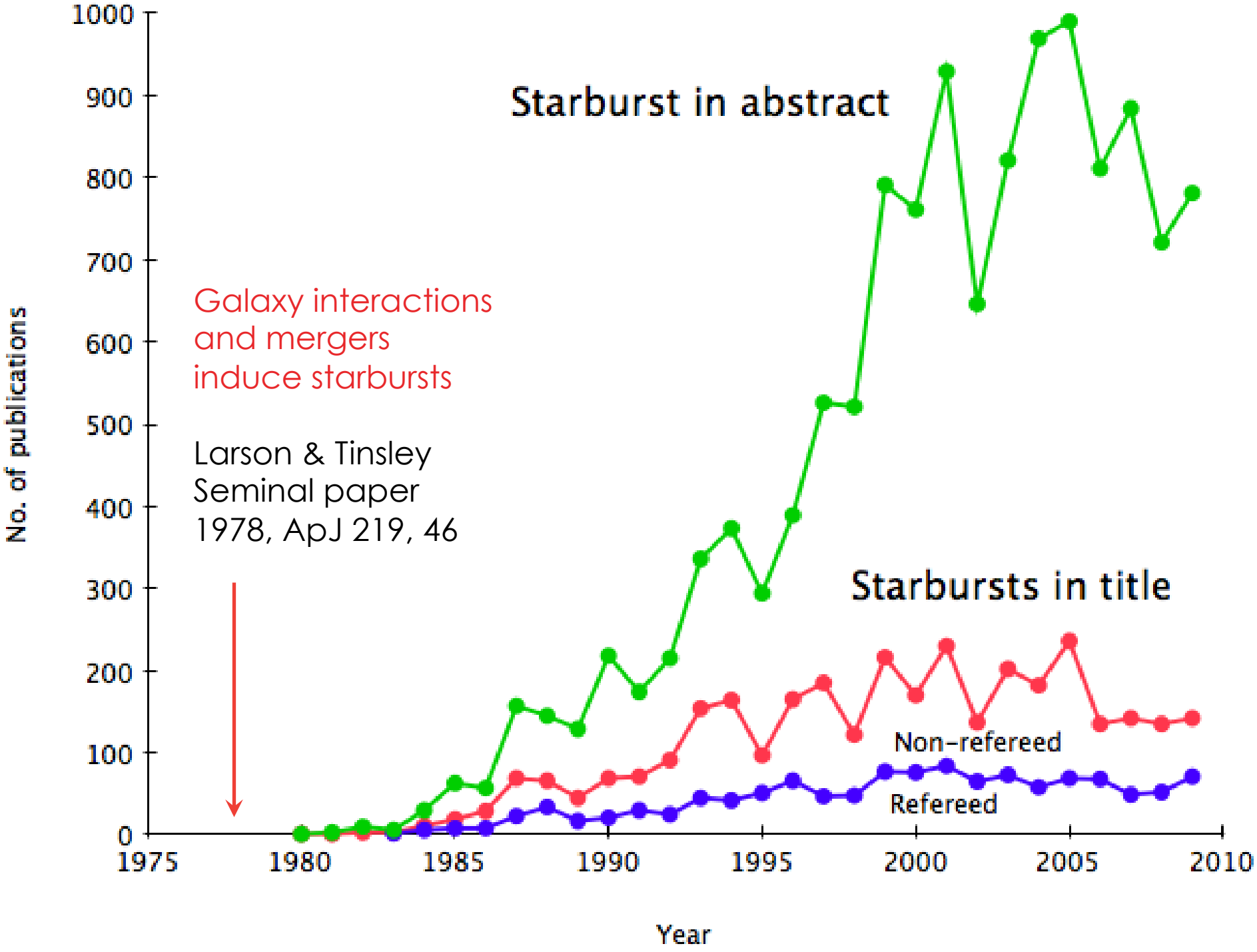
Starburst galaxies in the Sloan survey


Starburst in abstract
Galaxy interactions
and mergers
induce starbursts
Larson & Tinsley
Seminal paper
1978, ApJ 219, 46
Starbursts in title
Non-refereed
Refereed
No. of publications
Year
0
100
200
300
400
500
600
700
800
900
1000
1975
1980
1985
1990
1995
2000
2005
2010

Starbursts – hot topics

- The triggering mechanism
- Starburst lifetimes and duty cycles
- Starburst shutdown mechanism. The transition across the 'green valley'. SN superwinds or AGNs?
- Morphological transition. Blowout or blowaway?
- Starbursts as AGN triggers
- Starburst dwarfs and cosmic reionization

Defining the starburst

The birthrate parameter:

$$b = \frac{SFR_{present}}{< SFR >} > 3$$

Postburst criterion

$$EW(H\delta_{abs}) > 6\text{Å}$$

Fulfilled if the preceding burst mass fraction is

$$MF = \frac{\text{Burst mass}}{\text{Total mass}} > 3\%$$

Collaborators

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- Emma Holst
- Thomas Marquart
- Shirin Nouhi
- Michael Way
- Erik Zackrisson
- Göran Östlin

