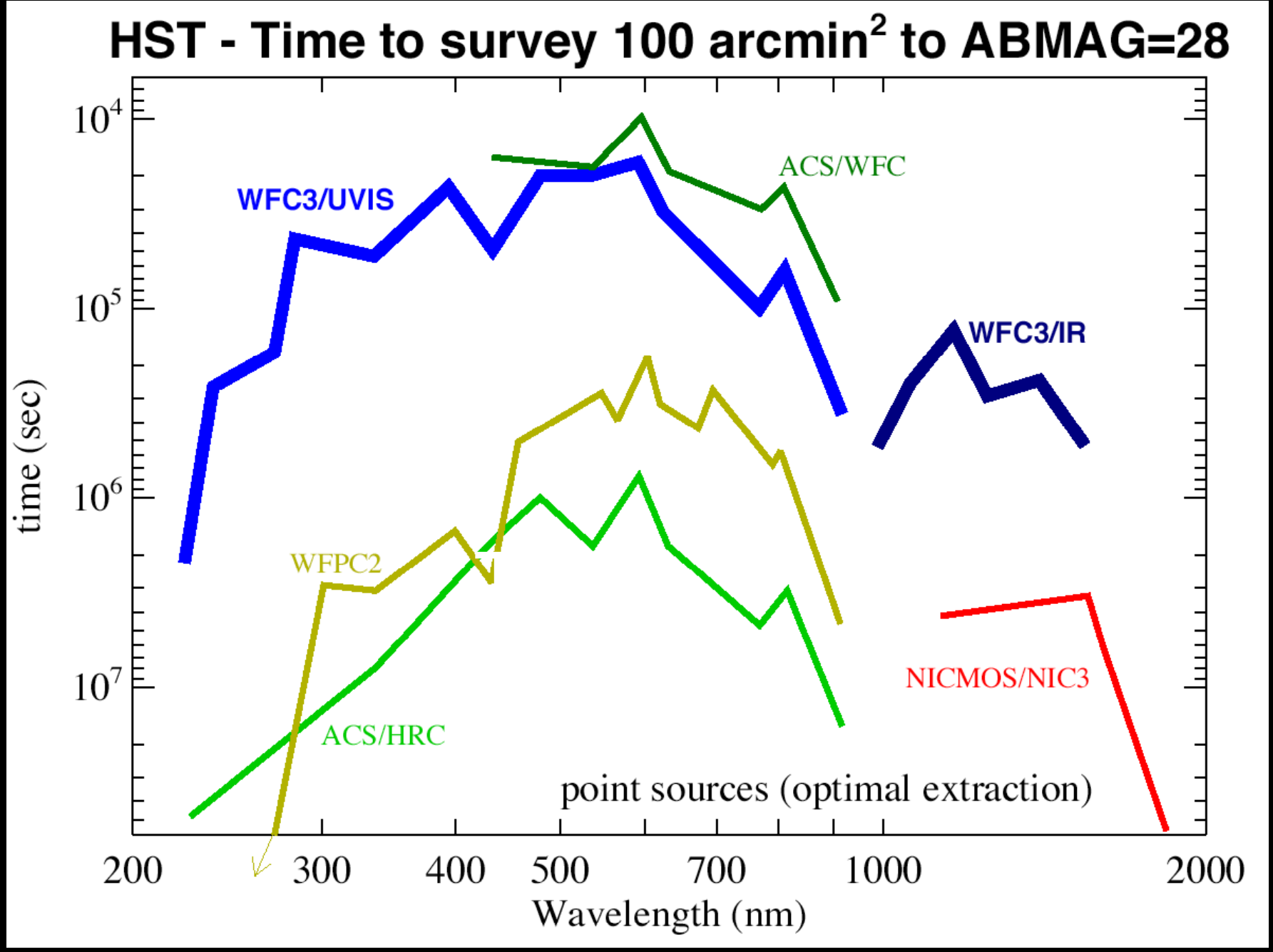

Wide Field Camera 3:
The SOC Science Program Proposal



- An extraordinary panchromatic survey efficiency covering a critical decade of frequency space combined with a large suite of narrow- and broad-band filters


Theme I:
Star Formation at Half the Hubble T

Star Formation at High the Hubble Fi

The Big Questions

- *What determined the properties that galaxies have today?*
- *What set the balance between star formation and galaxy as*
- *How did feedback shape the galaxy mass function?*

