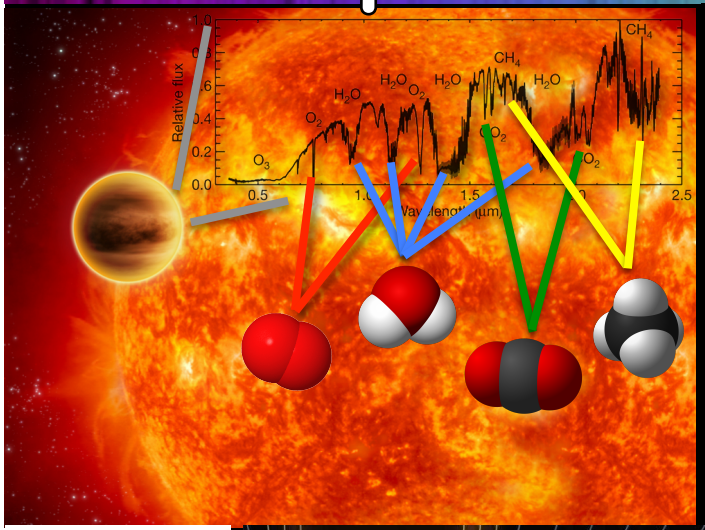
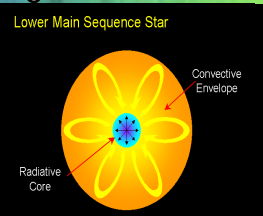
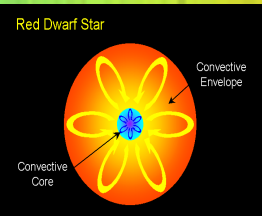
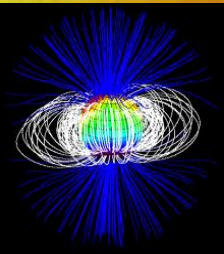
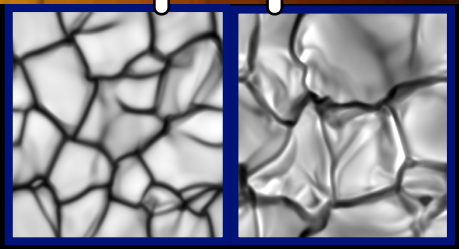
EELT-HIRES science cases
exo-planets, stars & stellar pops

