Double-peaked NEL galaxies from SDSS DR7: Sample and basic properties

Junqiang Ge

NAOC

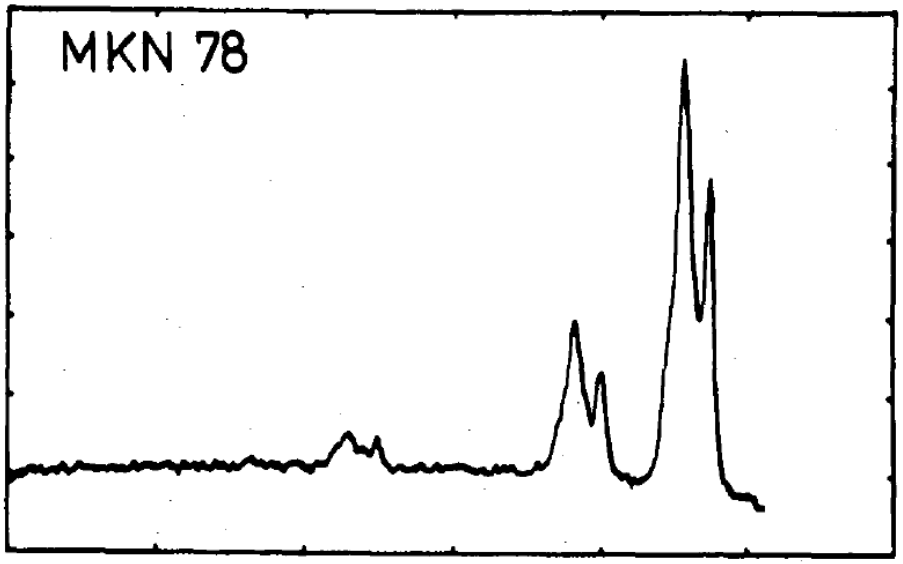
Collaborators: Chen Hu, Jian-Min Wang, etc

2012.11.30

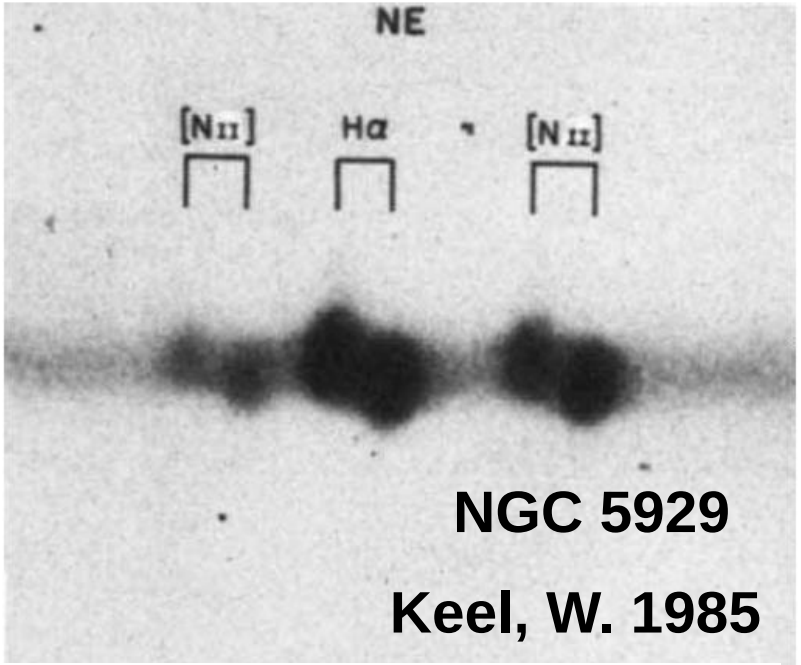
Outline

- **Introduction**
  - **Double-peaked NEL AGNs**
- **Our recent work**
  - **Sample selection**
  - **Interesting things we have obtained**
- **Conclusion**

Observations of double-peaked NEL AGNs



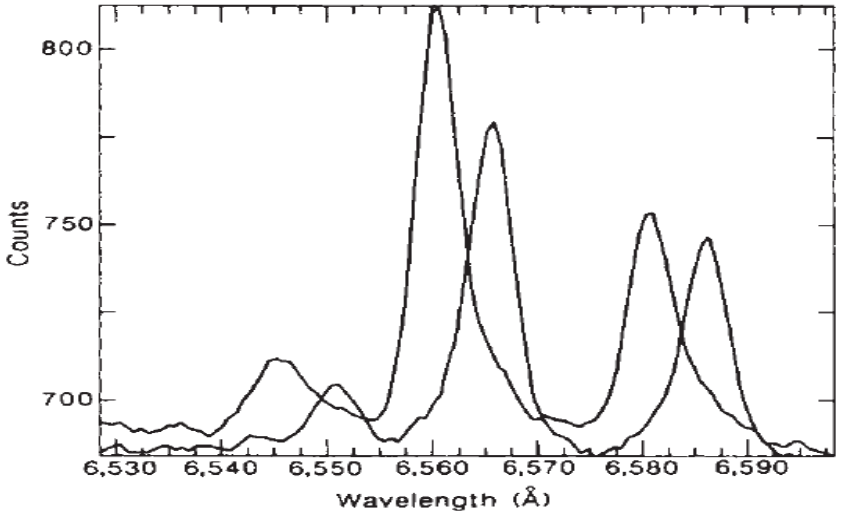
Heckman et al. (1981)



