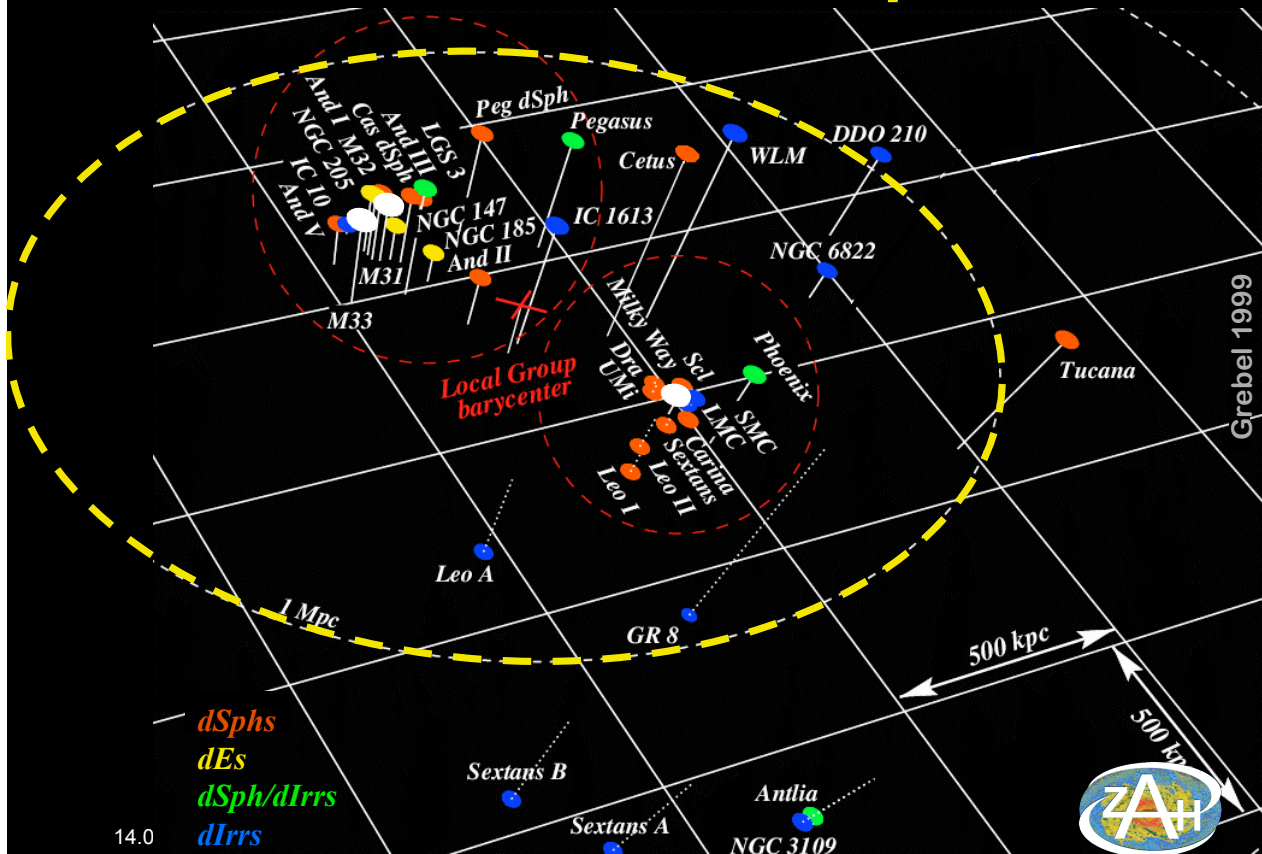


Star Formation in Dwarf Galaxies

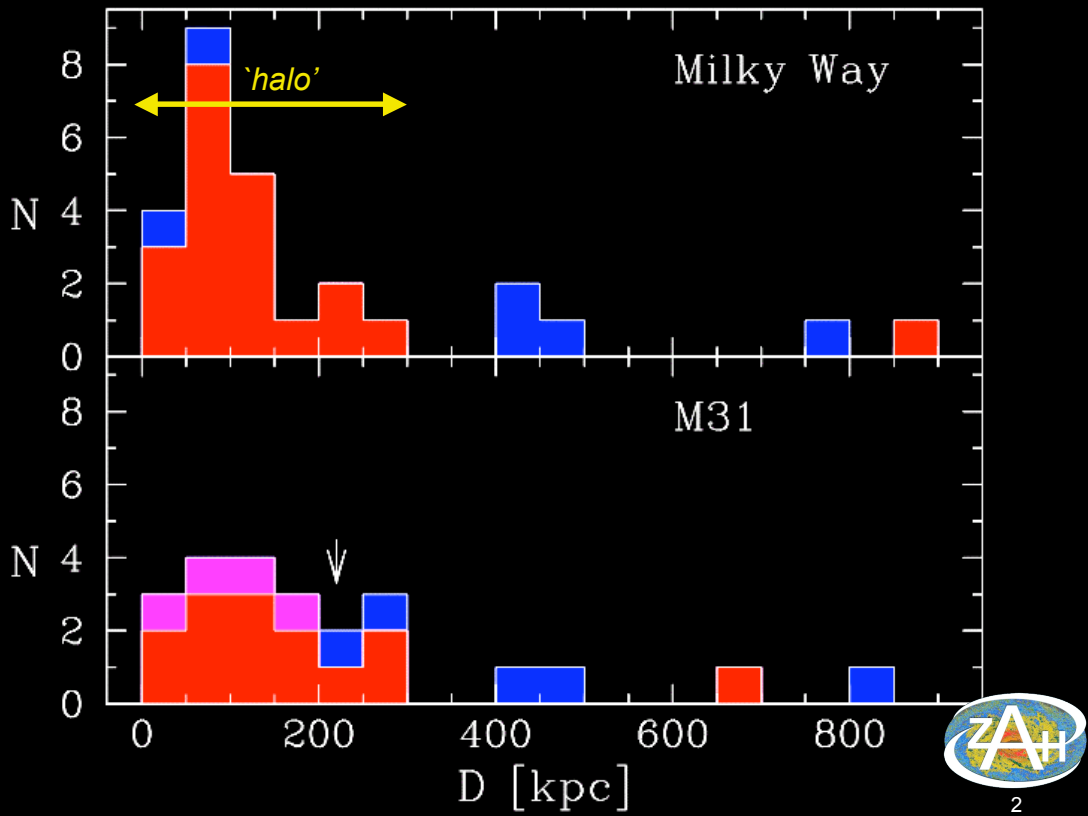
Eva K. Grebel
Astronomisches Rechen-Institut