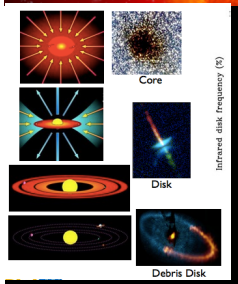


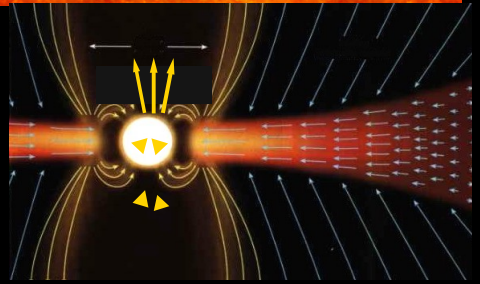


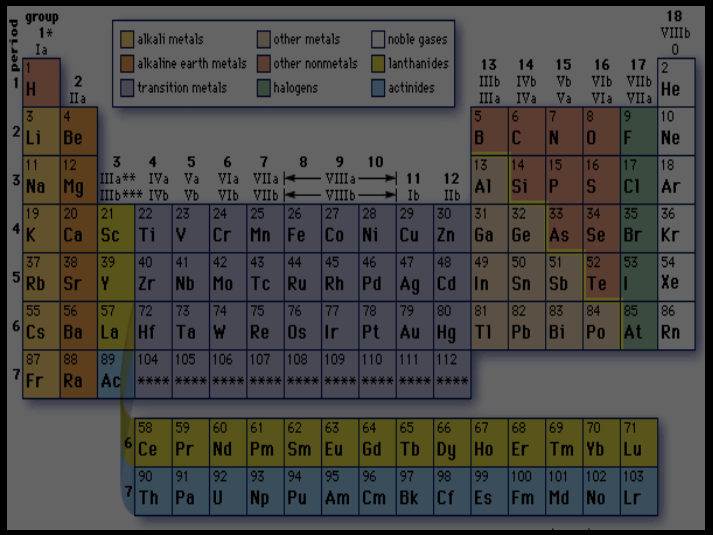


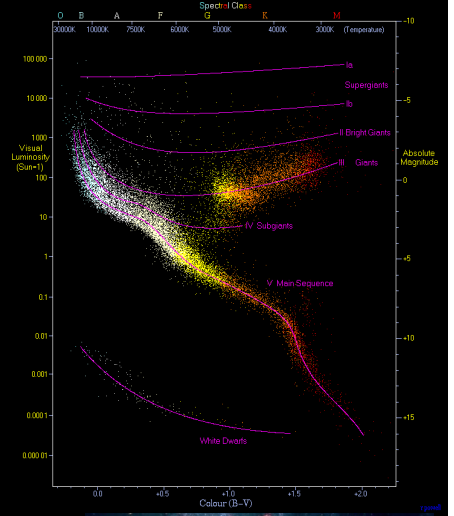


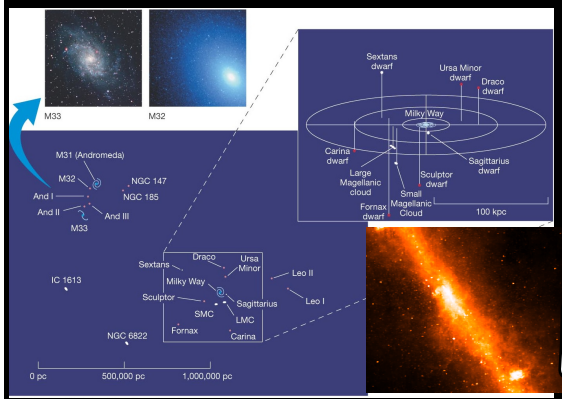


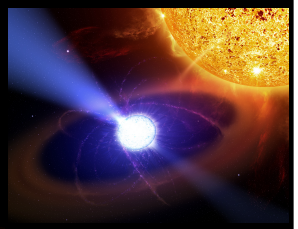


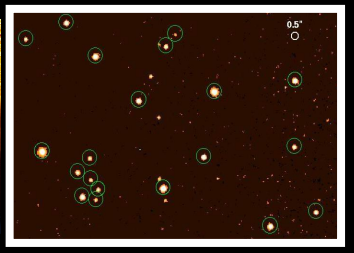


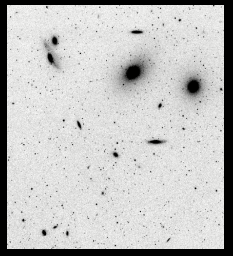












Livia Origlia - INAF Bologna

HIRES WhitePaper

http://arxiv.org/abs/1310.316v2

A Community Science Case for E-ELT HIRES

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(Affliations can be found after the references)

Abstract

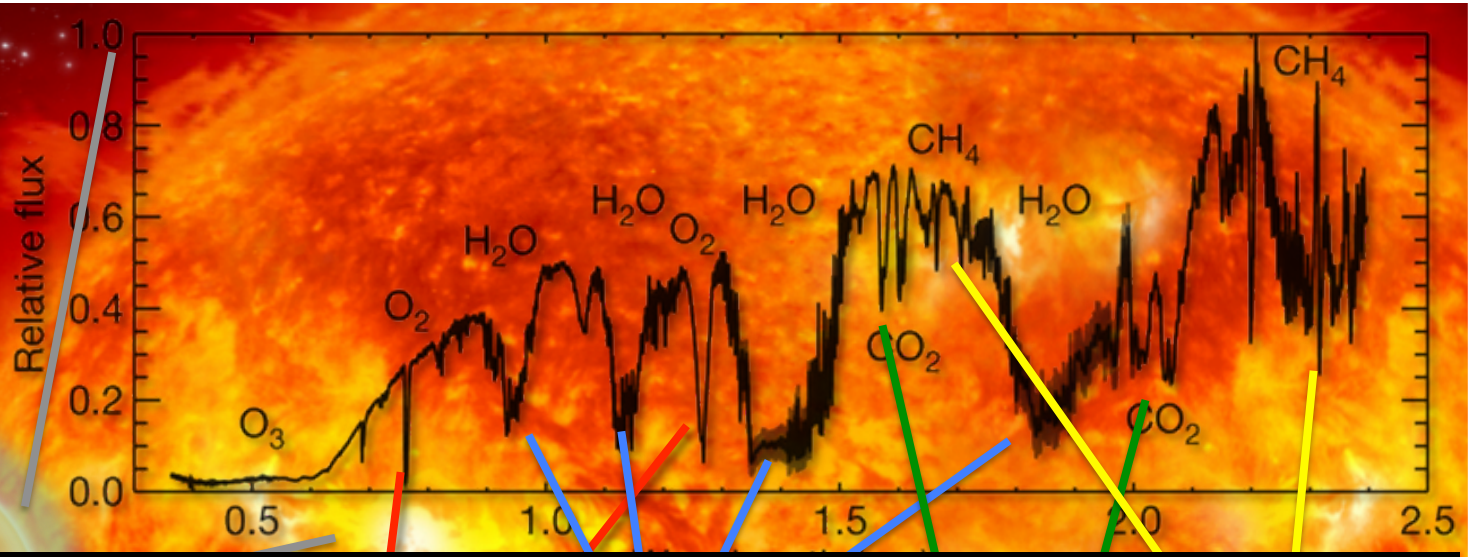
Building on the experience of the high-resolution community with the suite of VLT high-resolution spectrographs, which has been tremendously successful, we outline here the (science) case for a high-fidelity, high-resolution spectrograph with wide wavelength coverage at the E-ELT.

