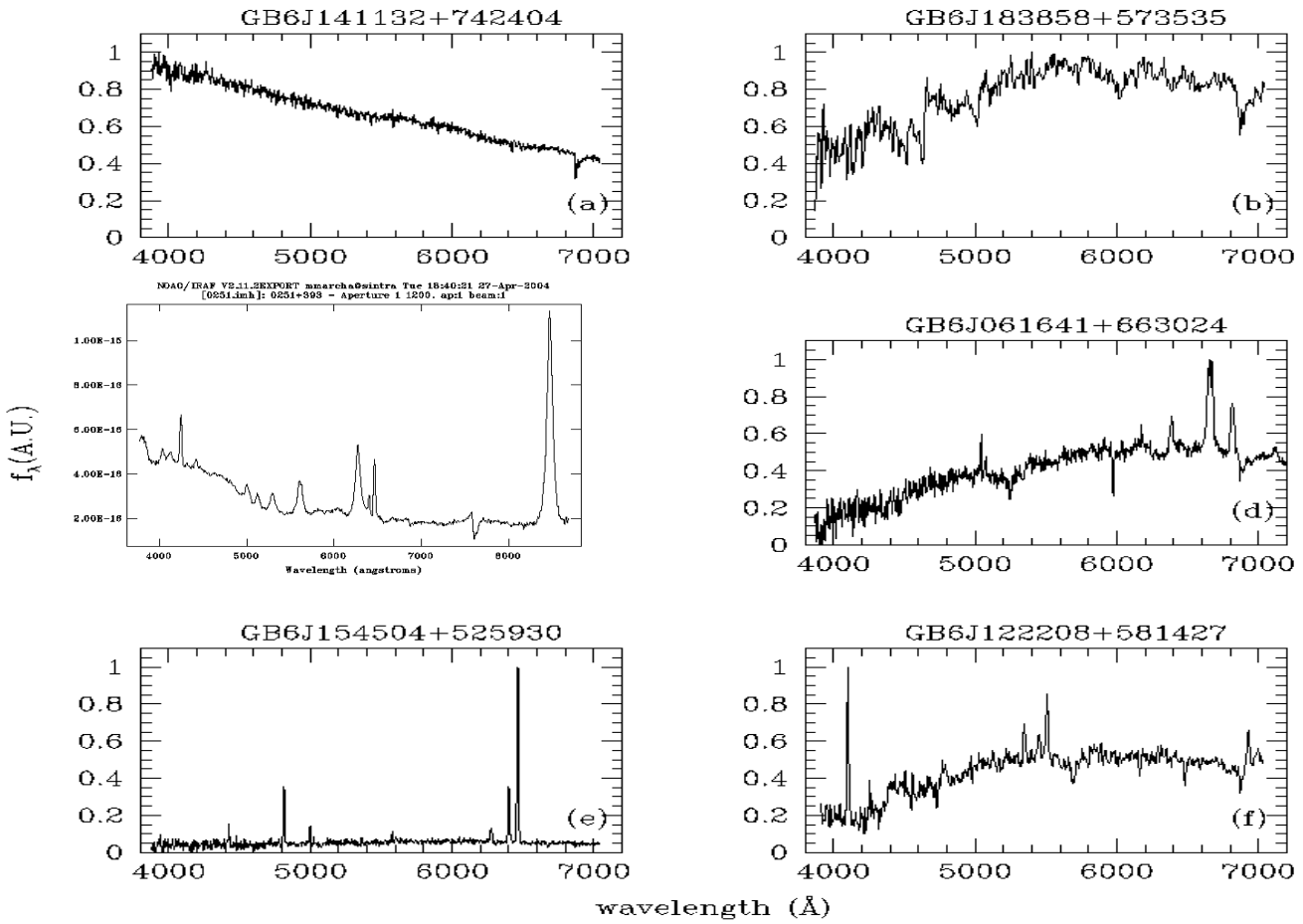
Classifying AGN (2/2)





(Urry & Padovani 1995)

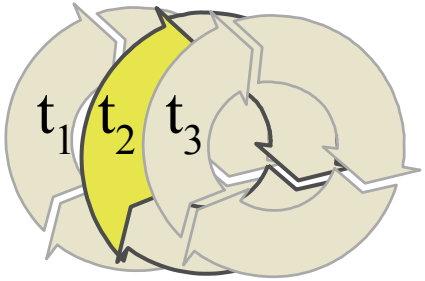
Examples of optical classification



Same classification but very different properties!