Star Formation at Half the Hubble Tim

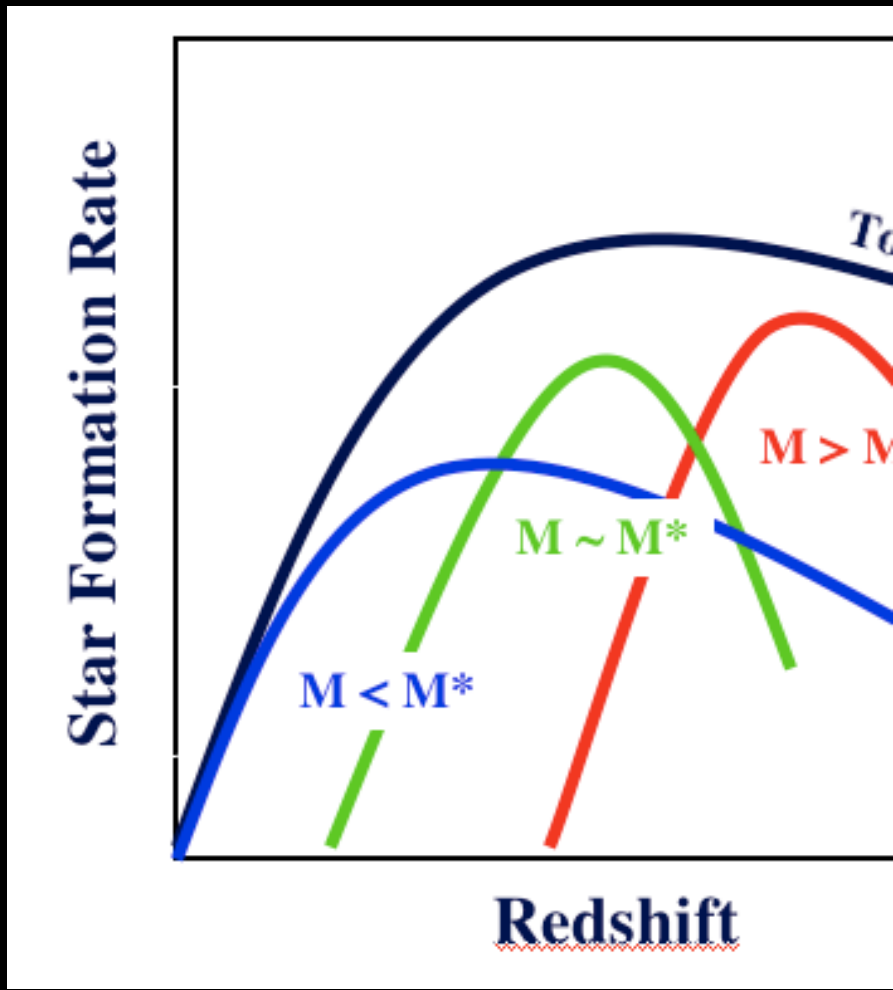
Objective: To probe downsizing and merging in th critical 1 < z < 2 range by the:

- Measurement of the star formation and stellar mass assem rates from H-alpha grism spectroscopy and the rest-frame U
- Determination of the evolution of the faint end slope of th luminosity and mass functions.

Downsizing in Star Formation

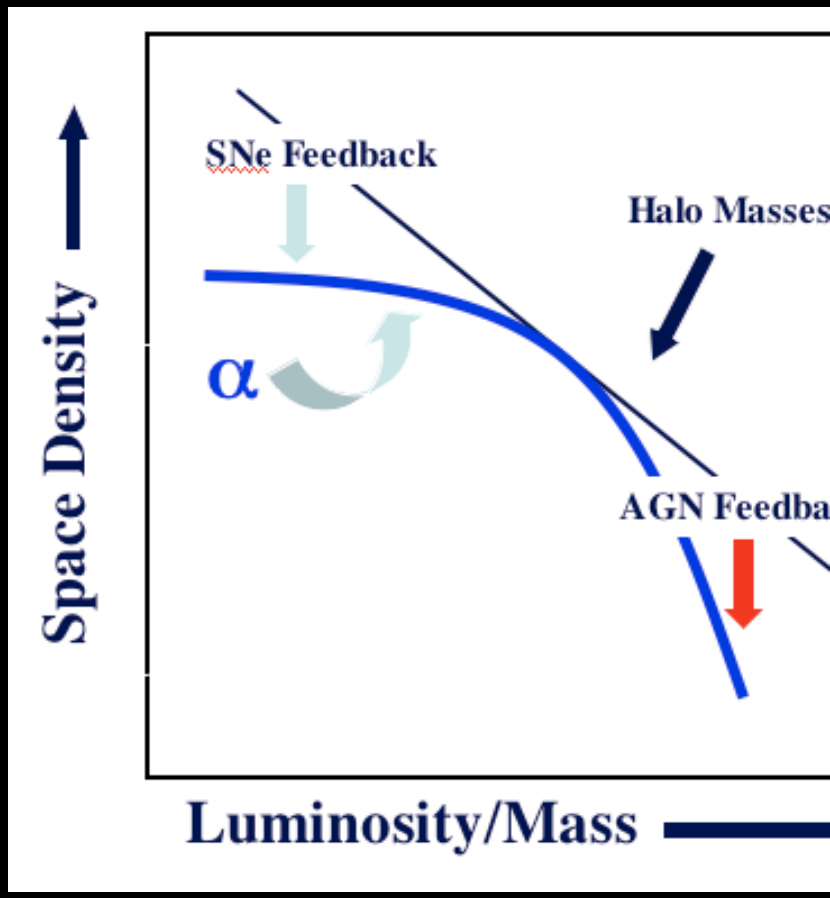
- Measure star-formation rates from H and UV continuum as a function of total stellar mass and environment for $0.7 < z < 2.5$
- Probe the LF down to $M \sim 0.01M^*$
- Probe high, average and low density environments at $z \sim 1.5$.
- Understand SFR f(mass, z,) and bridge from the present to $z \sim 3$.