Center for Astronomy
University of Heidelberg



The Local Group



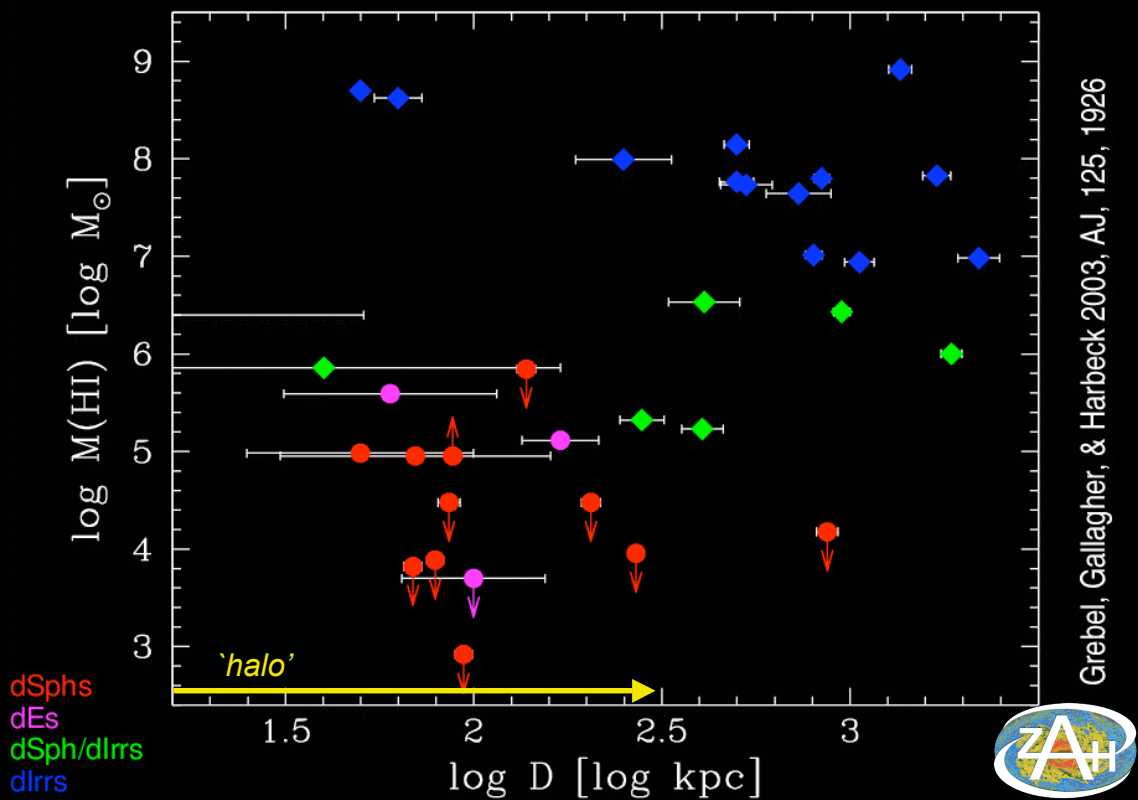
Morphology – Distance Relation for Dwarfs