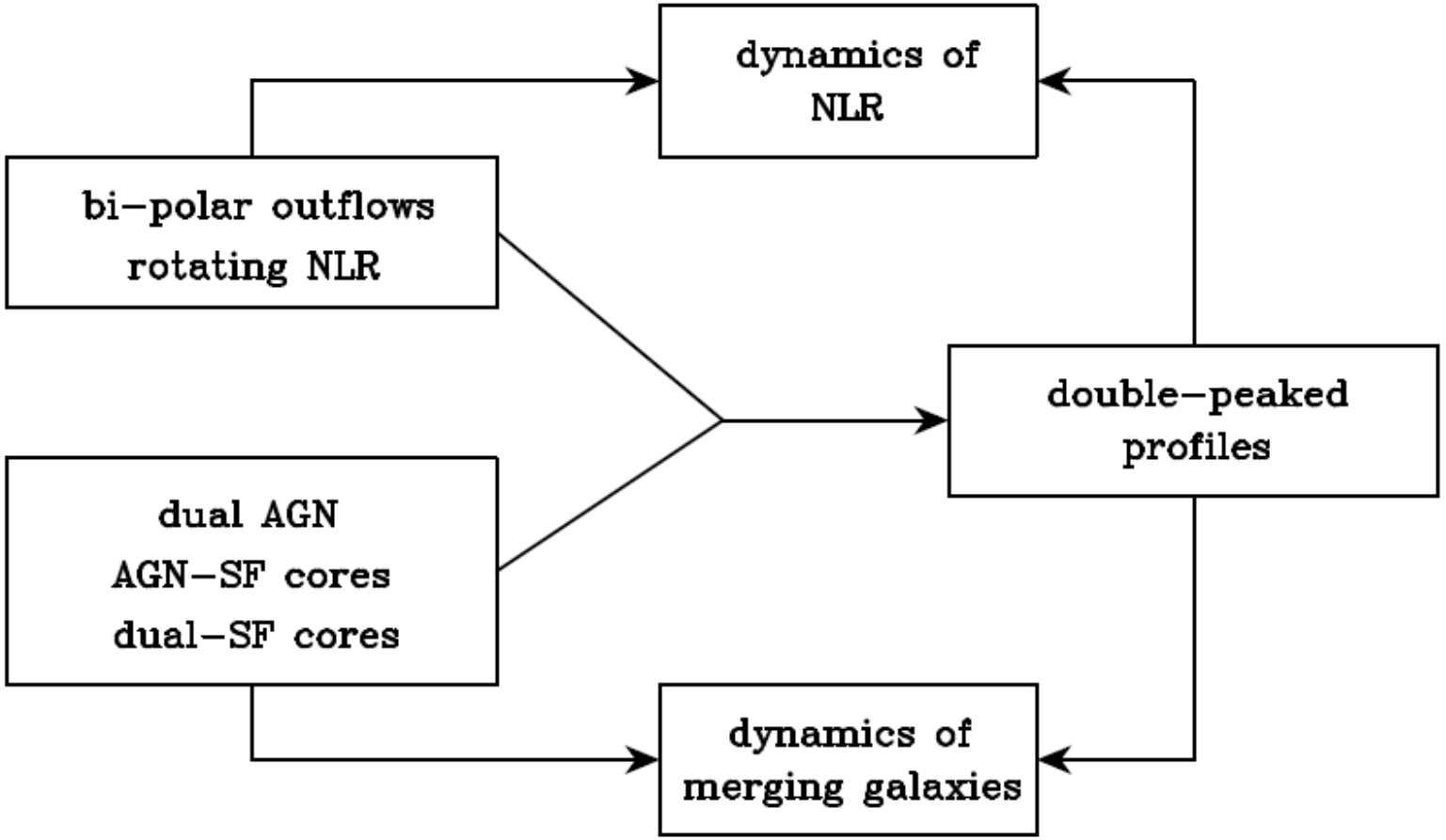
NGC 5929

Keel, W. 1985

Other works such as：
Zhou+2004; Gerke+2007;
Comerford+2009;
Xu & Komossa 2009;
McGurk+2011; Barrows+2012
……

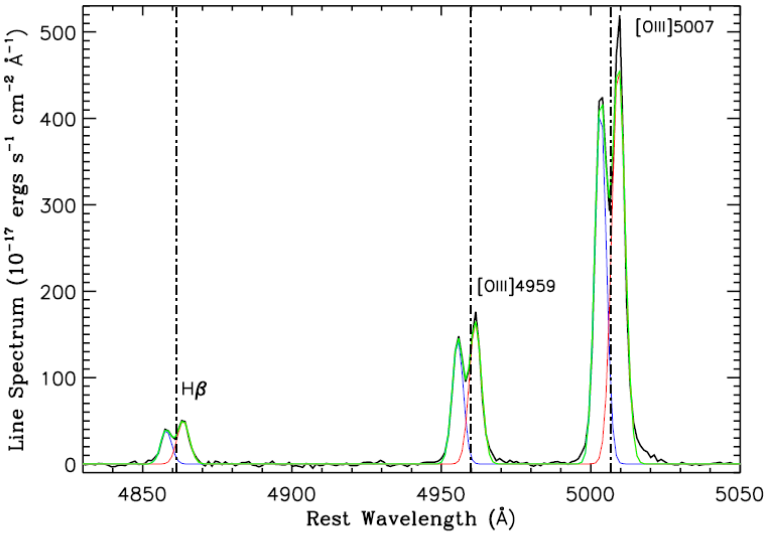


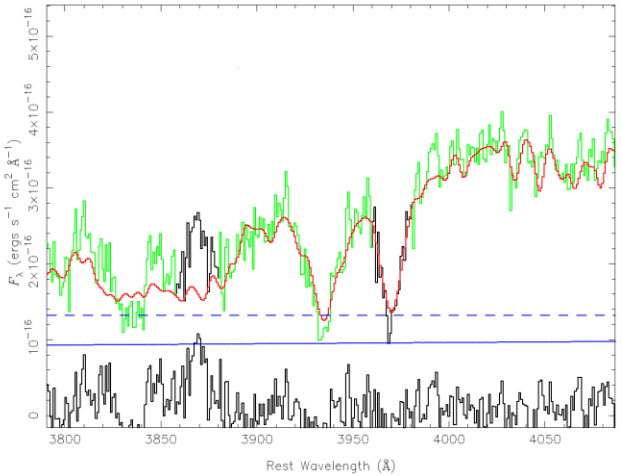
Production of double-peaked NELs



Sample: 87 double-peaked NEL type 2 AGNs

--Wang, J. M. et al. (2009)

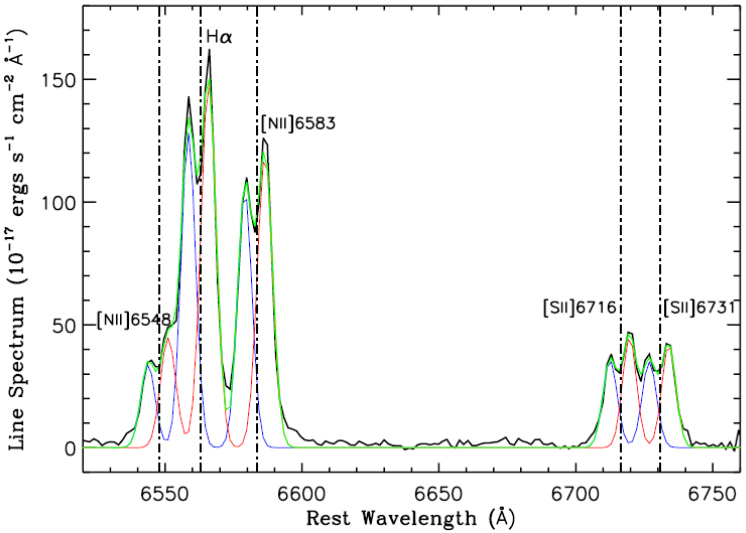


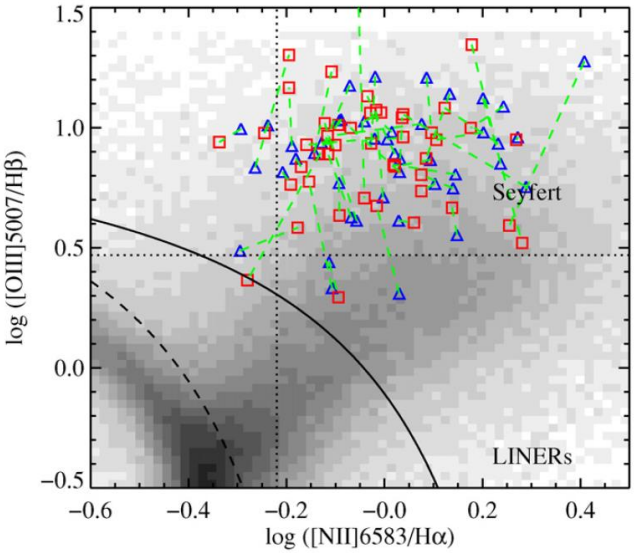


Absorption lines for fit:

Ca II H+K

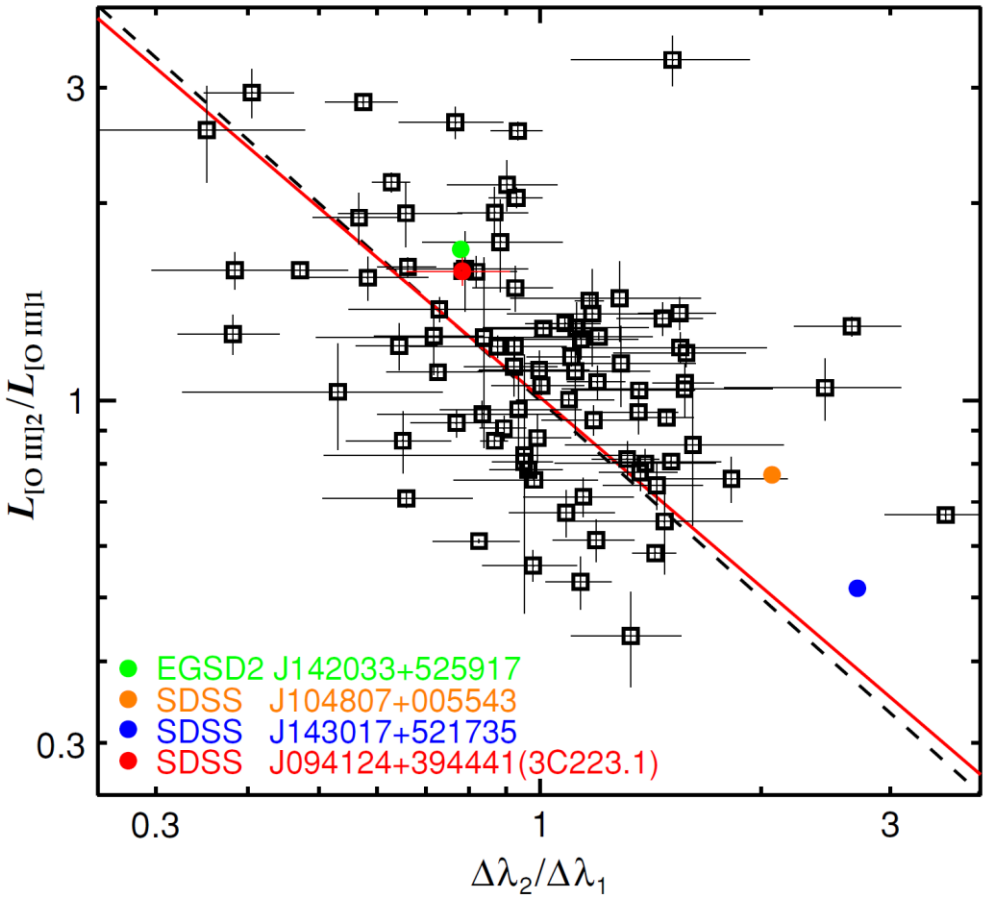
Mg Ib





The two peaks are different in BPT diagram

Keplerian relation

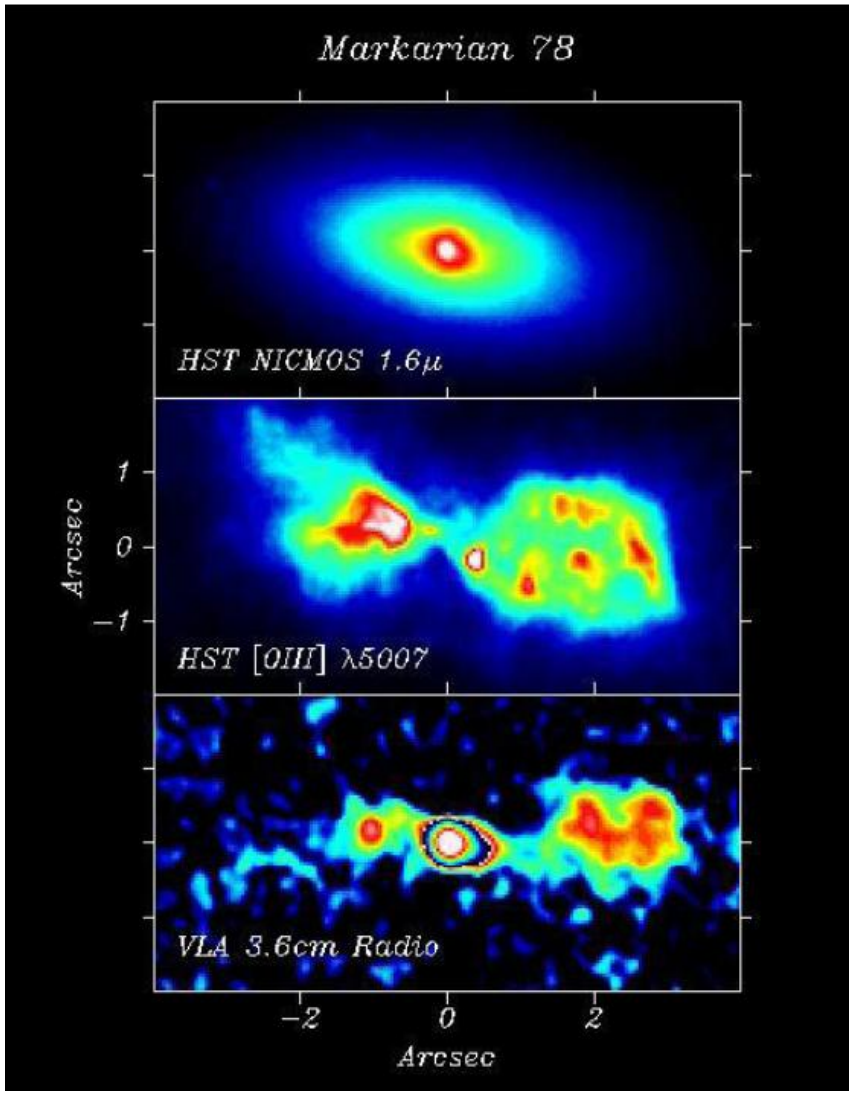


$$\frac{V_1}{V_2} = \frac{M_2}{M_1}, \quad \frac{V_1}{V_2} = \frac{\Delta\lambda_1}{\Delta\lambda_2},$$

$$\frac{M_{\bullet,2}}{M_{\bullet,1}} = \epsilon_{1,2}\frac{L_{[O\,III],2}}{L_{[O\,III],1}},$$

$$\frac{L_{[O\,III],1}}{L_{[O\,III],2}} = \epsilon_{1,2}\frac{\Delta\lambda_2}{\Delta\lambda_1}.$$

Outflows

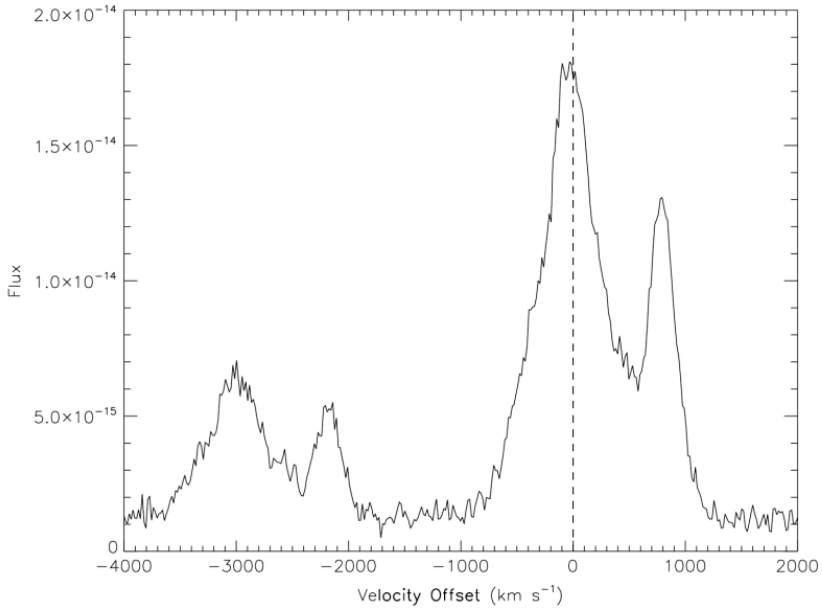


Whittle & Wilson (2004)

Symmetric bi-polar outflows only distribute around (1, 1)