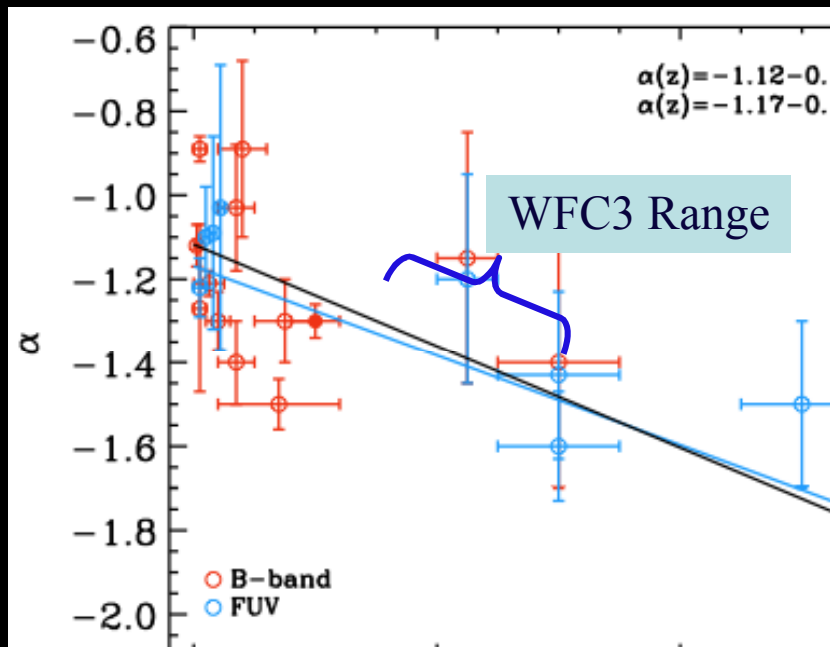
from Juneau et al.



The LF as a Probe of Feedback

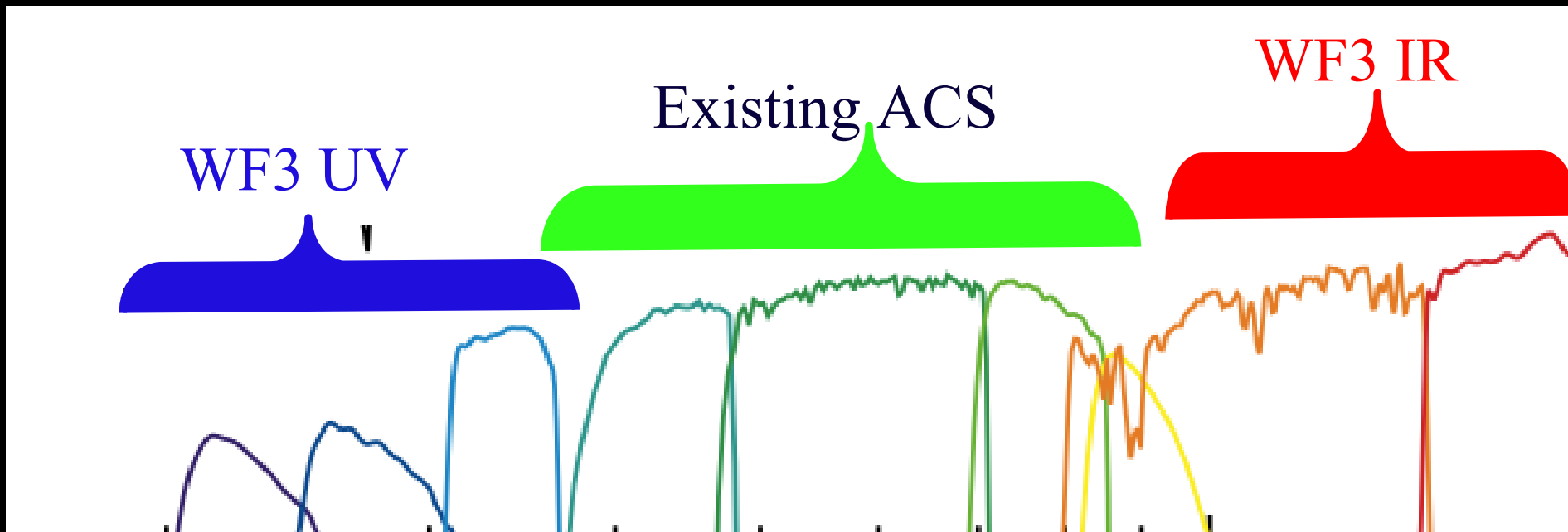
- Lambda-CDM predicts an LF much steeper than observed at the faint end
- AGN & SNe feedback and tidal stripping shape the bright & faint ends, respectively.
- The faint-end slope should evolve with redshift and environment.
- With WFC3 we can probe the faint-end slope at $0.7 < z < 2$ with high precision





WF3 IR & UV Survey at Intermediate Redshifts

- UVIS imaging in F225W, F275W & F336W
- UV G280 prism slitless spectra 2000-4000A
- NIR imaging in F125W & F160W
- NIR G141 grism slitless spectra 1.1 - 1.7m
- Build on existing ACS & spectroscopic survey fields



Preliminary Orbit Requirement

Three Fields are to be selected from GOODS or COSMO
@ high, average and low densities.

Overlap with GRAPES/PEARS sought, if possible.

Filter	Pattern	Area	Orbits	Depth
F225W	1 x 1	21	2	26.0
F275W	1 x 1	21	2	26.5
F336W	1 x 1	21	1	27.0
G280	2 x 2	63	2	25.0
UV Total			**45**	
F125W	2 x 2	60	1.5	27.0
F160W	2 x 2	60	2	27.0
G141	3 x 3	137	2	25.0
IR Total			**60**	


Theme II:
Star Formation in Nearby Galaxies

Star Formation in Nearby Galaxi
The Big Questions

- *How does star formation, and its history, vary amongs galaxies of different types?*
- *What triggers & regulates star formation?*
- *How universal is the Initial Mass Function?*

