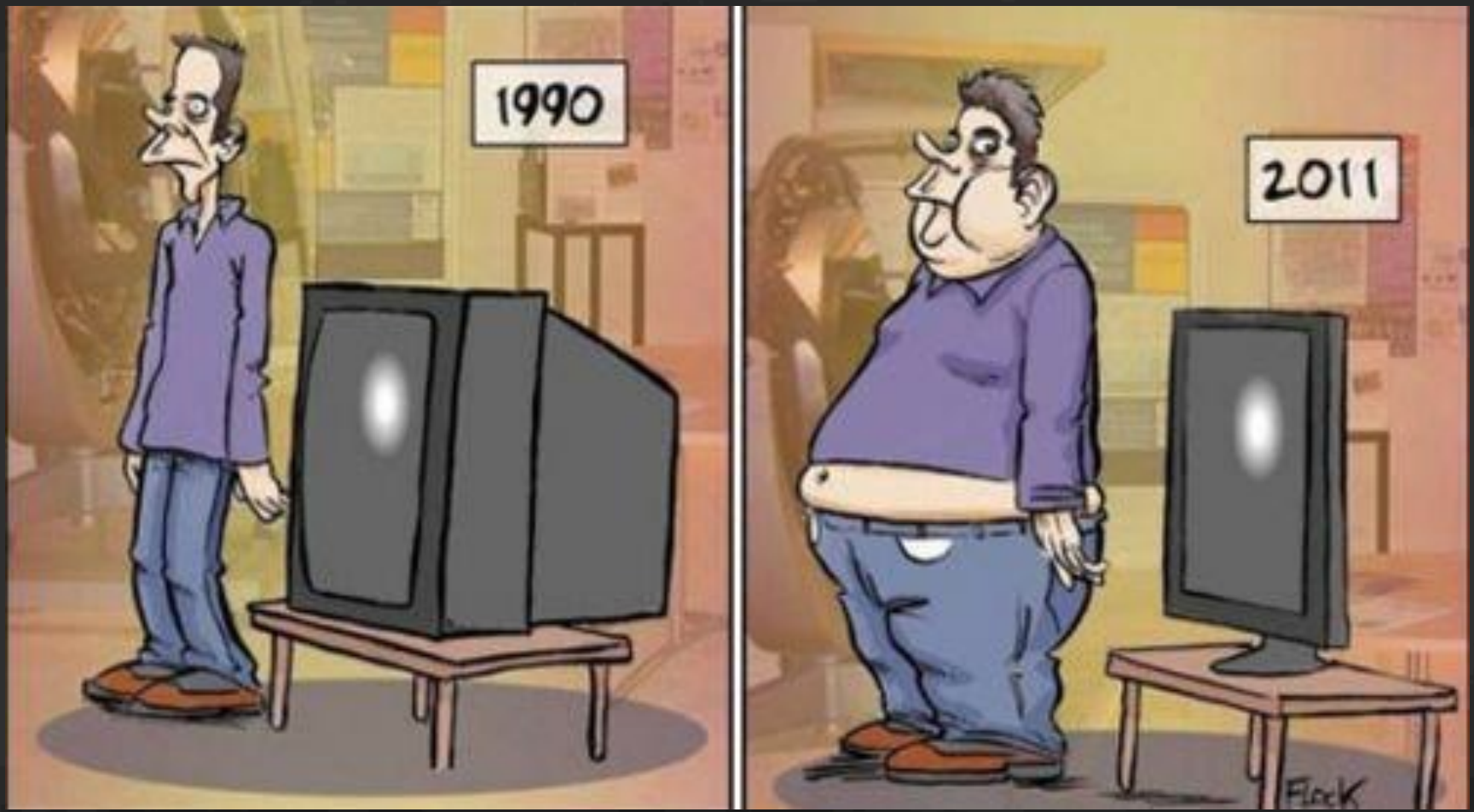
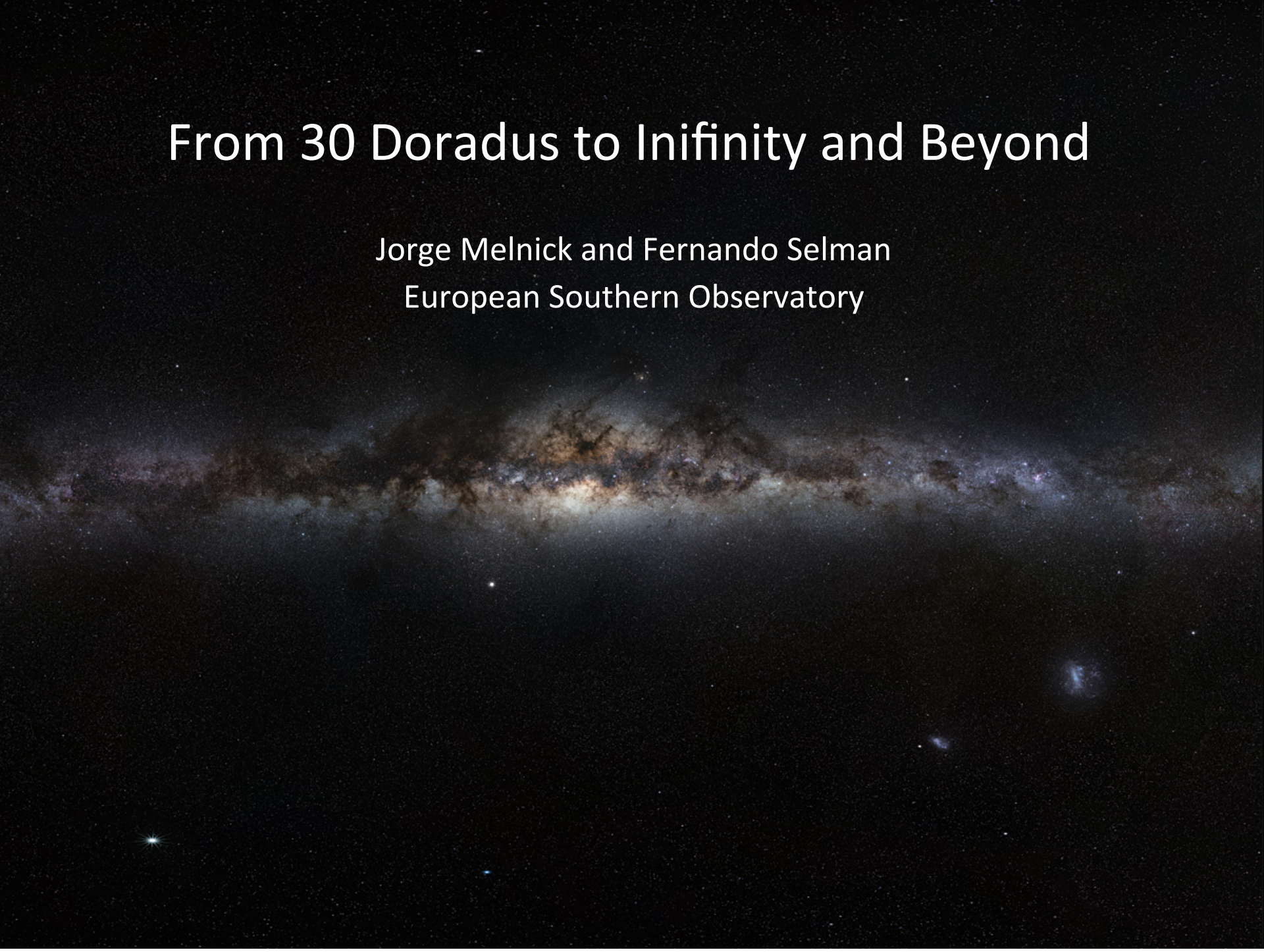
Good News and Bad News

