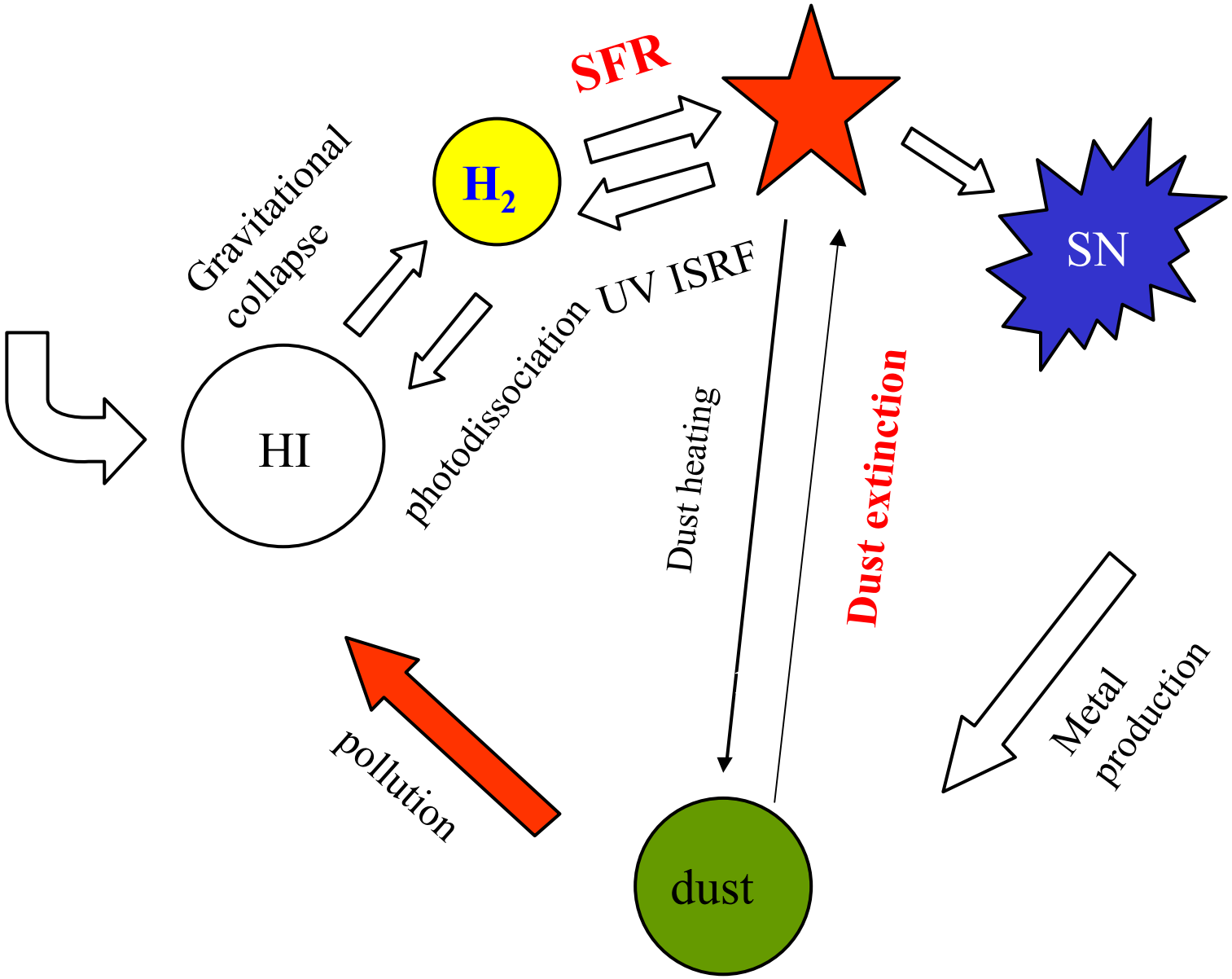
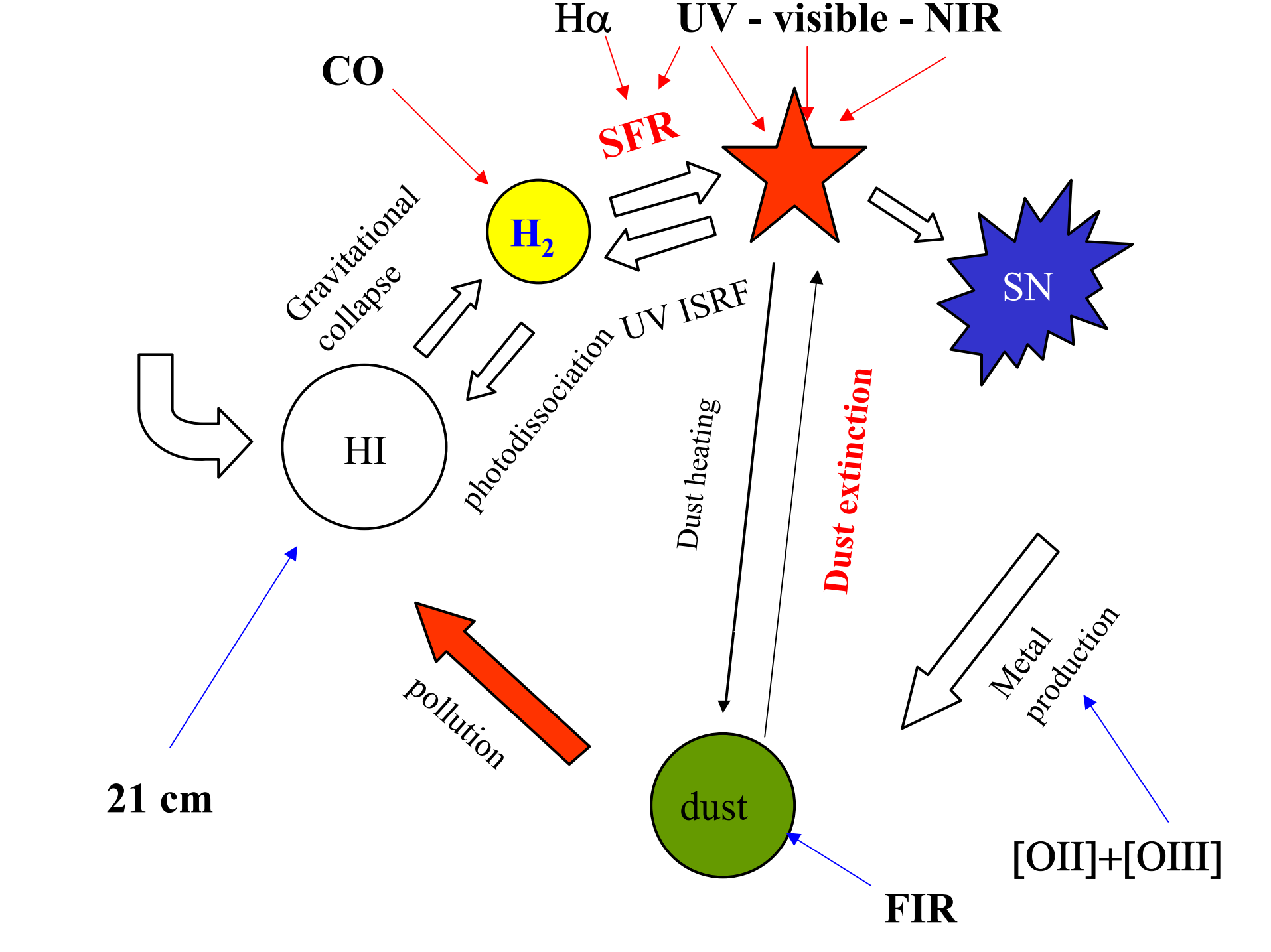
# The SFR and SFH of normal late-type galaxies

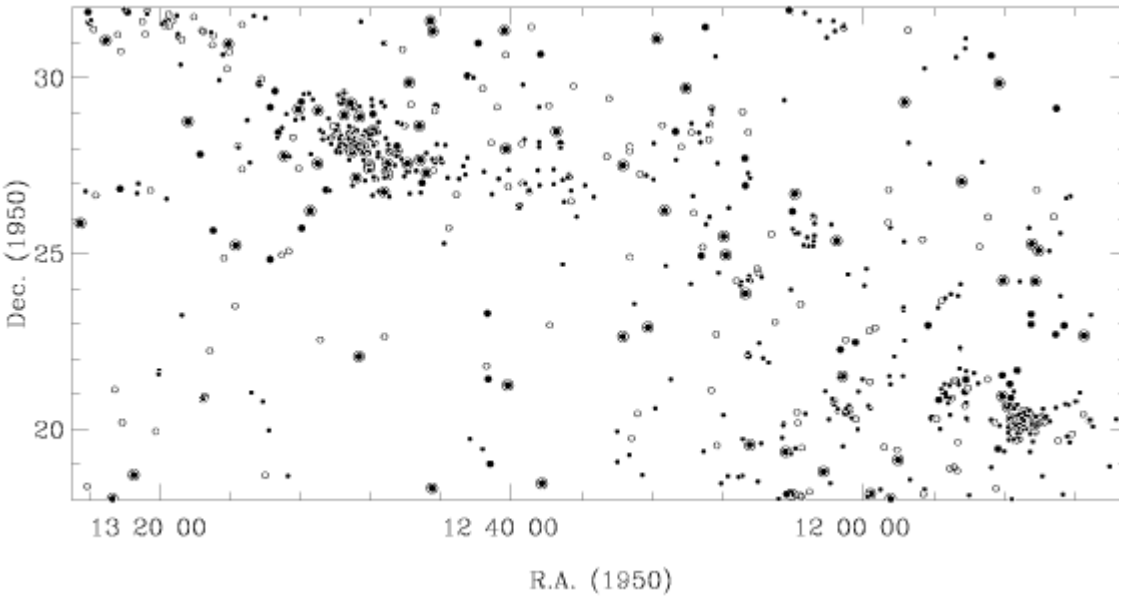
Alessandro Boselli, LAM, Marseille, France
Giuseppe Gavazzi, Universita di Milano, Italy