1

2

Dwarf Distance from Primary vs. HI Mass



Grebel, Gallagher, & Harbeck 2003, AJ, 125, 1926

dSphs
dEs
dSph/dIrrs
dIrrs

14.09.2007

E.K. Grebel: Star Formation in Dwarf Galaxies

3

Ages: The Earliest Epoch of Star Formation

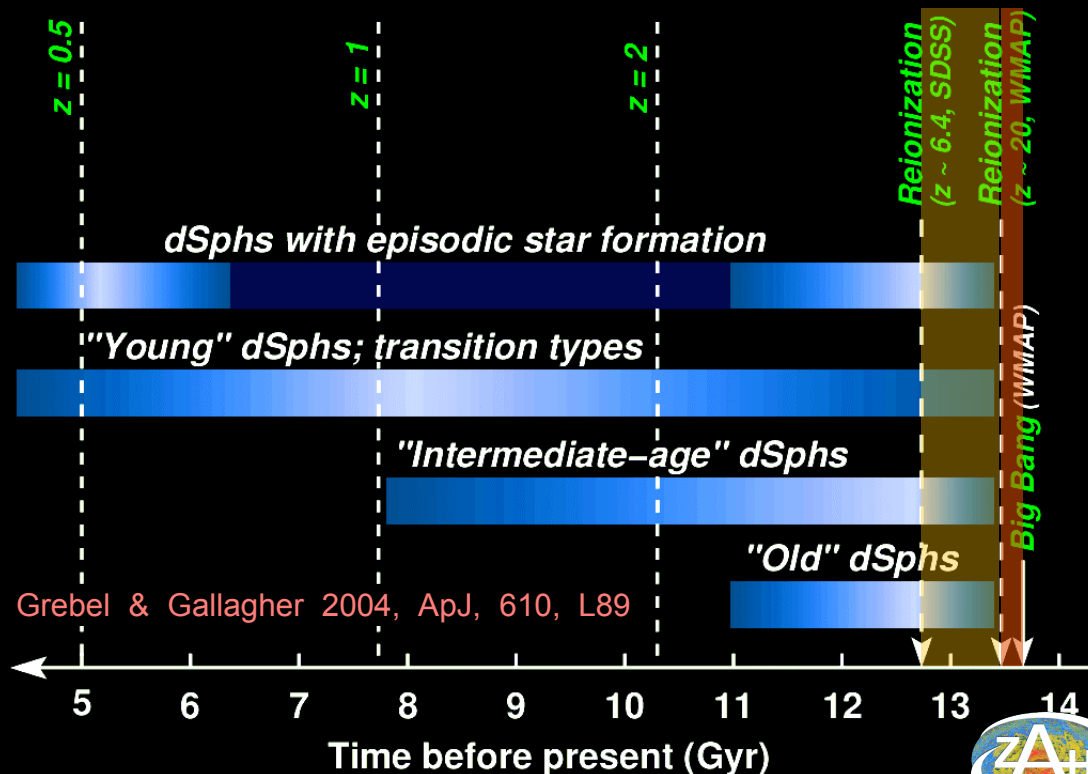
Observational Results (Pop II only)
 (from relative age dating of main-sequence turnoffs)

- ❑ **Old populations ubiquitous** but fractions vary
- ❑ Evidence for a **common epoch** of early star formation
 - ❑ *Globular clusters with main-sequence photometry*
 (Galactic halo & bulge, Sgr, LMC, For)
 - ❑ *Field populations with main-sequence photometry*
 (Sgr, LMC, Dra, UMi, Scl, Car, For, Leoll)
 - ❑ RR Lyrae stars in more distant systems

Grebel & Gallagher 2004, ApJ, 610, L89



Star Formation Activity in Low-mass Galaxies ($\sim 10^7 M_{\odot}$)