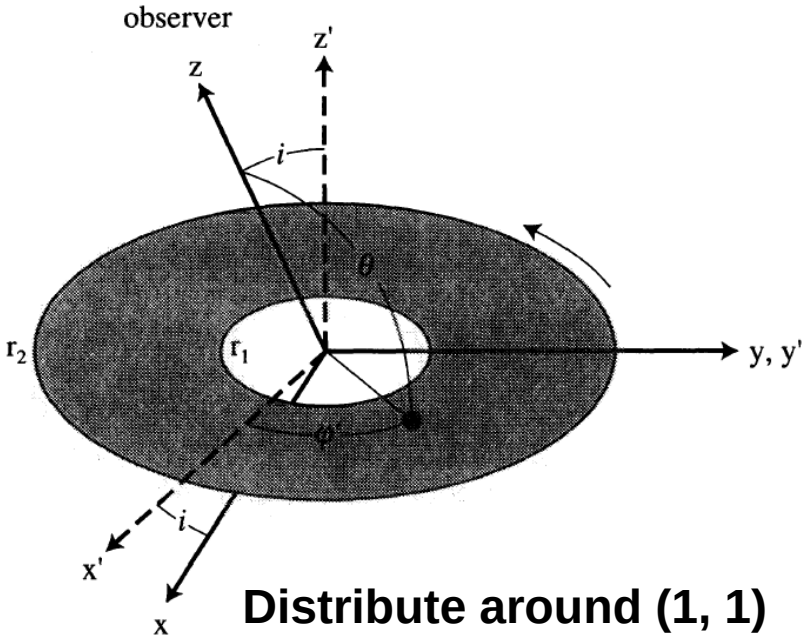
Asymmetric outflows with momentum conservation?

Different positions of the two peaks in BPT diagram?

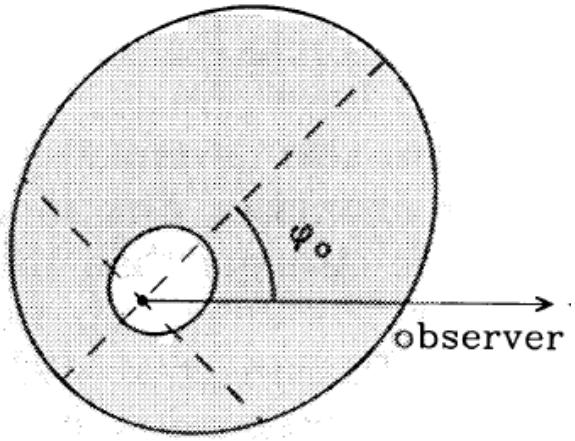


Fischer+2011

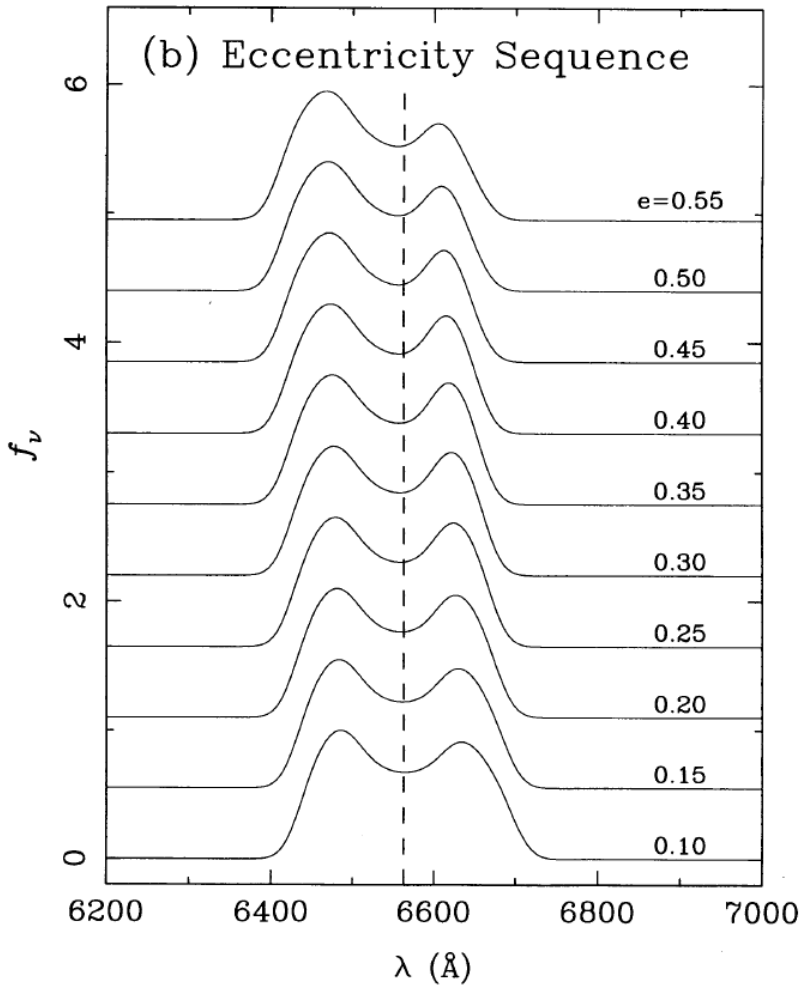
Rotating disk model



Distribute around (1, 1)



Seems like a positive correlation



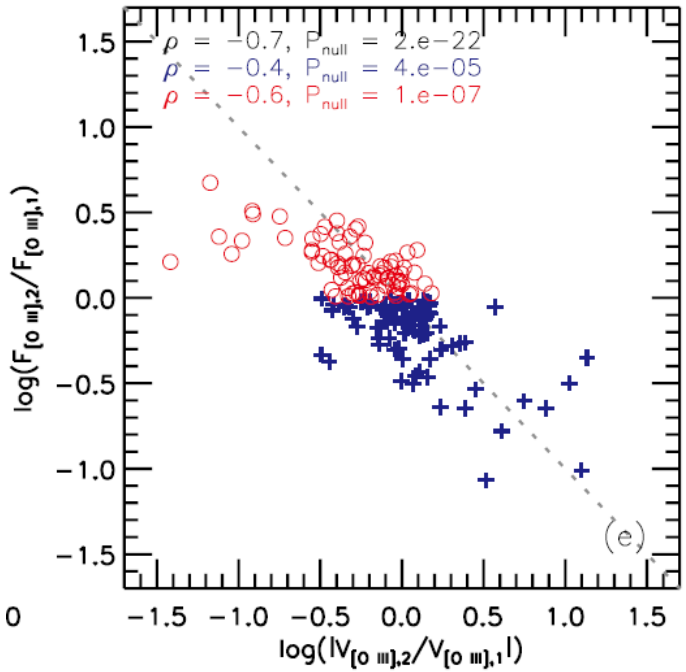
Eracleous+1995

Other samples

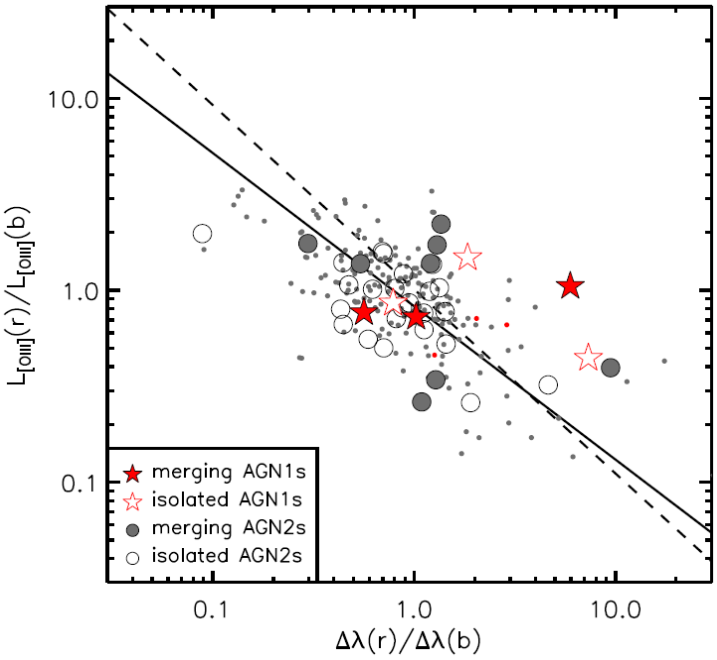
1. Liu, X. et al. 2010, ApJ, 708, 427 (167 type2 AGNs)