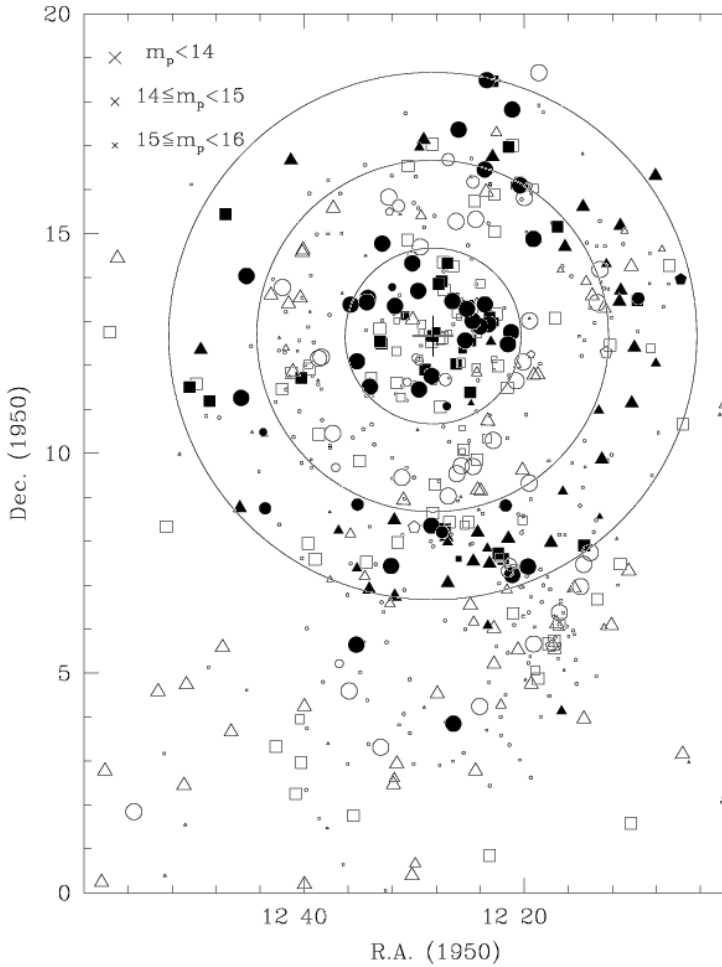
C. Bonfanti, L. Carrasco, J. Donas, A. Gallazzi, J. Iglesias-Paramo, J. Lequeux, P. Pedotti, G. Sanvito, M. Scodeggio, JM Vilchez,


SFR
$H_2$
Gravitational collapse
photodissociation UV ISRF
HI
SN
Dust heating
Dust extinction
pollution
Metal production
dust


Hα
UV - visible - NIR
CO
SFR
$H_2$
Gravitational collapse
photodissociation
UV ISRF
SN
HI
Dust heating
Dust extinction
pollution
Metal production
21 cm
dust
[OII]+[OIII]
FIR

# The sample: our surveyed regions




The Coma/A1367 supercluster
11h30<RA(1950)<13h30; 18<dec<32

The Virgo cluster (VCC)
12h<RA(1950)<13h; 0<dec<18

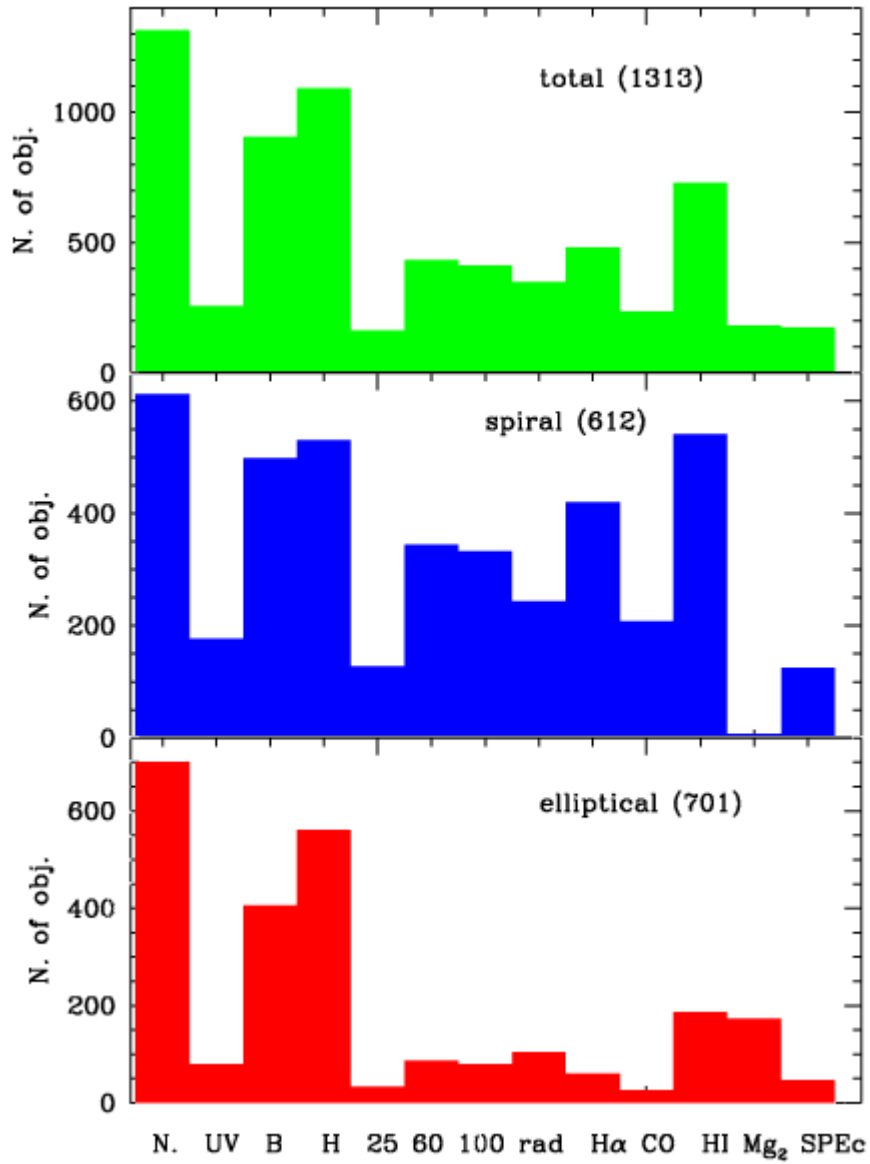
# The Sample

The Virgo cluster: VCC catalogue $m_B \leq$ 16.0 (880 giant + dwarf galaxies)

The Coma/A1367 supercluster and the Cancer cluster: CGCG catalogue $m_B \leq 15.7$ (693 isolated + cluster galaxies)

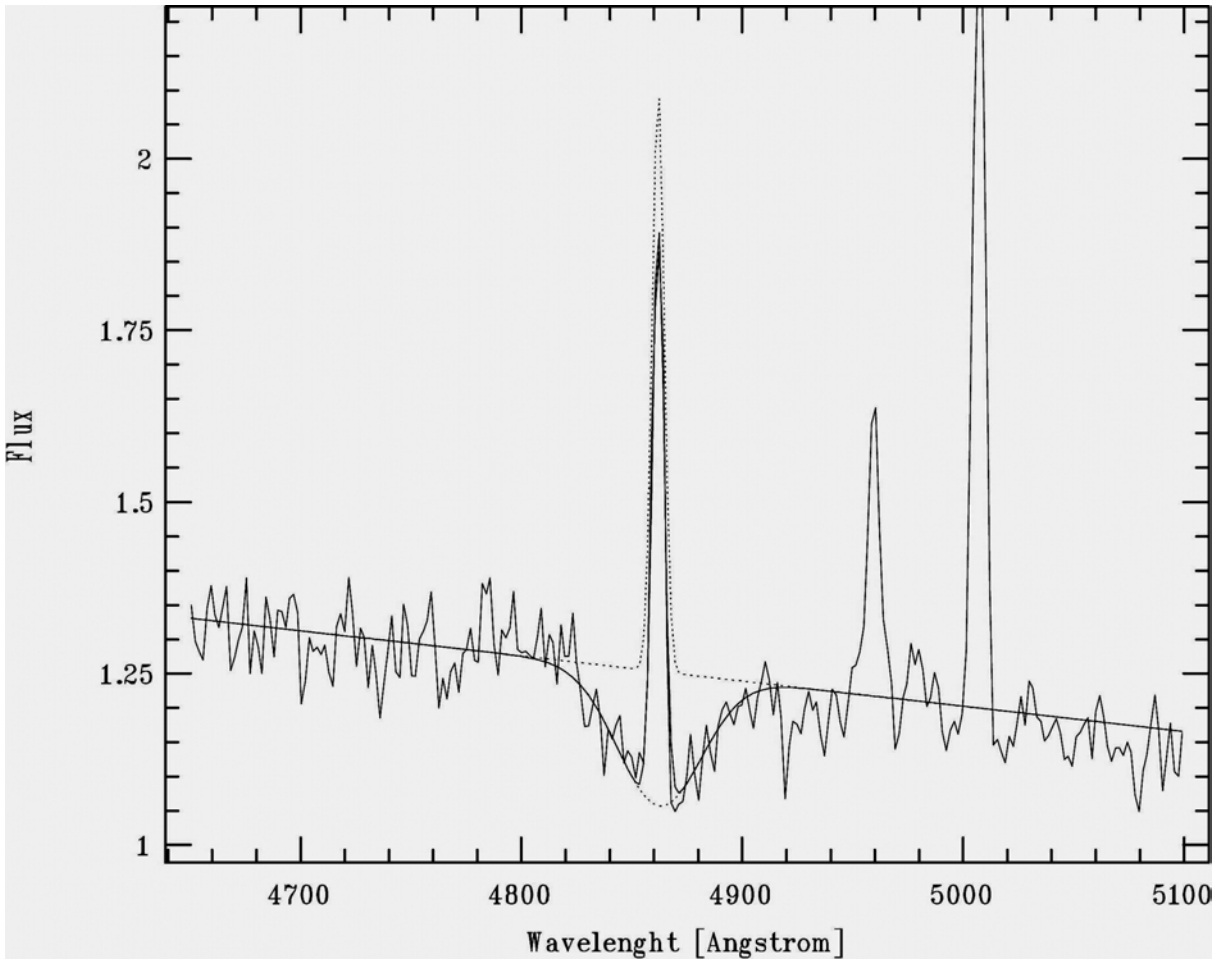
The ISO sample: 100 galaxies in Virgo + 18 galaxies in Coma with CAM and PHOT data

