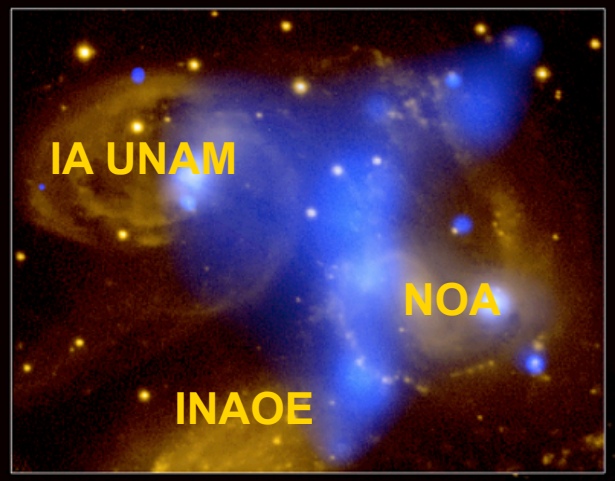
PART I

The Environment of Seyfert and BIRG galaxies



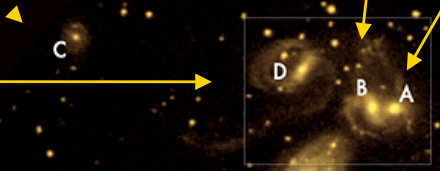
E. Koulouridis

M. Plionis

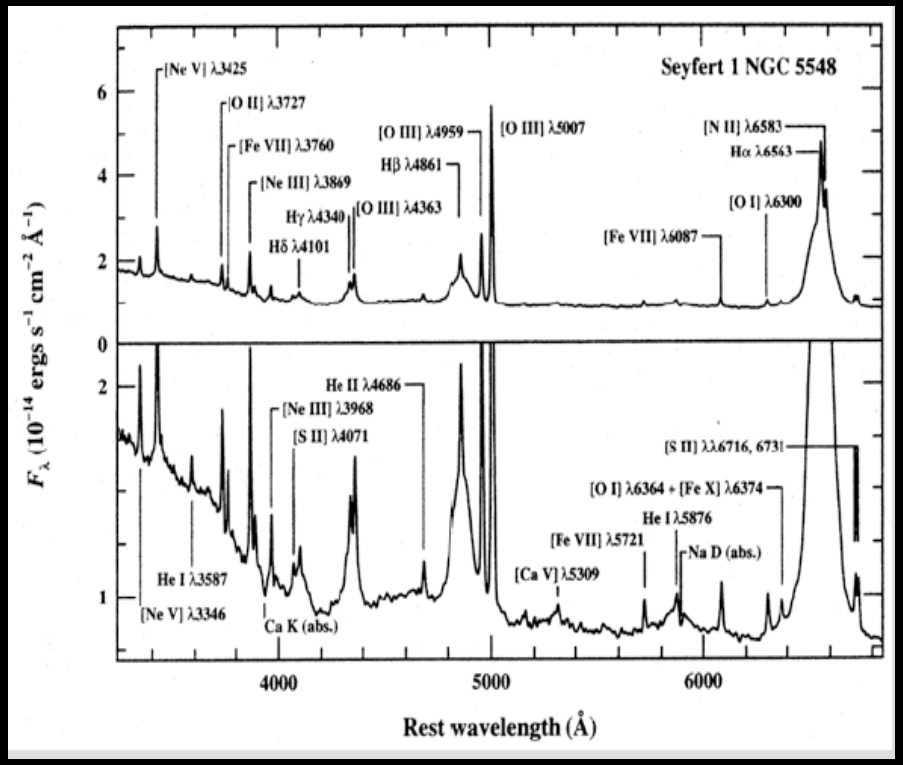
Y. Krongold

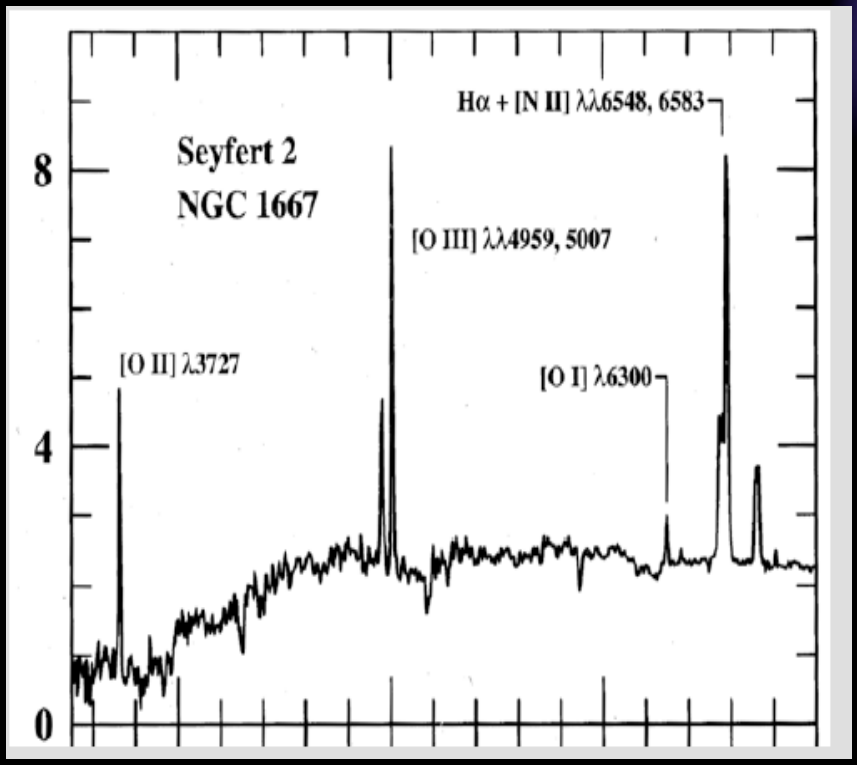
V. Chavushyan

D. Dultzin



Type 1 Seyfert galaxies have narrow and broad lines in their spectra; while **Type 2 Seyfert** have **only** narrow lines