(Caccianiga02: Marchã96)

Understanding relationships and selection effects



- *Case 1 – The radio-loud/radio quiet debate*
- *Case 2 - The Radio Luminosity Function (RLF)*

Case 1 – The RL/RQ debate (1/5)

- *Radio-'quiet' sources are not actually radio-silent!*
- *Is there an intrinsic bimodal distribution in the radio properties of a well defined sample?*
  - *References for bimodality: kellermann89,94; Miller90,93; Falcke96; Ivezic02....*
  - *References against: Goldschmidt99; White00, Becker00; Cirasuolo04...*

And the debate goes on...

Case 1 – The RL/RQ debate(2/5)

Parameters L_5 and R used to separate RL/RQ sources

Radio-loud:

$L_5 > 10^{25}$ W/Hz/sr

(Miller90)

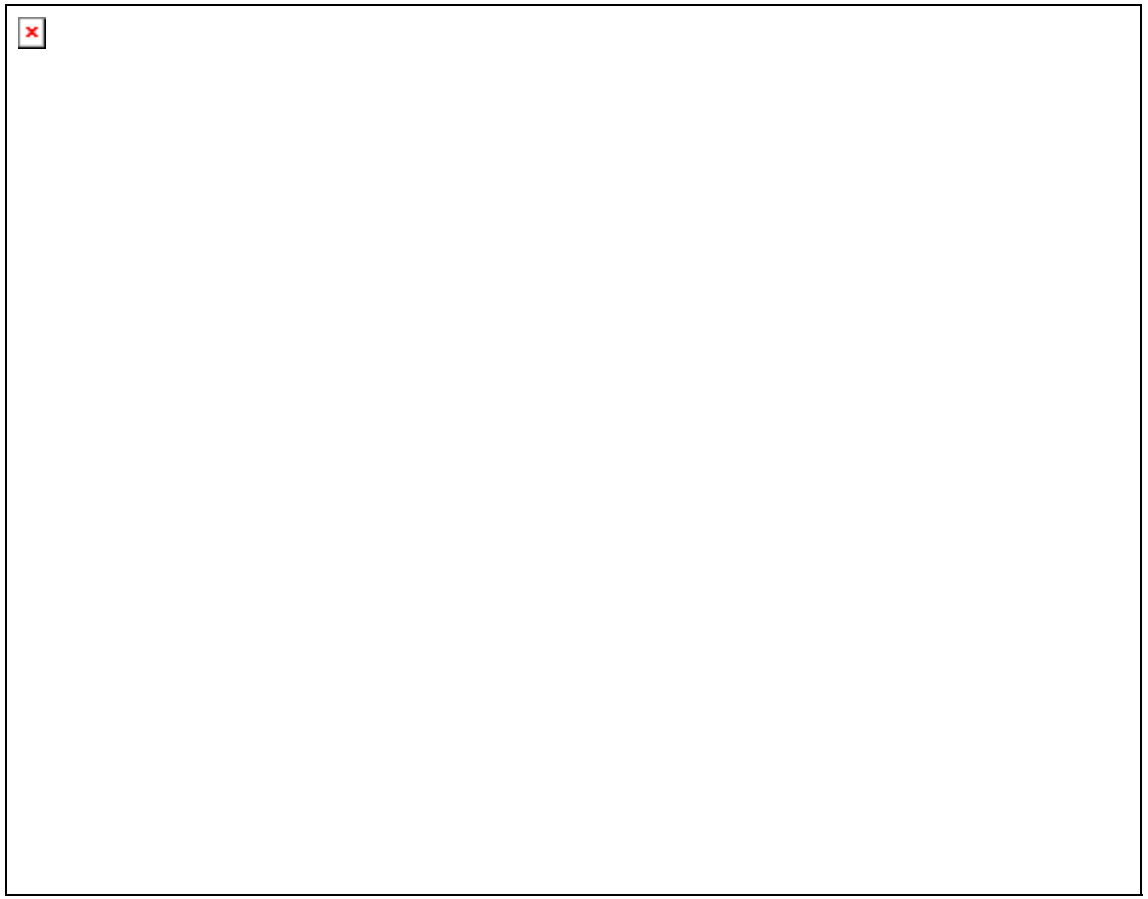
$R=S_{5GHz}/S_{4400} > 10$

(Kellerman94)

Radio-quiet:

$L_5 < 10^{25}$ W/Hz/sr

$R=S_{5GHz}/S_{4400} < 10$



(Elvis94)

Case 1 – The RL/RQ debate(3/5)

Dichotomy as a selection effect?