**http://goldmine.mib.infn.it/**



# The extinction

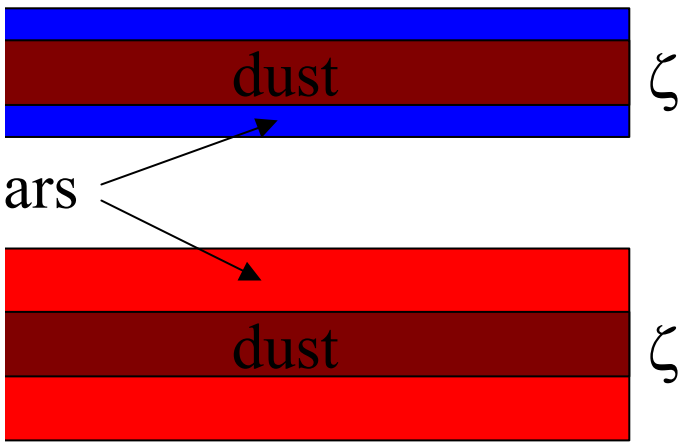
Hα - Balmer decrement (underlying absorption has to be properly estimated)

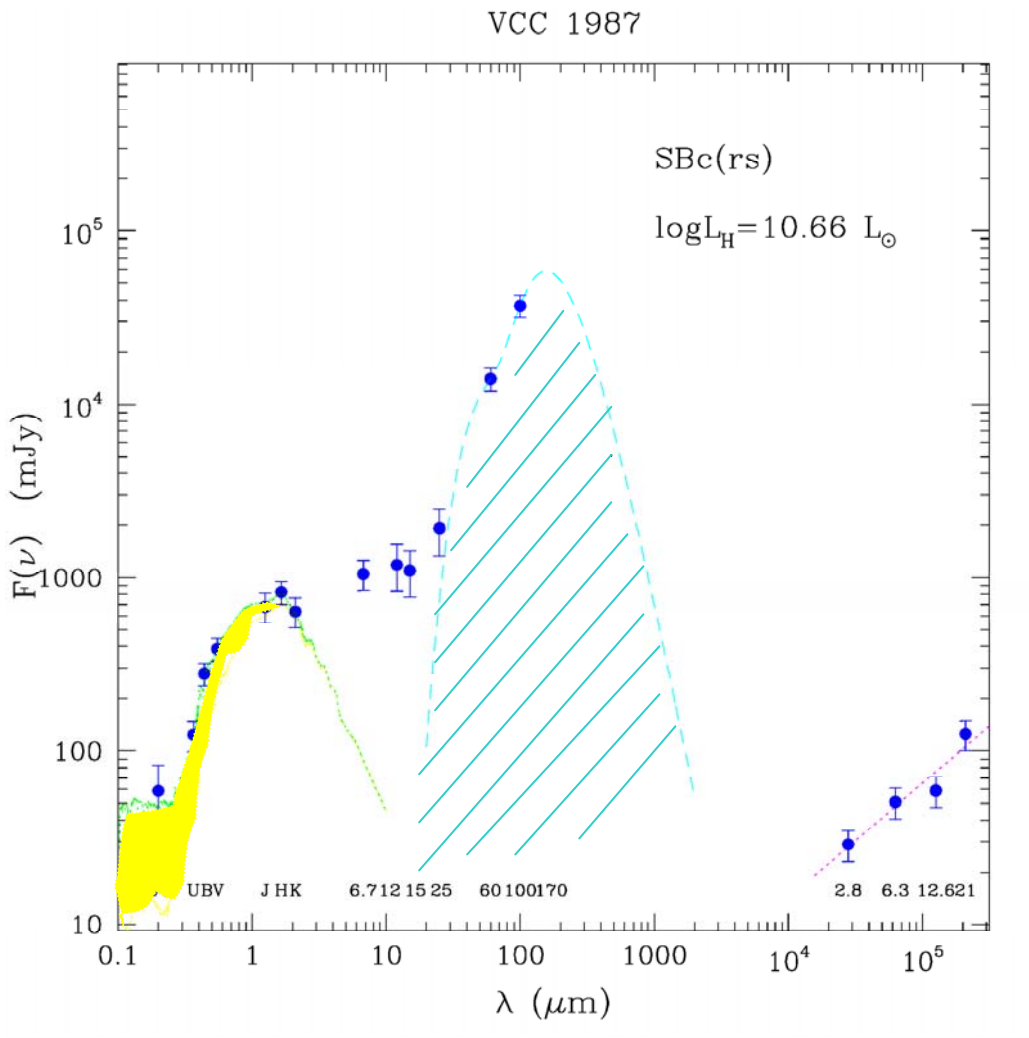


# The FIR/UV ratio as an extinction indicator

**(UV)=f(FIR/UV)**
**sandwich model**
**(UV)=f(τ(UV),ζ(UV))**

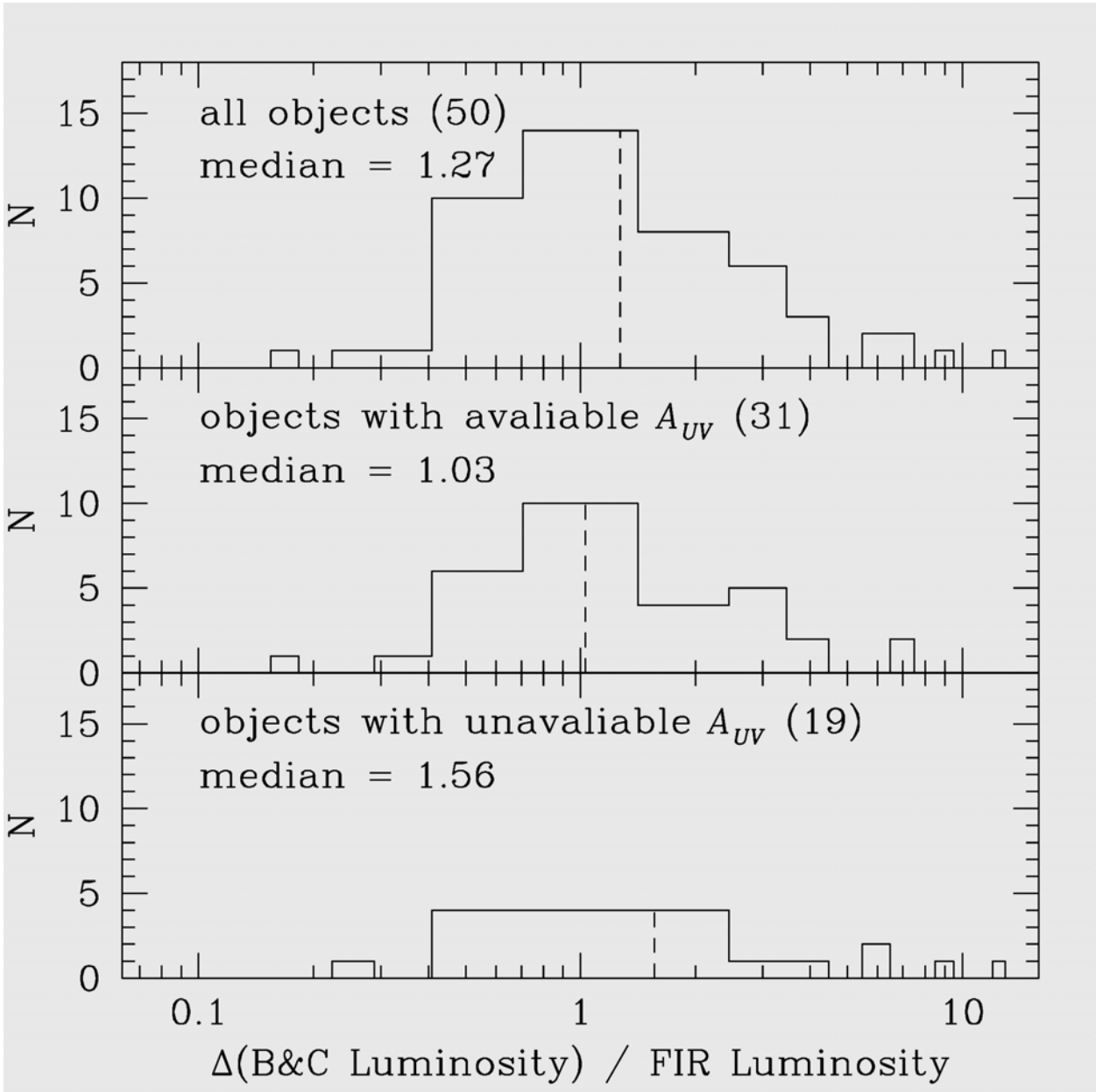
**(λ)=f(τ(λ),ζ(λ))**
λ)=galactic extinction law
λ)=calibrated on nearby f.o
laxies