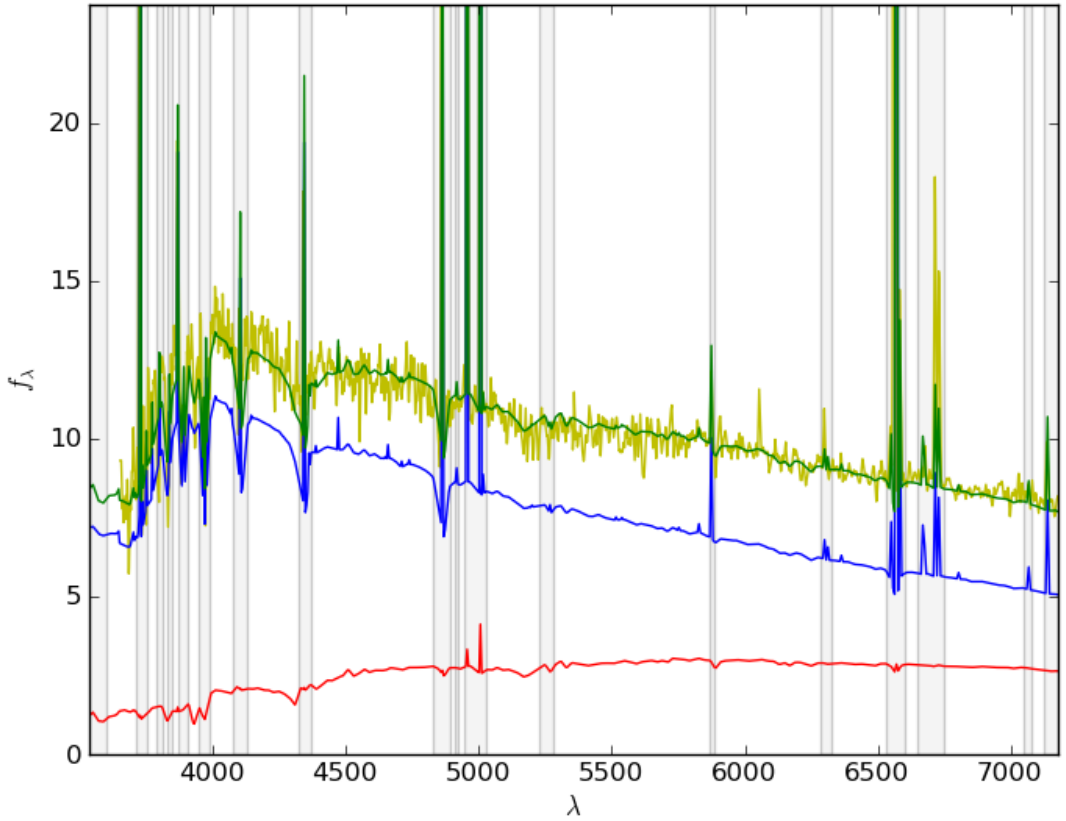
Starburst and postburst galaxies in SDSS DR 7- main objectives

- SFR
- Burst lifetime
- Mass of burst and host
- Luminosity function of starburst galaxies and postburst galaxies
- Starburst shutdown mechanism. SN superwinds or AGNs?

E.g. two component model of SDSS SpecObjId 8128813326978252 8

Criterion for selection
of starburst candidates:

EW($H\alpha_{em}$) > 60Å

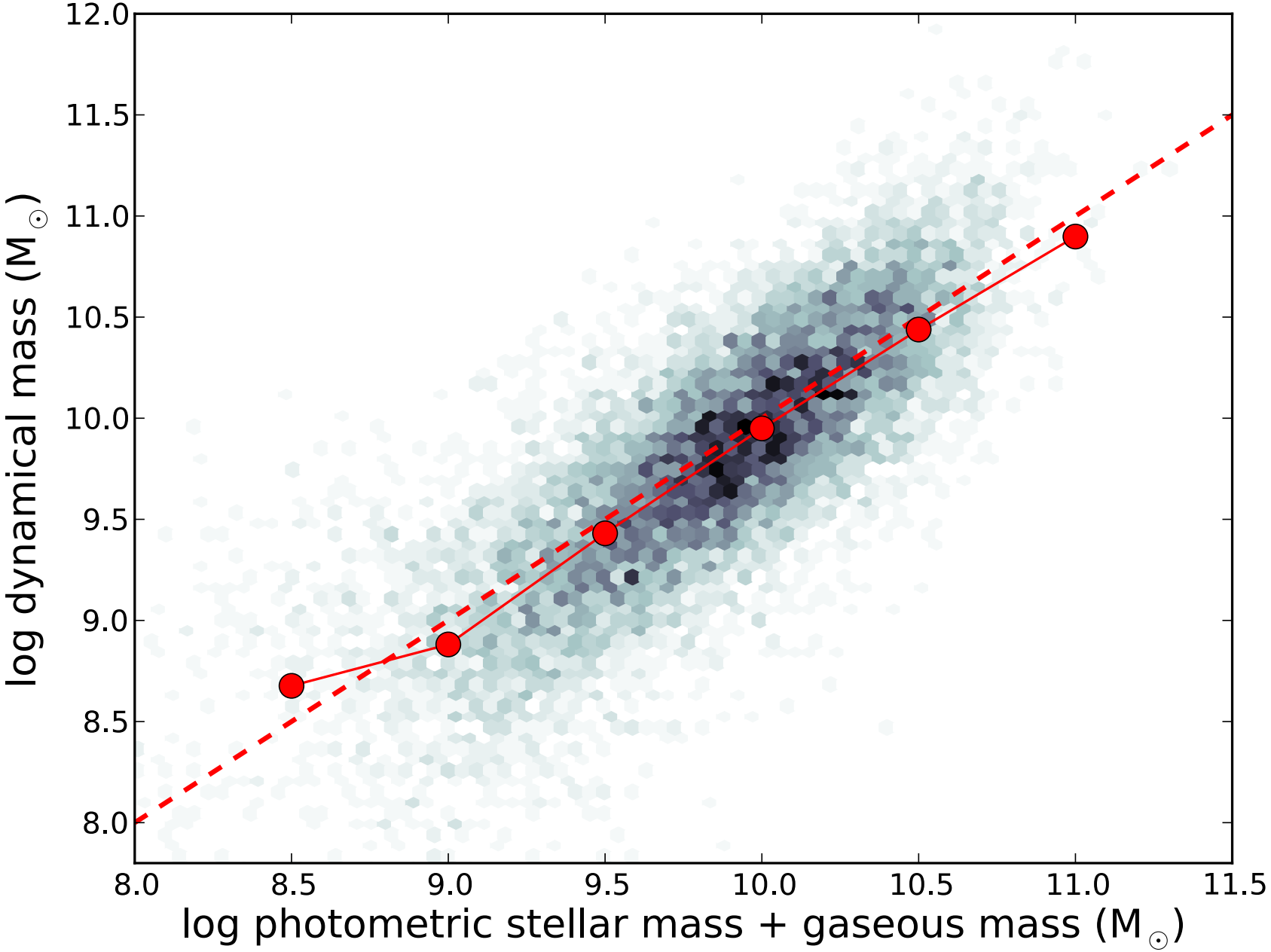


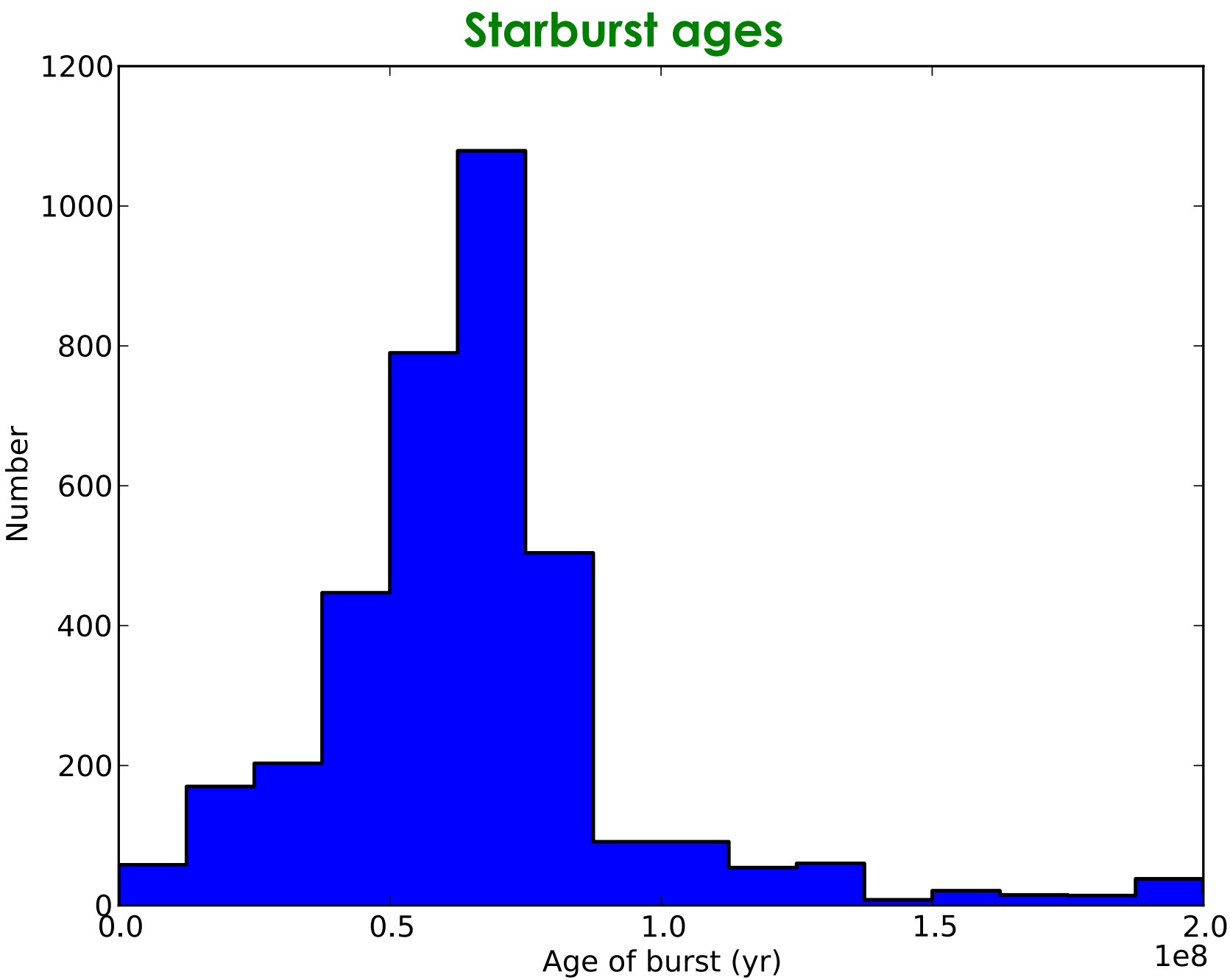
Model from Bergvall et al. (in prep.)
SEDs from Zackrisson et al. 2001
Nebular component included. Z=20-100% solar
Expon. timescales from 10^8 to constant
Gray regions excluded from the fit