Combination of sensitivity/incompleteness of samples

radio-loudness parameter R

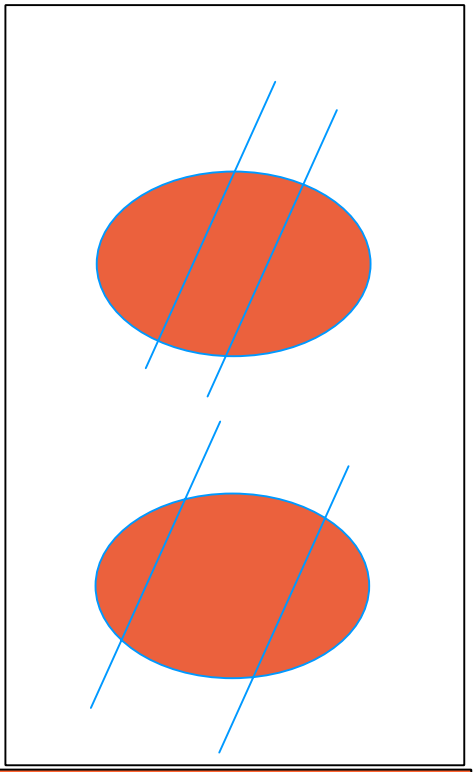
$R=S_{5GHz}/S_{4400} = 10$ But $S_{4400} = S^{AGN} + S^{glx}$

R = 10 means different things for different sources and/or observational conditions:

(i) S_{4400} is a function of z

(ii) S_{4400} is a function of intrinsic AGN/Glx

(iii) S_{4400} is a function of aperture used

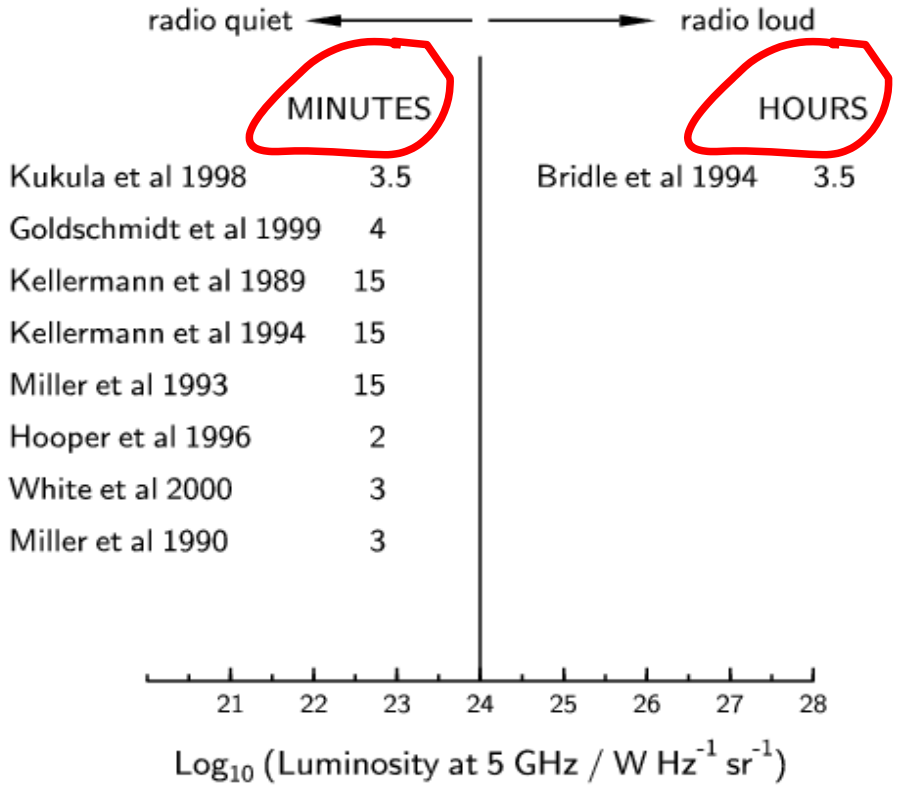


R is arbitrary and depends on many parameters, not necessarily all intrinsic to the source!

Case 1 – The RL/RQ debate (4/5)

Dichotomy as a selection effect?

A combination of integration time and observational set up used to observe different samples is not homogeneous and can prevent for example the detection of low surface brigthness in the 'radio-quiet' sources!