Wide-Field Panchromatic Imaging

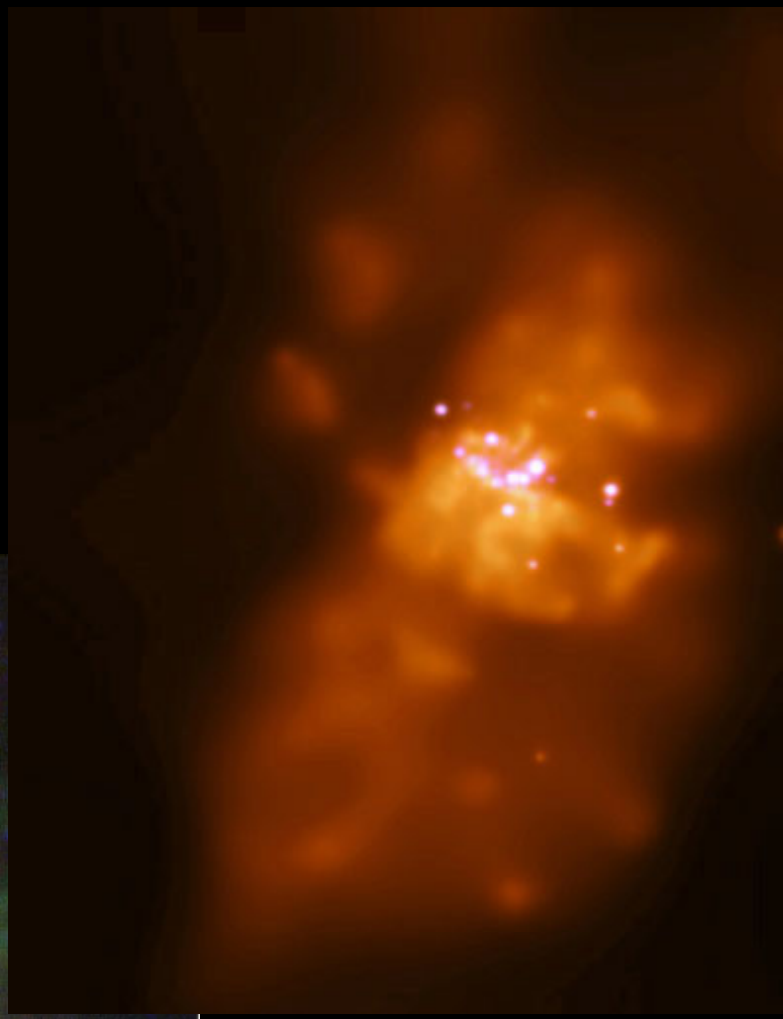
- **UV** (200 - 400 nm; critical for star cluster age dating)
- **IR** (to penetrate dust cocoons around the youngest reg of star formation)
- **Narrow band** (to determine physical parameters such shock parameters, gas pressure, ionization parameters, s formation rates, etc.)

Overall Approach

To observe star formation in a wide range of environments in the local universe to determine how star formation is triggered, how it is regulated through feedback, and the degree to which it is universal.

Subaru

Spitzer



Cha

Strategy:

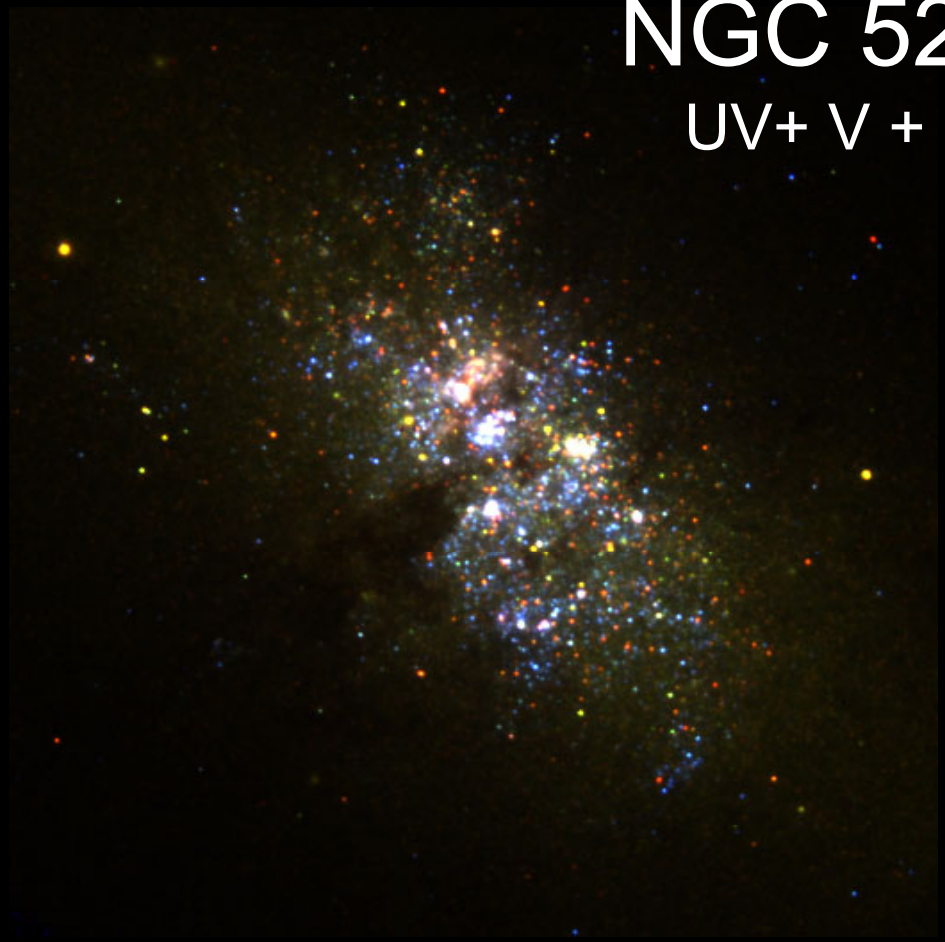
- Broad band panchromatic filter set to distinguish age, metallicity, and extinction:
  F225W, F330W, F435W, F550M, F814W, F110W, F160W

- Narrow band filters for ISM shocks, pressure, abundance, extinction & excitation:
  F373N [O II], F487N H-beta, F502N [O III], F656N H-alpha
  F673N [S II], F128N P-beta, F164N [Fe II]

- Build on existing data sets, both HST (primarily ACS, WFCP2, STIS) and others (SPITZER/SINGS, CHANDRA, ANGST, GALEX, radio, etc.)