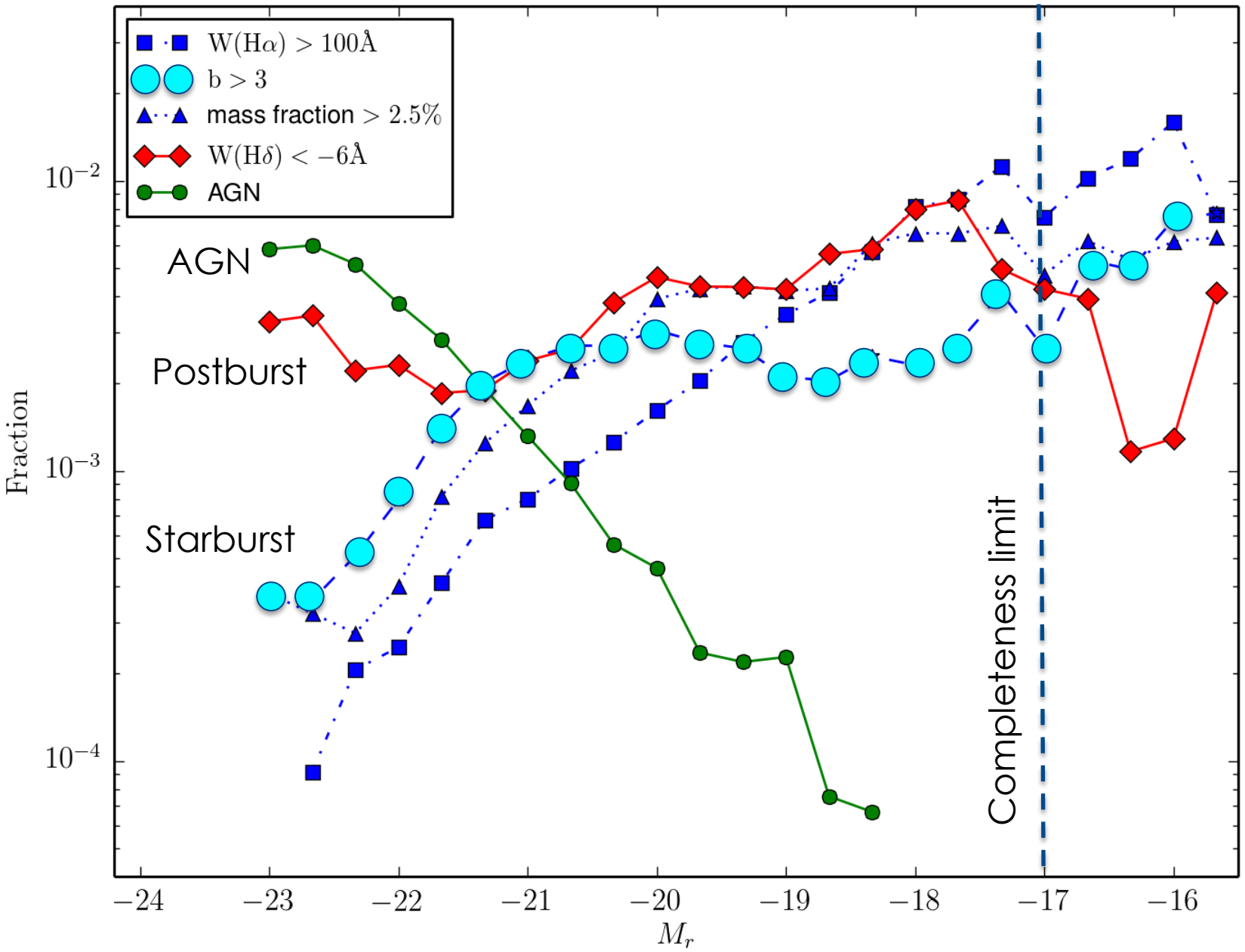
Uniqueness of our model

- Includes nebular component
- Age dependent dust attenuation
- Wide variety of metallicities and SF histories

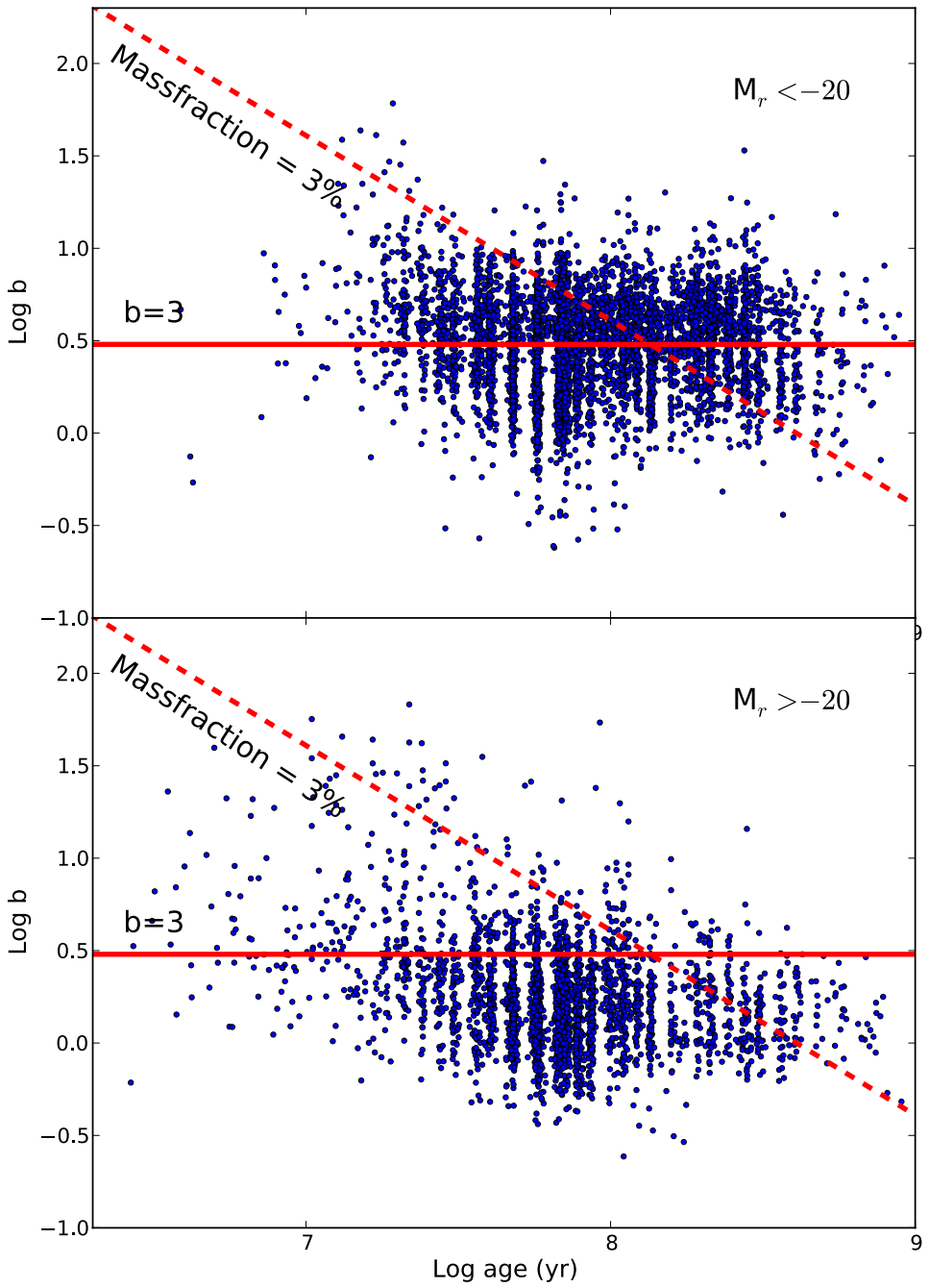
Dynamical and baryonic mass (stars+gas) agree!