Boselli et al. 2003

# Energetic balance = extinction

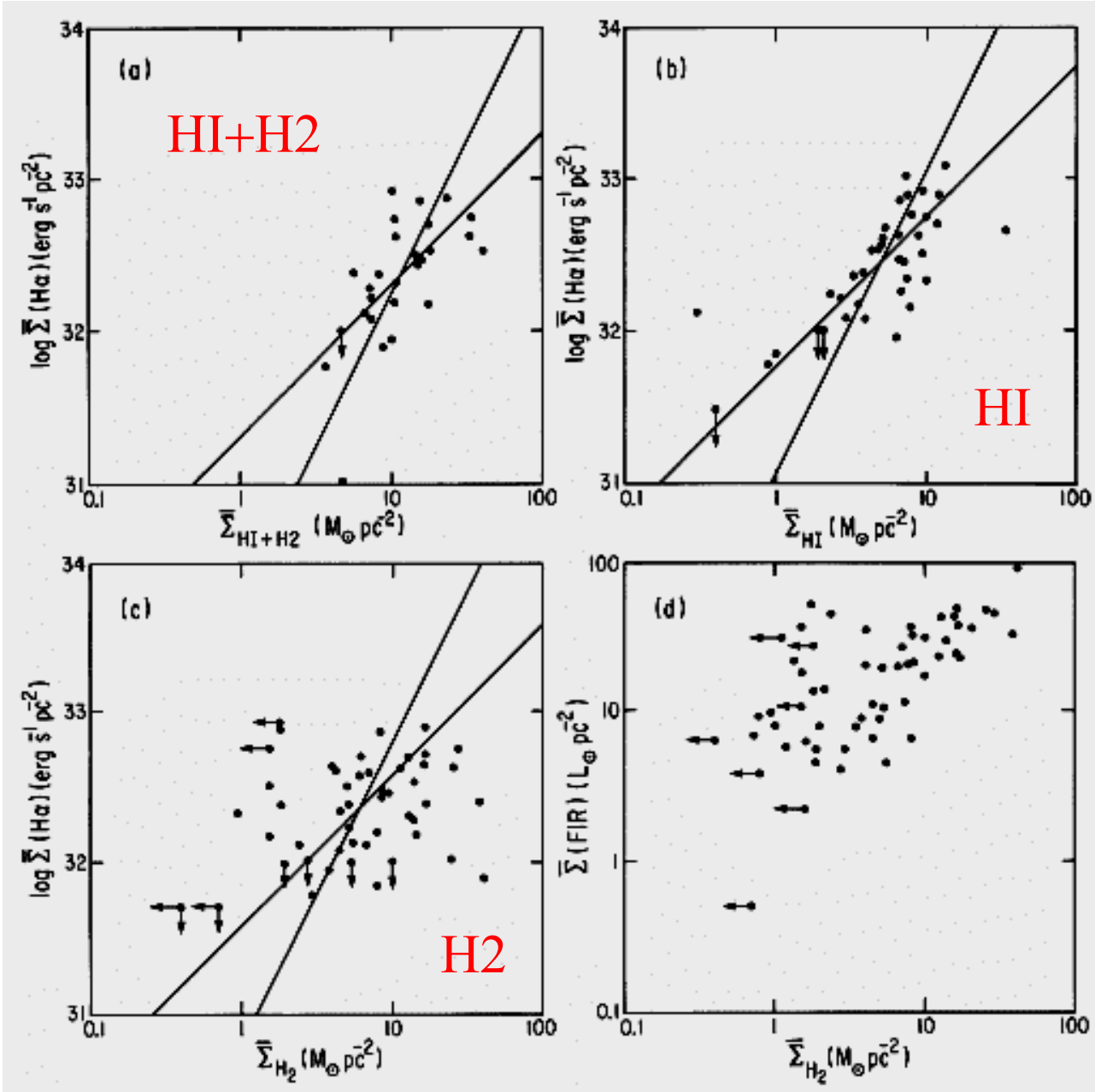



Boselli et al 2003

# SFR vs gas

Schmidt law:

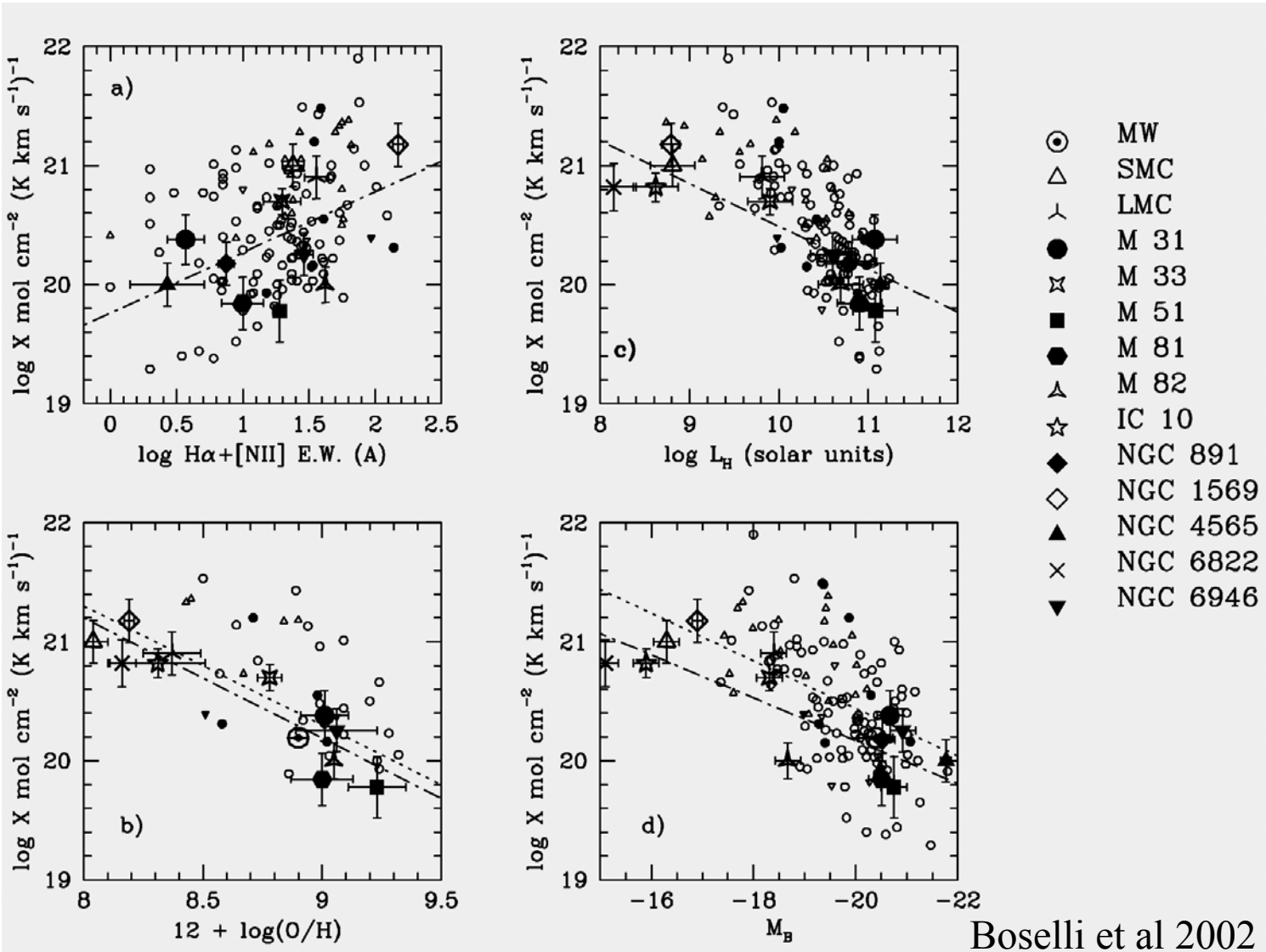
$$SFR = a\,\Sigma_{gas}^{n}$$




Kennicutt 1989

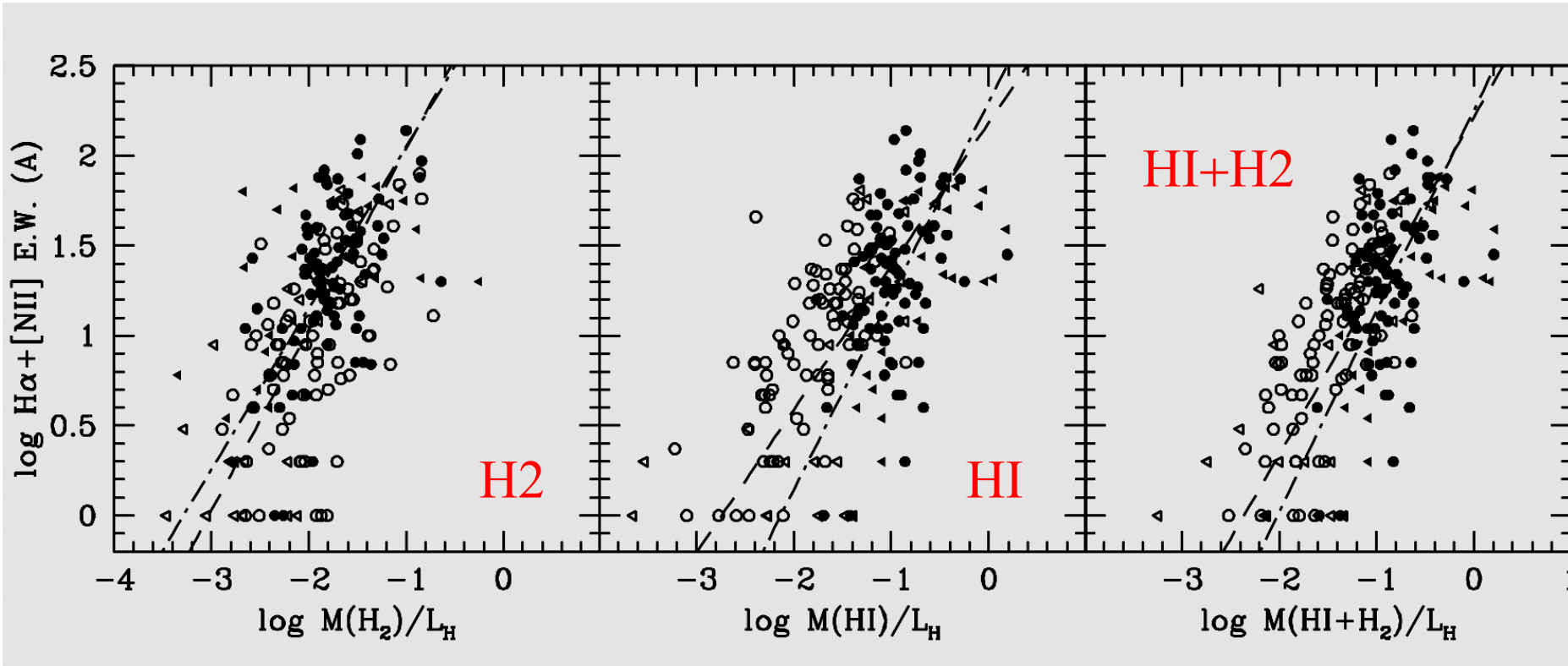
# The molecular gas mass

N(H2)=X· I(CO)  X= conversion factor




Boselli et al 2002

# SFR vs gas




Boselli et al 2002

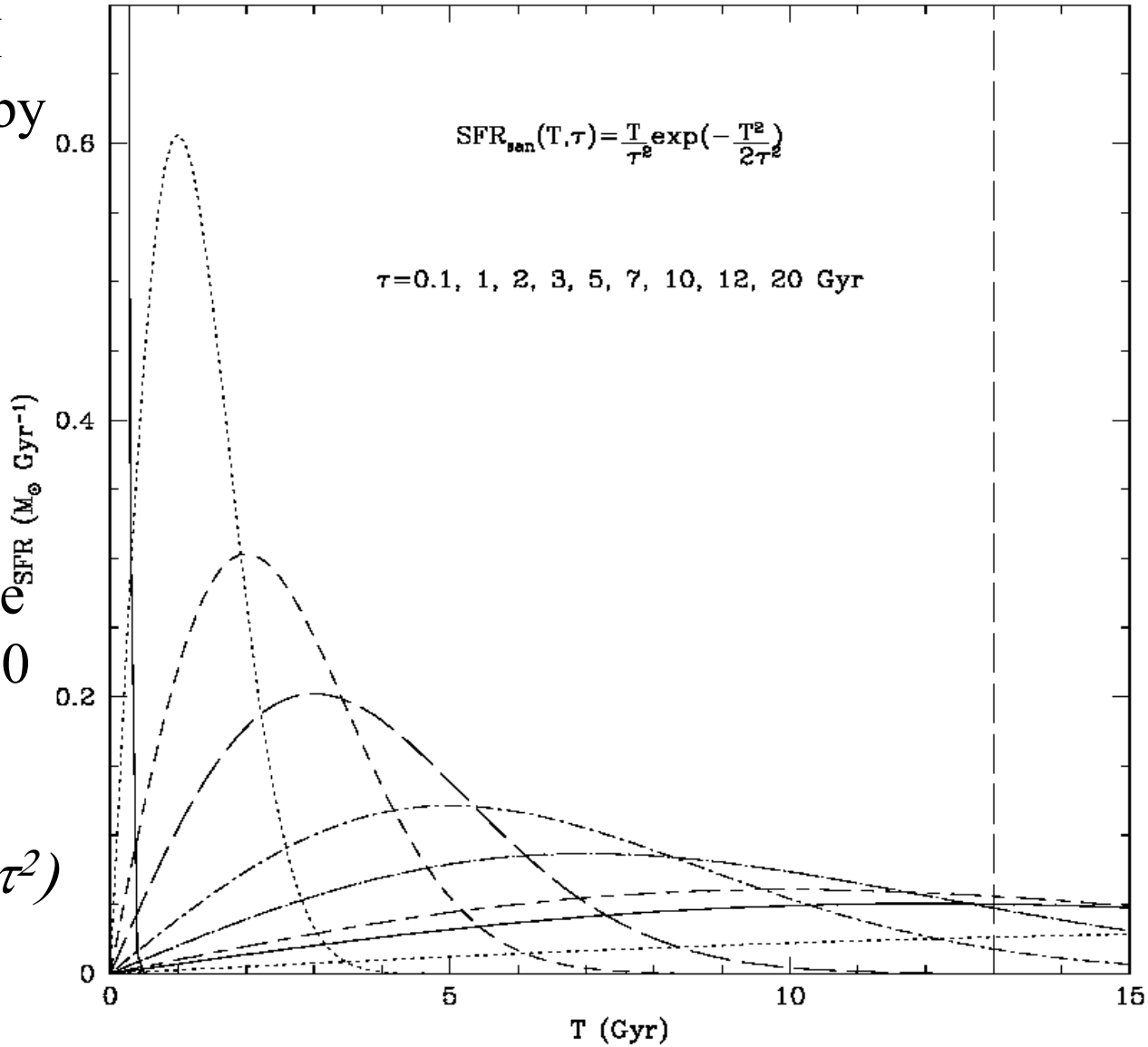
# SFH: the fitting model

We constrain the SFH of the target galaxies by fitting with Bruzual-Charlot population synthesis models the SED obtained by combining integrated spectra with photometric data in the wavelength range 2000 A - 2.2 μm