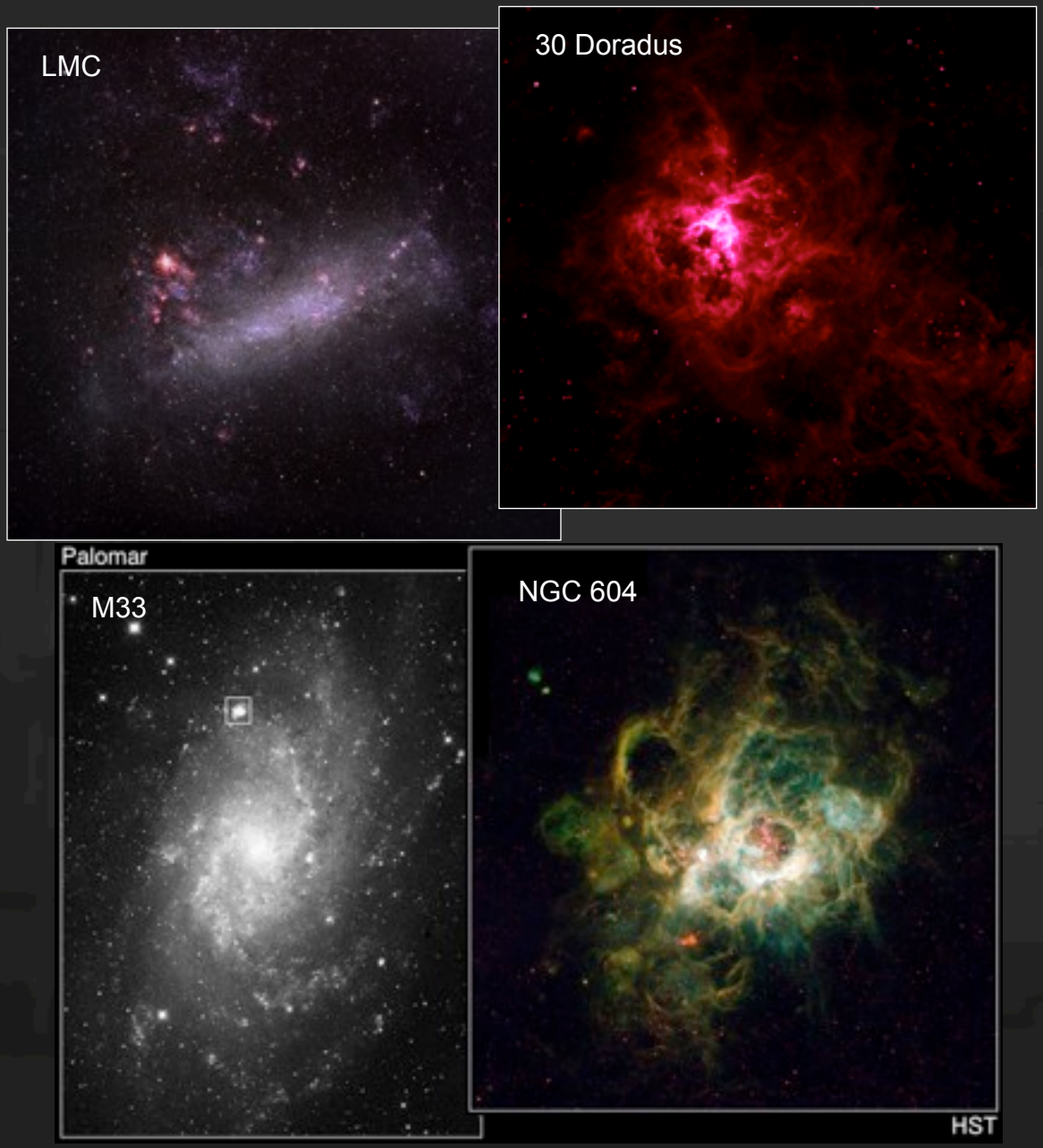


From 30 Doradus to Inifinity and Beyond

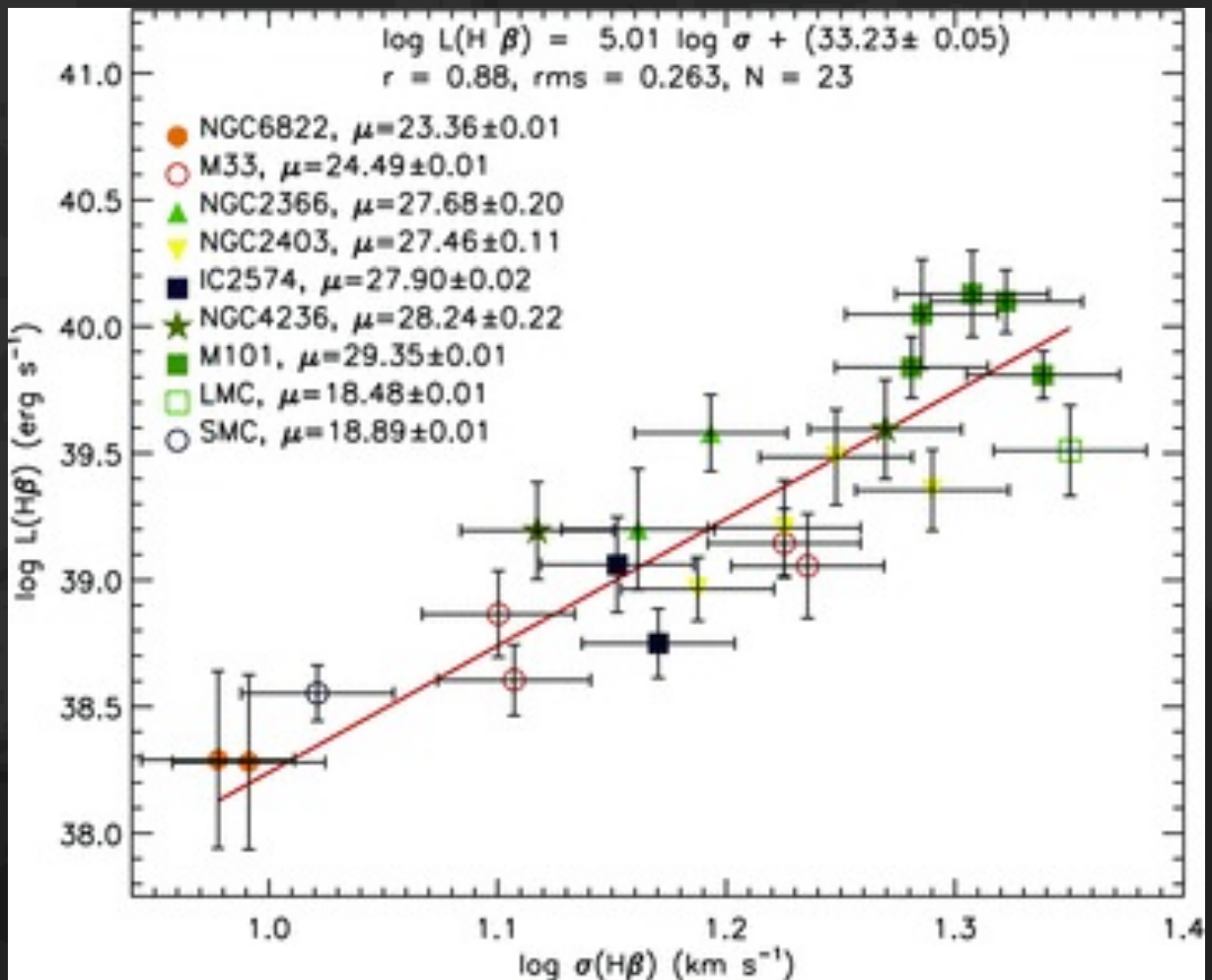
Jorge Melnick and Fernando Selman
European Southern Observatory



Giant HII regions (GEHRs), the largest nebulae in late type galaxies, are simple starbursts.

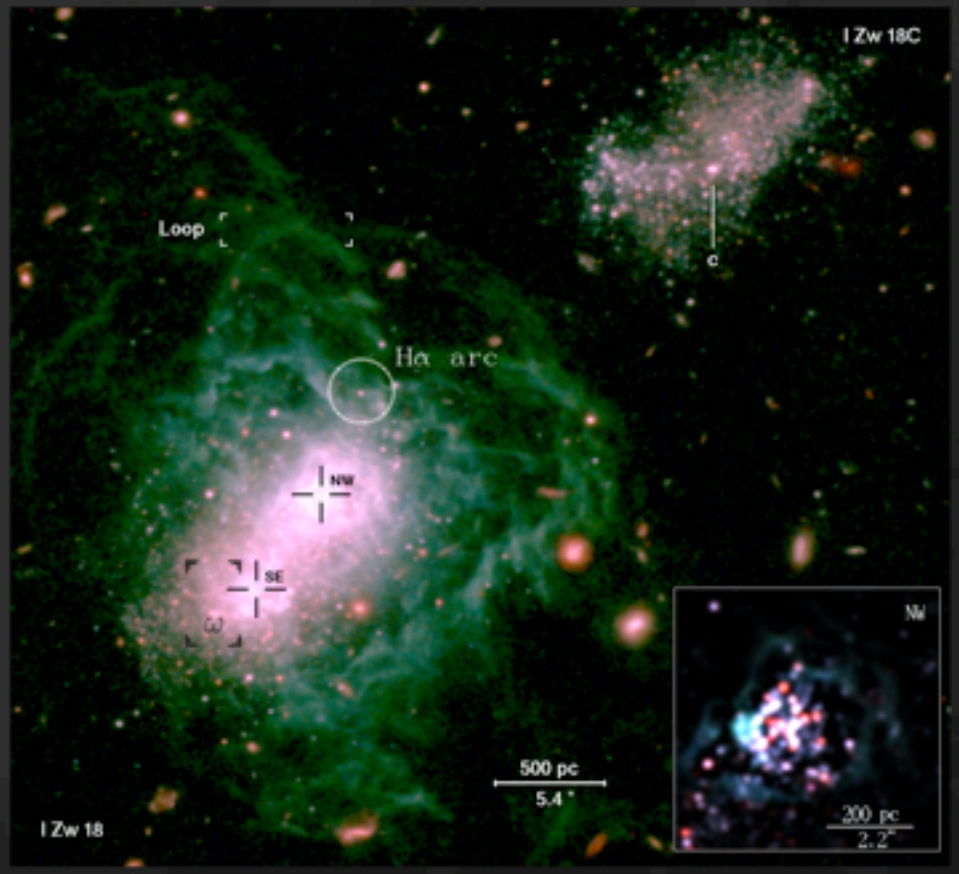


The emission-line widths of Giant HII regions correlate with their emission-line luminosities



Chavez et al., 2012

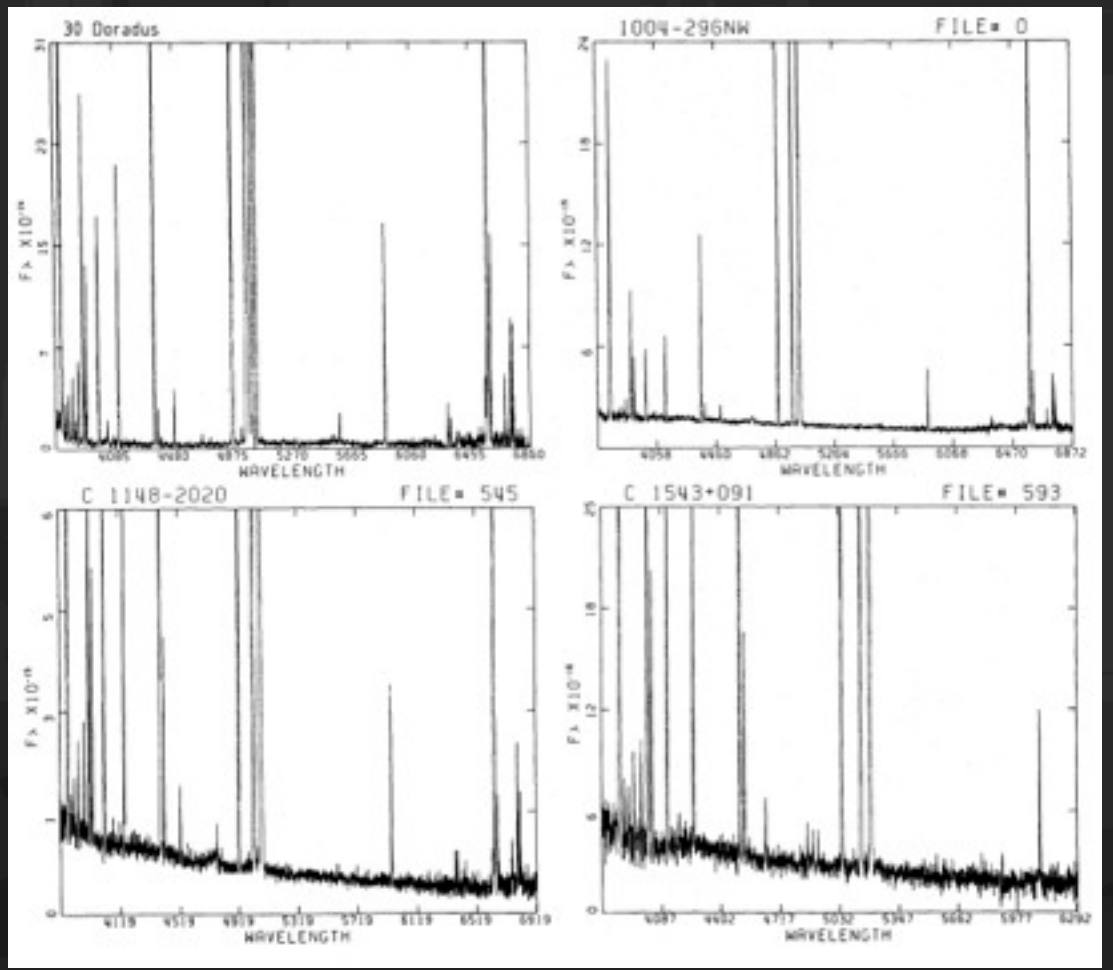
The Giant HII regions of Blue Compact Dwarf Galaxies (BCDGs) completely dominate their luminosities at all wavelengths