NGC 5253

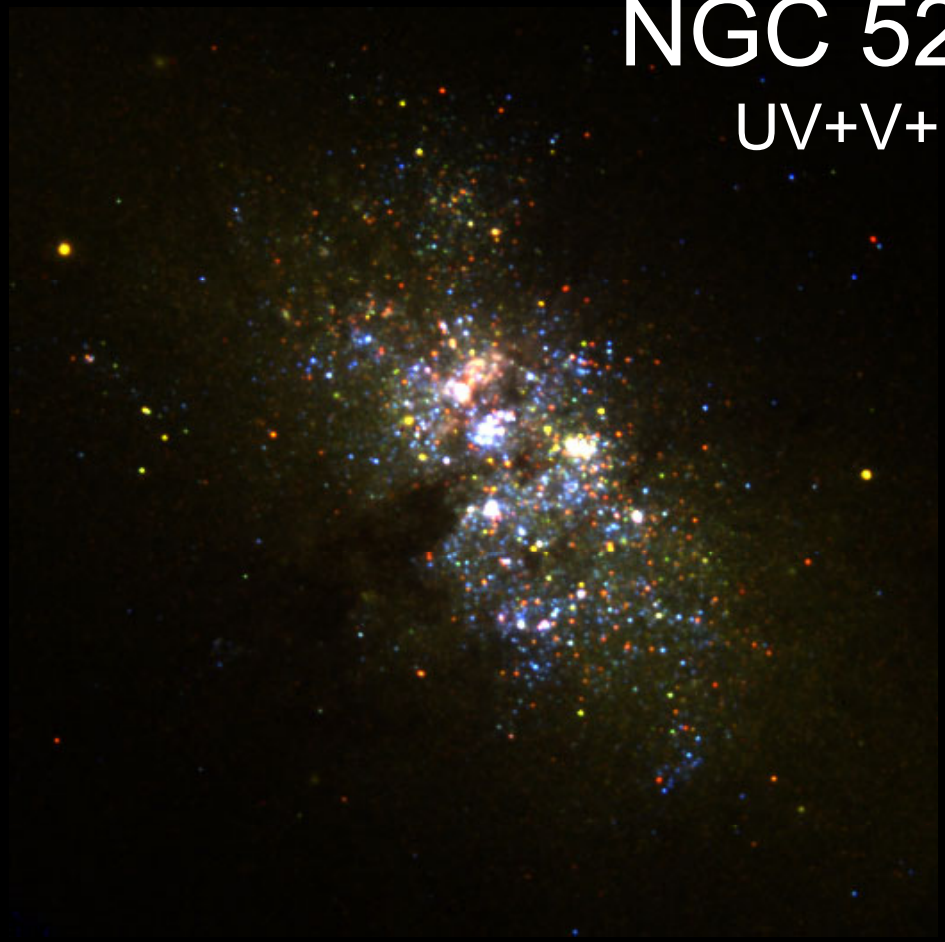
UV+ V + IR



- Panchromatic continuum images, plus extinction from Balmer Line Imaging gives the detailed star formation rate, star formation history and extinction distribution