$SFR=(T/\tau^2)exp(-T^2/2\tau^2)$

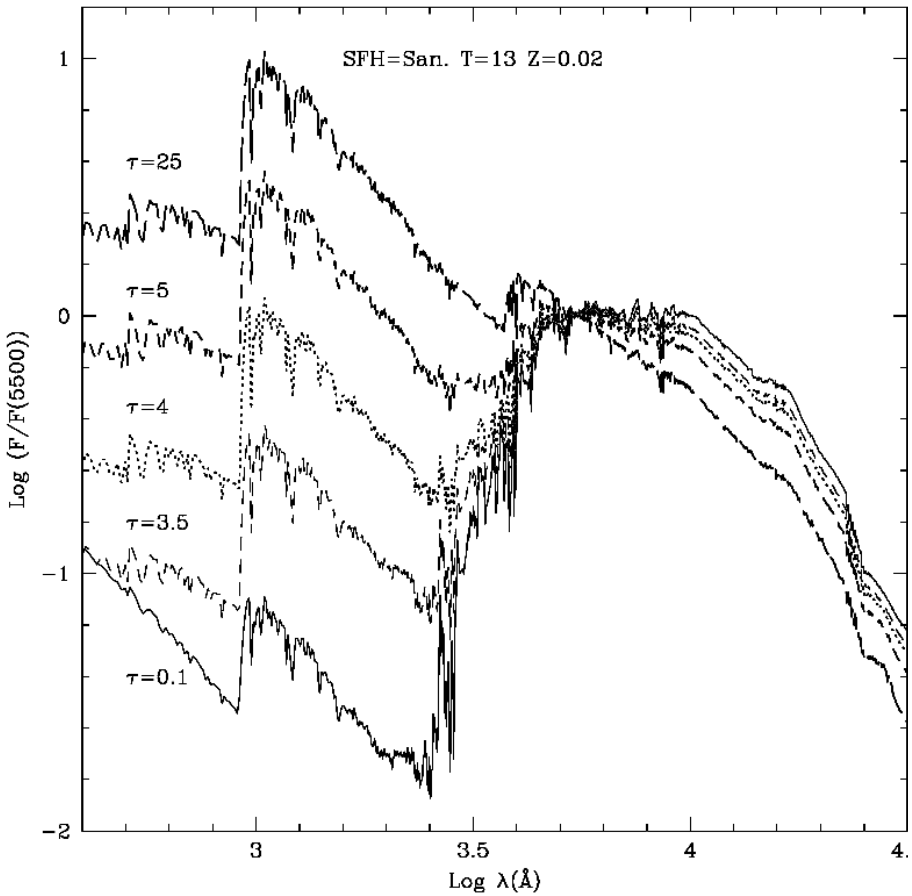
$T$=age=13 Gyr

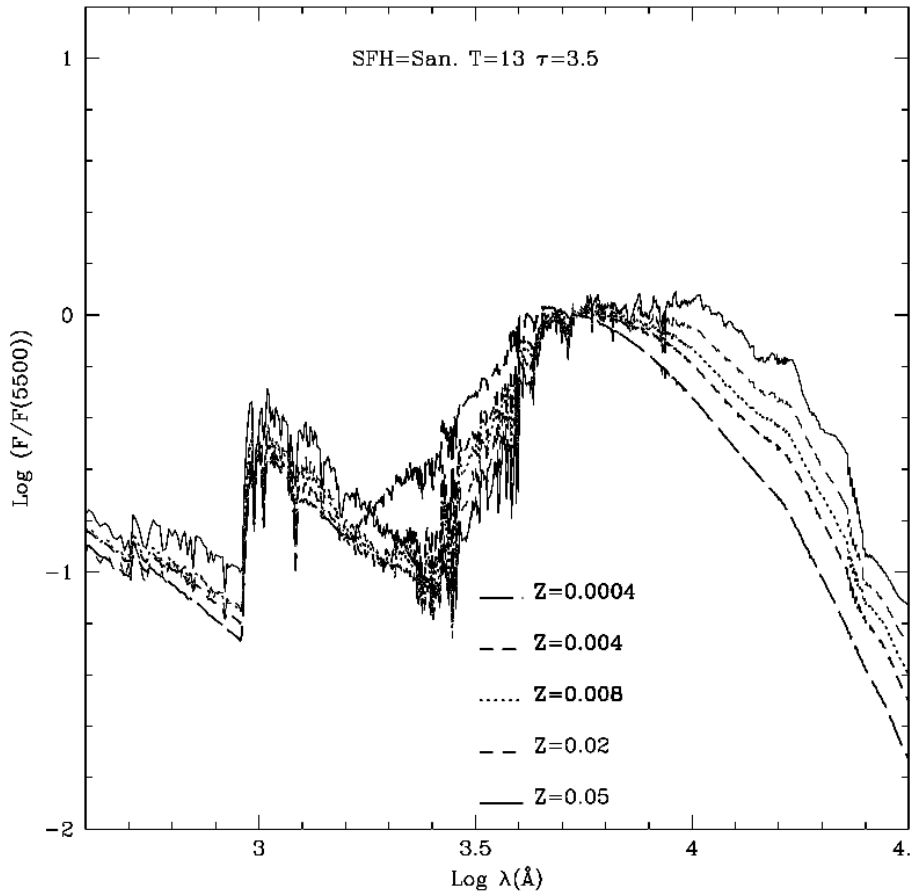
Gavazzi et al. 2002



# Model: age-metallicity

$SFR=(T/\tau^2)exp(-T^2/2\tau^2)$ $T$=age=13 Gyr



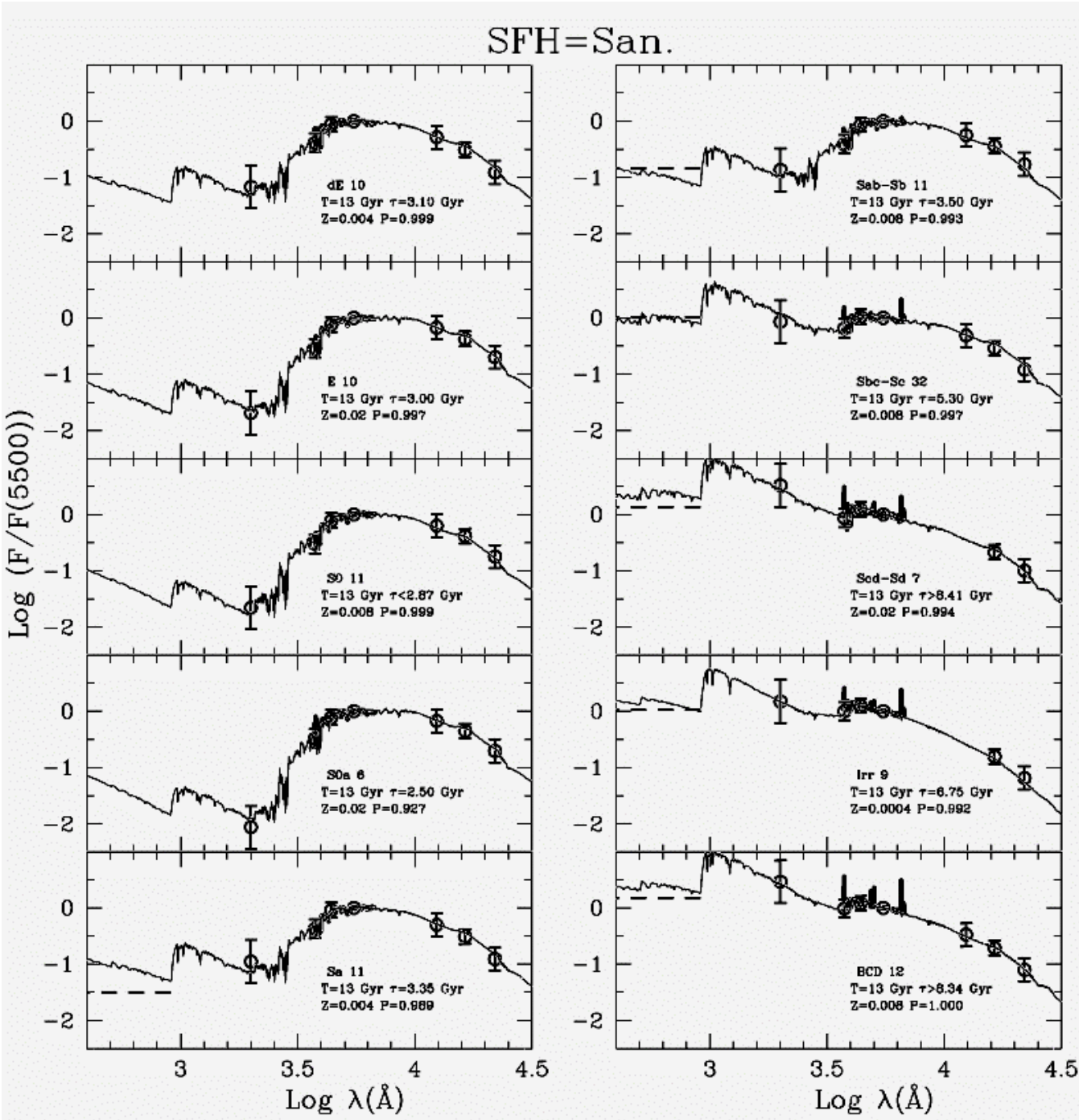

Gavazzi et al 2002

# Fit to the UV-NIR SED

Photometric data: Hα, UV (2000 A), U, B, V, J, H, K

Spectroscopic data: 3500-7200 A

Gavazzi et al. 2002



# SFH: the role of mass - spirals

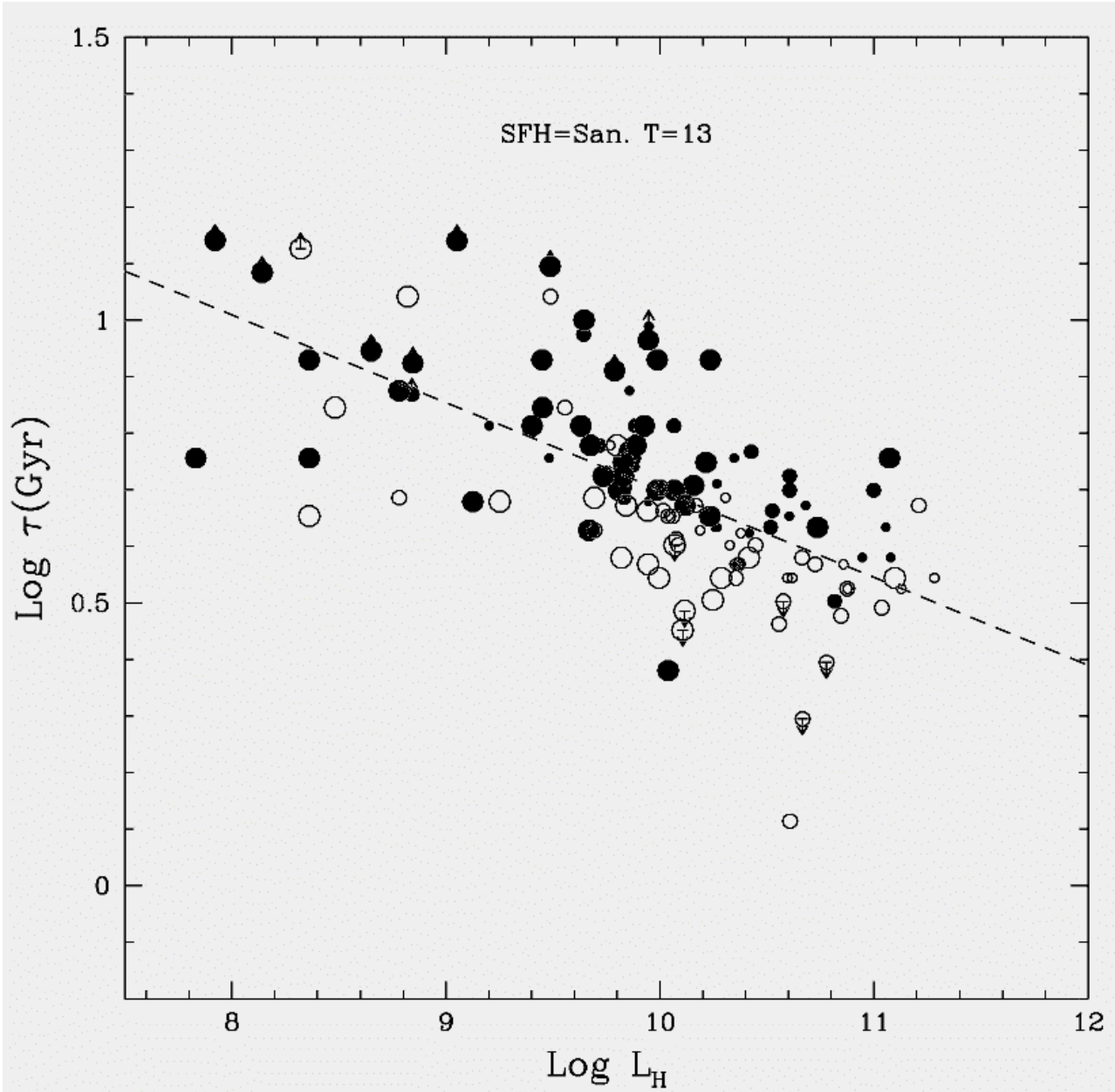
H band luminosity is an indicator of the total dynamical mass of galaxies

open dots: HIdef>0.5

filled dots: HIdef<0.5

size: metallicity (small=metal rich, big=metal poor)

Gavazzi et al 2002



# SFH: the role of gas and of present day SFR

Birthrate parameter $b = \frac{SFR}{<SFR>_{past}} = \frac{SFRt_0(1\text{-}R)}{M_{star}} = \frac{SFRt_0(1\text{-}R)}{L_H(M_{tot}/L_H)DM_{cont}}$

Normalized gas content: $\frac{M_{gas}}{L_H} = \frac{M_{HI+}M_{H2}}{L_H}$

Star formation efficiency: $SFE\ (yr^{-1}) = \frac{SFR}{M_{gas}}$

*SFR*: from Hα and/or UV(2000 A) data assuming a Salpeter IMF in the mass range $0.1 < m < 100$ Mo
Boselli et al 2001

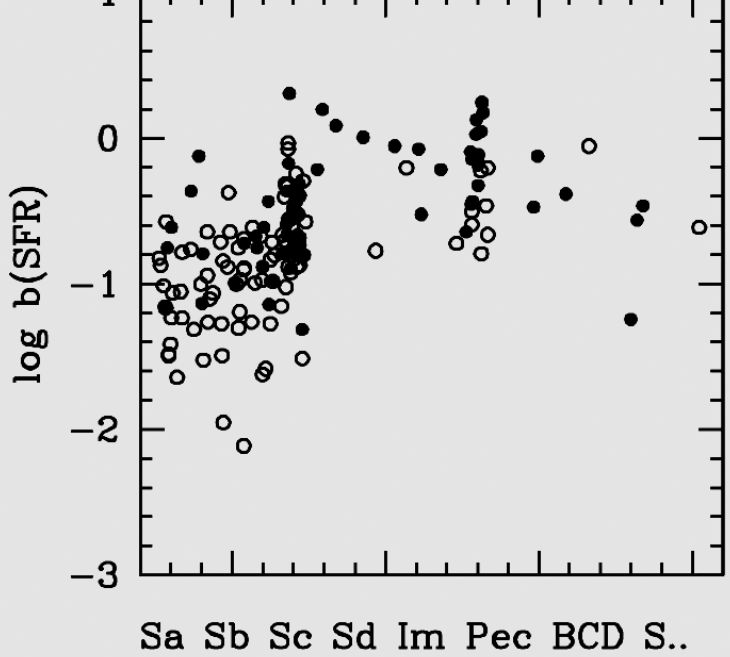
# SFR-SFH vs luminosity and type

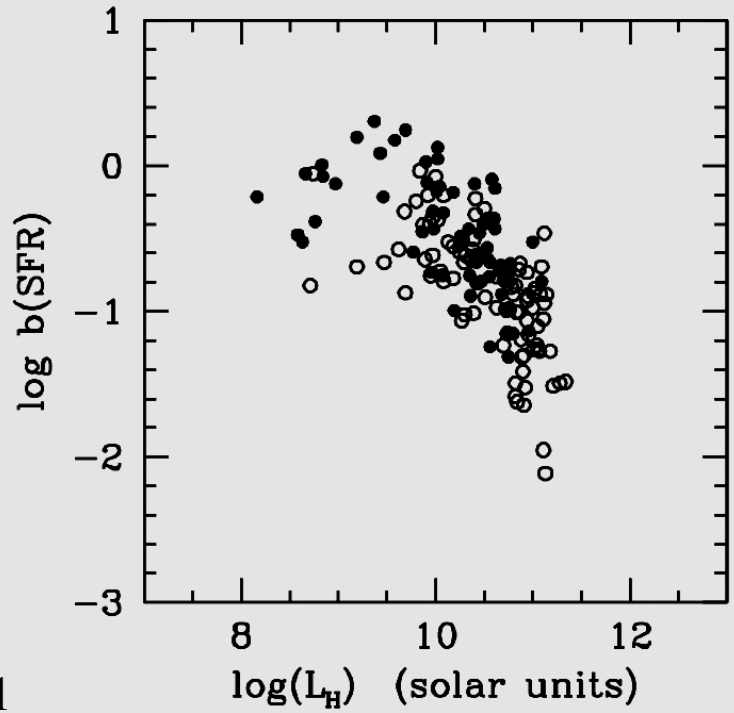
Birthrate parameter $b = \frac{SFR}{<SFR>_{past}} =$

$$\frac{SFRt_0(1\text{-}R)}{M_{star}} = \frac{SFRt_0(1\text{-}R)}{L_H(M_{tot}/L_H)DM_{cont}}$$

$$(\propto \quad H\alpha\text{+}[NII]EW)$$

The birthrate parameter *b* depends more on the total H band luminosity (mass) than on the morphological type