Flagship science drivers include:
- the study of exo-planetary atmospheres with the prospect of the detection of signatures of life on rocky planets,
- the chemical composition of planetary debris on the surface of white dwarfs,
- the spectroscopic study of protoplanetary and proto-stellar disks,
- the extension of Galactic archaeology to the Local Group and beyond,
- spectroscopic studies of the evolution of galaxies with samples that, unlike now, are no longer restricted to strongly star-forming and/or very massive galaxies,
- the unraveling of the complex roles of stellar and AGN feedback for the supply and retention of the baryonic component of galaxies across the full range of galaxy masses, morphologies and a wide range of redshift, with the help of IGM tomography at high spatial resolution,
- the study of the chemical signatures imprinted by population III stars on the IGM during the epoch of reionization,
- the exciting possibility of paradigm-changing contributions to fundamental physics due to the precision afforded by Laser Frequency Comb (LFC) calibrated high-fidelity spectroscopy.

The requirements of these science cases can be met by a stable instrument with a spectral resolution of R~100,000 and broad, simultaneous spectral coverage extending from 0.37μm to 2.5μm. Most science cases do not require spatially resolved information, and can be pursued in seeing-limited mode, although some of them would benefit by the E-ELT diffraction limited resolution. Some multiplexing would also be beneficial for some of the science cases.

HIRES will ensure the continued competiveness of the European high resolution community in the E-ELT era and in this way will largely enhance the overall competiveness of the E-ELT.

exo-planets



transit spectroscopy: atmospheres characterization

high spectral resolution critical

- **to measure Doppler shift differences between stellar/planetary/telluric** systems and eliminate contamination/systematics
- **to combine hundreds of molecular lines & boost the SNR**
- **to use individual lines to measure planet orbital vel & high altitude winds**