HST images

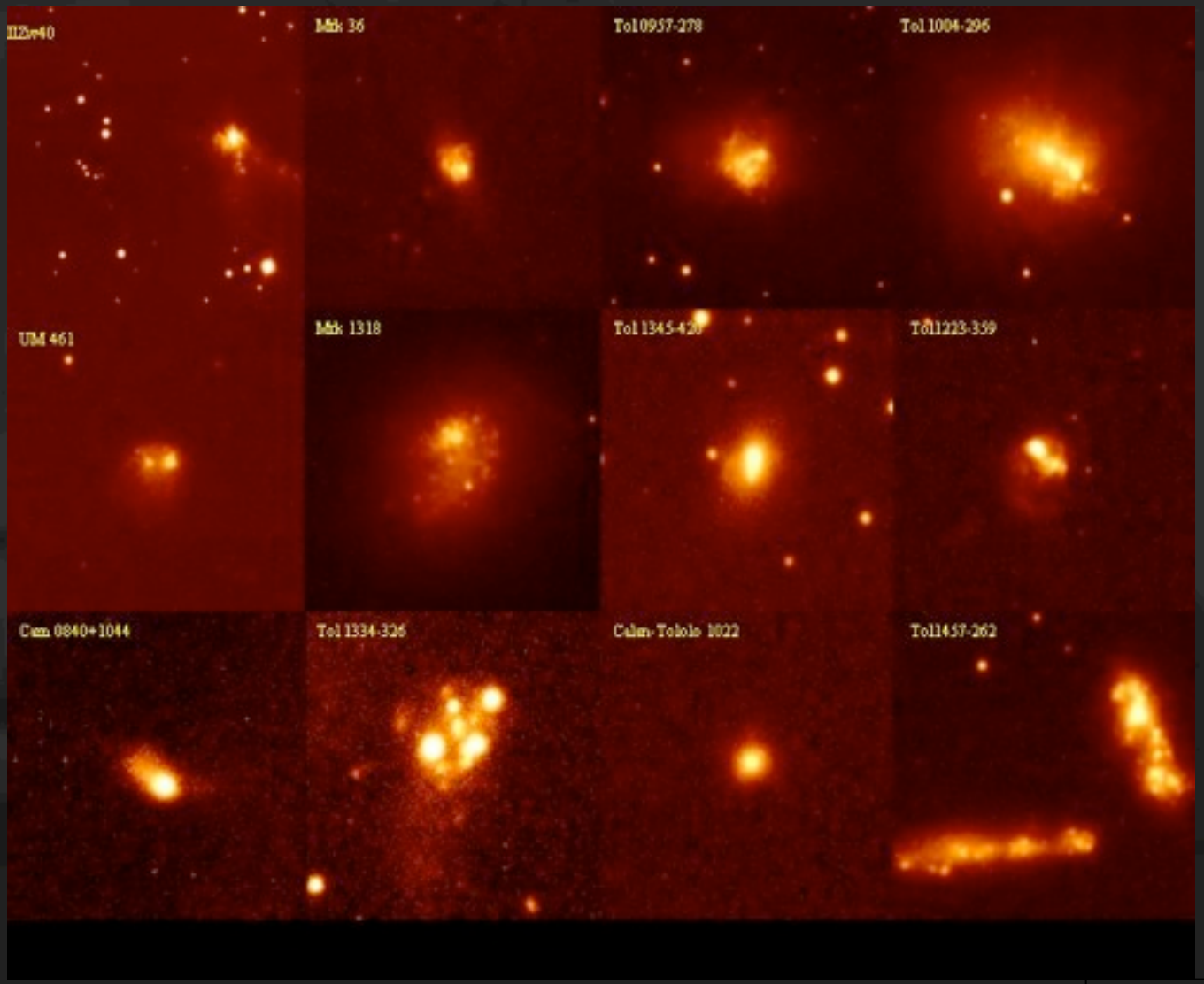
And their strong narrow emission lines make them detectable at distances relevant for cosmology

Could HII Galaxies be used to measure H_0 ?



Malcom Smith was finding dozens of HII Galaxies in his objective prism survey with the Tololo Curtis-Schmidt

Malcom Smith was finding dozens of HII Galaxies in his objective prism survey with the Tololo Curtis-Schmidt



Malcolm generously provided us with coordinates and finding charts well ahead of publication.

1991A&AS...91..285T

ASTRONOMY & ASTROPHYSICS
SUPPLEMENT SERIES

DECEMBER 1991, PAGE 285

Astron. Astrophys. Suppl. Ser. **91**, 285-324 (1991)

A spectrophotometric catalogue of HII galaxies

R. Terlevich[1], J. Melnick[2], J. Masegosa[3], M. Moles[3] and M. V.F. Copetti[1,4]

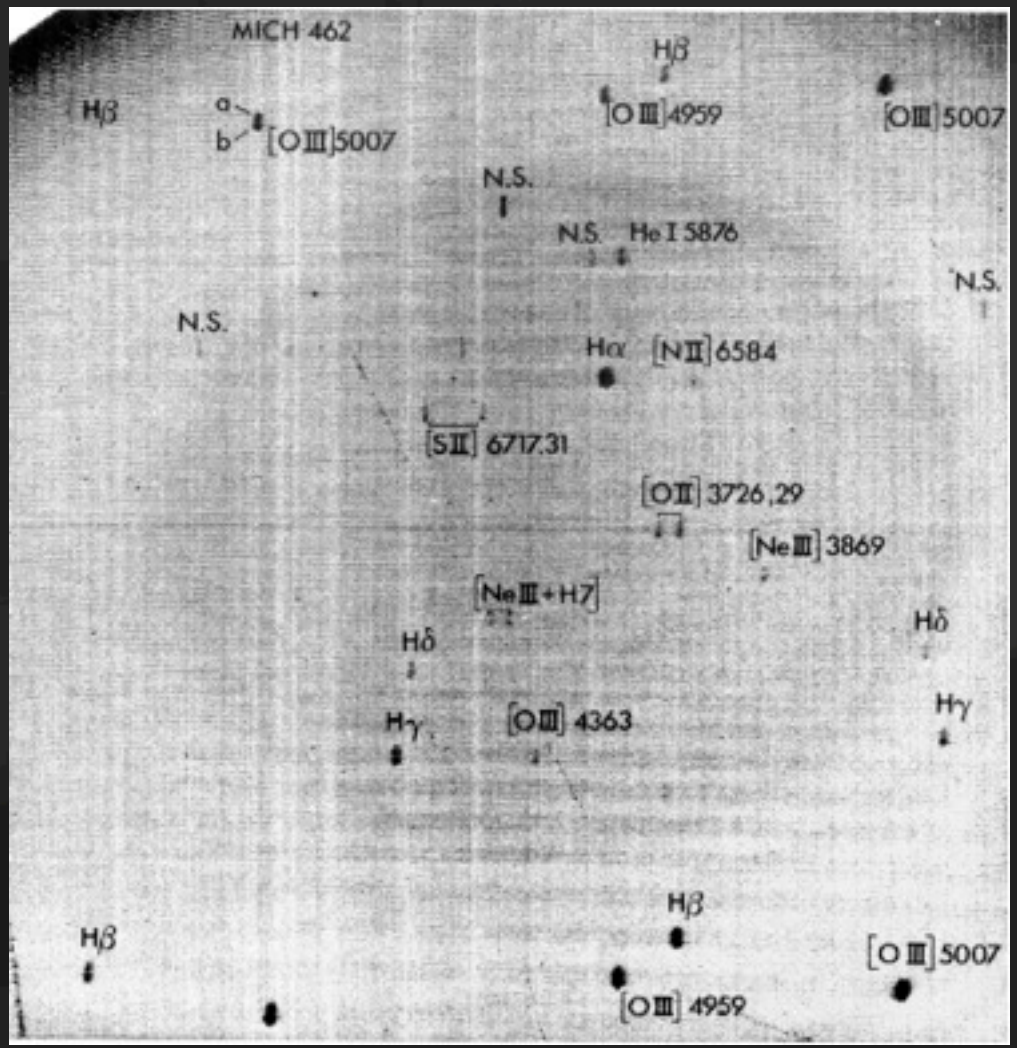
[1] Royal Greenwich Observatory, Madingley Road, Cambridge CB3 0EZ, U.K.
[2] European Southern Observatory, Casilla 19001, Santiago 19, Chile
[3] Instituto de Astrofísica de Andalucía, Apartado 2144, 18080 Granada, Spain
[4] Departamento de Matemática e NEPAE, Universidade Federal de Santa Maria, 97119 Santa Maria RS, Brazil

Received December 17, 1990; accepted April 8, 1991

Abstract. — We present a spectrophotometric catalogue of 425 emission line galaxies discovered in objective prism surveys for which we derived redshifts, emission line intensities, equivalent widths, and absolute fluxes. The vast majority of objects in the catalogue are HII region-like galaxies (HII galaxies). In more than 80 HII galaxies the line [OIII]λ4363 was measured with accuracy good enough to permit precise electron temperature determinations. The observational parameters that define the properties of HII galaxies as a class are characterized and discussed.

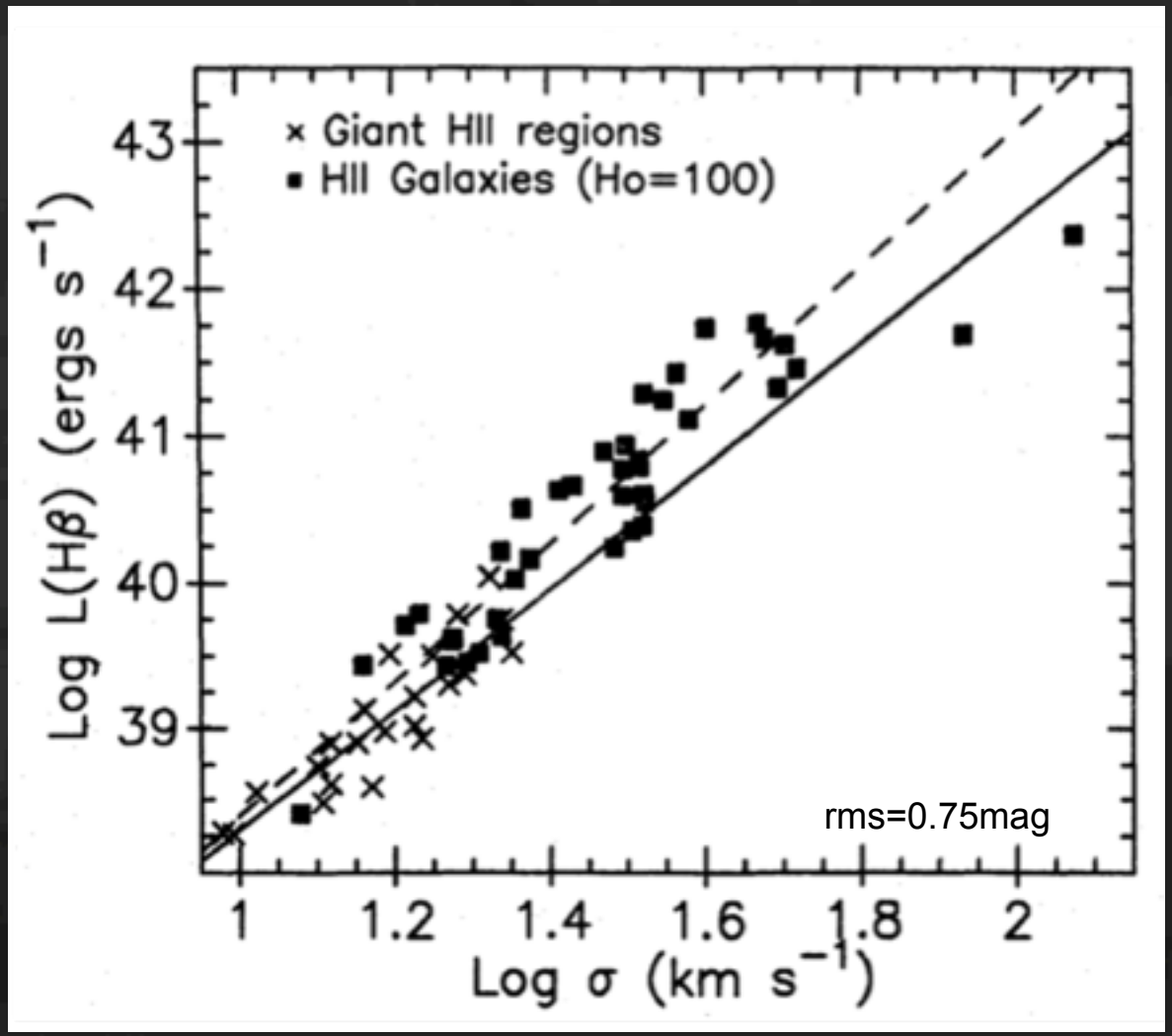
Key words: galaxies: active, emission lines, compact.