Starburst ages
1200
1000
800
600
400
200
0
Number
0.0
0.5
1.0
1.5
2.0
1e8
Age of burst (yr)


W(Hα) > 100Å
b > 3
mass fraction > 2.5%
W(Hδ) < −6Å
AGN
AGN
Postburst
Starburst
Completeness limit
Fraction
10^{-2}
10^{-3}
10^{-4}
−24
−23
−22
−21
−20
−19
−18
−17
−16
M_r

EW(H_α)>60Å



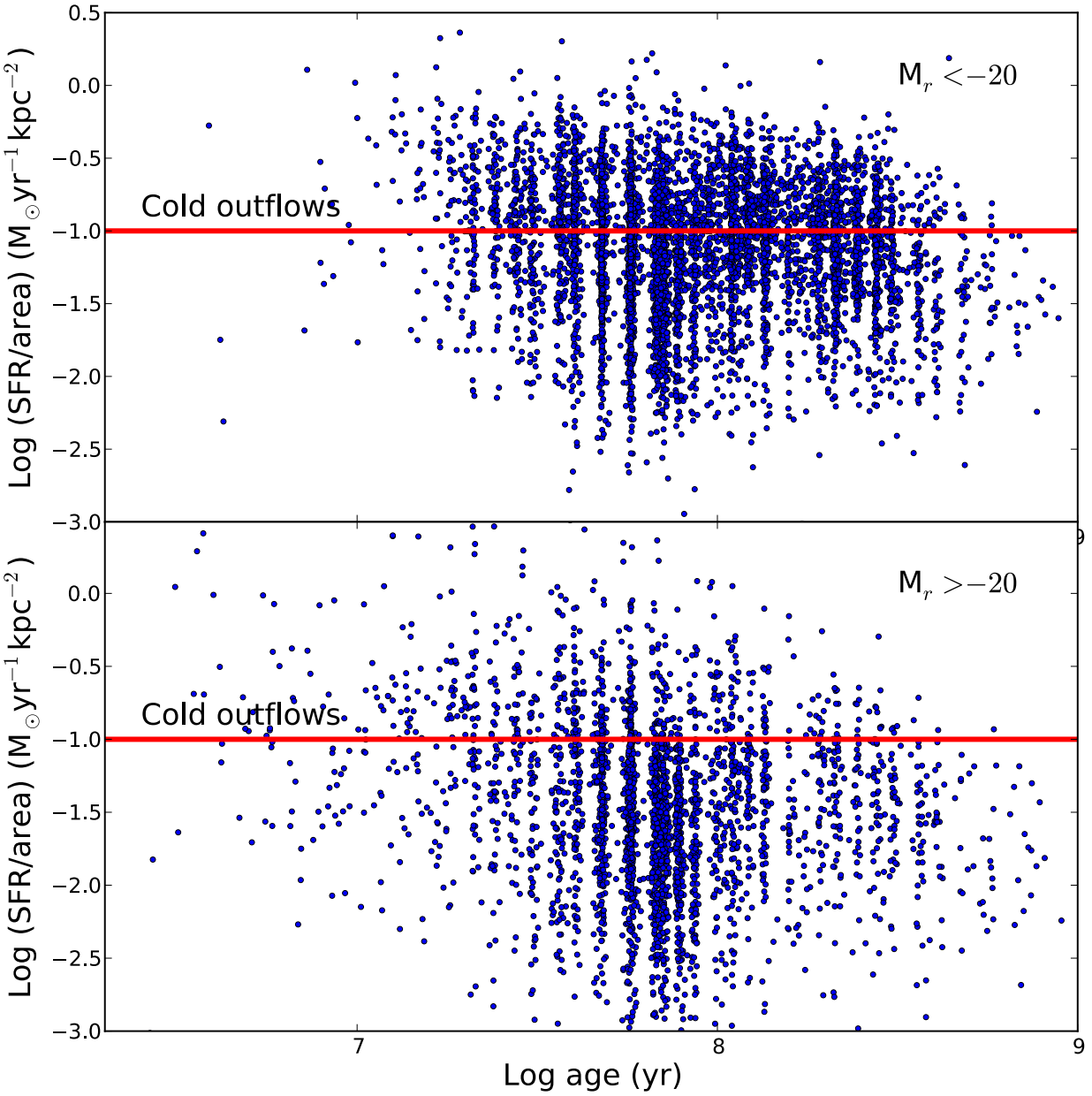
SN triggered outflows of cold (T<10kK) gas.