Left – a Sy1 Broad lines (≥ 1000 Km/sec and also **Narrow lines**

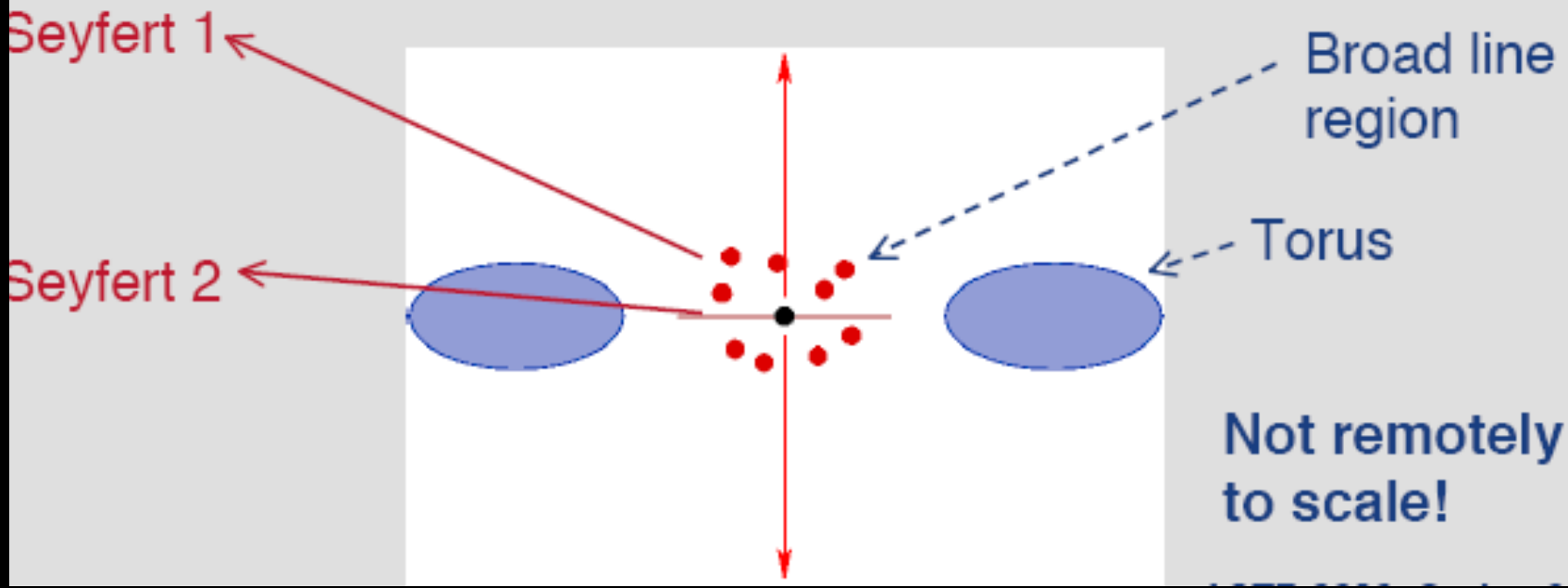
(~100 Km/sec)

Right – a Sy2 only narrow lines

Unified models seek to explain different classes of AGN as being due to different orientations of intrinsically similar systems to the observer's line of sight.

Seyfert 1 and Seyfert 2 galaxies

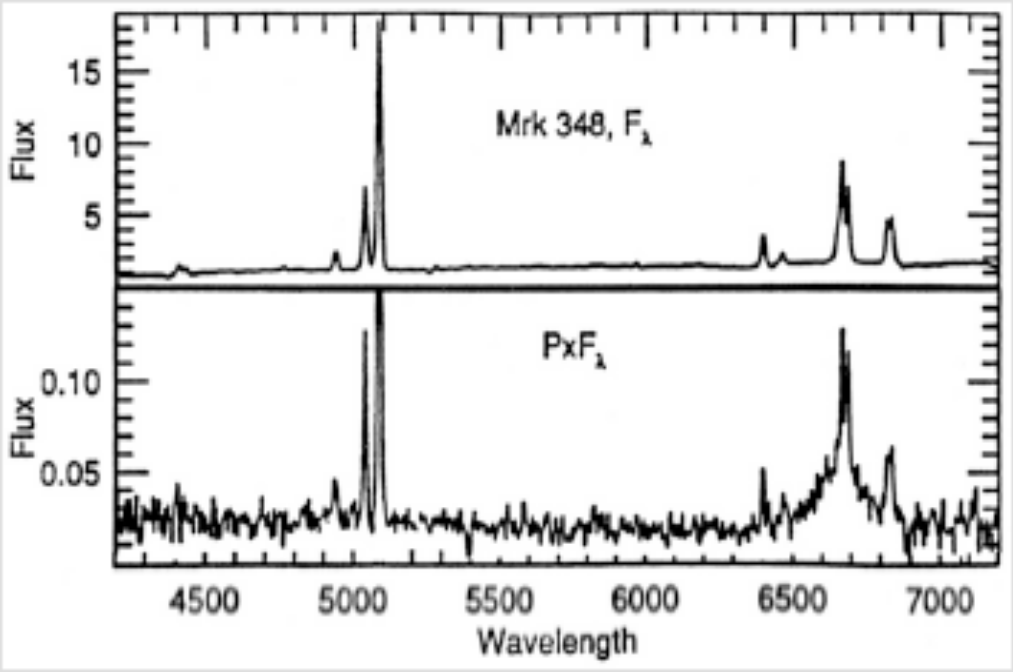
Most secure unification. Basic idea: an obscuring **torus** prevents us seeing the broad line region in Seyfert 2's.



Not remotely to scale!

Support for **Unified Model** (Antonucci et al. 1993)

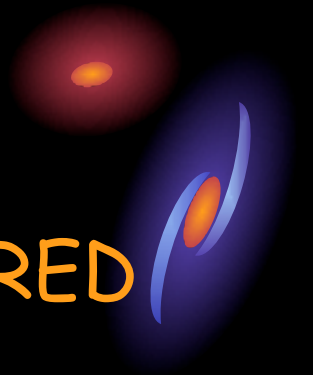
Support for this picture: in some Seyfert 2 galaxies the polarized emission shows broad lines!