NGC 5253

UV+V+I



NGC 52

H-alpha, H-B

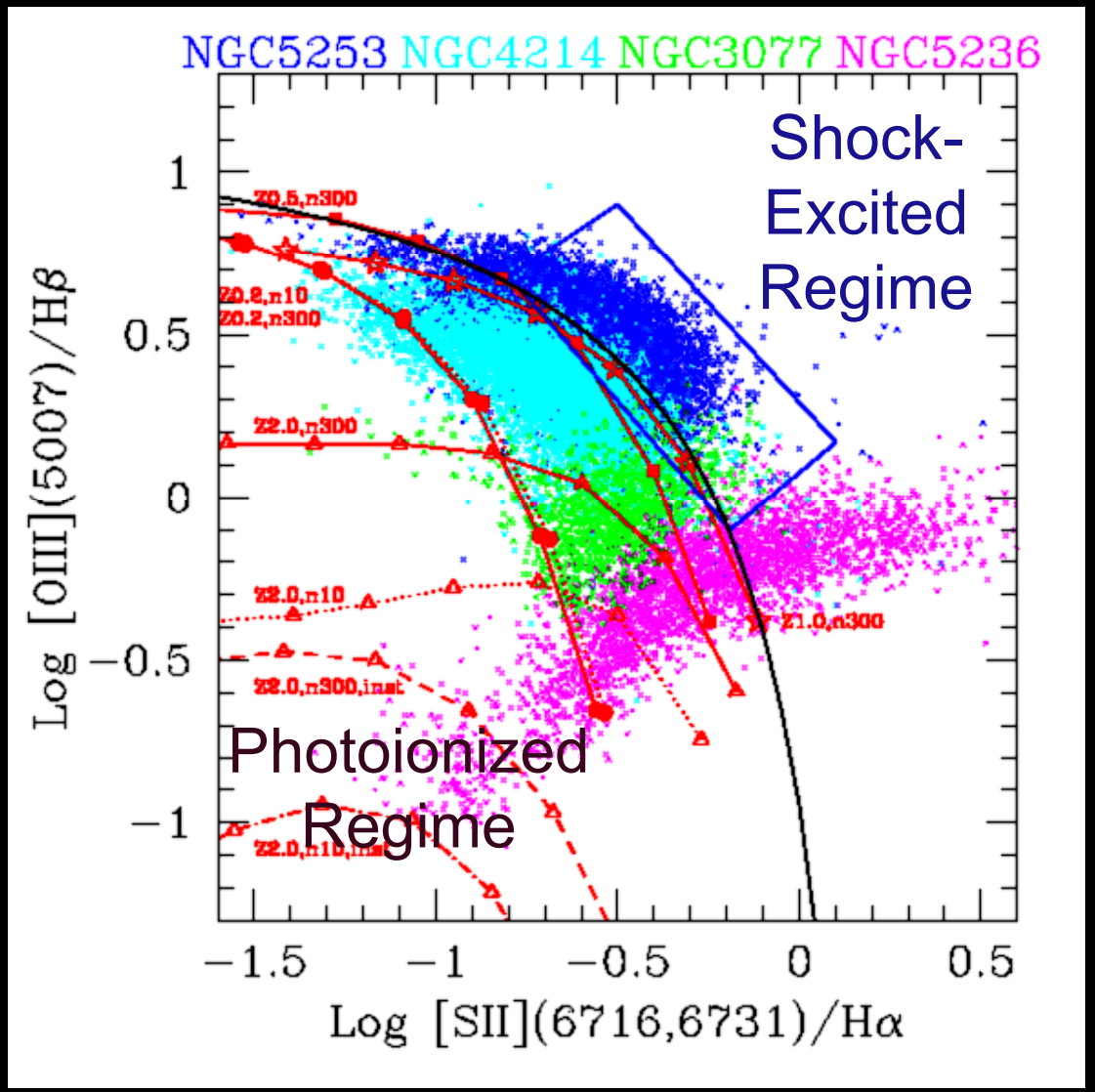
[OIII] & [S

- Panchromatic continuum images, plus extinction from Balmer Line Imaging gives the detailed star formation rate, star formation history and extinction distribution (Calzetti, Whitmore)

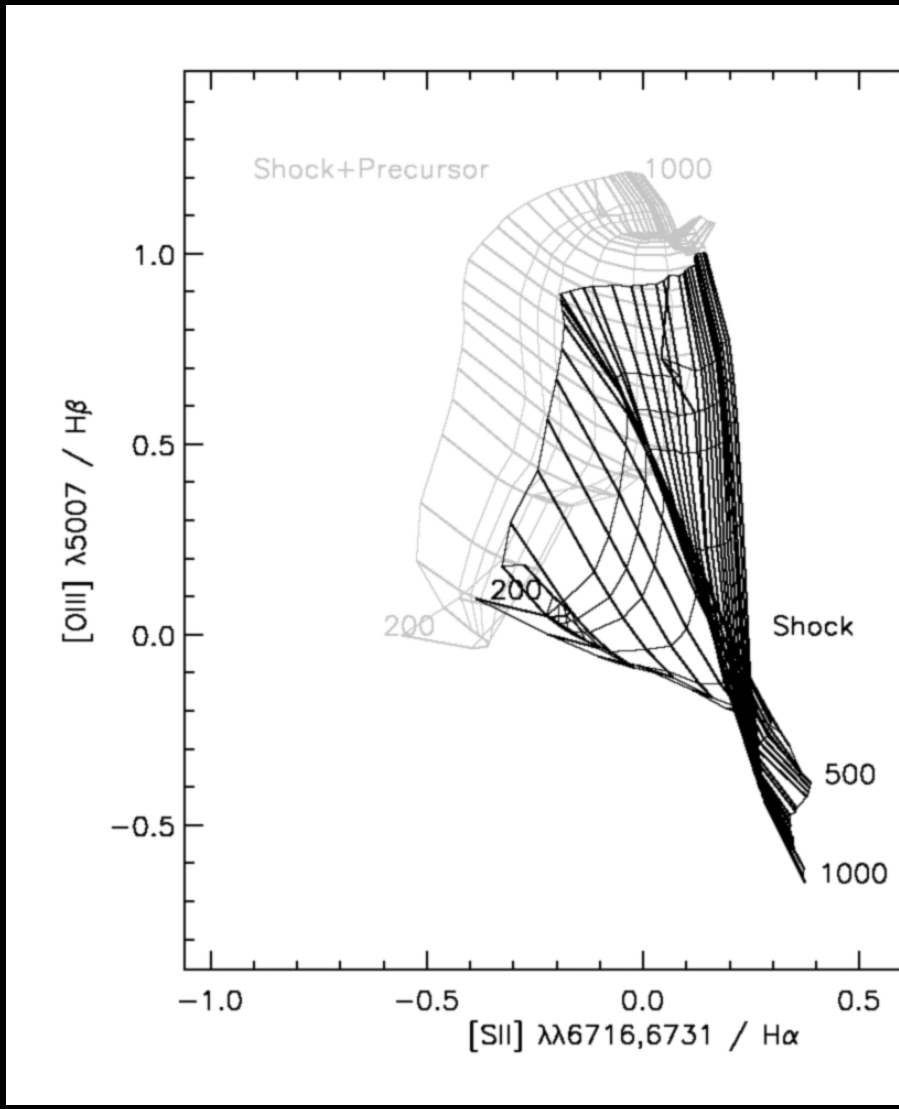
Balmer Line and Forbidde
Line ratios form Diagnosti
Plots which separate the
shock-excited gas from th
photoionized gas
(Dopita, Calzetti).