2. Smith, et al. 2010, ApJ, 716, 866 (86 type1，62 type2 AGNs）

Further confirmed the keplerian relation:

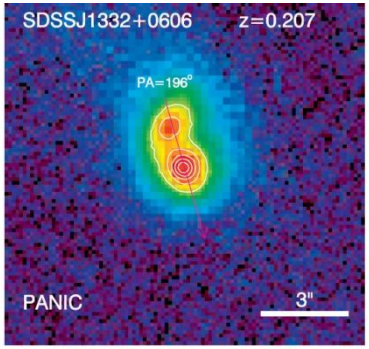


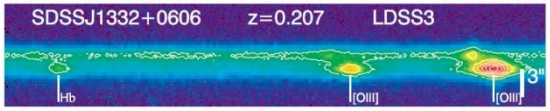
Liu, X. et al. (2010)



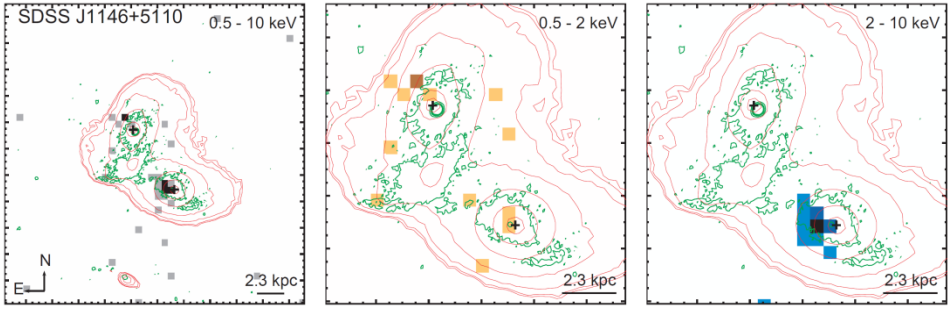
Fu, H. et al. (2011)

Further observations

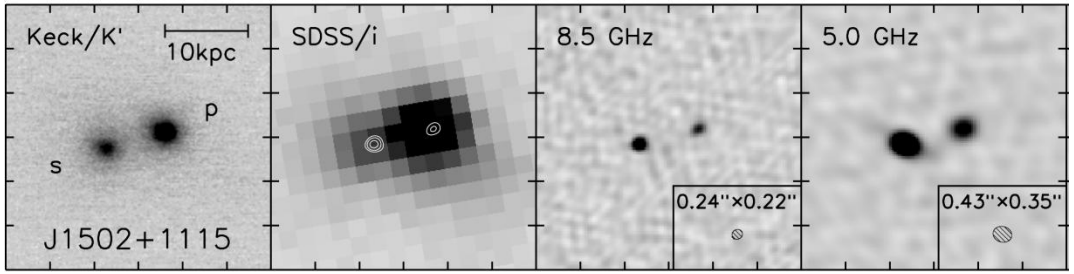




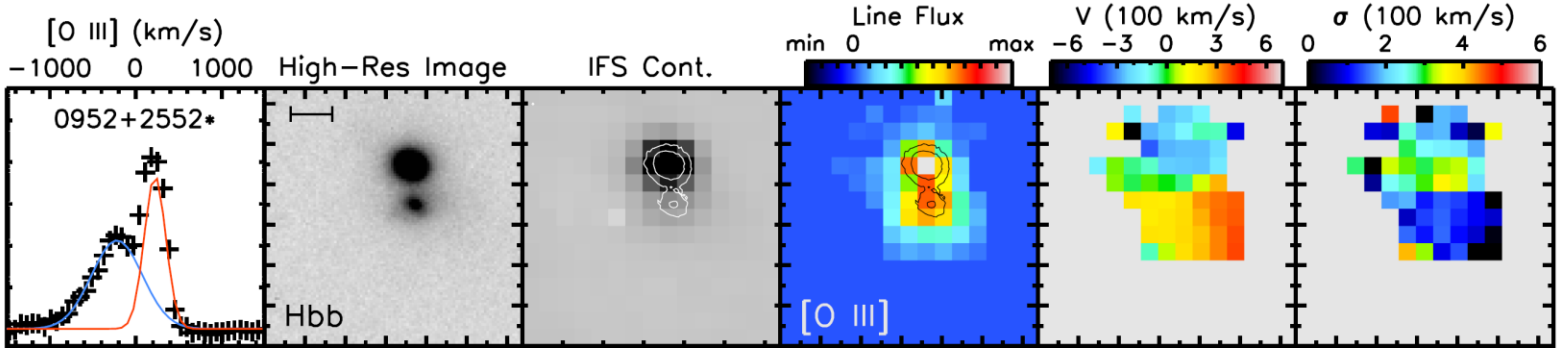
Shen, Y. et al. (2011)



Liu et al. (2012)



Fu et al. (2011)