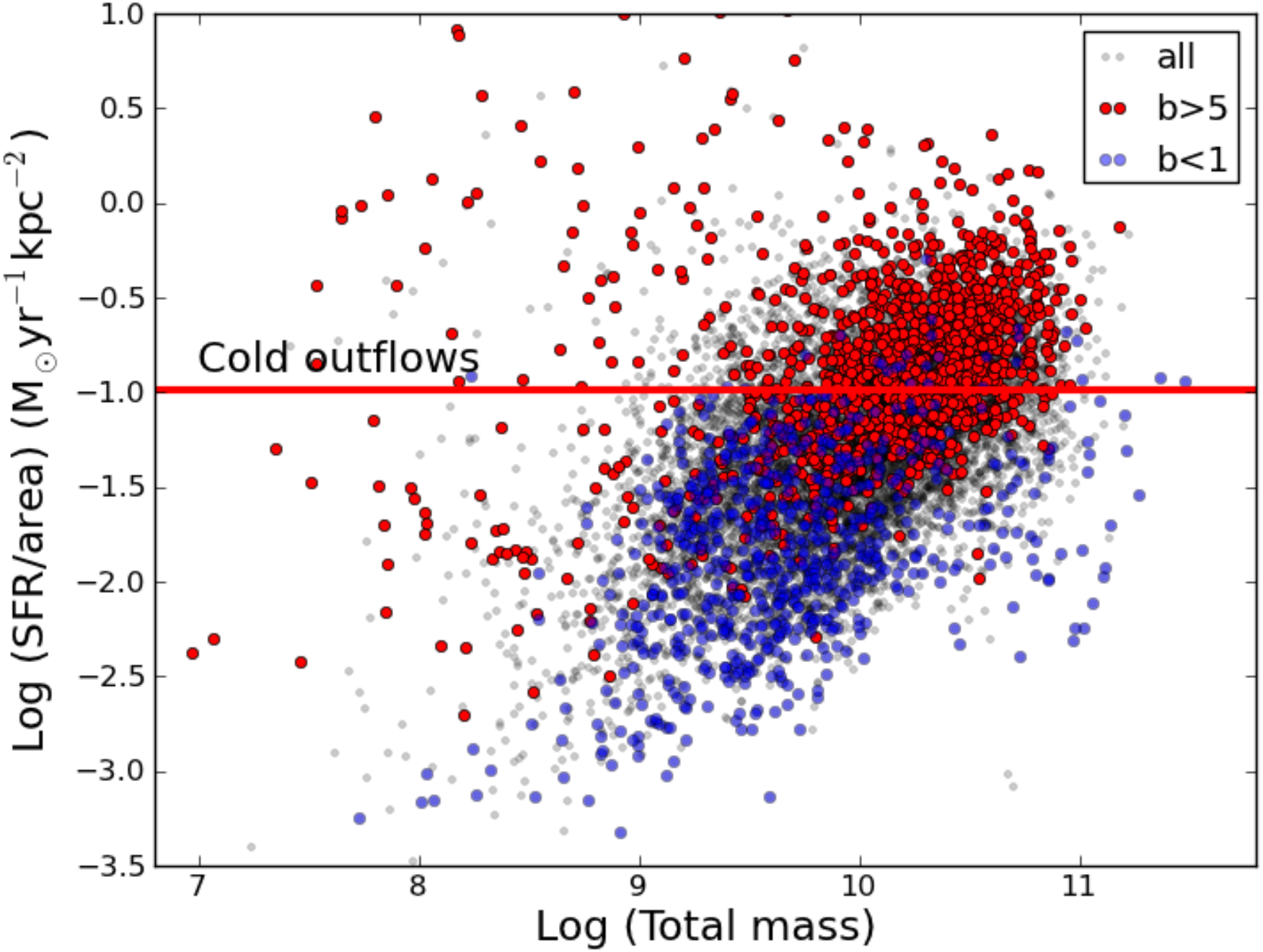
Transition across the green valley, Lyman continuum leakage
e.g. H I obs. of blowout in Ho I (Ott et al. 2001, ApJ 122,3070)