Consistent with the unified model, since scattering produces polarization. Conclude:

- At least some Seyfert 2 galaxies are intrinsically similar to Seyfert 1's

Astrophysical Fundamentalism



ALL SEYFERT 2 GALAXIES ARE OBSCURED SEYFERT 1 GALAXIES

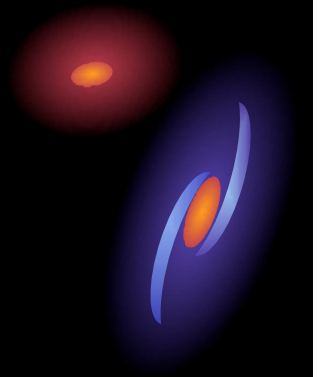
This is not true

Tran (2001;2003) showed that in a sample of 50 Sy2s half do not show Broad Lines in spectropolarimetric light.

Also evidence from X-Rays.

We are presently studying the close circumgalactic environment of the so called "TRUE" Sy2 (no BLR) Seyferts in Tran's sample

Dultzin-Hacyan et al. (1999) performed a 2D analysis which avoided previous biases



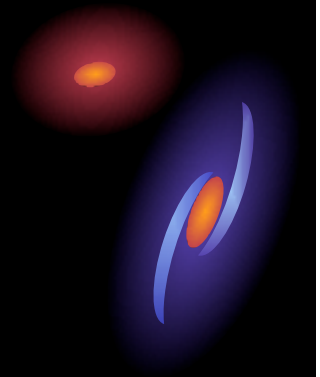
Volume limited sample from Lipovetsy's catalogue of Seyferts

- TWO DIFFERENT COLNTROL (non AGN) SAMPLES: one for Sy1s and another for Sy2s matching their different diftribution in z, morphological type and diameter (instead of luminosity).

- We searched for all close neighbuors within 100 Kpc down to the limiting magnitude of the POSS

- Field galaxies were elliminated assuming Poison distribution (first statistical approach)

MAIN RESULTS



Seyfert 1s: 40% have a close neighbour (as compared to their control sample of non-AGN Galaxies)

Syfert 2s: 70% have a close neighbour (idem)

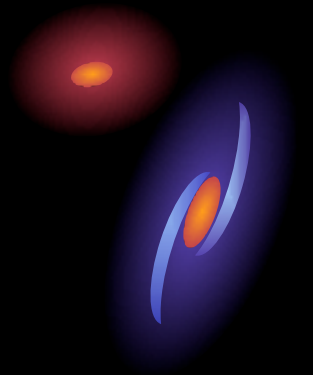
paper containns detailed analysis of methodological and statistical biases in previous contradictory results

The difference between the LOCAL environment of Sy1s and Sy2s poses a challenge to the simplest form of

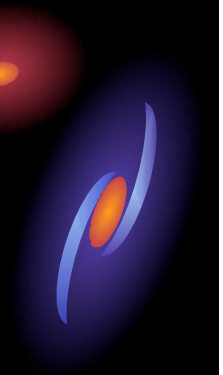
UNIFICATION SCHEEME -UM (Antonucci et al. 1993)

A possible interpretation is that we see **some** obscured Sy1 galaxies as Sy2

DUE TO INTERACTION



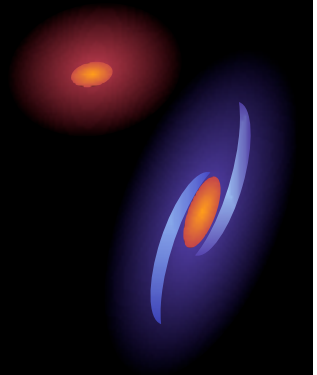
Evolutionary scenario - Krongold et.al. (2002; 2003)



Tidal forces can produce enhanced star formation near the nucleus (e.g. Storchi-Bergman 2008 and references therein). When the close neighbour galaxy starts to move away, Starburst activity is reduced with the simultaneous appearence of an obscured (type 2) AGN. Finally, the complete disentanglerment of the pair gives birth to an unobscured (type 1) AGN. In this scheeme Sy1 activity can be detected only ~10^9 years after the interaction took place

Sy1s and Sy2s may be the same objects

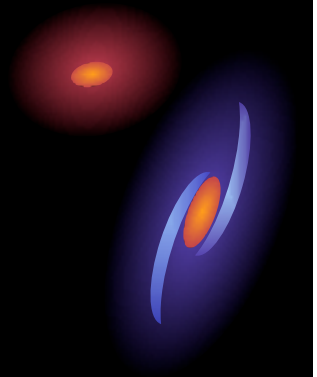
But not necesarily at the same evolutionary phase



There could be a phase where ONLY ORIENTATION would define the appearance: the stage where molecular clouds form a clumpy torus (Elitzur 2008) but have not yet been swept away. ~1 Gyr is a relevant timescale to produce either an unbound pair disruption or a merger)

Similar or related trends are found for LINERs (Krongold et al. 2003), QSOs (Serber et al 2006) and ULIRGs (Sanders et al. 1999; Wang et al. 2006)

we continued this work measuring radial velocities to exclude (not only statisticaly) all projected galaxies (3D analysis)

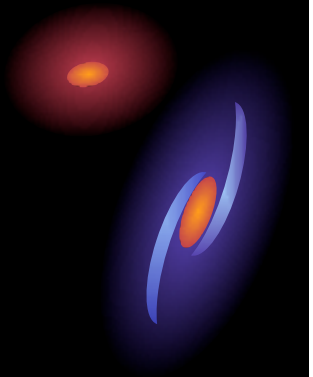


Kolouridis, Plionis, Chavushyan, Dultzin-Hacyan, Krongold & Goudis. Ap J 2006; 2007

- SSRS catalogs which contain redshifts down to m_B=15.5

- AND OUR OWN SPECTROSCOPIC OBSERVATIONS (from SPM and Cananea, Mex.) to determine redshifts of all neighbourgs down to m_B=19

WHEN WE GO FAINTER (by 3.5 mag) with our observations

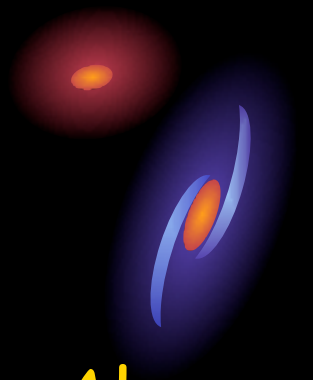


the increased number of companions gives 27% and 55% for Sy1s and Sy2s respectively. Therefore, the fraction of galaxies with close companiones increases by about the same factor

In order to test the evolutionary model, we also studied

Bright IRAS Galaxies (BIRG): $L_{FIR} = 10^{10-12} L_{sun}$

BIRG: $L_{FIR} = 10^{10-12} L_{sun}$



- A 2-D analysis can be found in Krongold et. Al. (2002)

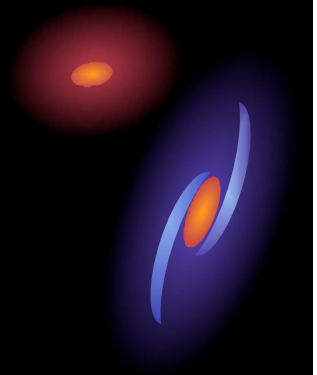
- THE METHOD USED FOR THE 3-D ANALYSIS OF BIRGs IS THE SAME TO THE ONE PERFORMED FOR SEYFERT GALAXIES.