Examples of Diagnostic Plots

Observations: Calzetti et al. 2007
Models: Kewley & Dopita

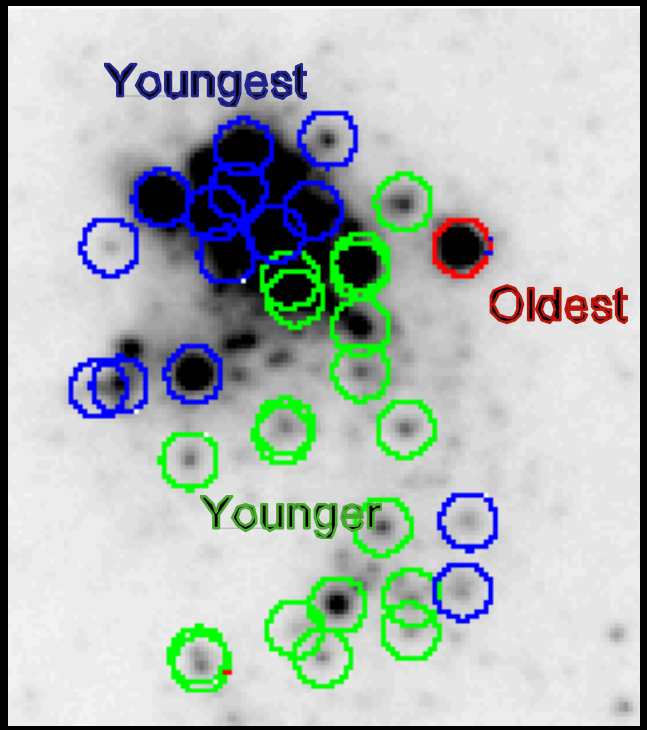


High Velocity Shock Mo
Allen, Dopita & Kewley 2



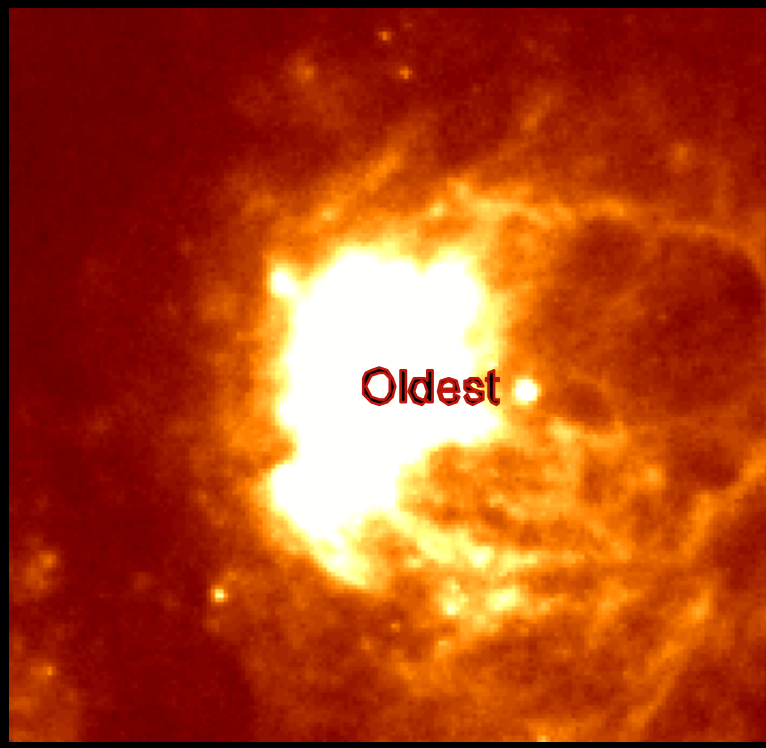
- These tools quantify the energetics and the stellar energy feedb into the ISM of the galaxy observed. They identify outflows and

Example: Cluster Age dating & Triggering



Cluster Ages

Clusters
in a
HII super-bubble
in the
Antennae Galaxy



Ionized Hydrogen

- The Age gradient implies there has been triggered star forma
- The HII super-bubble is centered on the old cluster, the you clusters are located in the dusty shell of the super-bubble.
- The young clusters have a total mass of 4 E6 Msun, some fiv more than the cluster which triggered their formation.

- Measurement of star cluster formation histories back to ~10 Gyr to use fossil record of the assembly history of galaxies (e.g., to compare with results from the intermediate-Z proposal).

- Exploration of the role of feedback. Obtain a full census of shock ioniz in a variety of galactic physical and metallicity environments, and deriv efiiciency parameter for feedback.

- Determination of whether the star formation laws (e.g., Schmidt law, cl mass and size functions, fractions of star formation in clusters/field, … the same in different environments.

- Measurement of the IMF down to ~0.1 Msolar in R136/30 Dor and NG 3603 to determine if it is top-heavy in starbursts (will these clusters sur become globular clusters ?).