We used the Echelle on the Tololo 4m (now Blanco) telescope to measure line widths



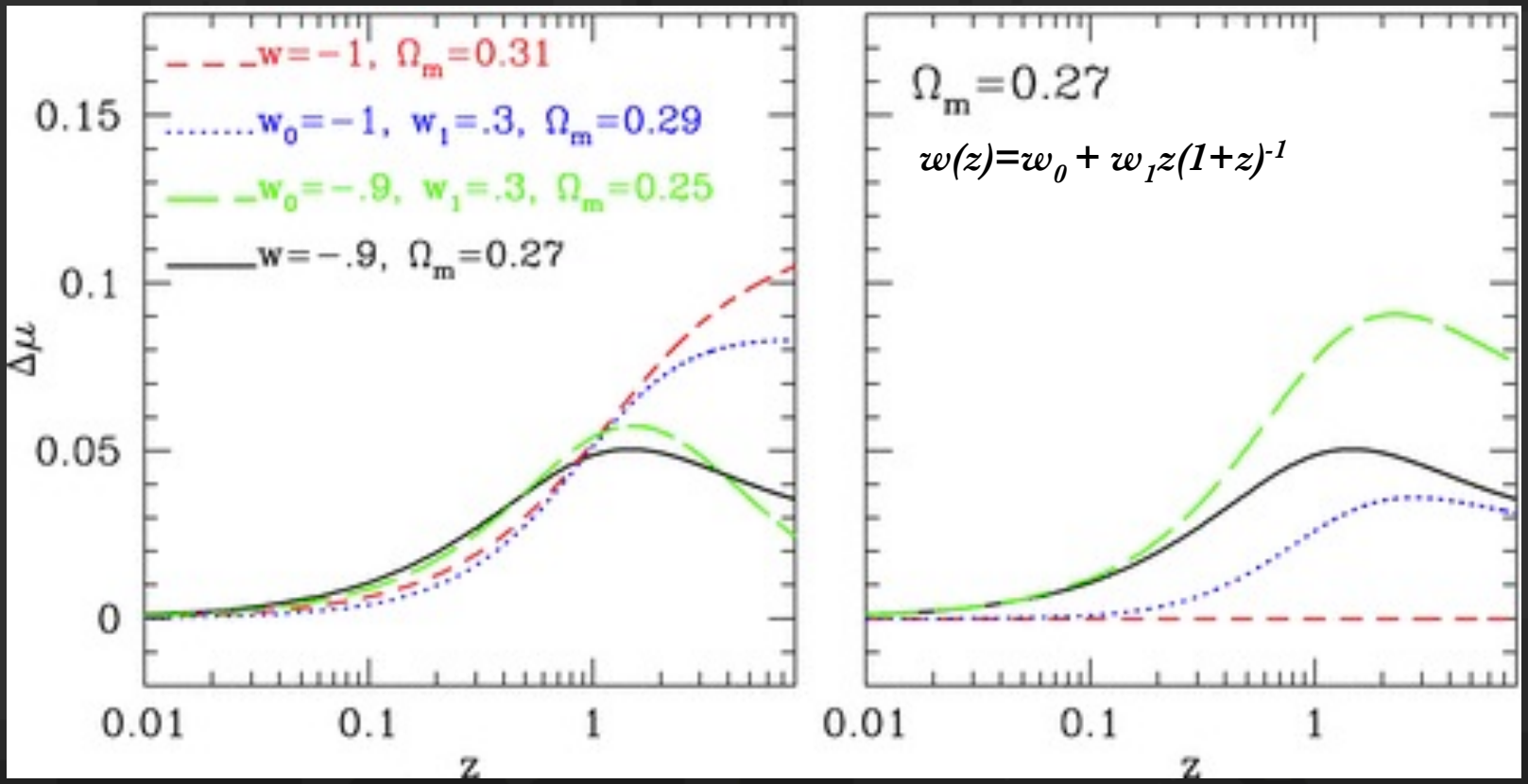
Melnick+ 1988: SIT-Vidicon Echelle spectrograph at CTIO 4m telecope

and... measured the Hubble constant!



Melnick, Terlevich, & Moles, 1988

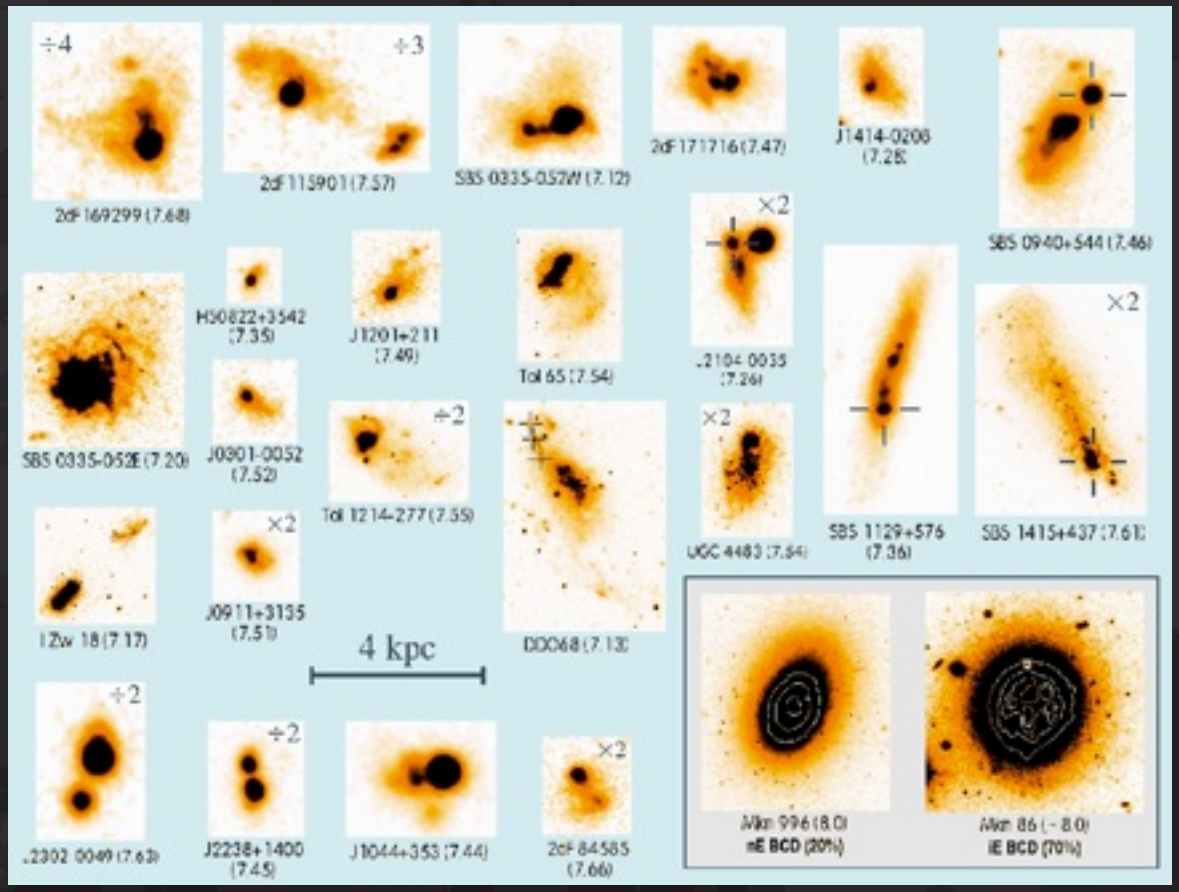
The holy-grail of contemporary cosmology is the equation of state of dark-energy ($p = w\rho$). For this, the ideal redshift range is z=2-3



Plionis et al., 2011

Still, (at z~3) we need to measure distances to $\Delta\mu$~0.1 mag!

Ground-based and space surveys are finding numerous HII galaxies at the optimal redshifts for probing Dark-Energy



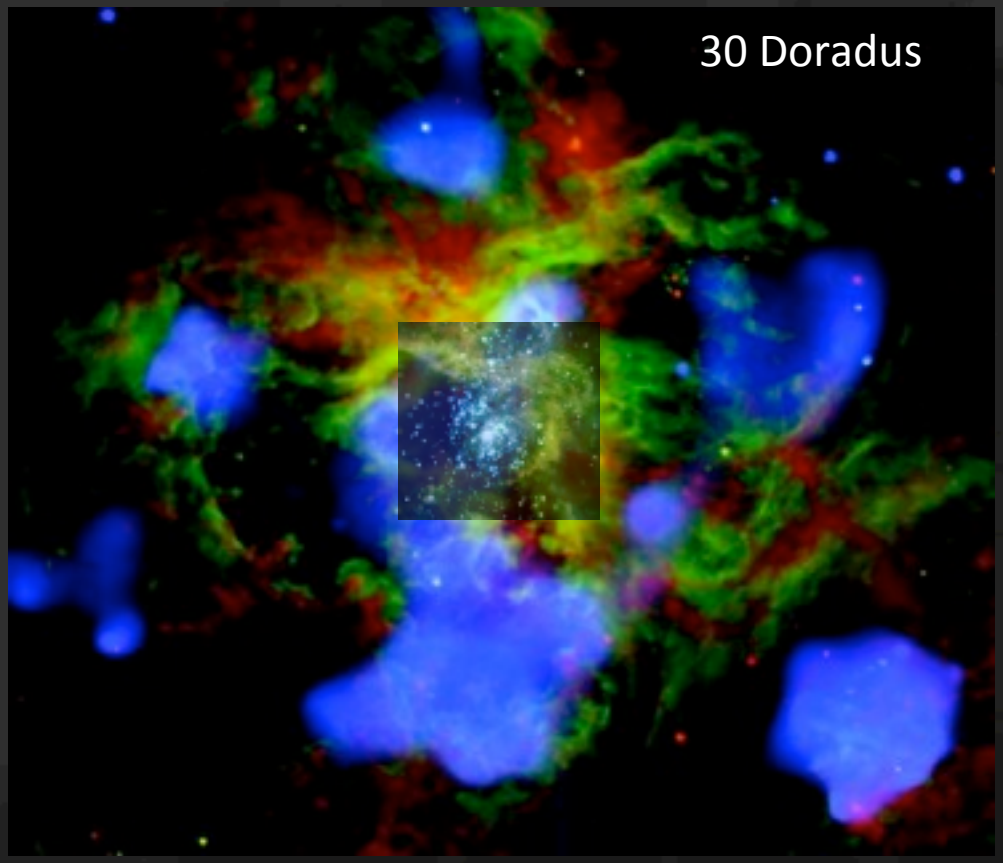
Papaderos et al.,

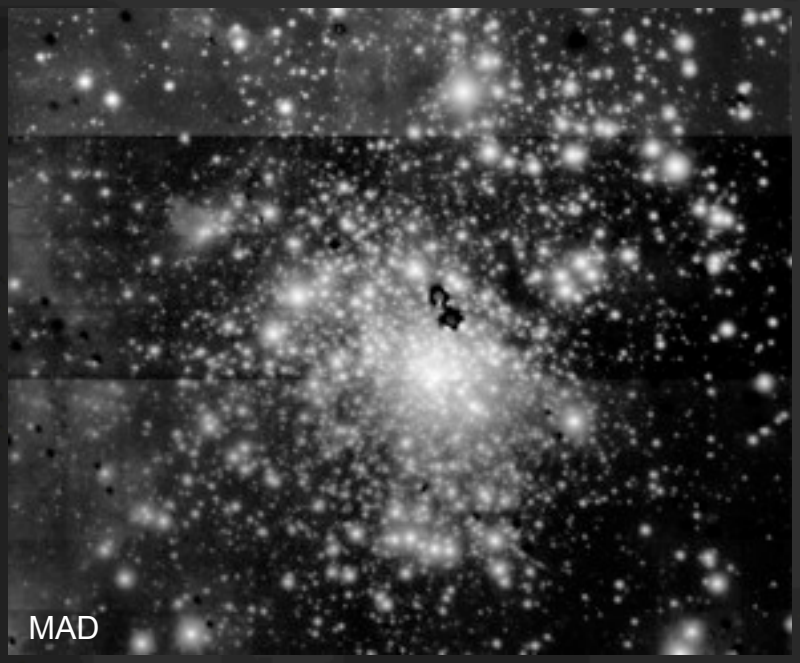
But HII galaxies are metal poor compared to local giant HII regions

Using 8m class telescopes it should be possible to measure the line-widths of HII Galaxies to z=3.