- In order to seek for fainter companions we observed all neighbors down to m_B=19.0 within a projected distance of 75 h^{-1} kpc and a radial velocity difference of up to $\delta v \leq 600$km/s

Our observations to detect fainter neighbours go to mag -15.2 (our most most distant galaxy is at z=0.018) . This is fainter than the SMC.

- The number of galaxies with close neighbours increases only from 42% to 54%, and thus
- The result of 2002 is confirmefd (within errors)
- The large scale environment of BIRGs is the same as the one for Sy2s

The most recent work (2009)

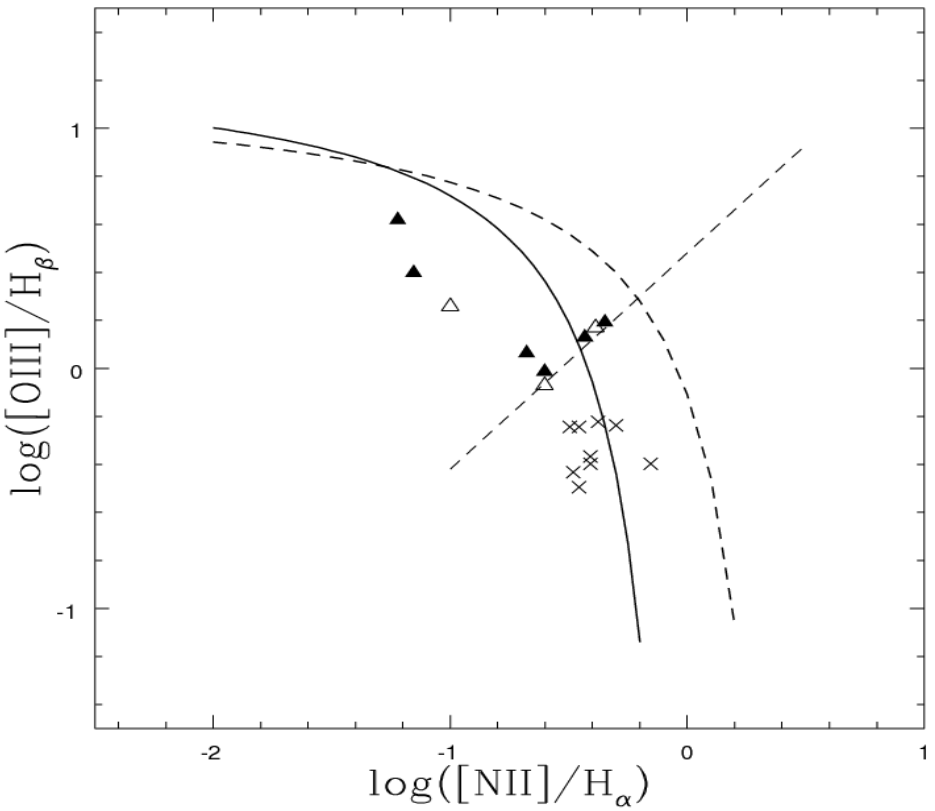


- Since BOTH galaxies of an interacting pair should be affected, we present a spectroscopic analysis of our catalog of physical neighbouring galaxies to our previous sample of Sy1s, Sy2s and BIRGs.

- We find that 70% of them have enhanced star formation and/or AGN activity (actual numbers to be evaluated –we have line flux calibrations)

- Neighbours of Sy2 are systematically more ionozed, and their Sb are younger than those of Sy1s.

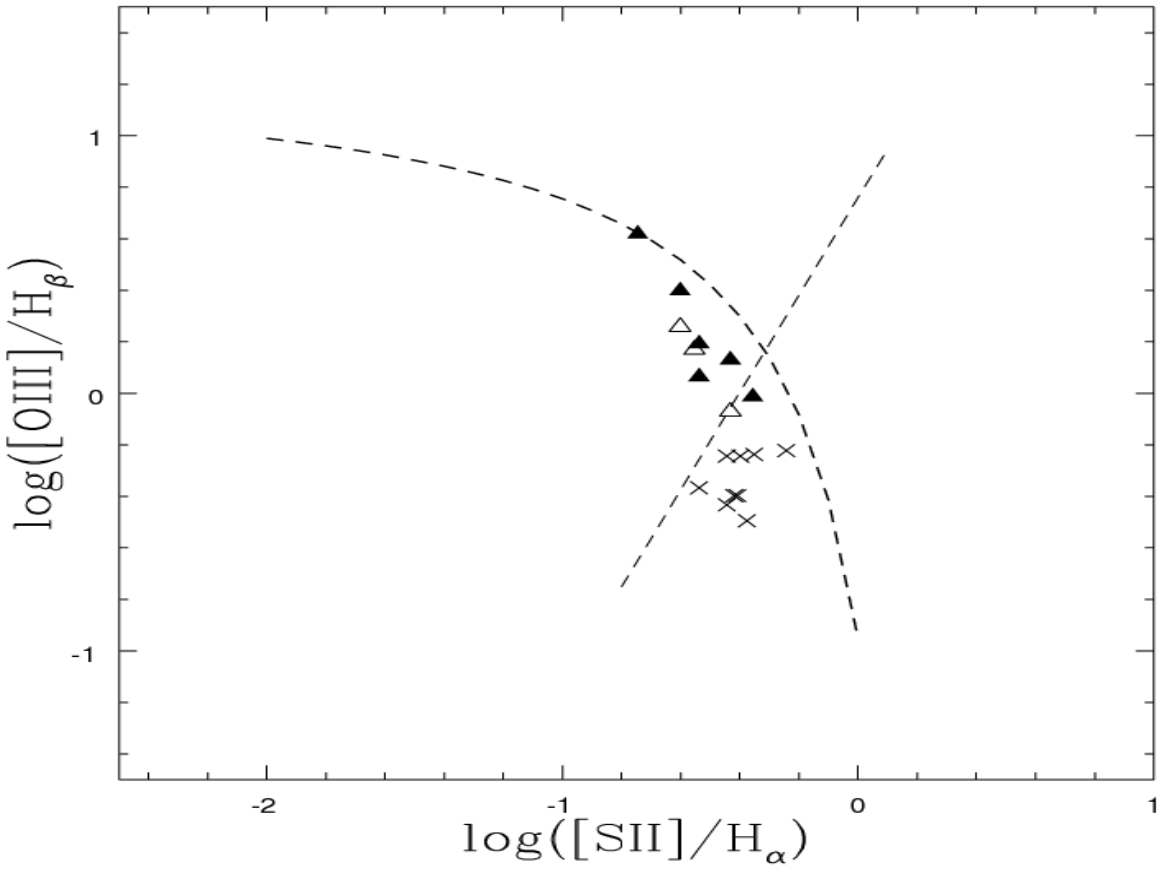
Koulouridis, Plionis, Chavushian, Dultzin, Goudis & Krongold (2009) **almost** accepted ApJ