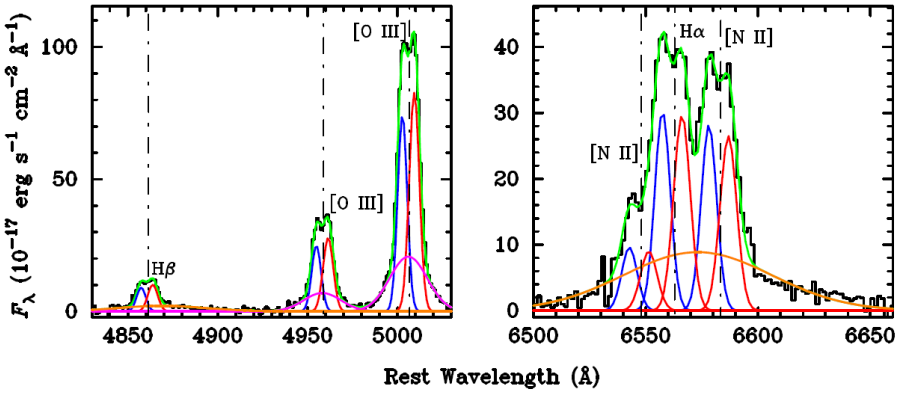


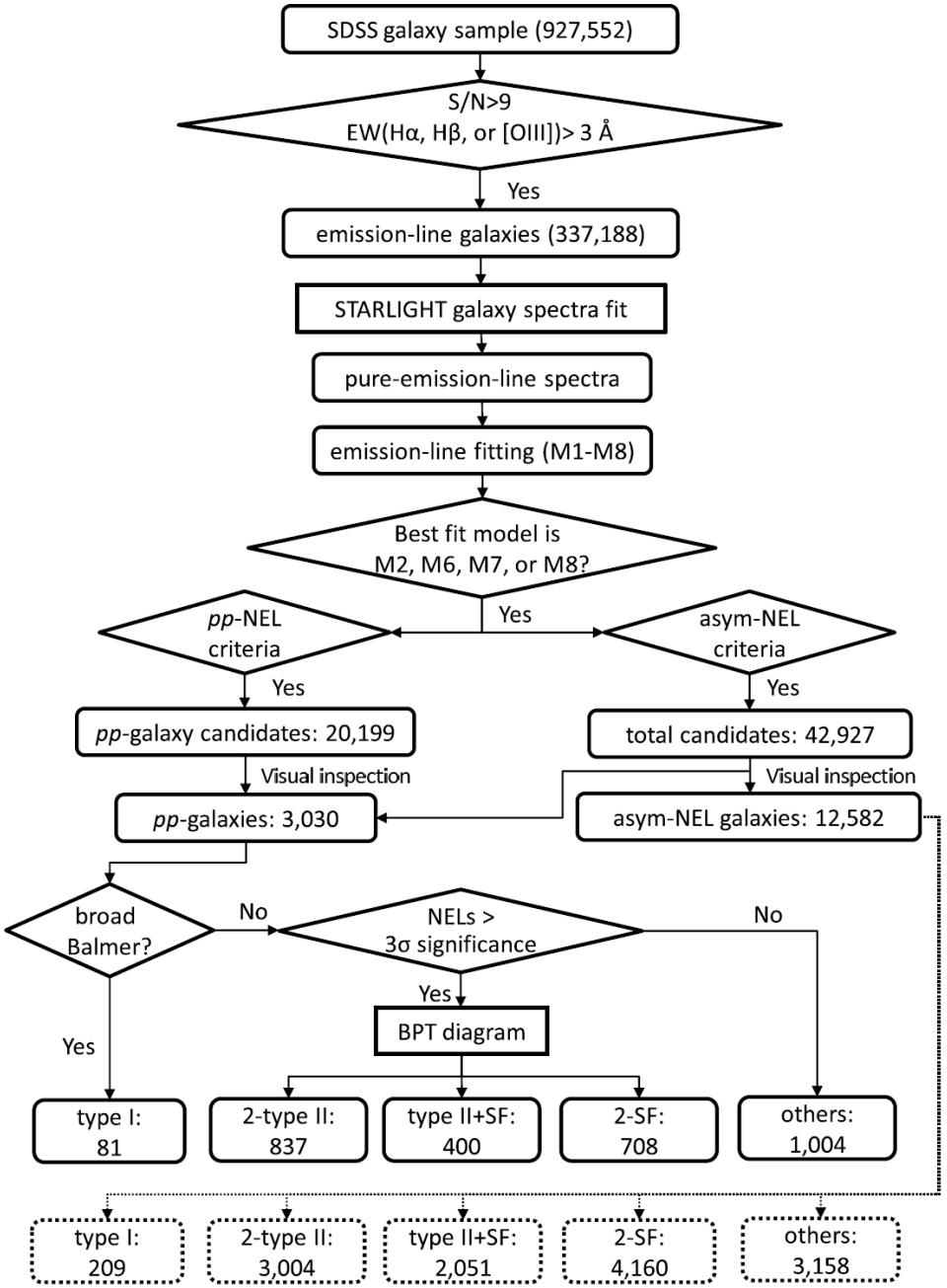
Fu et al. (2012)

Our recent work

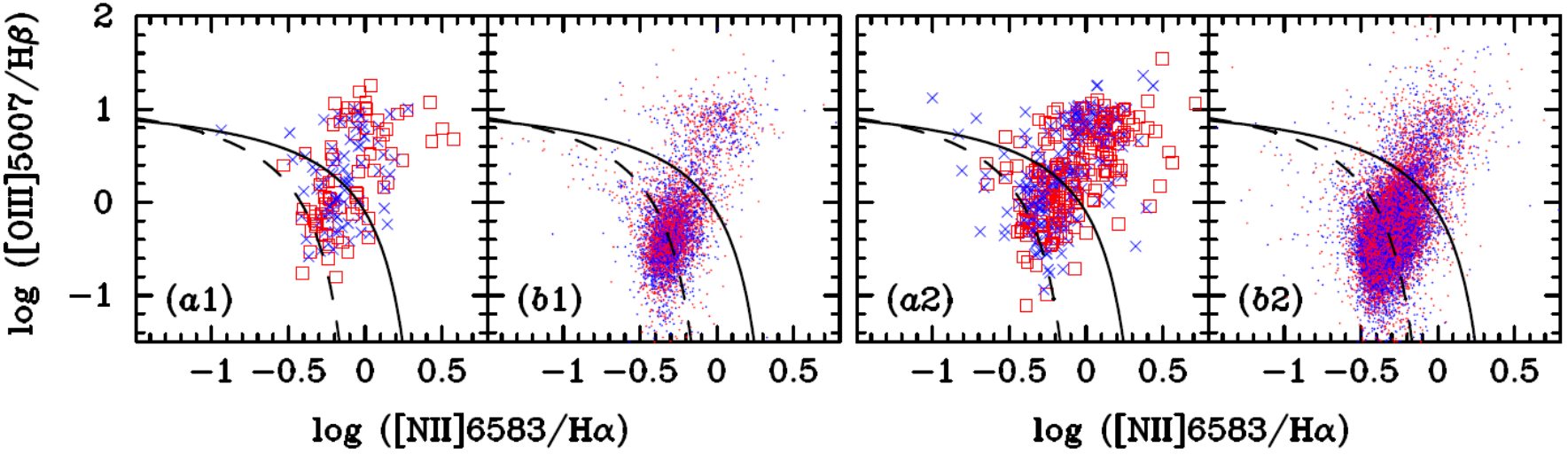
- **How about AGN+SF and SF+SF systems?**
- **Galaxy merger:**
  - **Trigger of Black hole activity & Starburst**
- **Aim to accomplish the whole story of galaxy merger**
- **Ge et al. 2012, ApJS, 201, 31**