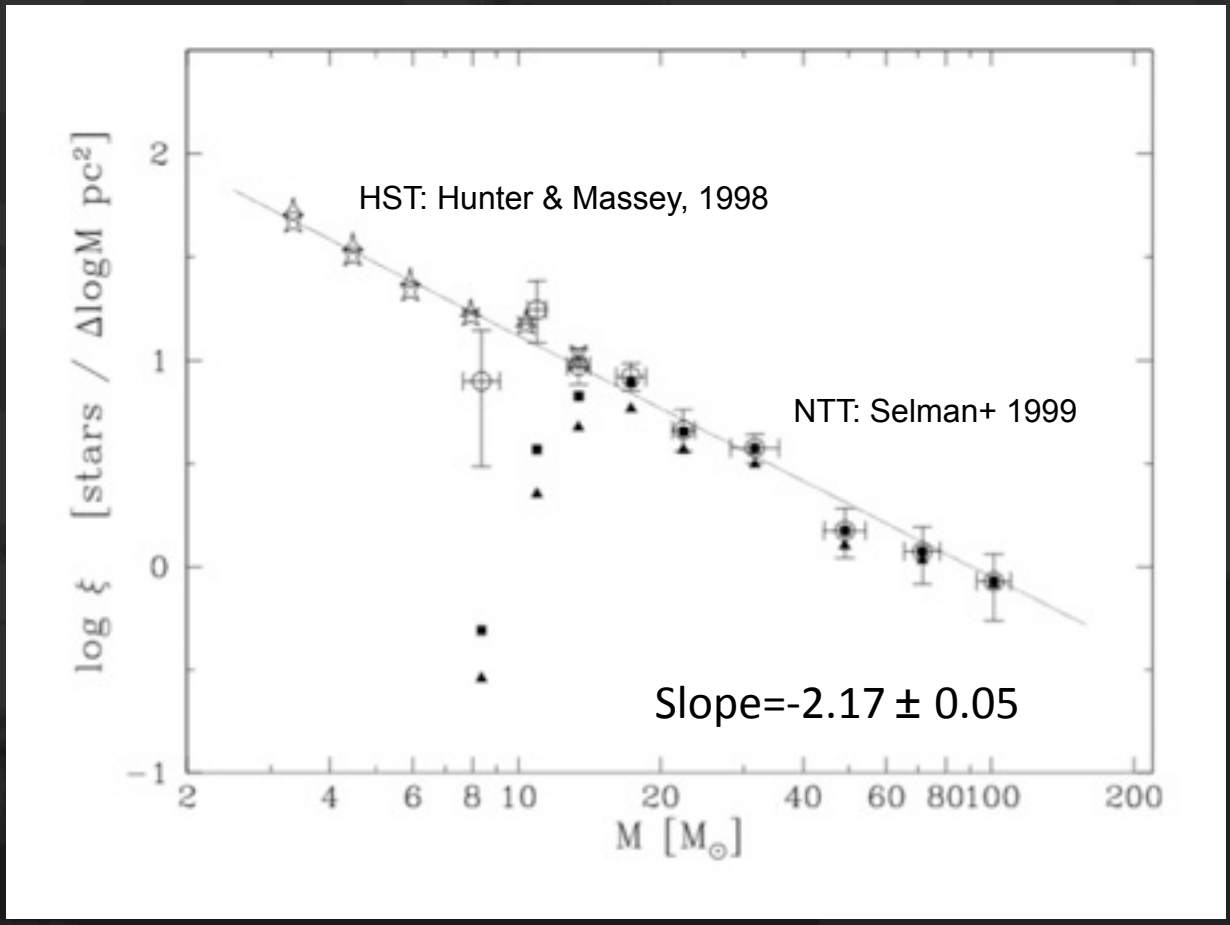
This is a huge leap forward from the local calibrators, so understanding the physics of the L-σ relation is critical if we are to use it as a cosmological distance indicator

Giant HII regions are powered by massive young clusters ($M>10^5 M_{sun}$) that also stir the gas to broaden the nebular lines

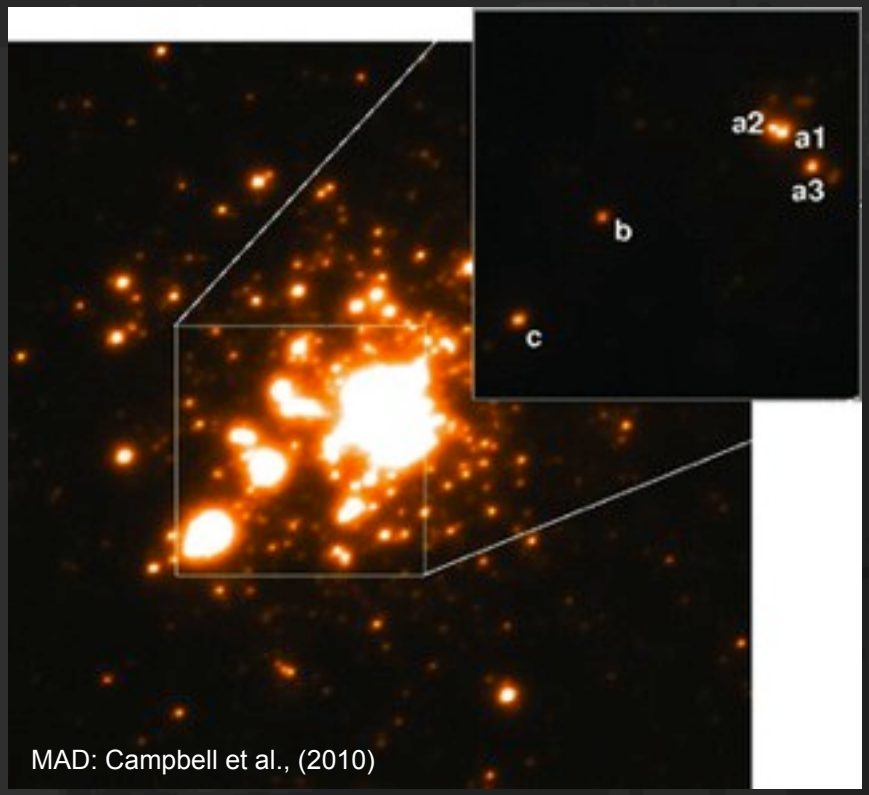




The IMF of 30 Dor, the best determined for any cluster, is normal between 3 and 100 solar masses

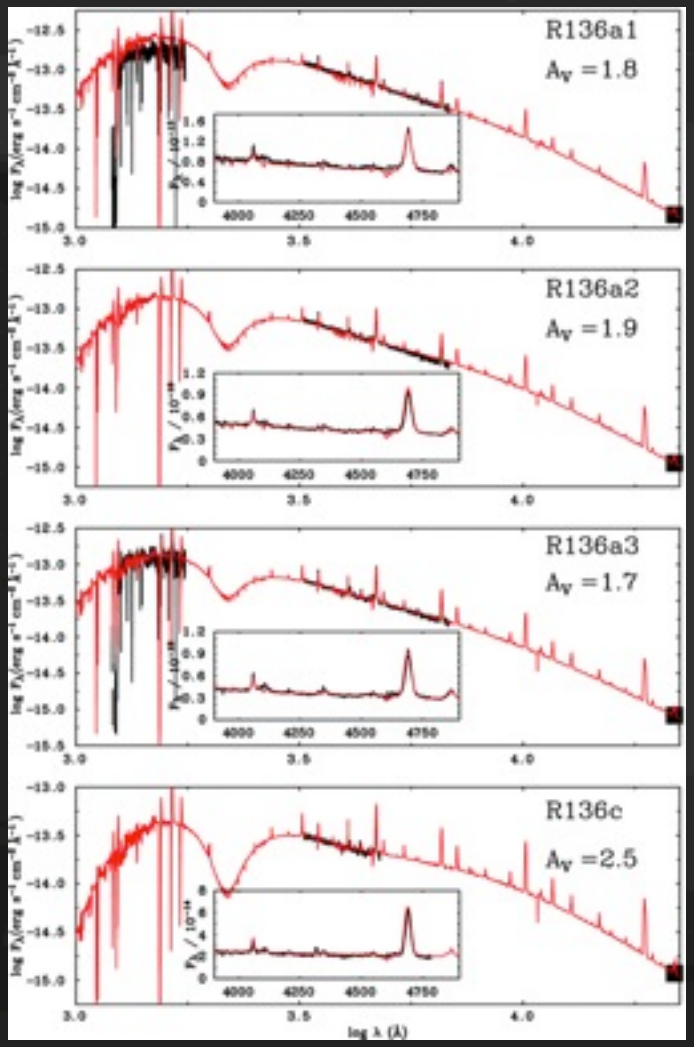


But surprisingly the IMF of 30 Dor seems to stretch to much larger masses than the standard limit of $100M_{sun}$.