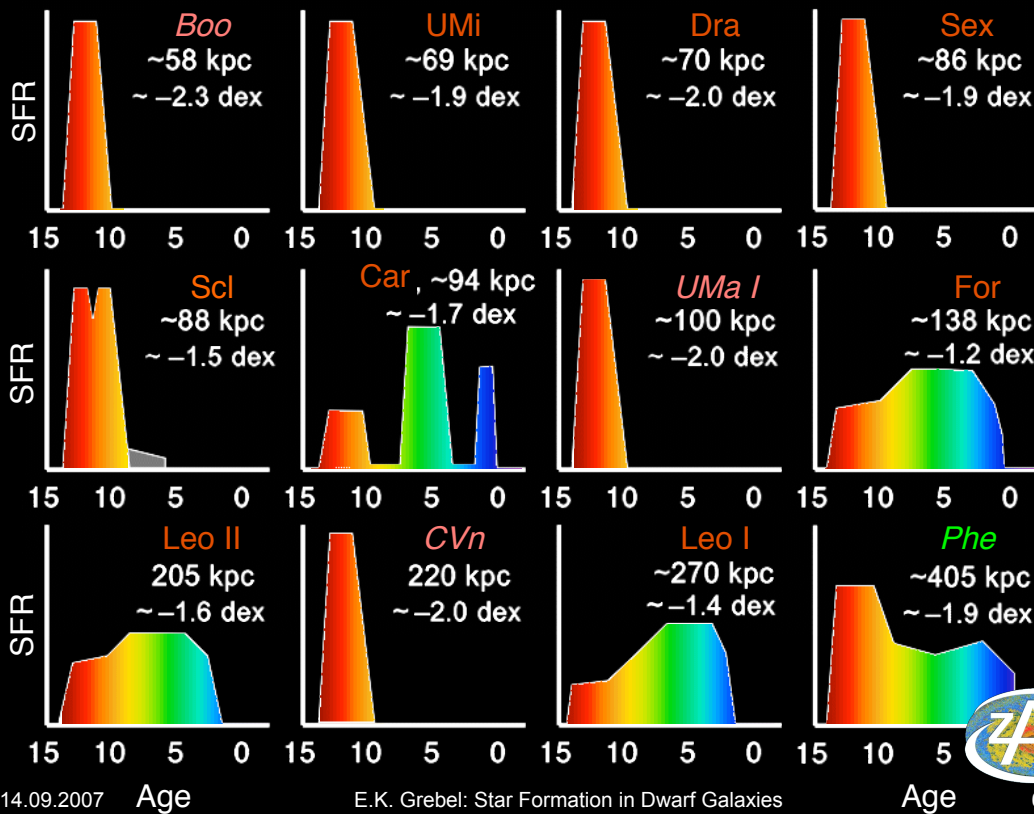


Cosmology: flat, $\Omega_m = 0.27$, $H_0 = 71$ km/s/Mpc



SFHs of Low-mass MW Companions

from resolved stellar populations (ground-based + HST)