- BPT classification diagram for neighbours of Sy1 and Sy 2 galaxies (very preliminar)

- Dashed line: demarcation SB-AGN (Kewley et al. (2991)
- Continuus line: Kauffman et al. (2003)
- Straight line: Seyfert – LINER
- Triangles – neioghbours of Sy2s/ empty BIRGs
- Crosses – neighbours of Sy1s

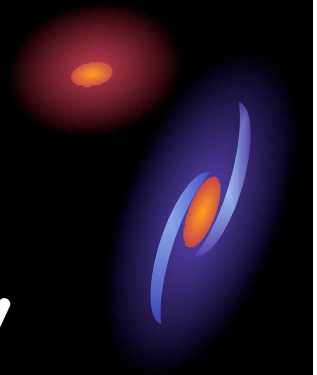
Koulouridis, Plionis, Chavushian, Dultzin, Goudis & Krongold (2009) -same as previous-



Classification of neighbours

- Triangles: neighbours of Sy1s
- Crosses neighbours of Sy2s

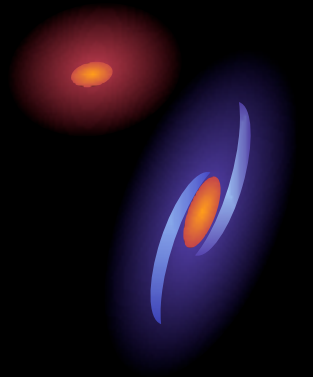
PART II



Induced Nuclear Activity in mixed-morphology (E+S) galaxy pairs

J. J. González, Y. Krongold, D. Dultzin, H. Hernandez-Toledo, E. Huerta L. Olguin, P. Marziani, Irene Cruz-Gonzalez &F.J. Hernandez-Ibarra

Isolated (E+S) galaxy pairs are the ideal laboratory to study gravitationaly induced interaction: one gas rich galaxy + a (nearly) gasless perturber

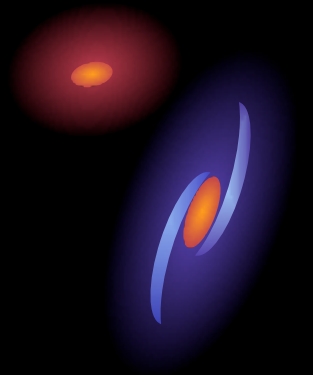


Sample from Karachentsev Catalogue of Isolated Galaxy pairs (with exclusion of S0s from our own images Franco-Balderas et al. 03; 04; 05)

Is there evidence of induced activity in these pairs?,

- What is the proportion of activity (type 1/type 2)
- Is this activity correlated with some interaction indicator ?

For (E+S) pairs we ised the Catalogue of Isolated Pairs in the Northern Hemisphere (Karachentsev, 1972) which contains ~130 pairs.