(Blundell01,03)

Case 1 – The RL/RQ debate (5/5)

- Wide range of new results concerning:
  - variability (Barvainis04);
  - the detection of 100s of kpc FRI structrure in 'radio-quiet' quasars (Blundell01);
  - superluminal motion and relativistic jets in 'radio-quiet' sources (Brunthaler00,Blundell03)
  - pc-scale radio structrures (Blundell01; Ulvestad04; Middelberg04)
  - core spectral index distributions (Barvainis96,04)

Shift the debate from **bimodality** to what is (are) the parameter(s) driving **radio-loudness**

Case 2 – The RLF (1/3)

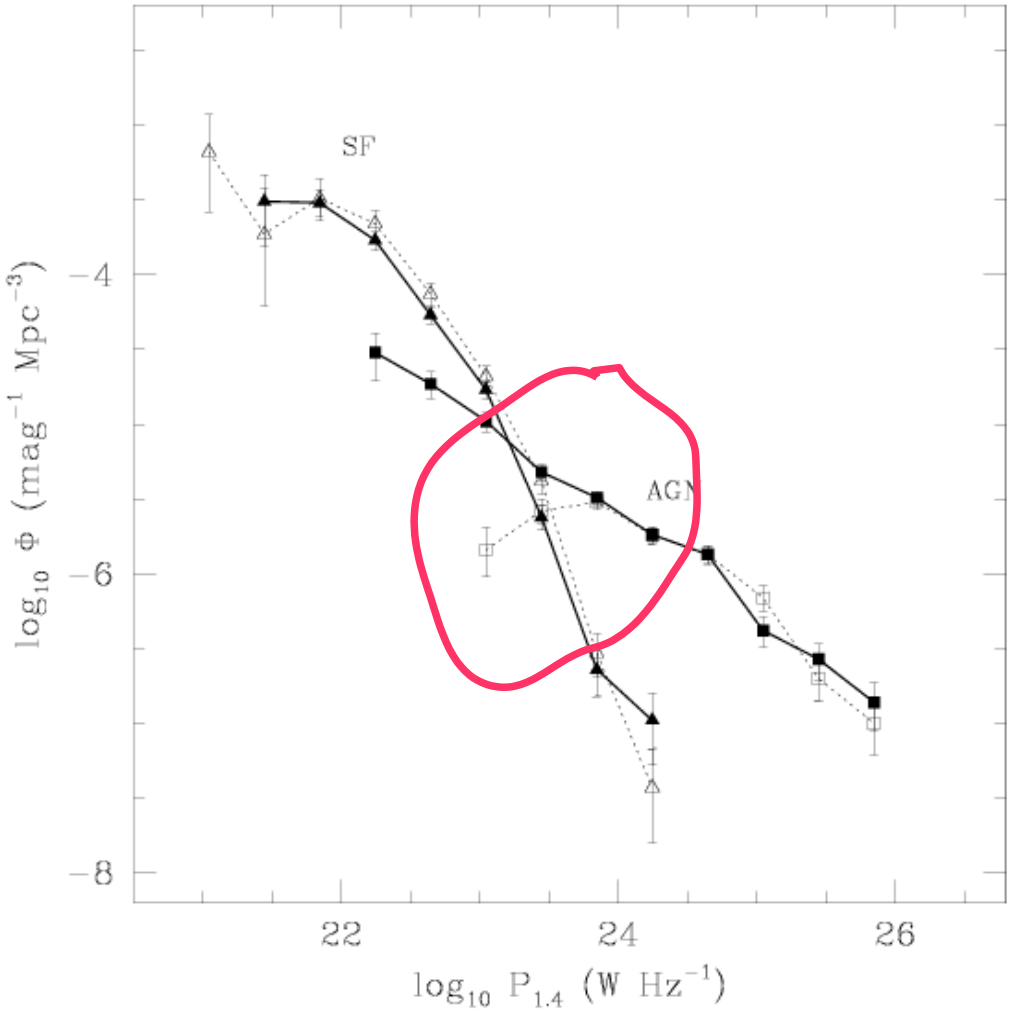
- *The Luminosity Function (LF) describes how the comoving number density of sources varies with luminosity.*
- *The LF addresses the issues of*
  - *How many sources are there?*
  - *How do they distribute themselves?*
  - *How do they evolve?*
- *The RLF is an important diagnostic because it gives a statistical description of the universe unaffected by dust obscuration.*

Case 2 – The RLF (2/3)

- AGN and SF contribute significantly at P~10^{24} W/Hz.