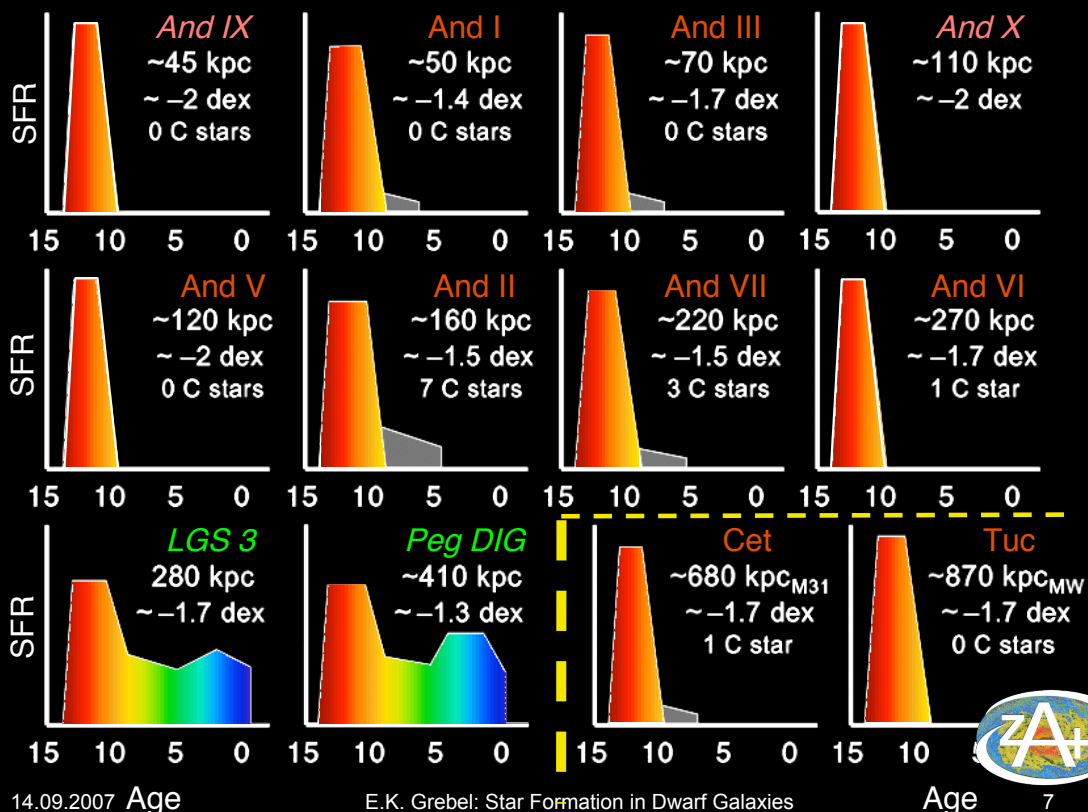


Grebel, Gallagher, & Harbeck 2007



SFHs of Low-mass M31 Companions

from resolved stellar populations (ground-based + HST)

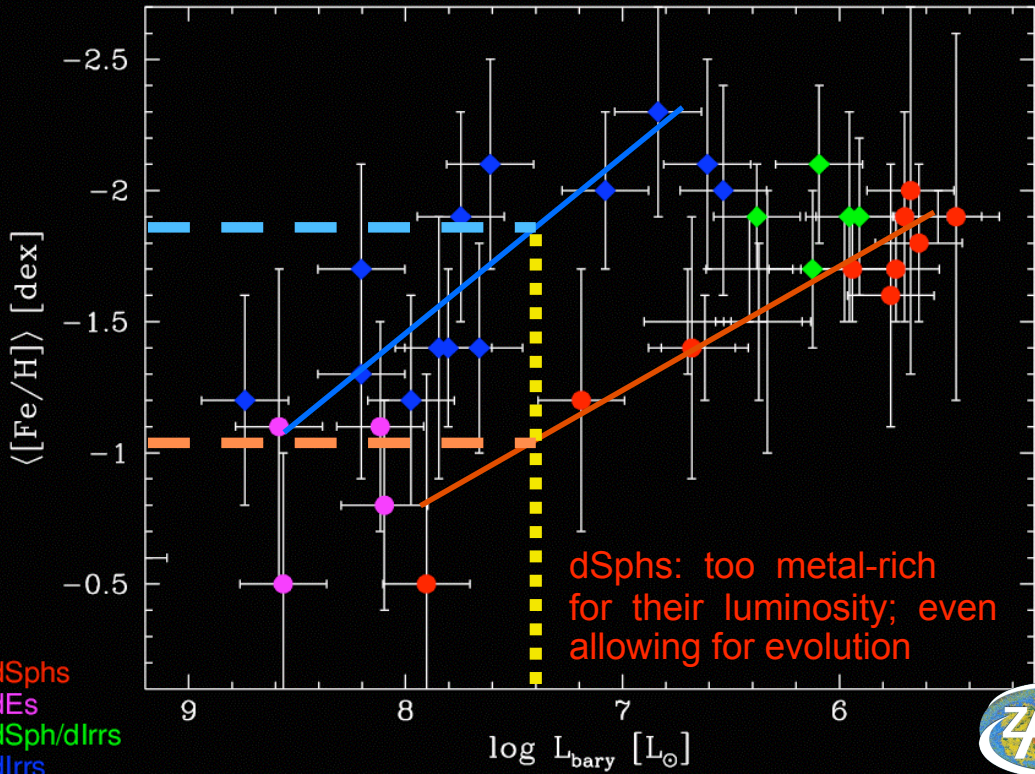


Grebel, Gallagher, & Harbeck 2007



Metallicity–Luminosity Relation

dSphs \rightarrow dlrrs; but also: evolution as independent entities!