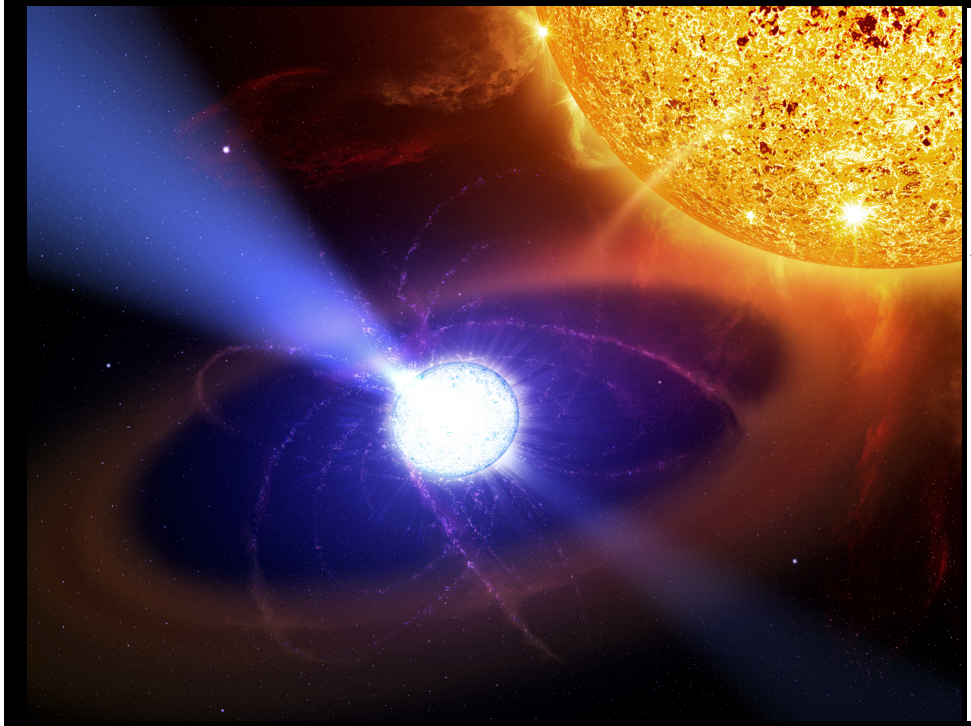
E-ELT critical

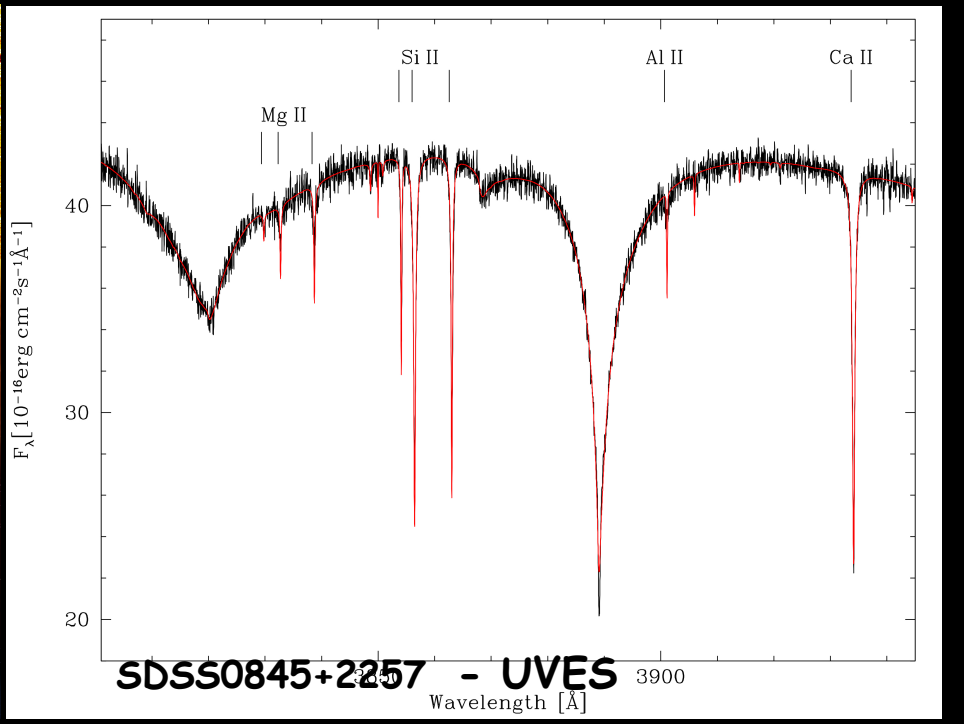
- **to get very high SNR in relatively short (e.g. transit duration) exposures**

IR critical

- **to study transiting planets around M giants (highest planet/star contrast)**
- **to measure (bio-markers?) molecules like O_2, H_20, CO, CO_2, CH_4**

metal polluted white dwarfs & planet debris





high spectral resolution critical

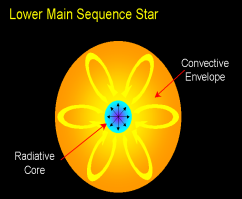
- to measure the faint metallic lines

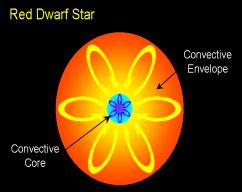
E-ELT critical

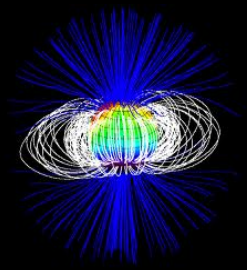
- faint stars
- new environments: Solar neighbohrs ➔ MW