- Different estimates for AGN contribution below P~10^{24} W/Hz.

Could the discrepancy be the result of selection effects?



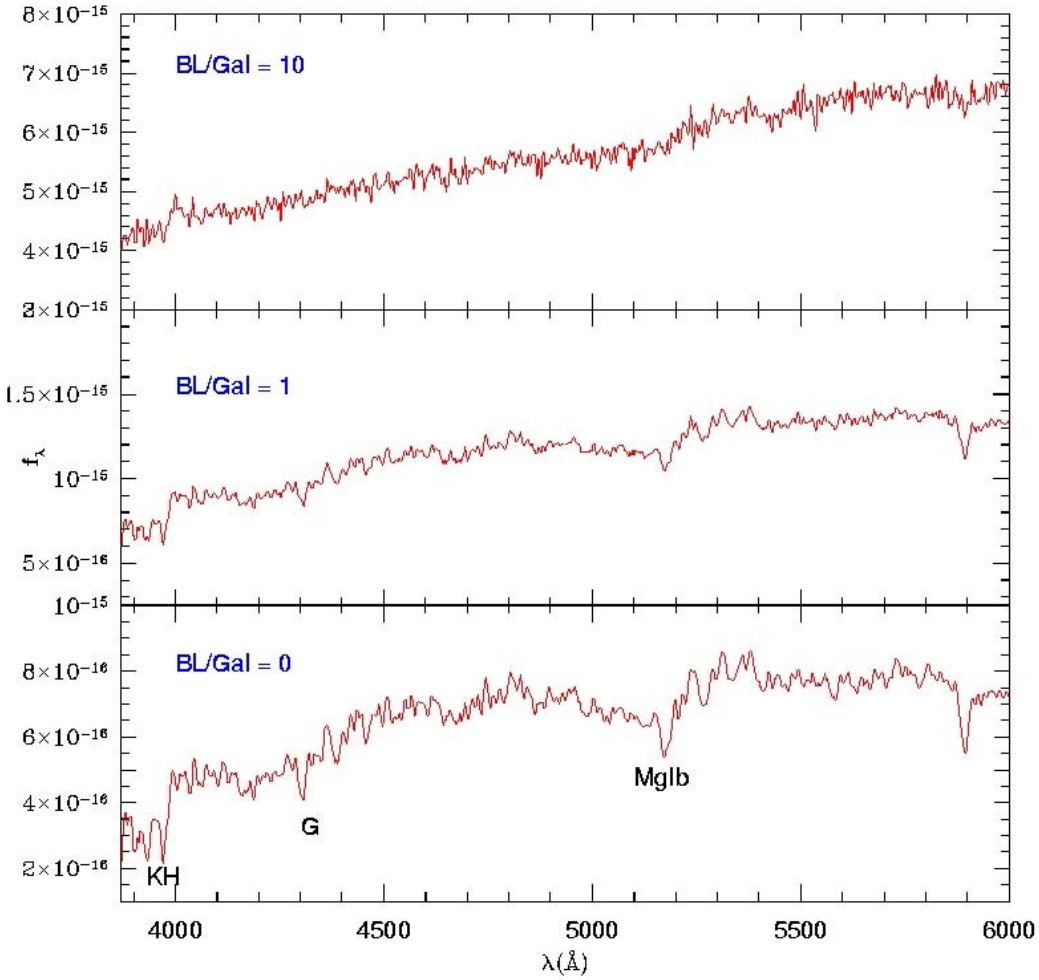
log $P_{1.4GHz}$ (W/Hz)

(Sadler02)

Case 2 – The RLF (3/3)

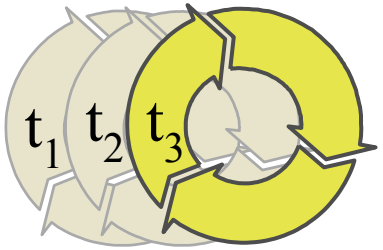
Separating AGN from galaxy is not an easy task !

What is the threshold for AGN detection?