Grebel, Gallagher, & Harbeck 2003, AJ, 125, 1926

dSphs
dEs
dSph/dlrrs
dlrrs
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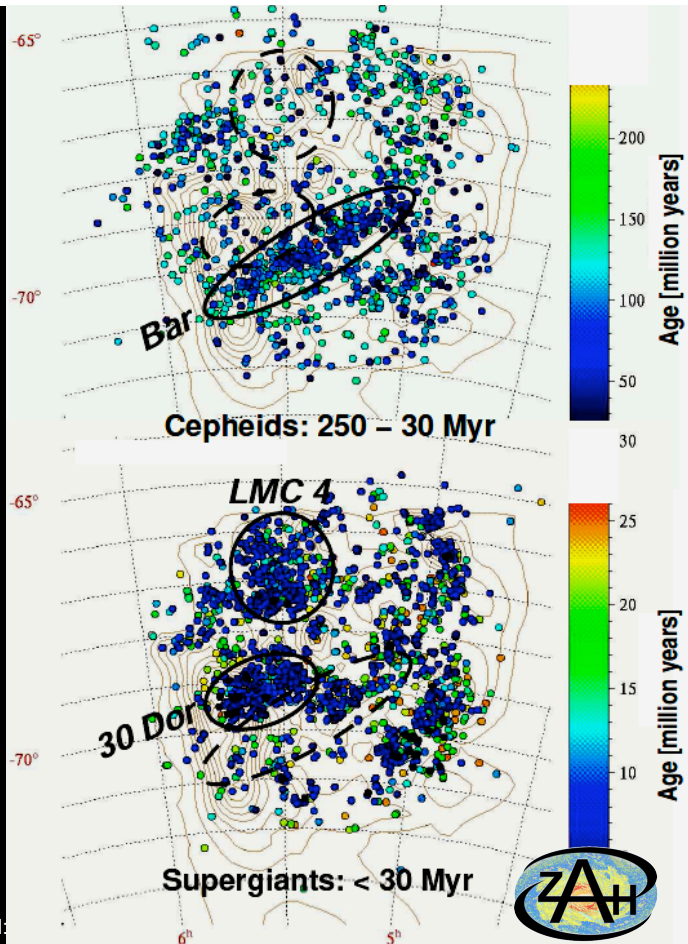
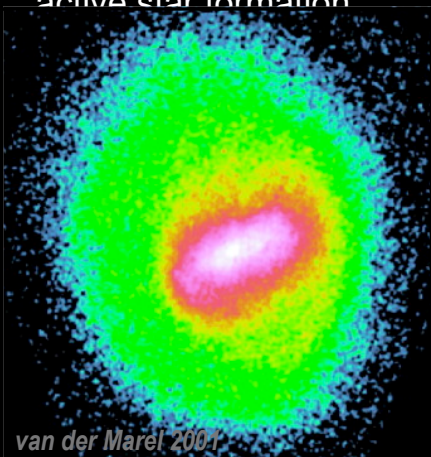


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Spatial Variations: Recent Star Formation History of the LMC