Boselli et al 2001

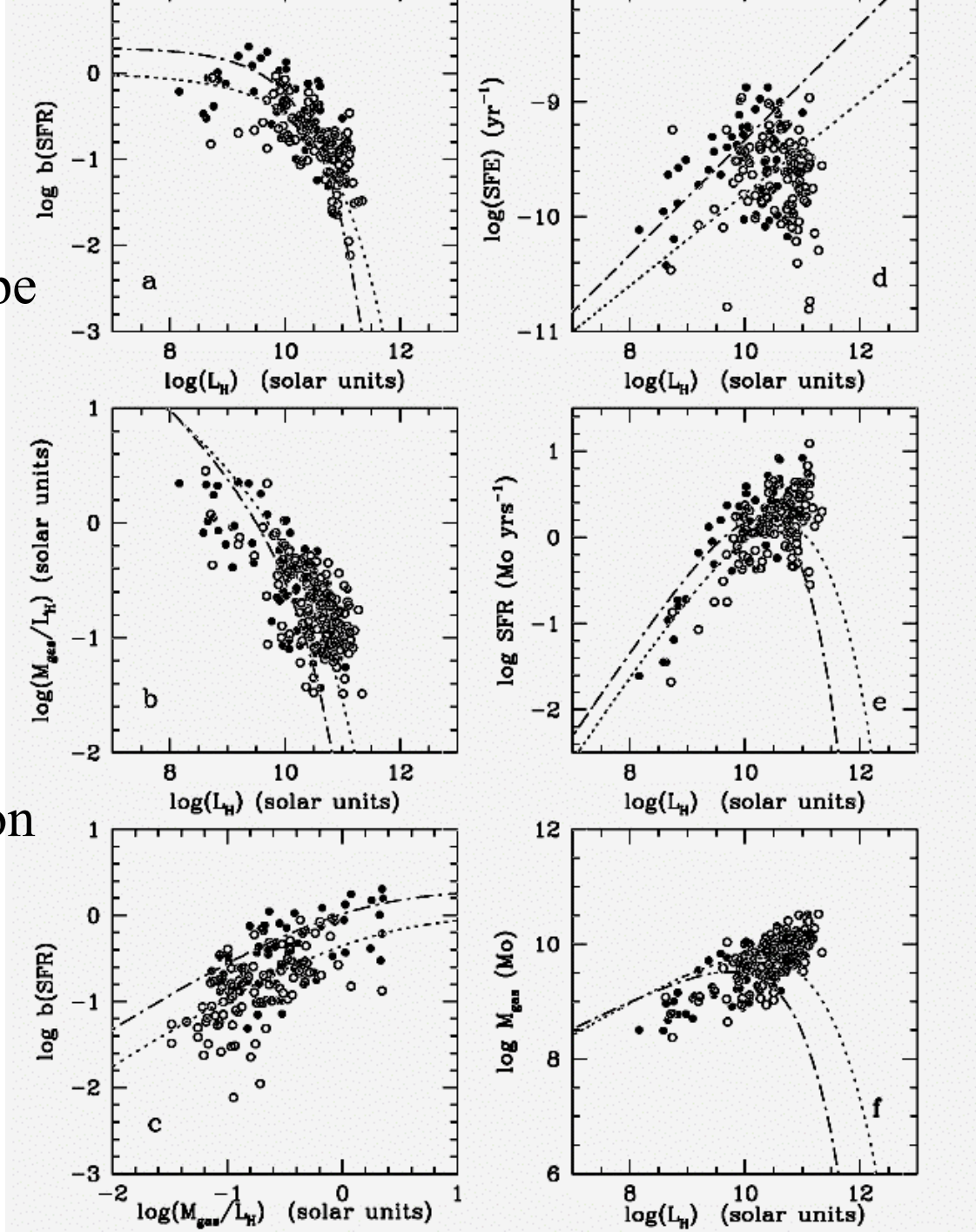
# Gas and SFR

Assuming a simple relation between $\tau$ and $L_H$ of the type

$log(L_H) = a + c\ log(\tau)$

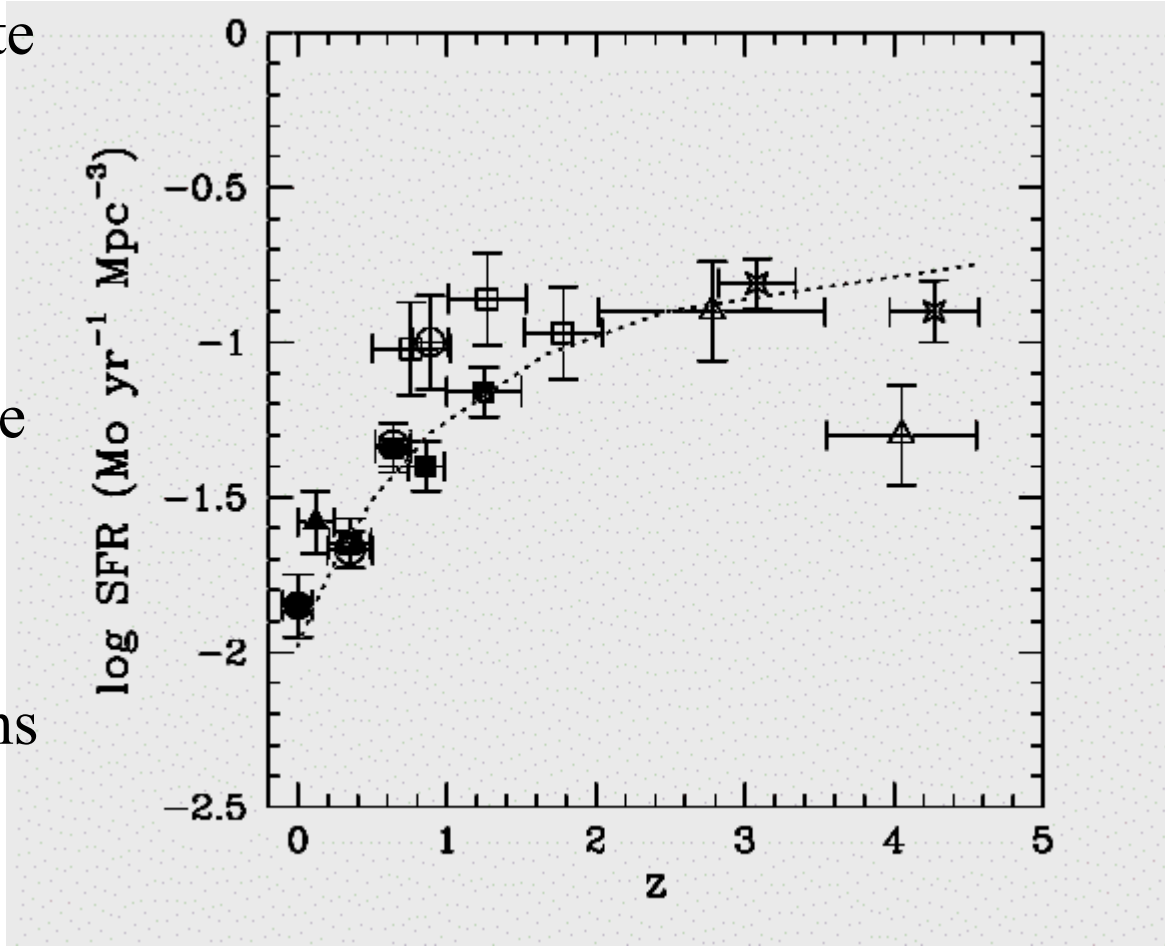
we can fit the data with a delayed-exponential star formation history (Sandage law, dashed-dotted line) or an exponential star formation history (dotted line)

Boselli et al. 2001



# SFR vs. z

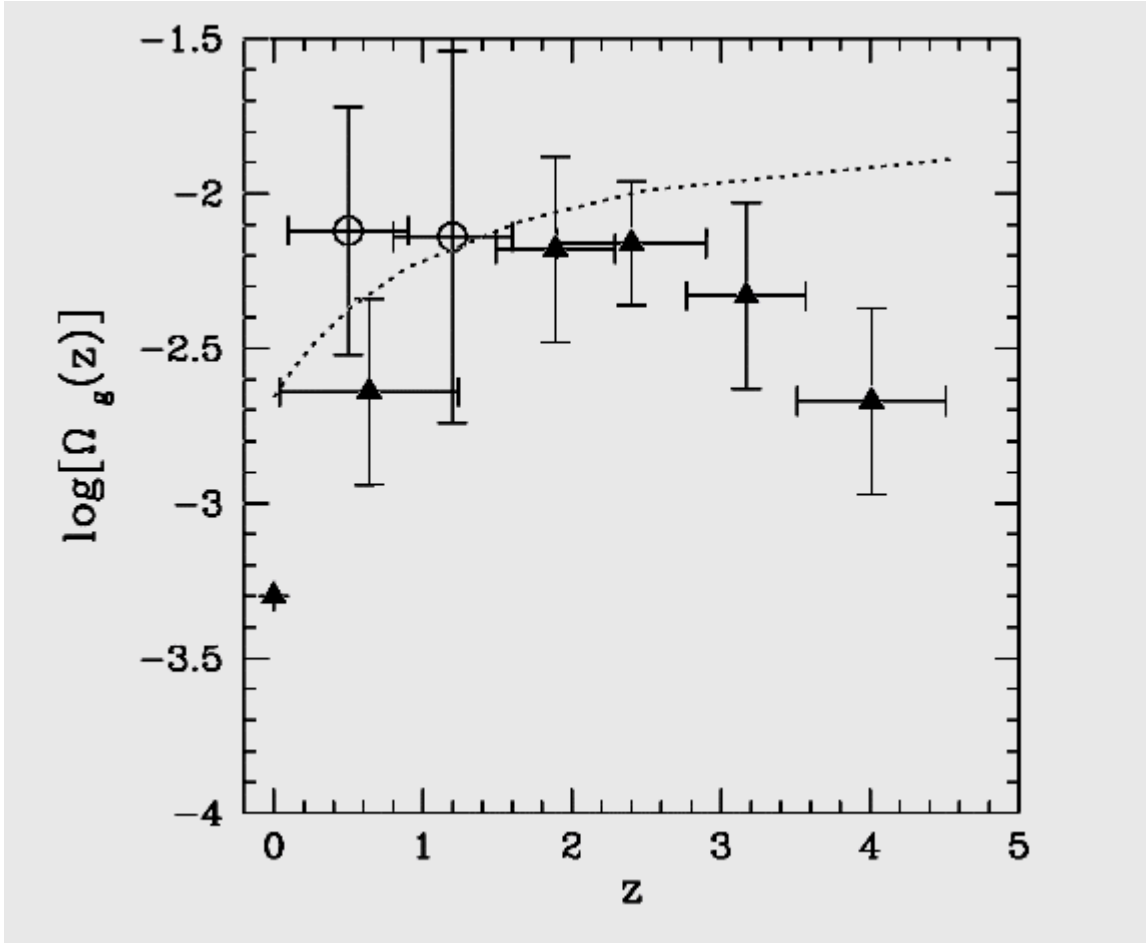
Assuming a H band luminosity function for late type galaxies, and a given law for the star formation history of galaxies of a given mass ($L_H$) we can predict the evolution of the SFR with time; by integrating the SFR over the entire luminosity function at different epochs we can reconstruct the evolution of the SFR per unit comoving volume of the Universe and compare it to the observations.