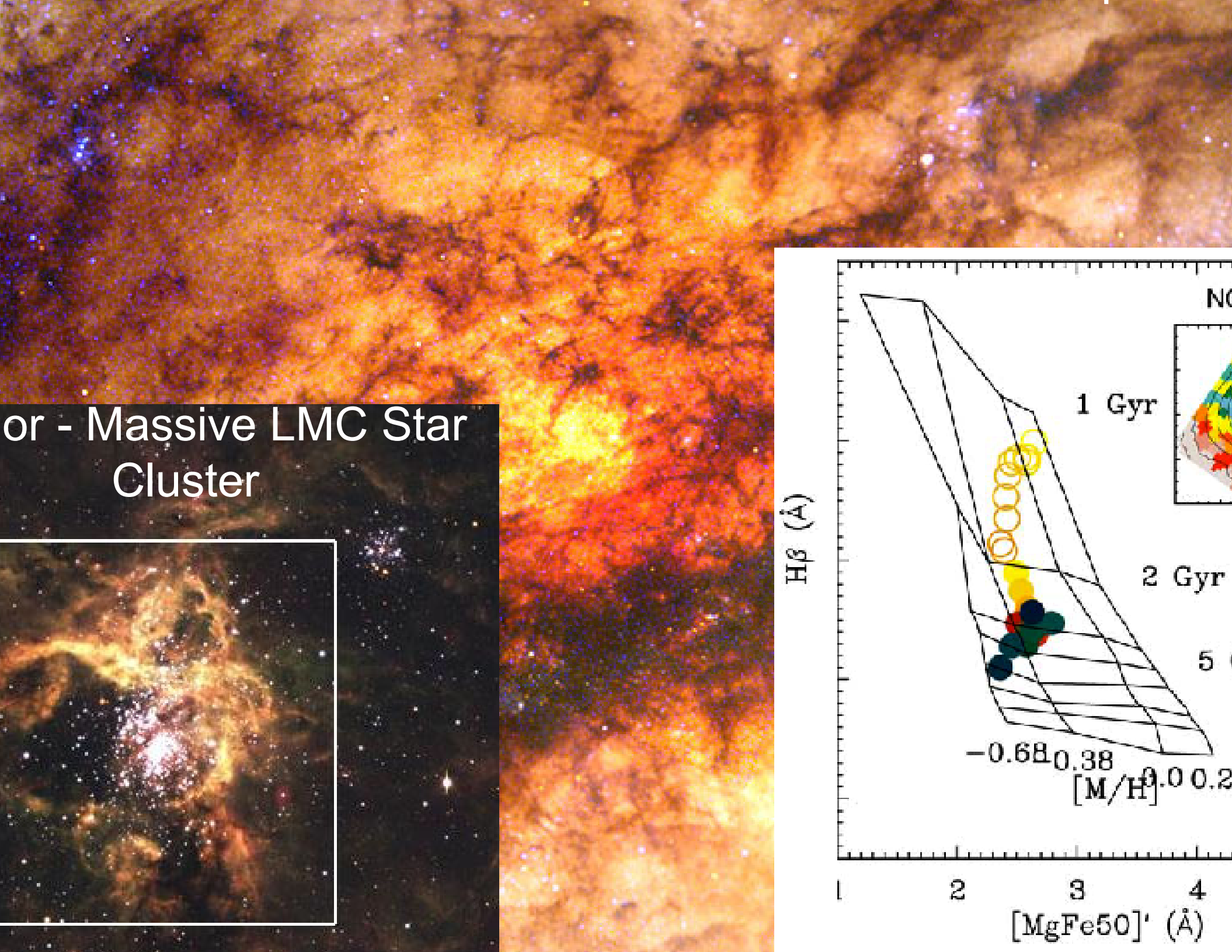
Nearby Galaxies covering a wide range of typ

(m-M)	Galaxy	Nature	Type
31.0	NGC 4382	- SO in Virgo (star formation)	S0
31.0	NGC 4150	- SO in Virgo (star formation)	S0
30.0	NGC 4592	- "retarded" galaxy	Spiral
29.9	NGC 2841	- flocculent spiral	Spiral
28.6	CenA	- nearest elliptical (accretion)	Elliptical
28.6	M 83	- grand-design spiral	Spiral
27.9	NGC 4214	- dwarf	Irregular
26.9	M 82	- dusty starburst	Irregular
18.5	30 Dor	- $10^5 M_\odot$ LMC star cluster	Star clus
13.9	NGC 3603	- $10^4 M_\odot$ Galactic star cluster	Star clus

ome Targets...

Grand Design Starburst

NGC4214 - Dwarf Gas-Rich


or - Massive LMC Star Cluster
1 Gyr
2 Gyr
5
Hβ (Å)
−0.68
0.38
[M/H]
0.0
0.2
2
3
4
[MgFe50]' (Å)

Preliminary Orbit Requirements

Galaxy Name	UV broad band	Optical broad band	IR broad band	Optical narrow band	IR narrow band	Totals
NGC 4382	2.1	4.0	5.2	3.9	2.6	17.8
NGC 4150	2.1	4.0	5.2	3.9	2.6	17.8
NGC 4592	1.4	2.1	5.2	3.4	1.7	13.8
NGC 2841	0.9	B-done,1.0	5.2	2.3	1.2	10.6
Cen A	0.9	DONE	3.3	1.3	0.9	6.4
M 83	0.9	DONE	3.3	1.3	0.9	6.4
NGC 4214	0.6	0.9	1.5	0.9	0.6	4.5
M 82	0.6	DONE	0.8	0.9	0.6	2.9
30 Dor	2.6	3.9	5.2	3.4	3.4	18.5
NGC 3603	1.3	2.6	0.5	2.6	3.4	10.4
Total						109.1