Flowchart of sample selection





Source classification and distribution



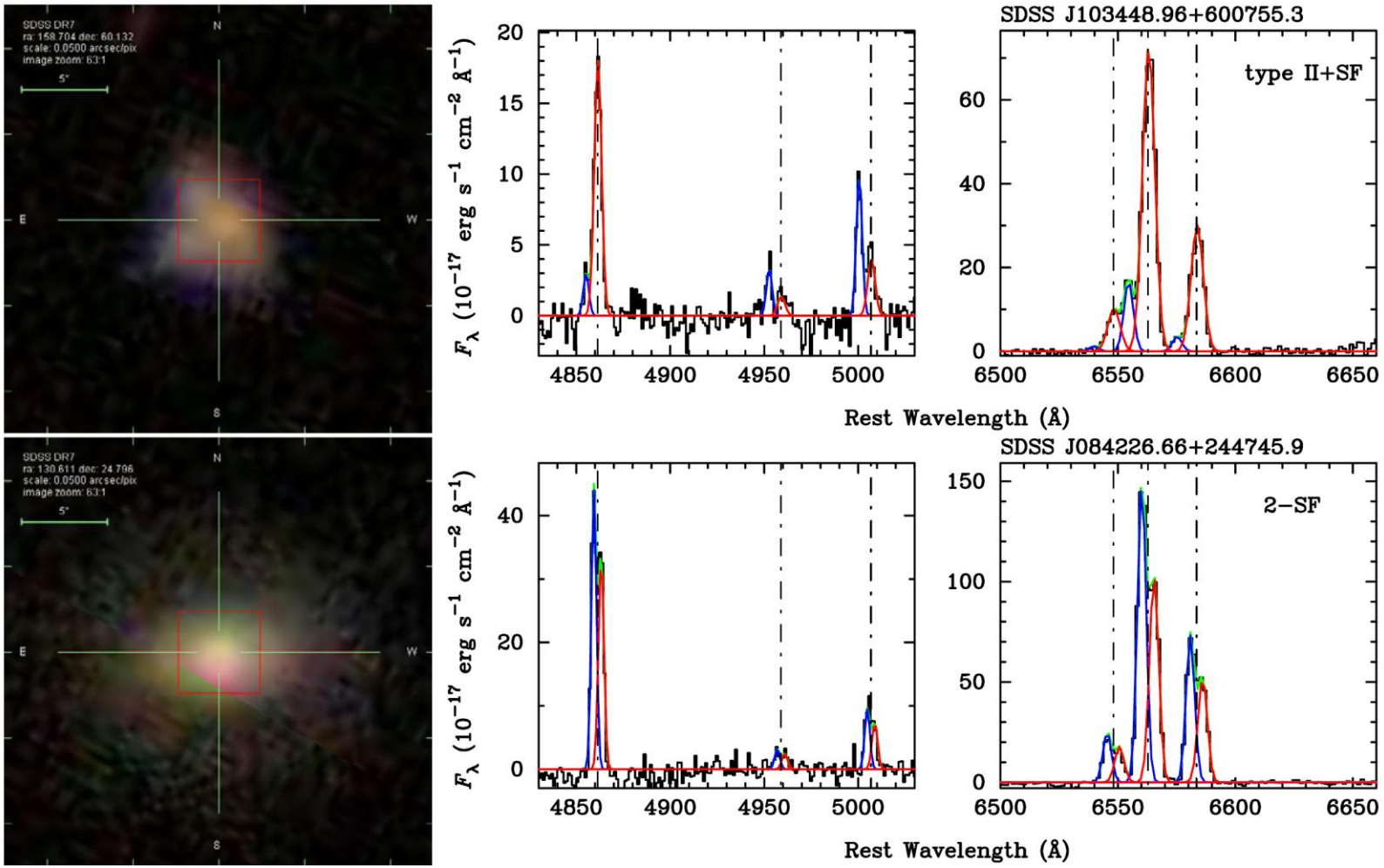
pp-galaxies: 3,030

asym-NEL galaxies: 12,582

type I: 81	2-type II: 837	type II+SF: 400	2-SF: 708	unknown: 1,004

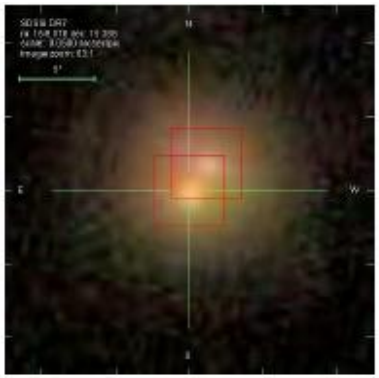
type I: 209	2-type II: 3,004	type II+SF: 2,051	2-SF: 4,160	unknown: 3,158

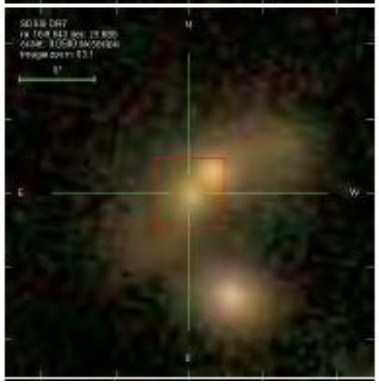
Examples of type II+SF and 2-SF sources

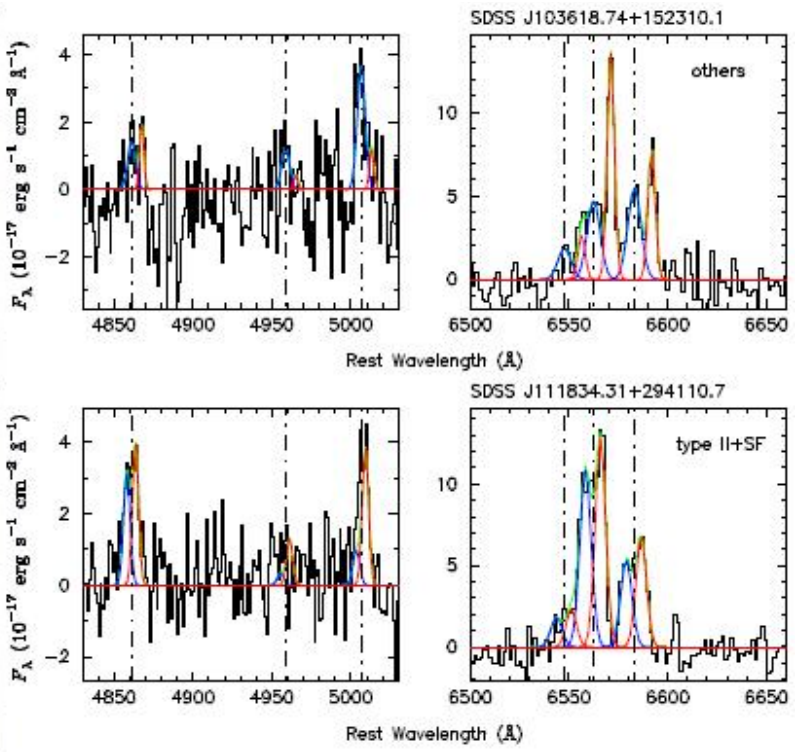


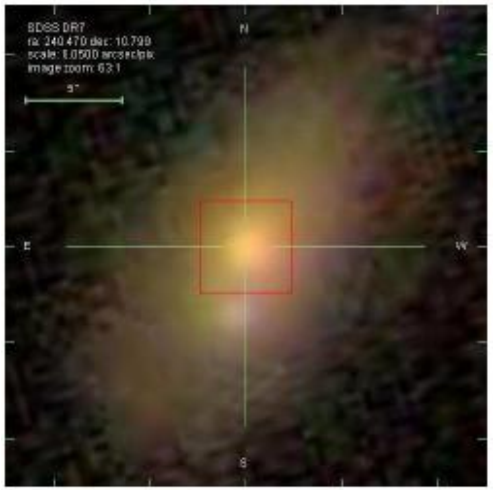
What can we learn from the current SDSS data??