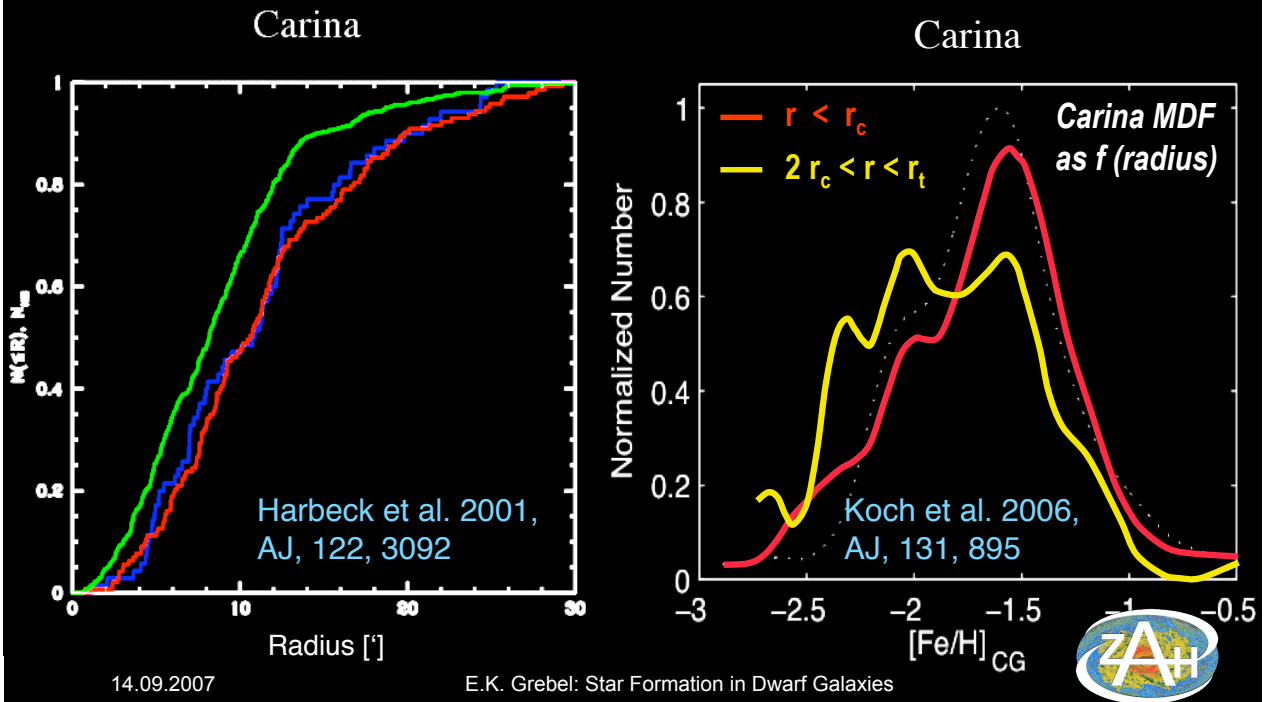
Grebel & Brandner 1997

Long-lived regions of active star formation



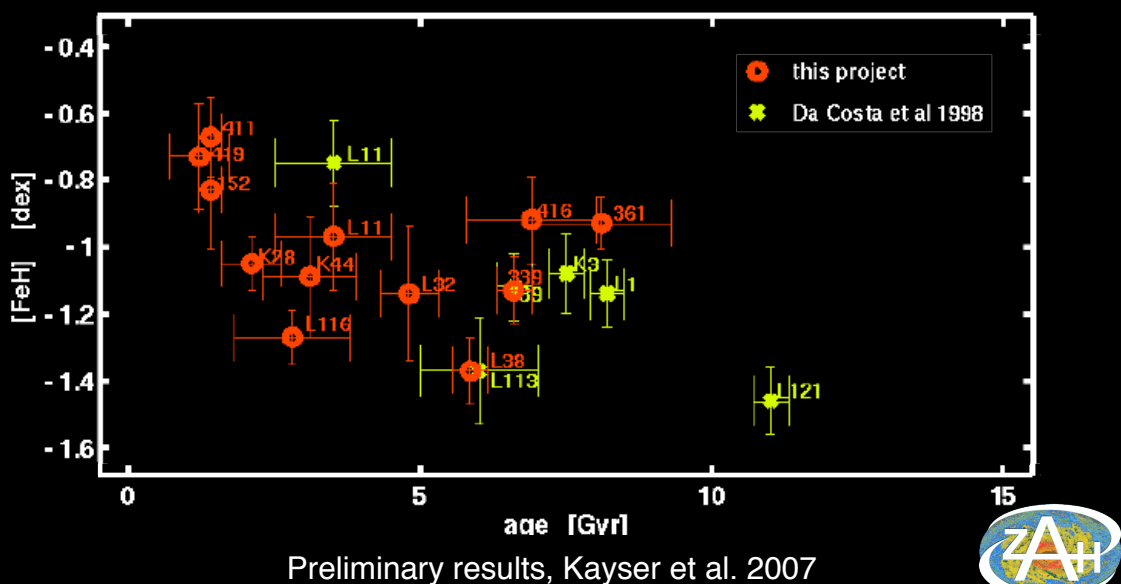
Spatial Variations: Age & Metallicity

Spatial distribution of stellar populations: even old stars vary. Younger and/or more metal-rich stars: more centrally concentrated