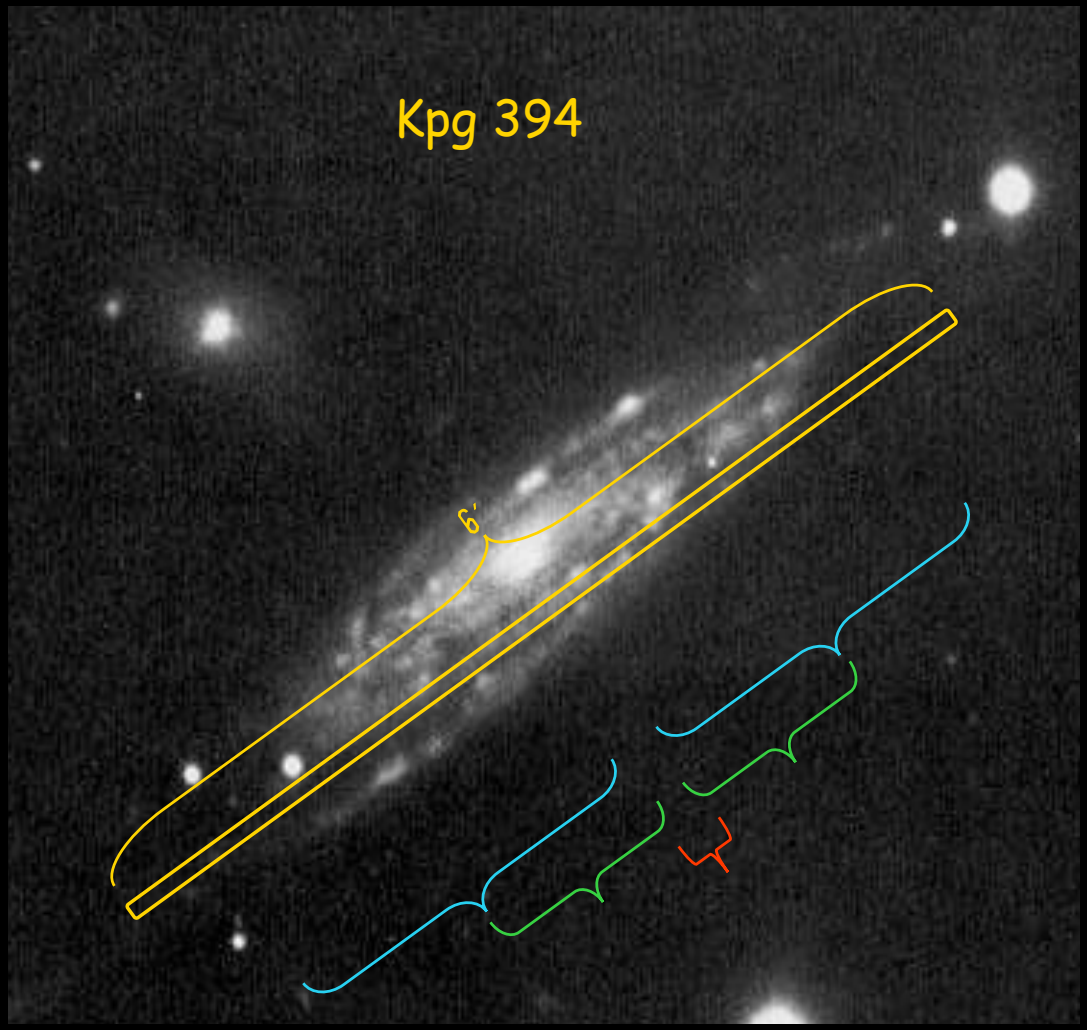


Pairs

(with exclusion of S0s from our own images Franco-Balderas et al. 03; 04; 05)

We knew they show optical and FIR excess emission (Hernandez-Toledo Dultzin-Hacyan & Sulentic 1999 2001; PhD Thesis)

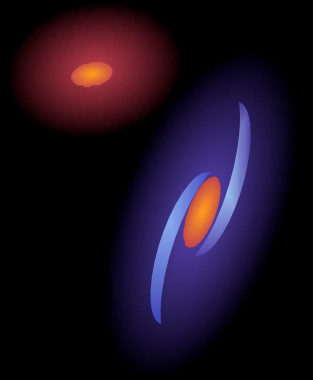
S-component spectroscopy



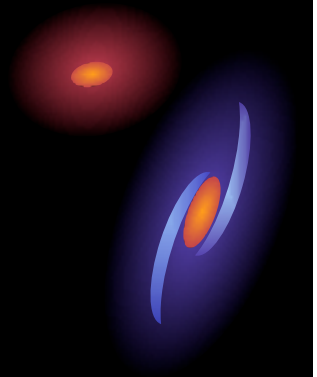
1 - Nuclear: central 5"

2 - Inner Disk: 1.5" > |r| > 0.4 R_{25}

3 - Main Disk: 2.5" > |r| > 0.8 R_{25}



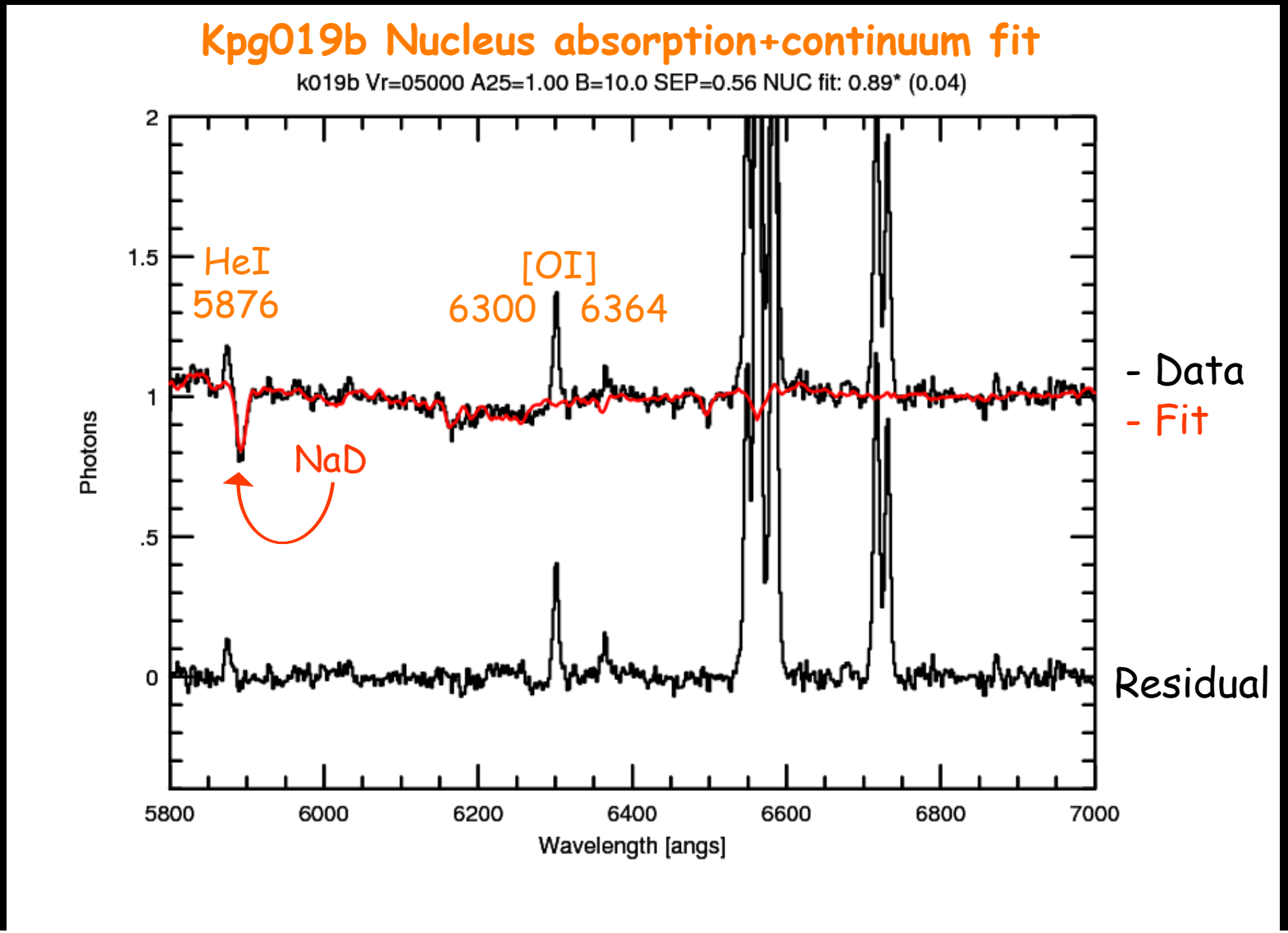
- 2.1m SPM telescope, Low-R, Long-slit Spectrograph
  - Range: 5700-7000 A
  - 4.5A resolution (FWHM)
  - To derive Ha rotation curves (Huerta et. al 2007)
- 104 gals in 103 (E+S) pairs:
  - 2 are actually (E+E)
  - 1 we observed also the E
  - ~95 pairs have >3σ emission