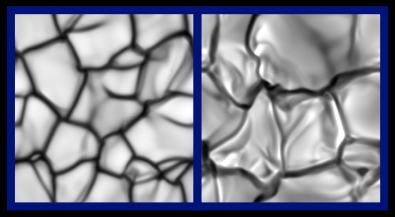
stellar physics

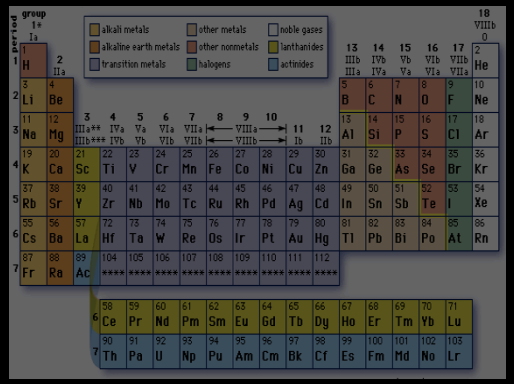
asteroseismology | magnetic fields | granulation | chemical abundances











3D structure, asteroseismology,accurate surface parameters, activity, mixing, diffusion, yields & nucleosynthesis

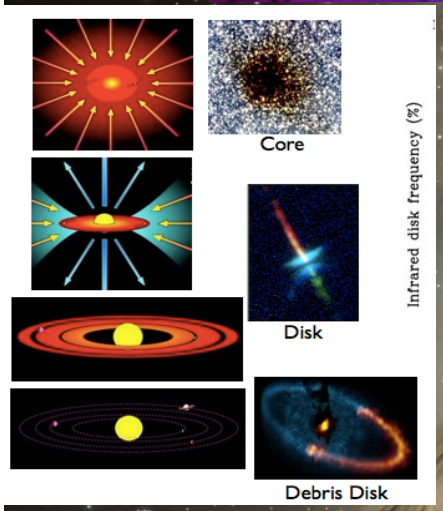
high spectral resolution critical

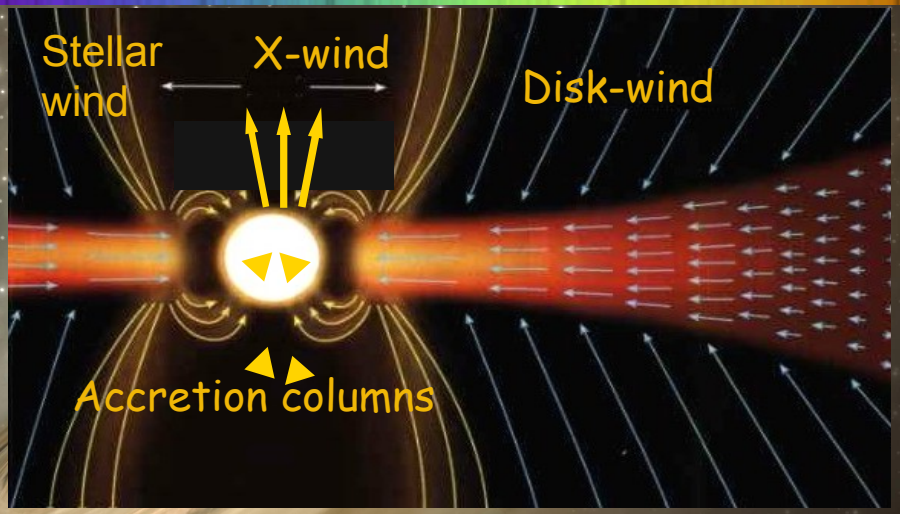
- to fully de-blend lines of any chemical specie, including isotopes
- to kinematically resolve line profiles, i.e. to resolve [sub]structures