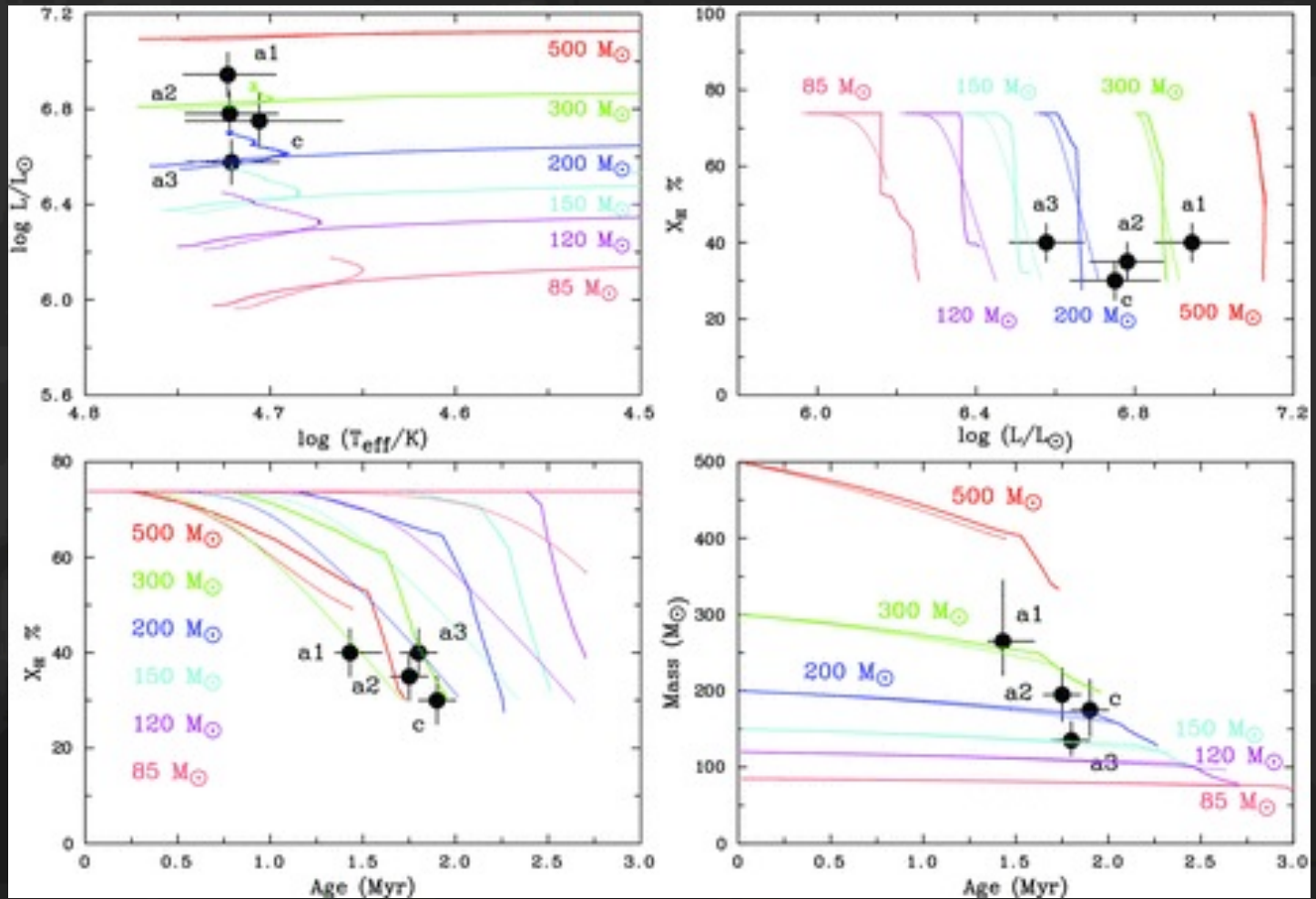
MAD: Campbell et al., (2010)

SED fits to SINFONI, MAD, and HST data revealed that several stars in the core of 30 Doradus have T_{eff}>50,000°K



Crowther et al., (2010)

New Geneva isochrones indicate that these stars have $M>150M_{\odot}$



Crowther et al., (2010)

Text

The Astrophysical Journal **753** (2012) 85
doi:10.1088/0004-637X/753/1/85

THE FORMATION OF YOUNG DENSE STAR CLUSTERS THROUGH MERGERS

M. S. Fujii[1], T. R. Saitoh[2] and S. F. Portegies Zwart[1]

[1] Leiden Observatory, Leiden University, NL-2300RA Leiden, The Netherlands
[2] Interactive Research Center of Science, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro, Tokyo 152-8551, Japan

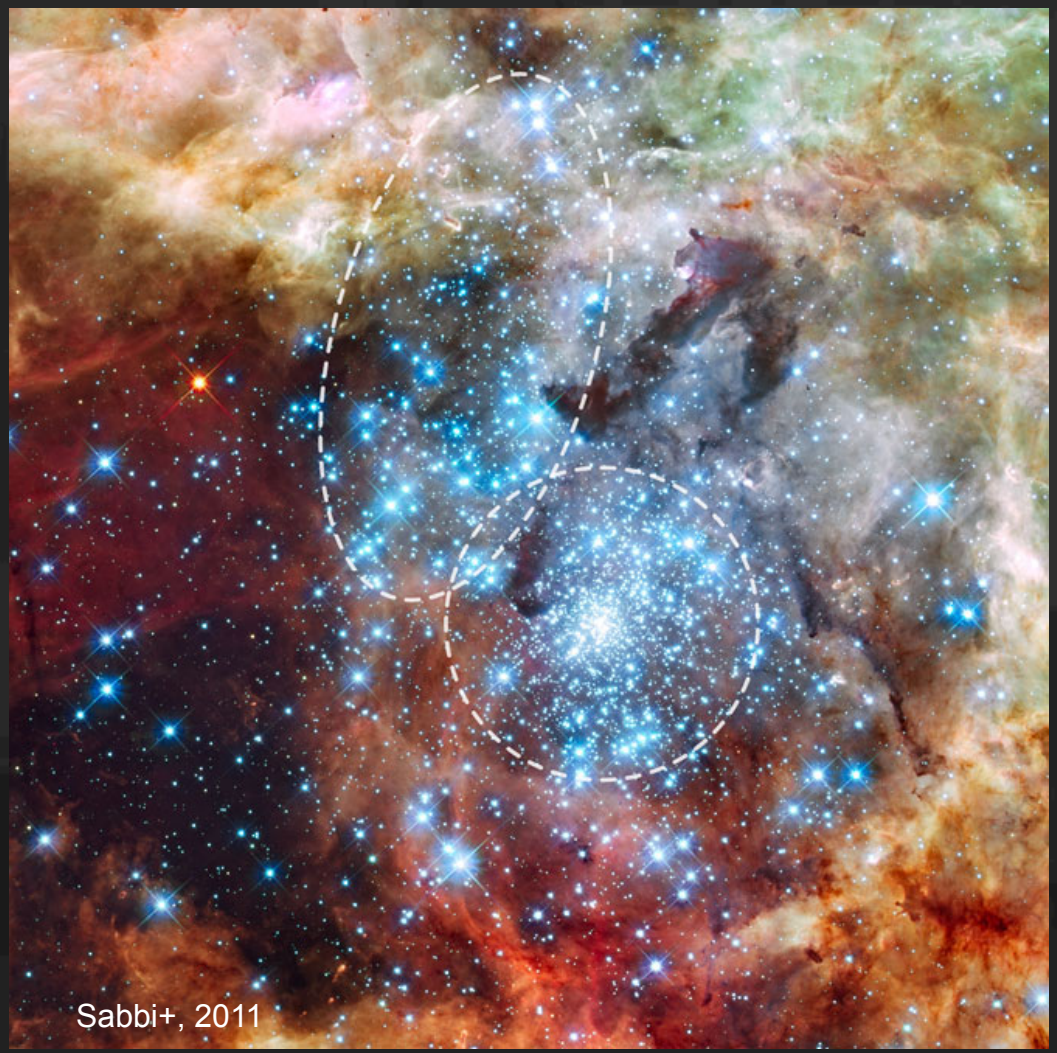
Received 2012 January 11; accepted 2012 April 30; published 2012 June 15

ABSTRACT

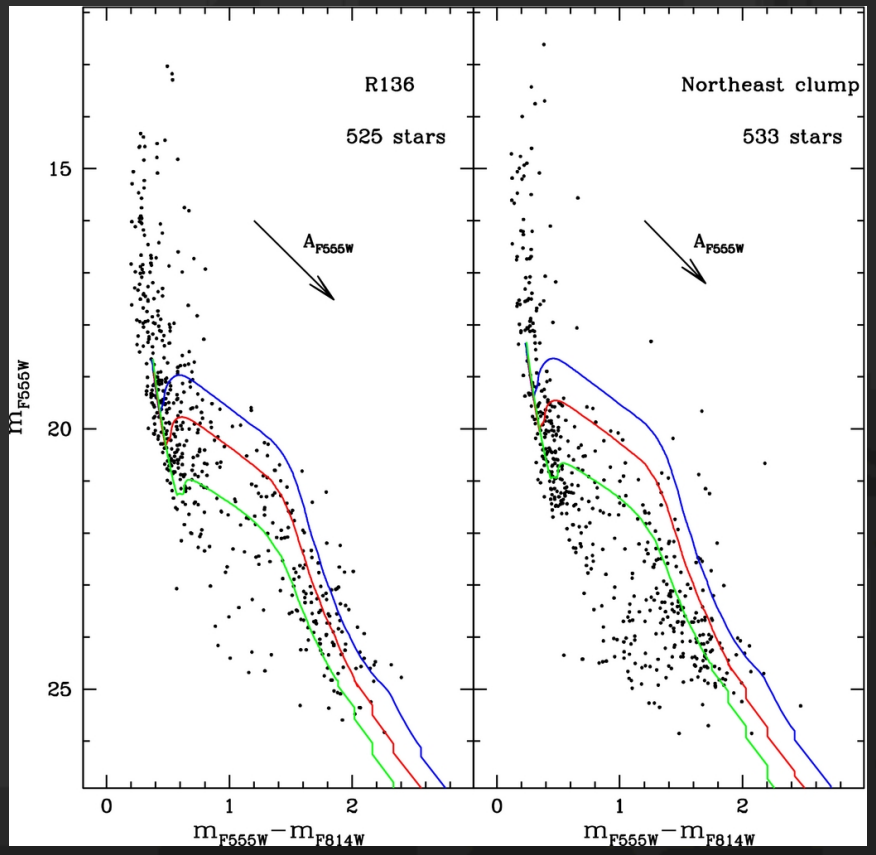
Young star clusters such as NGC 3603 and Westerlund 1 and 2 in the Milky Way and R136 in the Large Magellanic Cloud are dynamically more evolved than expected based on their current relaxation times. In particular, the combination of a high degree of mass segregation, a relatively low central density, and the large number of massive runaway stars in their vicinity are hard to explain with the monolithic formation of these clusters. Young star clusters can achieve such a mature dynamical state if they formed through the mergers of a number of less massive clusters. The shorter relaxation times of less massive clusters cause them to dynamically evolve further by the time they merge, and the merger product preserves the memory of the dynamical evolution of its constituent clusters. With a series of *N*-body simulations, we study the dynamical evolution of single massive clusters and those that are assembled through merging smaller clusters together. We find that the formation of massive star clusters through the mergers of smaller clusters can reproduce the currently observed spatial distribution of massive stars, the density, and the characteristics (number and mass distribution) of the stars ejected as runaways from young dense clusters. We therefore conclude that these clusters and possibly other young massive star clusters formed through the mergers of smaller clusters.

keywords: galaxies: star clusters: individual (R136); methods: numerical; open clusters and associations: individual (NGC 3603, Westerlund 1, Westerlund 2)