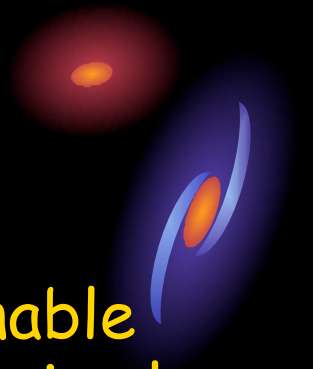
We have analyzed the incidence of activity in the SPIRAL (S) component of the pairs using line diagnostic diagrams.

Very careful removal of the underlying galaxy spectrum is required BEFORE the measurement of nuclear emission line intensities. Reduction was done using XVISTA package

Originally we only covered the Ha region we have presently observed all the pairs in the Hß region (we'll be able to have a better clasification, e.g. distinguish Seyferts from LINERs)



In the mean time we have defined a Activity Type Index (ATI)

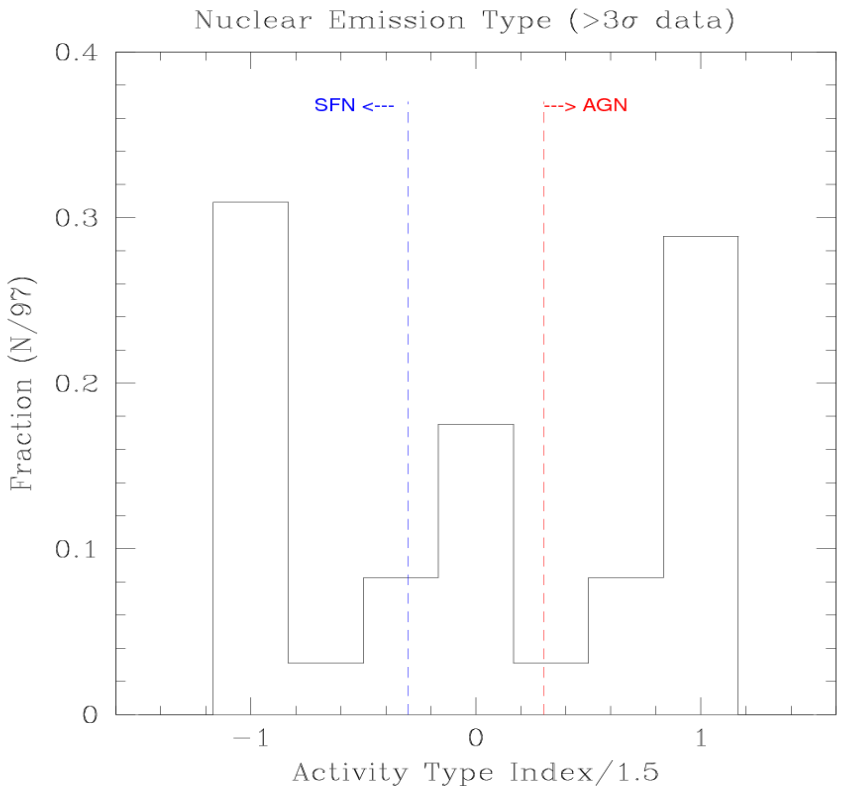


Because we lacked the [OIII]/ Hβ ratio, we were unable to distinguish between Seyferts and LINERs. We simply lump them together as ACTIVE GALACTIC NUCLEI (AGN). Neither can we distinguish between Starburst and normal star-forming nuclei (SFN) and consider both as NON-ACTIVE "normal" nuclei.

To quantitatively classify the S galaxy into AGN or SFN we defined an Activity Type Index based on all three [SII]/Ha, [NII]/Ha and [OI]/Ha line ratio measurements and errors, combined with their thresholds

full details in Gonzalez et al. 2009 nearly-accapted by ApJ

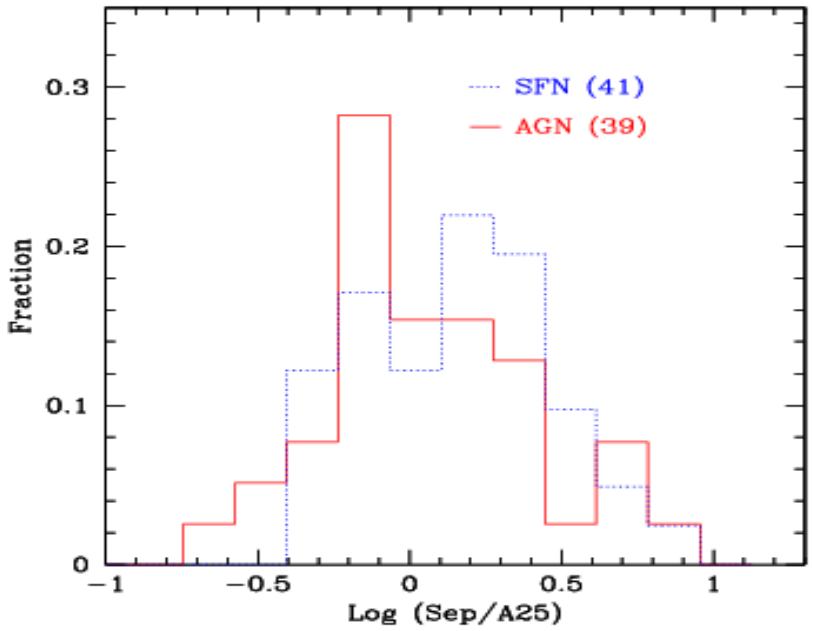
Activity Type Index (ATI) for 97 spiral components



