Nearby Primeval Dwarf Galaxies with ELT

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Big Eyes in the Early Universe - Rome, September 9-13, 2019

Late-type dwarf galaxies in the nearby Universe

In Λ CDM, dwarfs are first systems to form

Primary candidate sources for cosmic re-ionization

Low metallicity, high gas content, active SF: resemble primeval galaxies in the early Universe!

Best systems to study feedback from massive stars and development of galactic winds

Deep **photometry** and **spectroscopy** of individual stars

Dwarf irregular IC 1613, D=760 kpc



HST Color-Magnitude Diagram



Deep photometry and spectroscopy of individual stars

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... but the most extreme dwarfs are outside the LG !



Effect of distance on star resolution (i.e. on reachable lookback times)



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Searching for "satellites of satellites"

✓ SSH (the Smallest Scale of Hierarchy Survey) is a strategic program at LBT to image 45 latetype dwarfs in the Local Volume (PI Annibali)



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LBT LBC deep images



• Annibali *et al.*, ApJ 826, L27, 2016: DDO 68: A Flea with Smaller Fleas that on Him Prey Searching for "satellites of satellites"

HST WFC3 follow-up



From the luminosity of the **RGB tip,** DDO 68 and S1 are at the same distance, i.e. **they are physically associated**

Annibali et al 2019, arXiv:1904.01986



The future with ELT: deep individual star photometry with MAORY + MICADO



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Schreiber et al. 2014

Spectroscopy of Chemical Tracers as a Function of Distance (with current instrumentation)



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- HII regions (present-day)
- Planetary Nebulae (>100 Myr)
- Individual (RGB) stars (>1 Gyr)
- Integrated light (cluster) abundances

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Spectroscopy of star forming dwarfs outside LG



FORS2 @ VLT, 10 h (PI Tosi) H II regions and PNe



MODS @ LBT, 10 h + 4h (PI Annibali) HII regions and PNe Globular clusters



MODS @ LBT, 4h (PI Annibali) HII regions

Spectroscopy of star forming dwarfs outside LG



Spectroscopy of star forming dwarfs outside LG



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The future with ELT: individual star metallicity

Gonzalez & Battaglia 2018: CenA at D=3.8 Mpc

HARMONY (SCAO), 2"x 1.5" FoV, R=7000, 5h exptime





The future with ELT: metallicity of PNe

... several bright [S III] lines in the NIR (IC 5117 PN from Rudy et al.2001)



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Conclusions

Most extreme late-type dwarfs (highly starbursting and/or very metal poor) are found outside the LG, at D> 3 Mpc

At such distances, even with HST, stellar photometry is not deep enough to characterize in detail the oldest SF

Individual star metallicities only within $D \lesssim 1$ Mpc, PN metallicities within $D \lesssim 4$ Mpc

The future with ELT:

- deep resolved star photometry reaching the oldest HB stars out to $D \gtrsim 5$ Mpc
- Stellar metallicities out to D~4 Mpc
- **D** PN metallicities out to D $10 \gtrsim Mpc$

The End