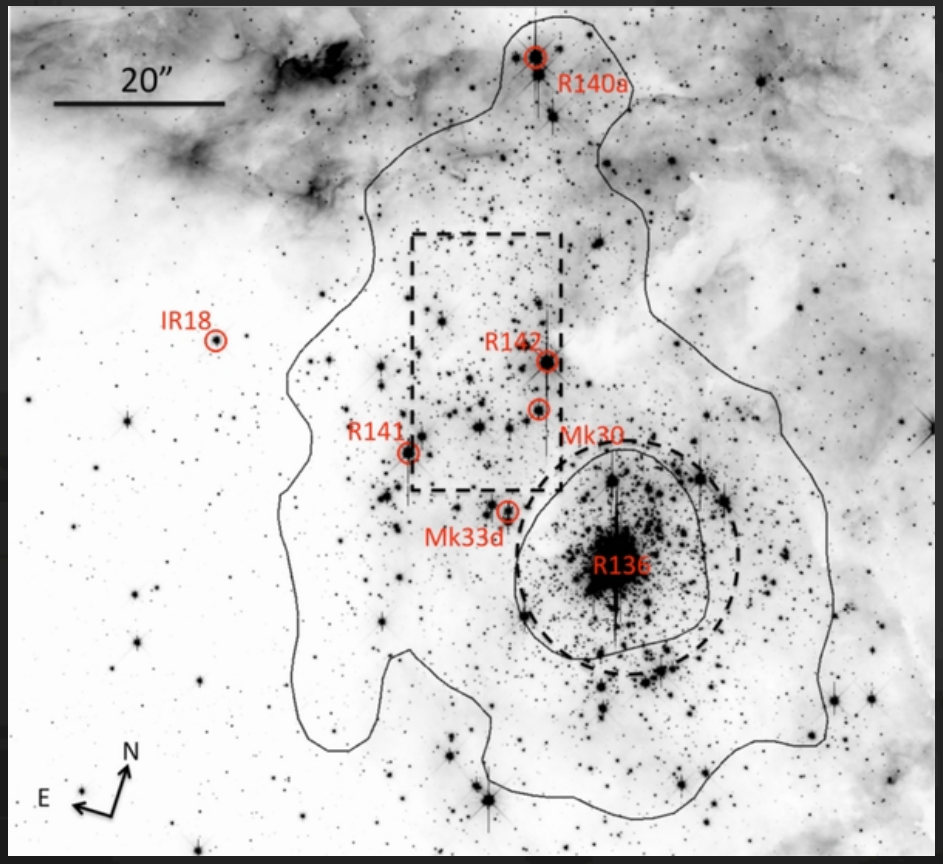
It has recently been proposed that 30 Dor was formed by the collision of two young clusters



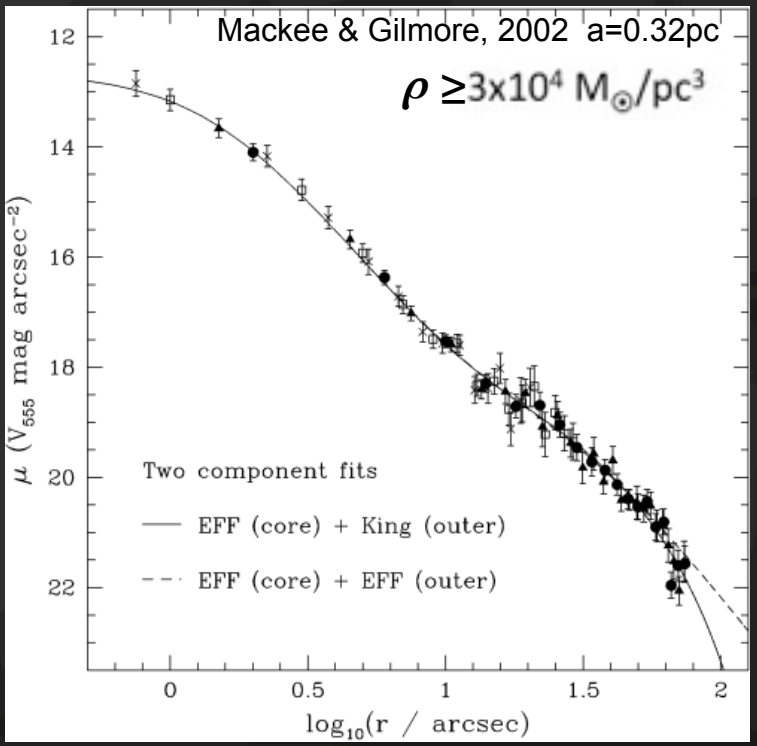
Indicated by two populations of slightly different ages

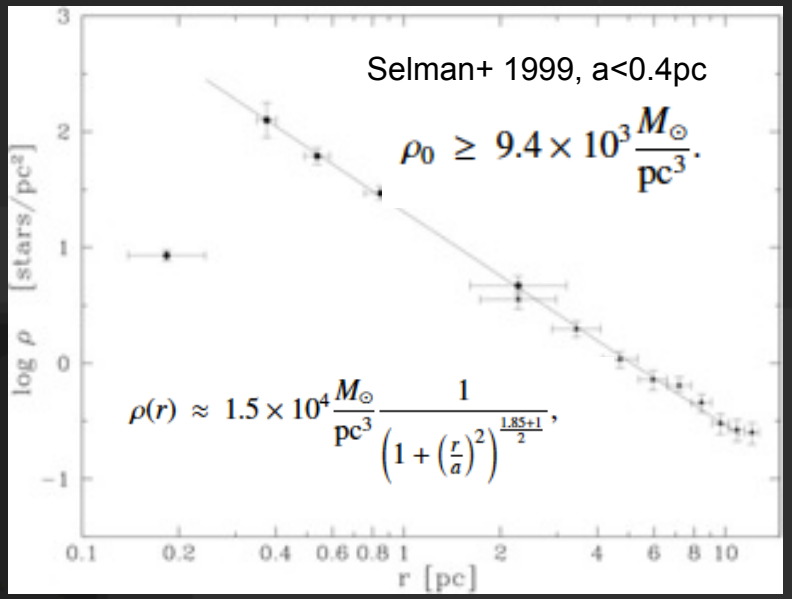


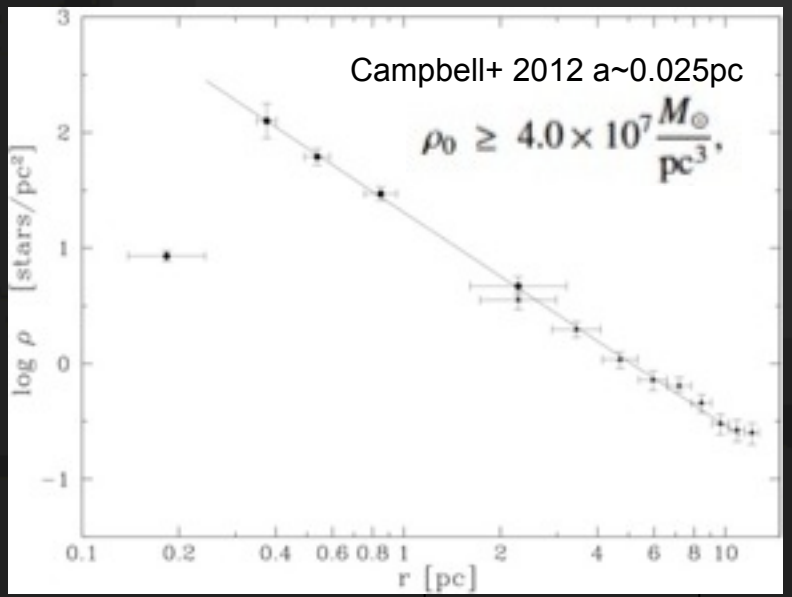
Sabbi et al.



But the ionizing clusters of Giant HII regions may be dynamically evolved for "natural" reasons







Mass segregation and core collapse depend critically on the central density

A&A 552, A94 (2013)
DOI: 10.1051/0004-6361/201220396

Astronomy & Astrophysics

The central density of R136 in 30 Doradus

F. J. Selman and J. Melnick

European Southern Observatory, Alonso de Cordova 3107 Vitacura Casilla 7630355, Santiago, Chile
e-mail: fselman@eso.org

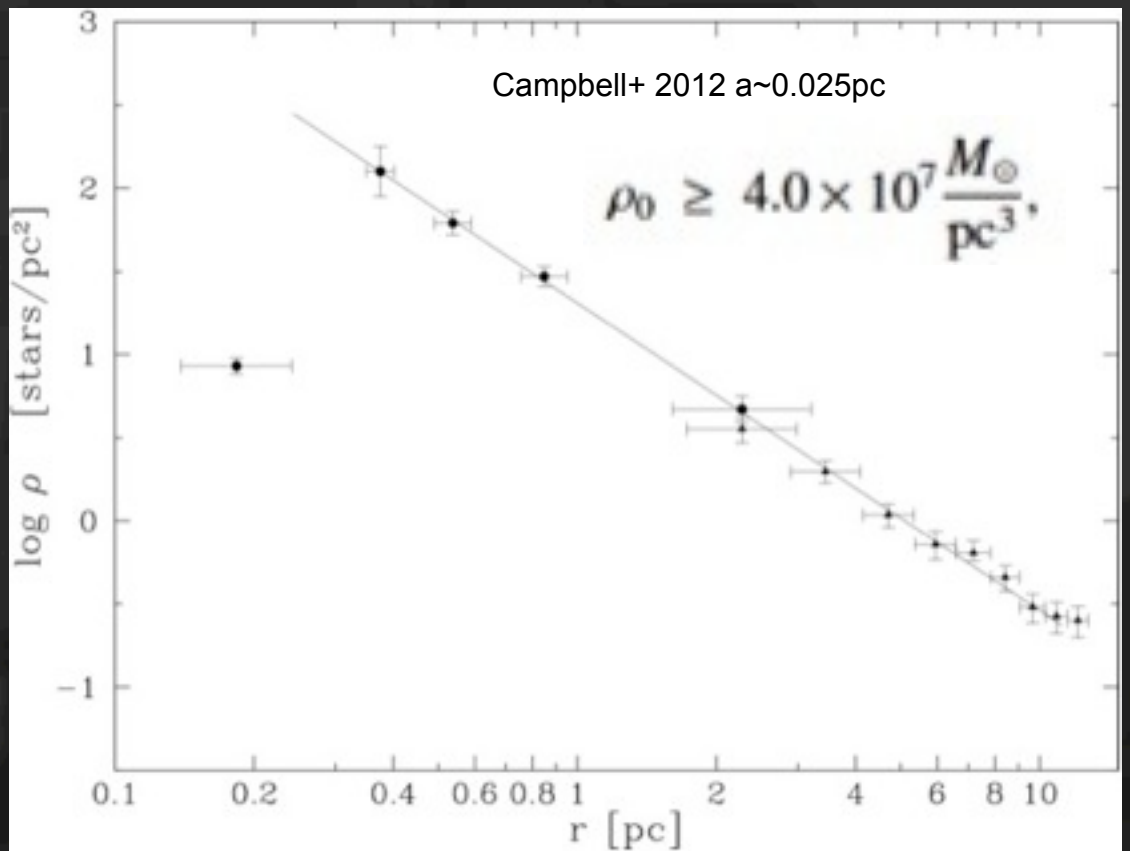
Received 18 September 2012 / Accepted 13 February 2013

ABSTRACT

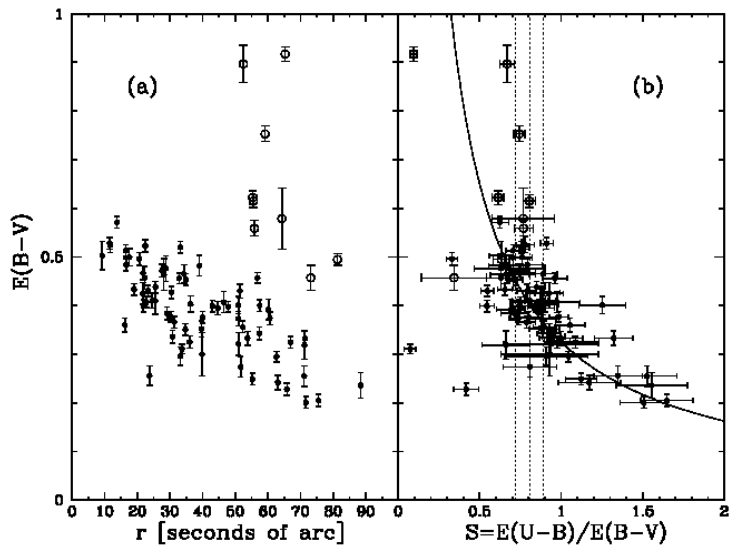
The central density, ρ_0, of a stellar cluster is an important physical parameter for determining its evolutionary and dynamical state. How much mass segregation there is or whether the cluster has undergone core collapse both depend on ρ_0. We reanalyze the results of a previous paper that gives the mass density profile of R136 and combine them with both a conservative upper limit for the core parameter and a more uncertain recent measurement. We thus place a lower limit on ρ_0 under reasonable and defensible assumptions about the IMF, finding $\rho_0 \geq 1.5 \times 10^4\ M_\odot/\mathrm{pc}^3$ for the conservative assumption $a < 0.4$ pc for the cluster core parameter. If we use the lower, but more uncertain value $a = 0.025$ pc, the central density estimate becomes greater than $10^7\ M_\odot/\mathrm{pc}^3$. A mechanism based on the destruction of a large number of circumstellar disks is posited to explain the hitherto unexplained increase in reddening presented in that same work.