- Distribution of ATI
- Galaxies with ATI > 0.45 are clear-cut AGNs, while spirals with ATI < -0.45 have a Star-Forming Nucleus (SFN)
- Intermediate ATI values include composite AGN+SFN, pure Starburst or faint AGN
- See Gonzalez et al. (2009) for full details

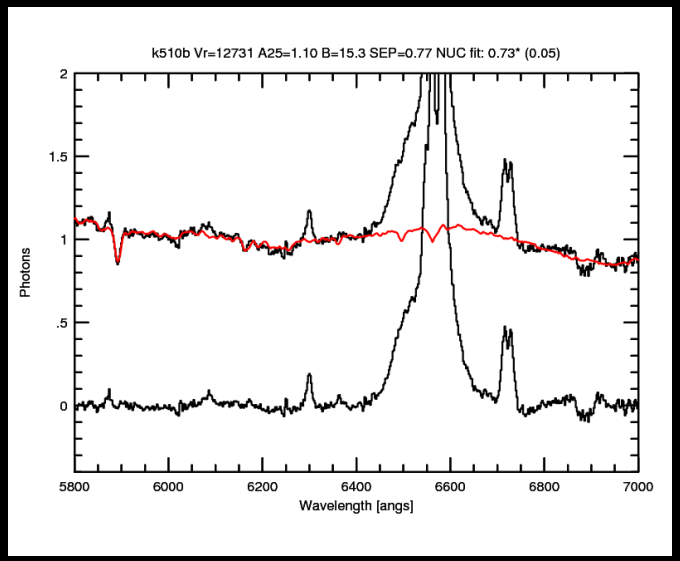
Distribution of pair separation (in units of the 25th mag arcsec^{-2} isophote diameter)

- 39 Active Galactic Nuclei & 39 Starburst and/or "normal" Star-Forming Nuclei



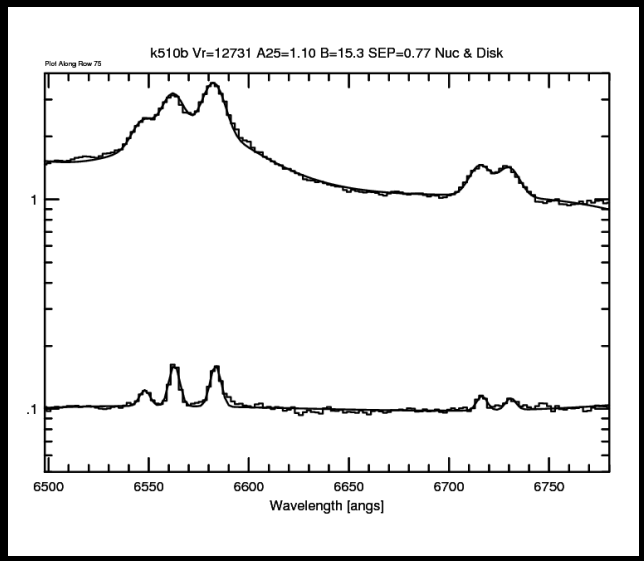
- SPIRALS IN (E+S) PAIRS ISOLATED PAIRS THAT HARBOR AN AGN ARE TYPICALLY CLOSER TO THEIR ELLIPTICAL COMPANION (at 98% SP confidence level)

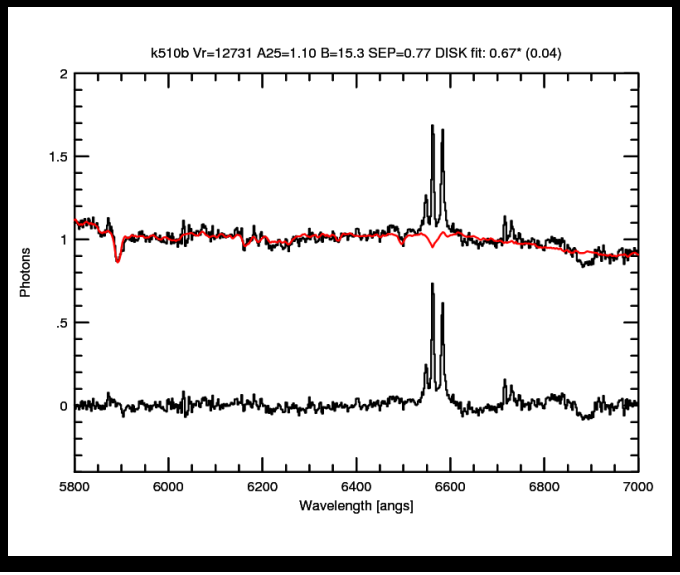
There is only ONE case for a Type I AGN among the (E+S) sample



KPG 510b (FWHM)
Narrow-line ΔVr = 550 km/s (12.0 A)
Broad-line ΔVr = 3700 km/s (80.9 A)
Disk lines ΔVr = 170 km/s (3.80 A)

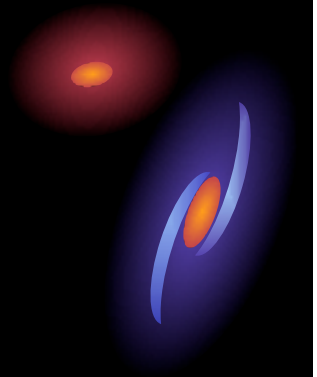
Nucleus





Disk

Conclusions



40% of spirals in isolated (E+S) pairs show nuclear activity

Only ONE out of 39 clear-cut AGN in our sample is type1. A 2.6% frequency is too low to be explained by obscuration/orientation effect only.

→Activity is more common in closer pairs

ALL THESE FACTS MAY NATURALLY FOLLOW FROM THE EVOLUTIONARY SCENARIO

We have also started to study ALL the pairs (E+S). (E+E) & (S+S) from the SDSS (R7)

- In order to study nuclear activity, the galaxy cpomponent has been removed using a very accurate PCA algorithm developed by J. Perea

- Preliminary search for nuclear emission lines has been done by del Olmo et al.

- We would lilke to do simulations in the future, in order to study the effects of morphology and dynamics of the encounter

THANKYOU!!!