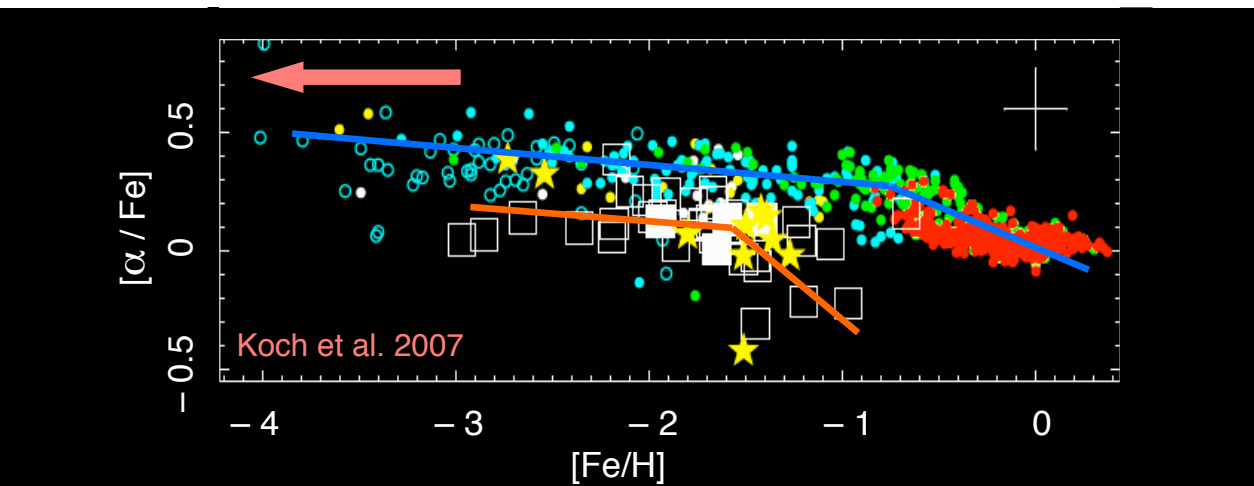
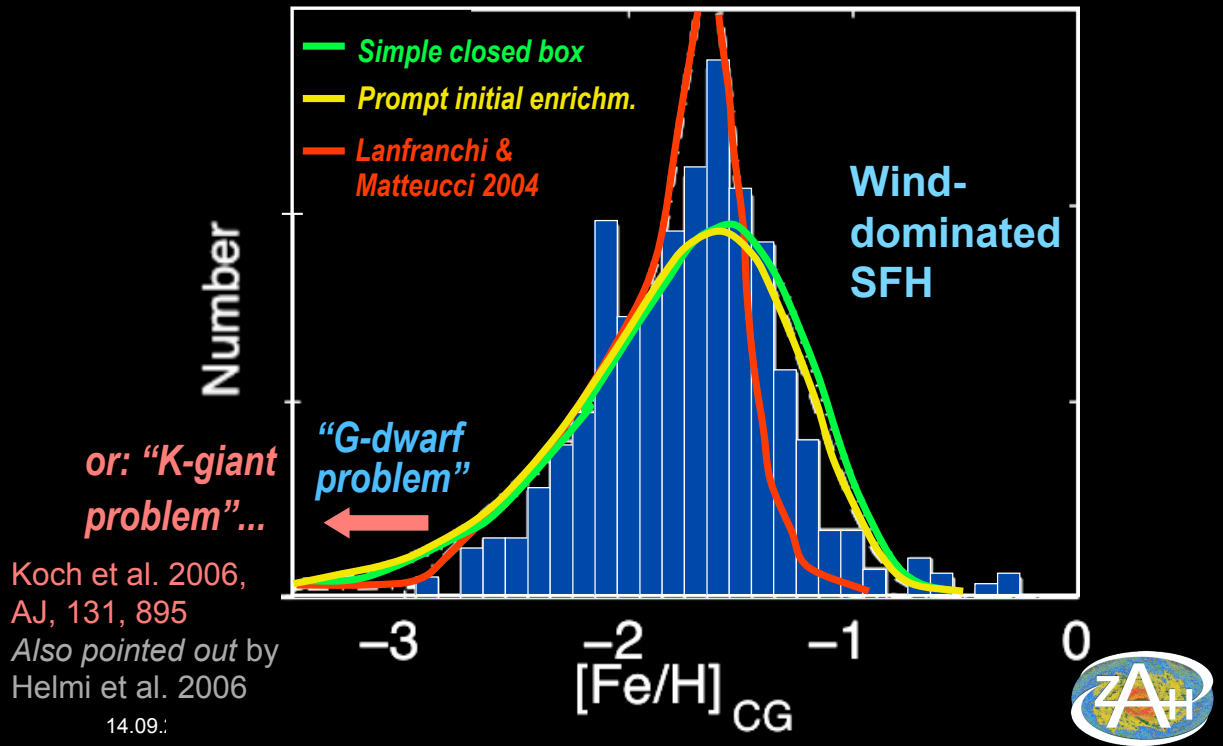
Example: The Age-Metallicity Relation of the SMC

VLT spectroscopy & ACS photometry of SMC clusters:
Metallicity spread at a given age; SMC not well mixed!
(SMC exceptional in high number of populous clusters.)



Metallicity Distribution & Chemical Evolution

Example *Carina* dSph: VLT spectra of red giants



Lower $[\alpha/\text{Fe}]$ @ $[\text{Fe}/\text{H}]$ in dSphs than in Galactic halo:

- ❑ Low SFRs (little contribution from massive SNe II (α)), or
- ❑ Loss of metals and SN ejecta, or
- ❑ Larger contribution from SNe Ia (Fe enhanced over α)

→ **Present-day dSphs cannot have been dominant contributors to the build-up of the Galactic halo**

Shetrone, Côté, & Sargent 2001

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Star Formation in Dwarf Galaxies



- ❑ Environmental impact on dwarf galaxy star formation:
 - ❑ Morphology - density relation
 - ❑ Distance - gas content relation
- ❑ Old populations ubiquitous; fraction varies
- ❑ ~ Common epoch of early (Pop II) star formation.
- ❑ No two dwarfs share the same star formation history.
- ❑ Slow, continuous star formation w. amplitude variations.
- ❑ Gradients in age, metallicity; kinematics. Subpopulations.
- ❑ Metallicity–luminosity relation: offset even for old pop.
- ❑ Metallicity distribution: lack of low $[\text{Fe}/\text{H}]$ stars.
- ❑ Abundance ratios: $[\alpha/\text{Fe}]$ lower than in MW halo.
- ❑ Strong, continuous winds may determine MDF.