Simple criterion: SFR/area > $0.1 M_{solar}\ yr^{-1}\ kpc^{-2}$

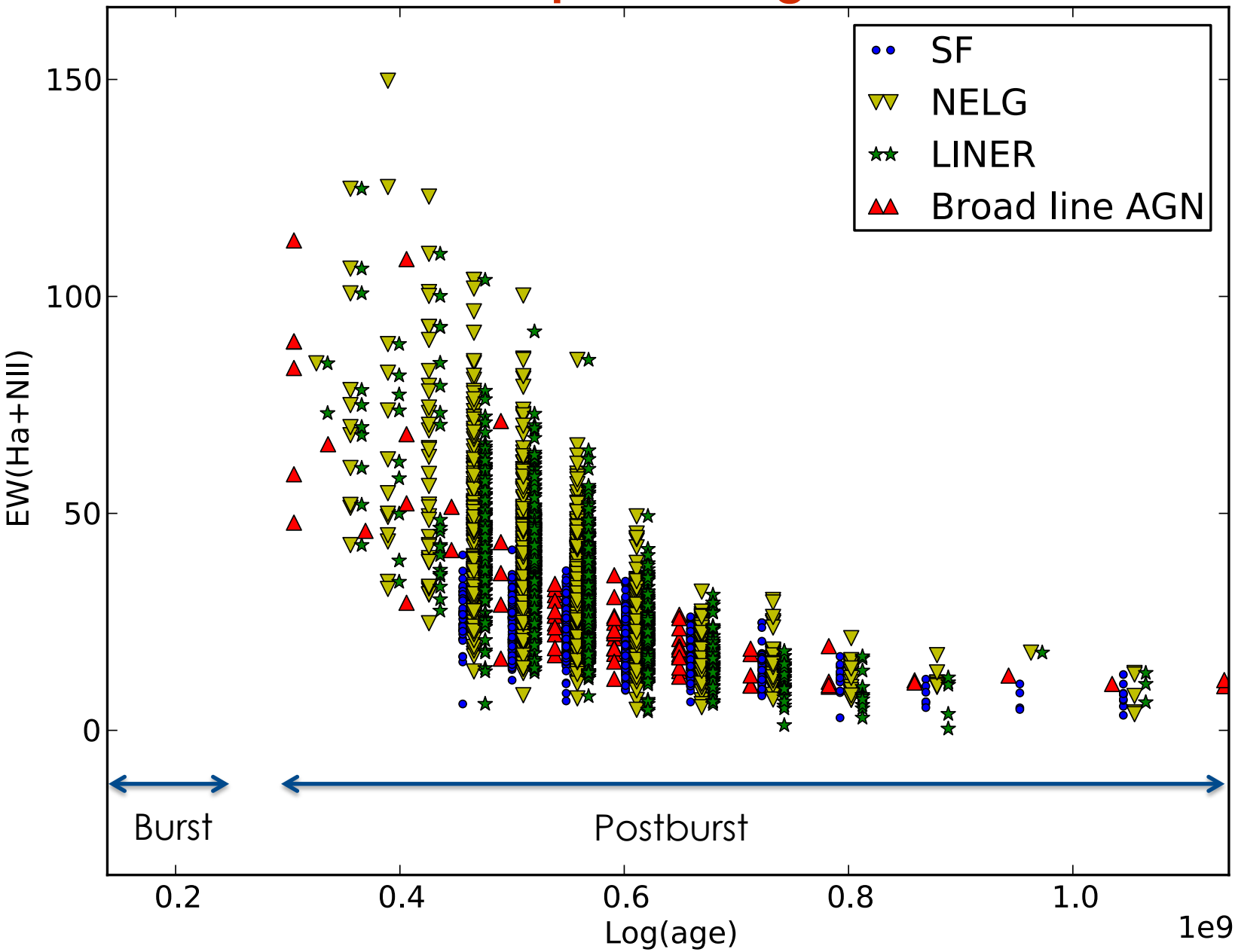
Observations:
Heckman, 2002, ASPC 254, 292

Model:
Murray *et al.* 2011 *ApJ 735, 66*


0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
Log (SFR/area) ($M_\odot yr^{-1} kpc^{-2}$)
$M_r < -20$
Cold outflows
$M_r > -20$
Cold outflows
7
8
9
Log age (yr)


all
b>5
b<1
Cold outflows
Log (SFR/area) ($M_\odot yr^{-1} kpc^{-2}$)
Log (Total mass)
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
7
8
9
10
11

Massive postburst galaxies



Conclusions

- Global starbursts with b>3 are extremely rare events (< 1% among star forming dwarfs)
- Typical lifetimes of 'true' starbursts is ~100 Myr
- Burst mass fractions in postbursts are >~3%
- Self-regulation is strong and weakly dependent on mass
- The high number of luminous postbursts can only be explained if a major fraction of luminous AGNs host starbursts with mass fractions >~3% or the SF activity has been shut down quite recently (<1Gyr).
- AGN activity strongly coupled to starbursts.

SKA

- H I (morphologies, velocity fields and H I masses) and radio continuum (star formation rates).
- Low z: H I mapping of dwarfs to search for evidence of mergers and superwinds
- Low -intermediate z: Distinguish between SB or AGN quenching in massive postburst galaxies. Transition across the green valley.

Results fom a related study
(Brinchmann et al. 2004 MNRAS 351, 1151)

- The majority of the star formation in the low-redshift Universe takes place in moderately massive galaxies (10^{10}-10^{11} $M_\odot$), typically in high surface brightness disc galaxies.
- Roughly 15 % of all star formation takes place in galaxies that show some sign of an active nucleus.
- ~20 % occur in starburst galaxies if a starburst is defined as one in which b >2-3
- ~3 % occur in starburst galaxies if a starburst is defined as one in which b >10.