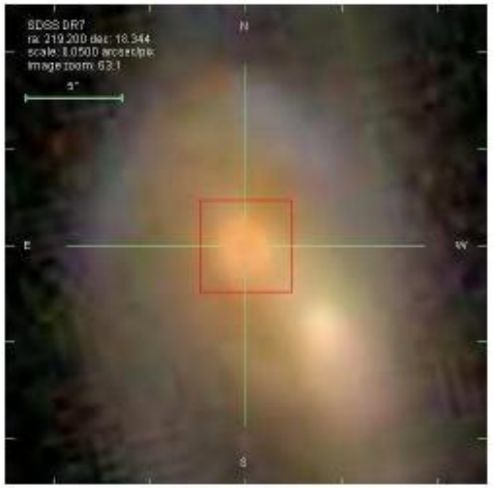
Dual-cored galaxies







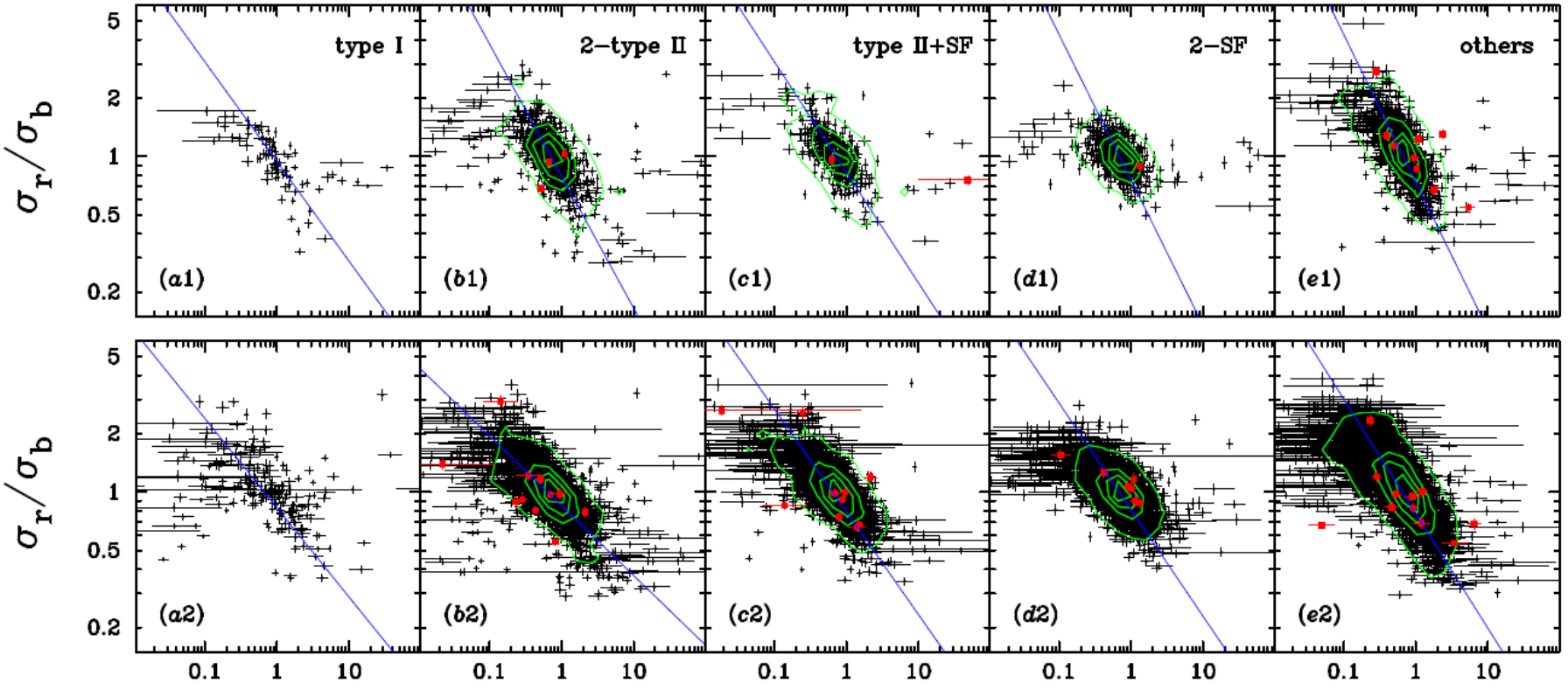




Dual cores separate <3”：54

>3”：255

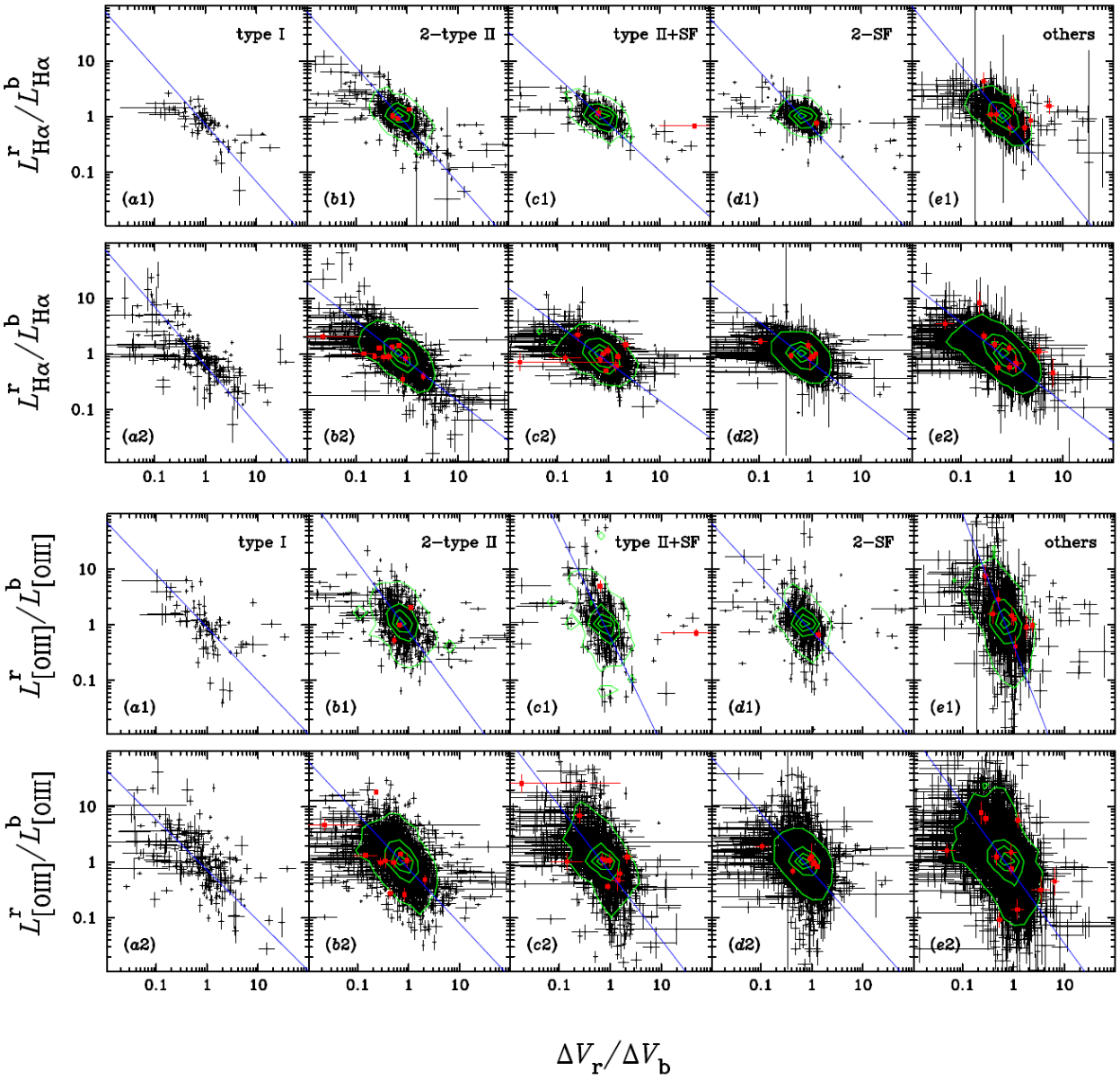
Dynamical correlation



$$\frac{V_\mathrm{r}}{V_\mathrm{b}} = \frac{M_{*,\mathrm{b}}}{M_{*,\mathrm{r}}} = \frac{M_{\bullet,\mathrm{b}}}{M_{\bullet,\mathrm{r}}} = \left(\frac{\sigma_\mathrm{b}}{\sigma_\mathrm{r}}\right)^{\Delta V_\mathrm{r}/\Delta V_\mathrm{b}} = \left(\frac{\sigma_\mathrm{b}}{\sigma_\mathrm{r}}\right)^{4},$$

- galactic disk?
- correlation uncertainty

Radiative correlation



Possible explanation:

Dual AGNs

Outflow

Rotating disk

Conclusion

- **Sample:**
  - **3,030 double-peaked NL galaxies**
  - **12,582 asymmetric NL galaxies**

- **Dual-cored galaxies：309**
  - **<3’’ : 54**
  - **>3’’ : 255**

- **Dynamical and radiative correlations,**
  what do they really mean?