Boselli et al 2001

# Gas vs. z

As for the SFR we can compare the model prediction with the observed comoving density of the gas as determined from observations of damped Lyα systems.

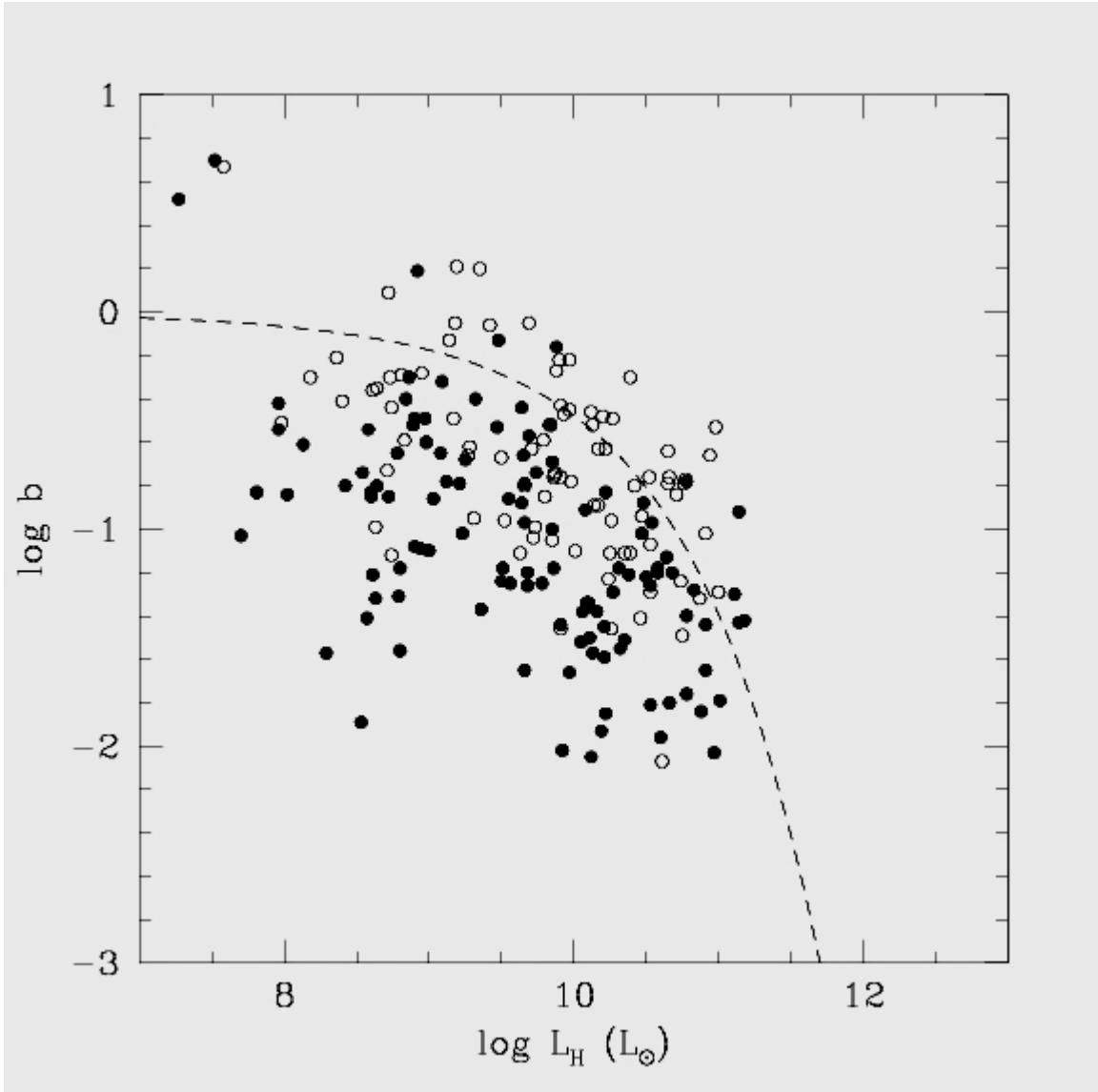



Boselli et al. 2001

# SFR-SFH vs environment

Virgo galaxies

Gas deficient galaxies (def gas>0.4, filled symbols) have lower birthrate parameters than galaxies with a normal gas content (open symbols)

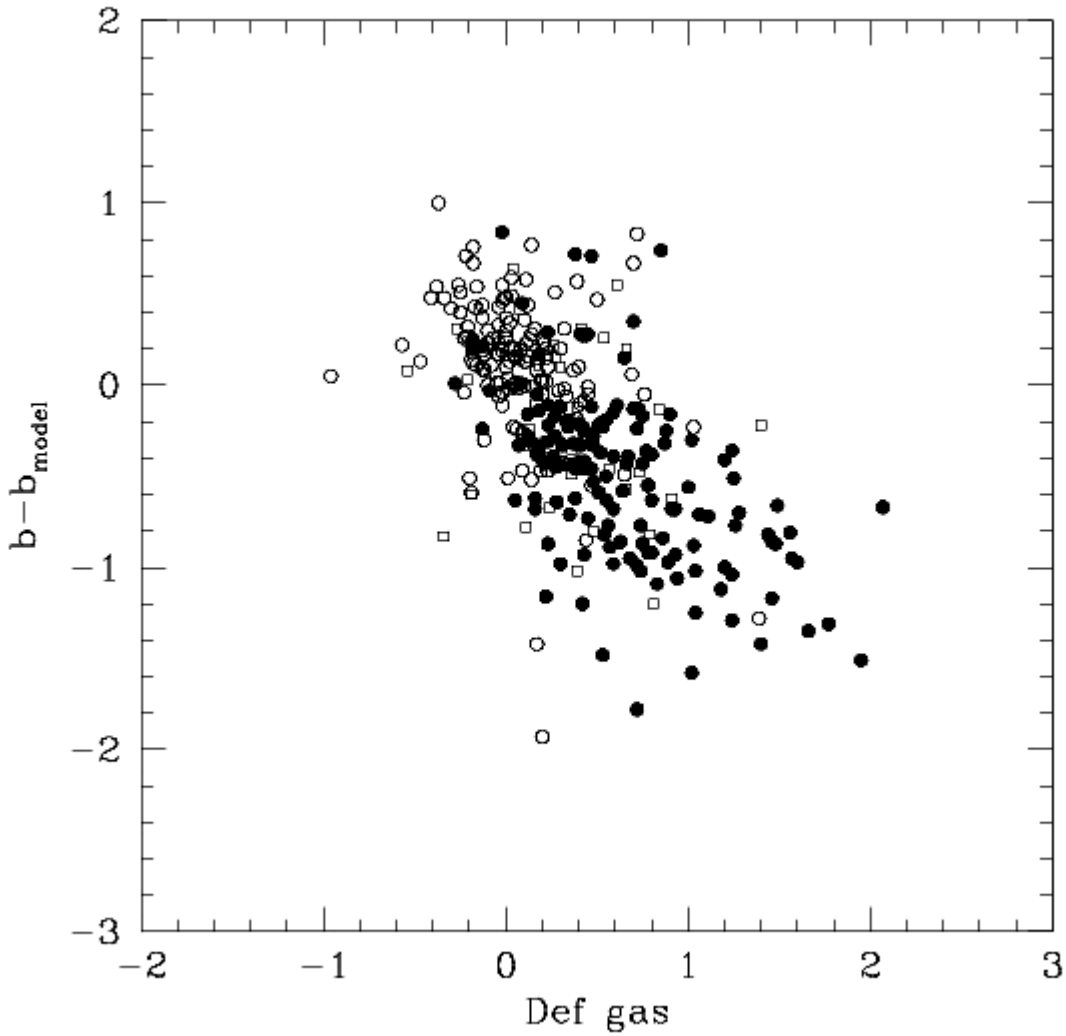



Gavazzi et al 2002

# The birthrate parameter *b*

The residual of the birthrate parameter is correlated with the gas deficiency: gas deficient galaxies have a lower present day star formation activity than objects with a normal gas content.

HI gas infall on time scales ~ to the star formation time is needed




Gavazzi et al 2002

# The SFR-SFH of normal late-type galaxies

1) In normal late-type galaxies the present and past normalized star formation activity and the total gas content are more related to the total mass than to the morphological type

2) These observational evidences are consistent with the hypothesis that galaxies are coeval (13 Gyr), that they evolved as closed boxes following an ~ exponentially declining SFR, with a declining time-scale anticorrelated to the total mass of the galaxy: bright, massive galaxies formed most of their stars in the past ($\tau$~3 Gyr), while low-mass dwarfs are still forming stars at an high rate ($\tau$~10 Gyr) (**monolithic scenario**)

# GALEX

- All sky survey at 1500 and 2500 A , complete at $m_{AB}$~21 mag, + a number of deep and ultra-deep surveys

- Spatial resolution of ~ 5 arcsec

- Spectroscopic (1500-2500 A, R~150) survey of some regions

- Launch expected for march 26, data directly available to the community

In Virgo (dist=17 Mpc) all BCD with $M_B$<-13 should be detected