Key words. circumstellar matter – galaxies: clusters: individual: R 136 – stars: luminosity function, mass function – Magellanic Clouds – dust, extinction

If a~0.03 30 Dor is a post-core collapse cluster. But this photometric measurement is very uncertain



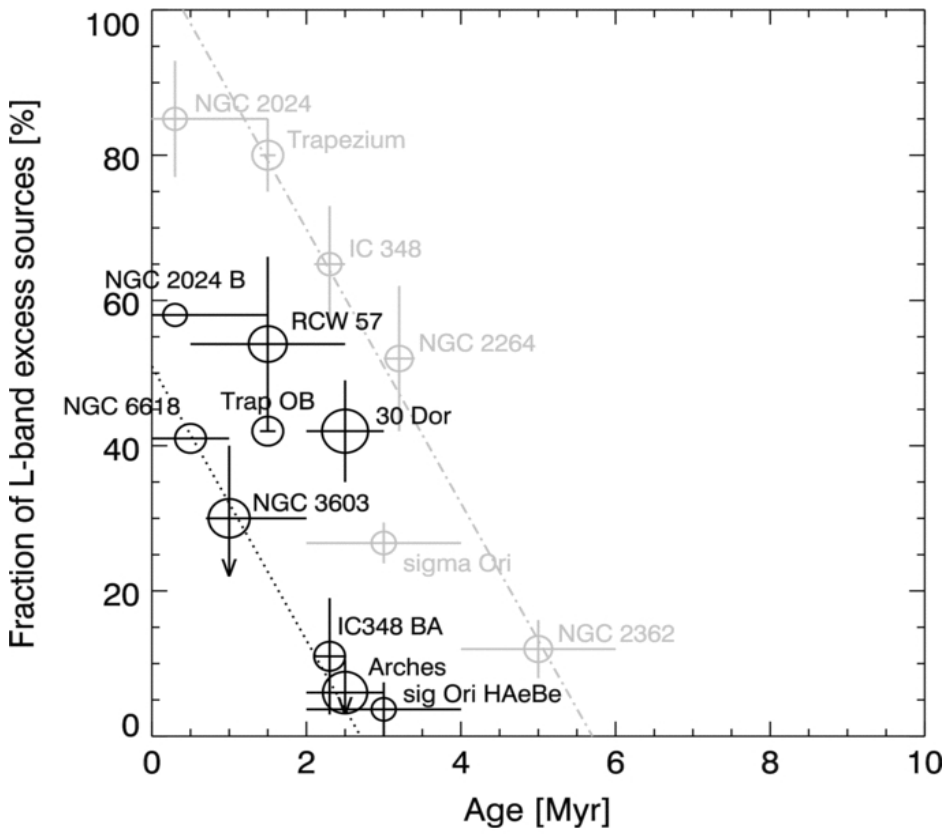
The extinction increases sharply in the core. Where does the dust come from?



How much dust does this reddening implies?

Disk distruction!

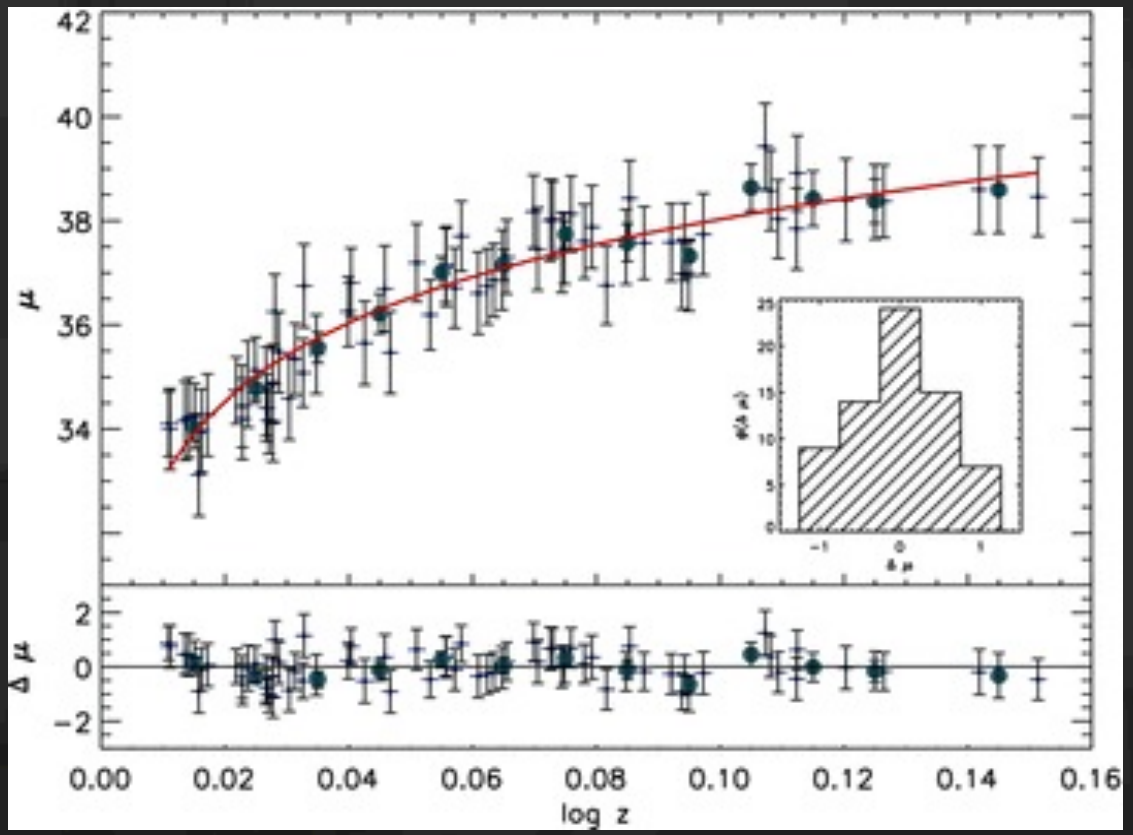
Figure 13 from Disks in the Arches Cluster—Survival in a Starburst Environment
A. Stolte et al. 2010 ApJ 718 810 doi:10.1088/0004-637X/718/2/810



30 Doradus point from SPT investigation by Maercker, M. & Burton, M. G. 2005, A&A, 438, 663

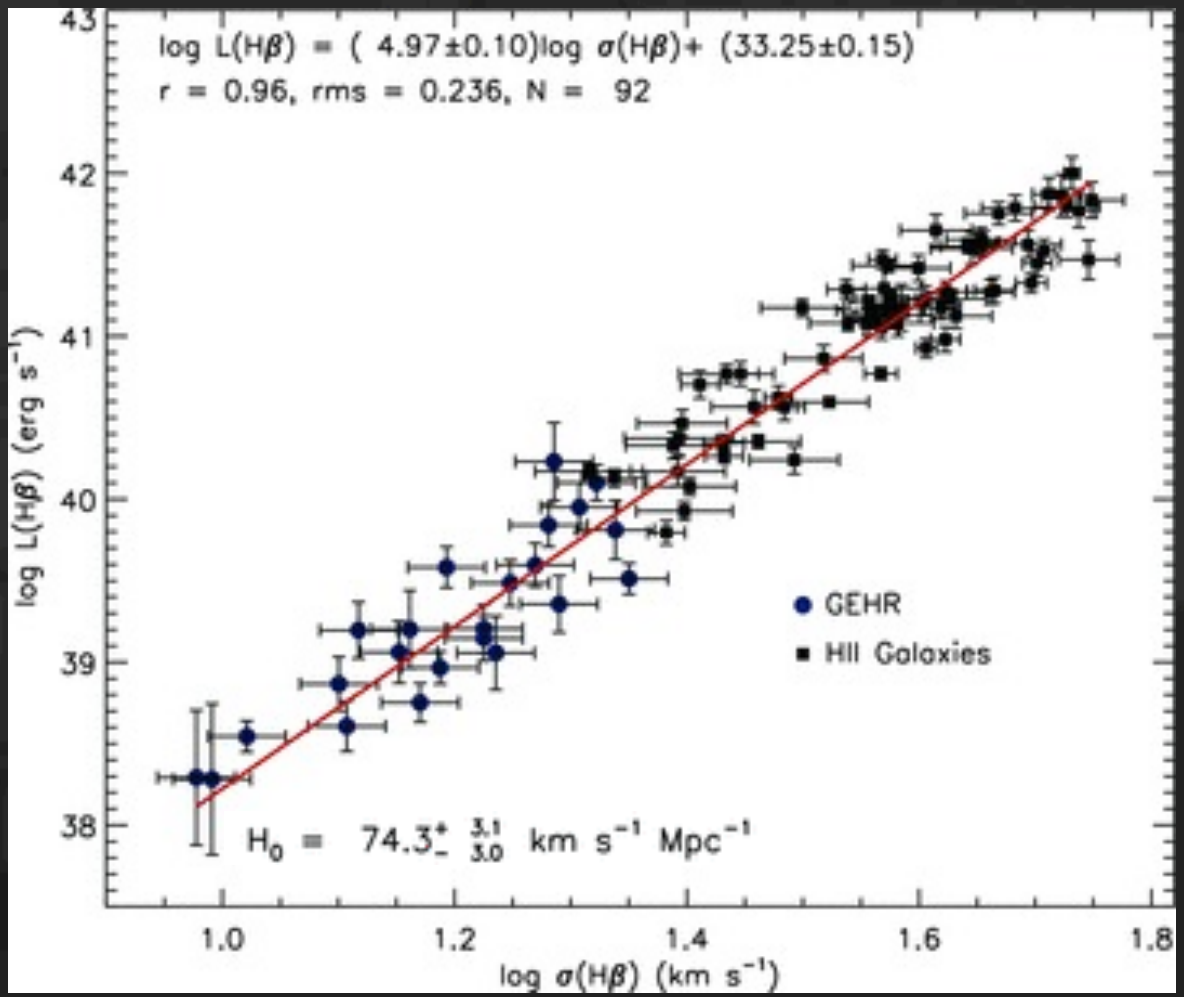
Back to HII Galaxies

Recently we re-calibrated the L-σ relation using 128 SDSS HII Galaxies and echelle spectrographs on VLT and Subaru improving the scatter to δμ = 0.57mag



Chavez et al.,

And used the new calibration to derive a value of $H_0 = 74.3 \pm 3.0$ km/s/Mpc for the Hubble constant.



CONCLUDING REMARKS

The story of the calibration of Giant HII galaxies as cosmological probes has been for us (Roberto Terlevich and me) the story of our relation with Cerro Tololo.

Tololo has been essential for the development of Astronomy in Chile, and for my astronomical career in particular!


THANK YOU TOLOLO!!!