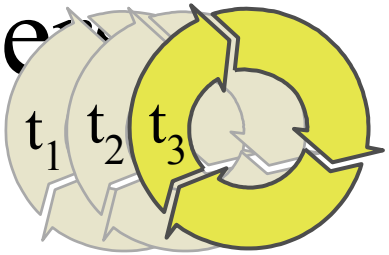
Selection criteria and misclassification can give different statistical results

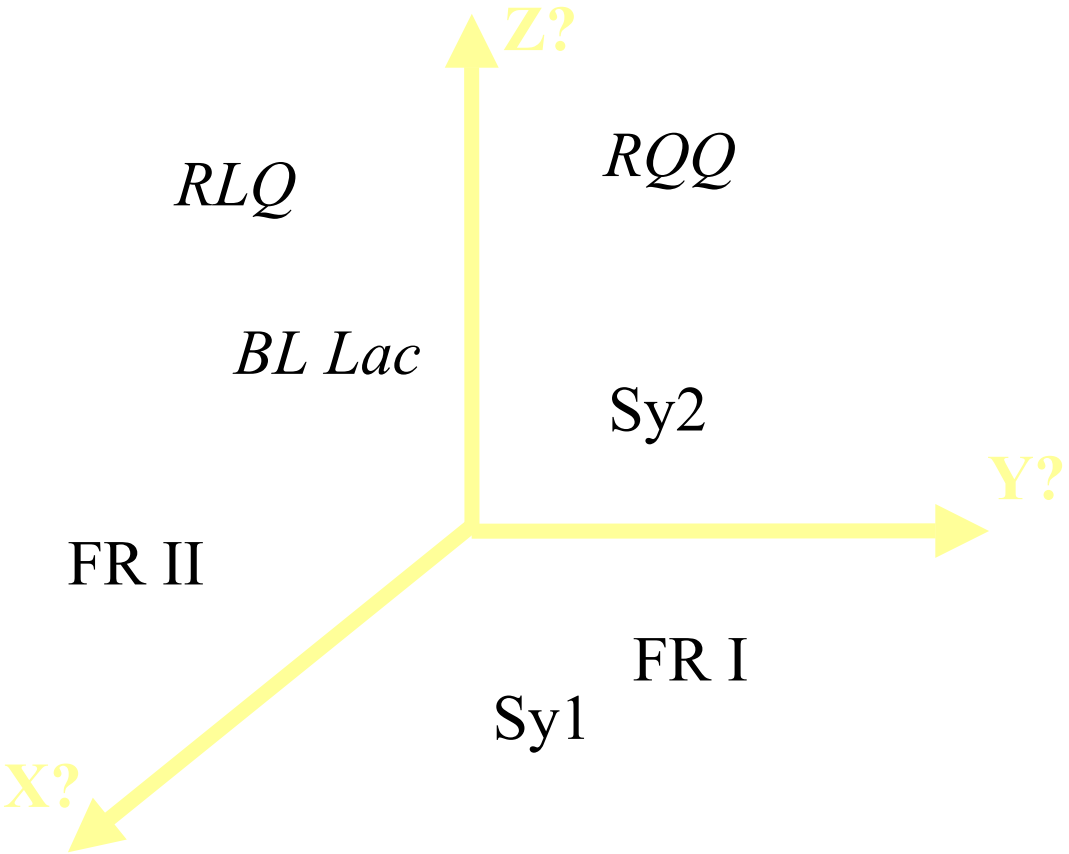
What lies ahead...



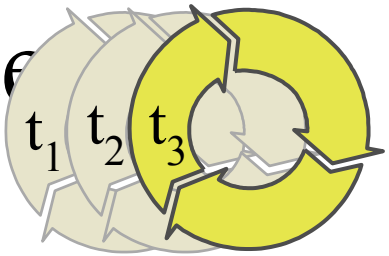
- ***What makes a galaxy show an AGN?***
  - All galactic bulges have a supermassive b.h. whose mass is related macroscopic properties:
    - Luminosity and stellar velocity dispersion (Magorrian98;Gebhardt00, M&F01....)
    - AGN must be a phase/phases in galaxy life-cycle: Evolutionary aspects have to be important.
  - Accretion rate alters significantly the observed properties of a system: triggering mechanism?***(Meier02,Urry03,Cao03)***
  - ***b.h. Spin is important for jet production (B&Z77, Meier02)***
  - ***Environment (magnetic field) certainly important***

Searching for the right parameter





Searching for the right paramete



- *Lack of a universal criteria for AGN classification:*
  - *We identify an AGN when we recognise certain properties BUT we may be missing significant numbers of AGN that are either too weak, or too obscured, or simply missed because of the set-up.*
- *Multi-frequency techniques may be the best way we have to make sure we do not miss large fractions of AGN of a certain type*

refs

Blundell,

Middelberg et al. 2004, A&A, 417, 925