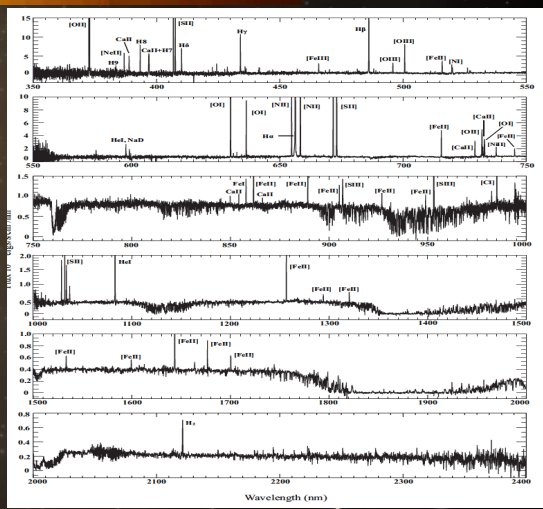
E-ELT critical

- to get very high SNR with major impact on accuracy
- enlarging the space of parameters: Sun-like stars ➔ M-dwarfs
- new environments: Solar neighbohrs ➔ MW

star/disk/planet formation







high spectral and spatial resolution and E-ELT critical

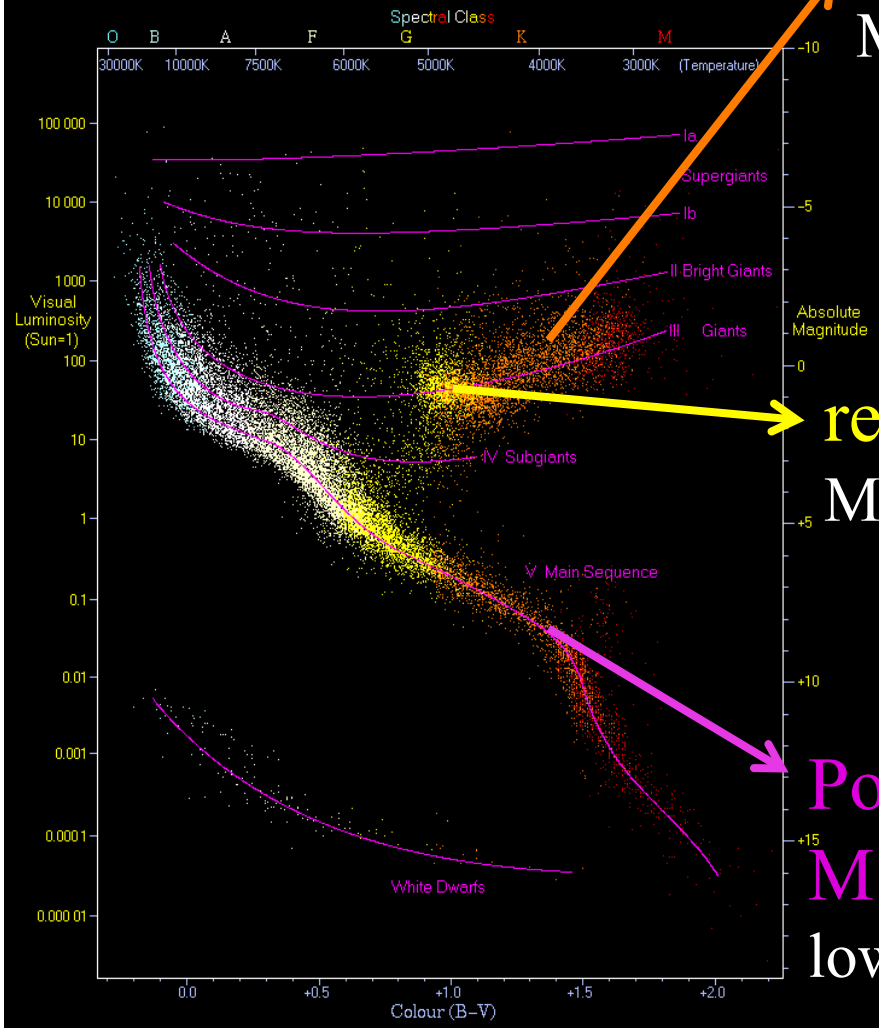
- to trace the innermost disk/wind/jet regions where planet formation should occur
- new environments: Solar neighbohrs ➔ MW

IR critical

- for AO correction
- to study highly reddened SF regions
- for atomic and molecular wind/disk/jet line diagnostics

stellar evolution

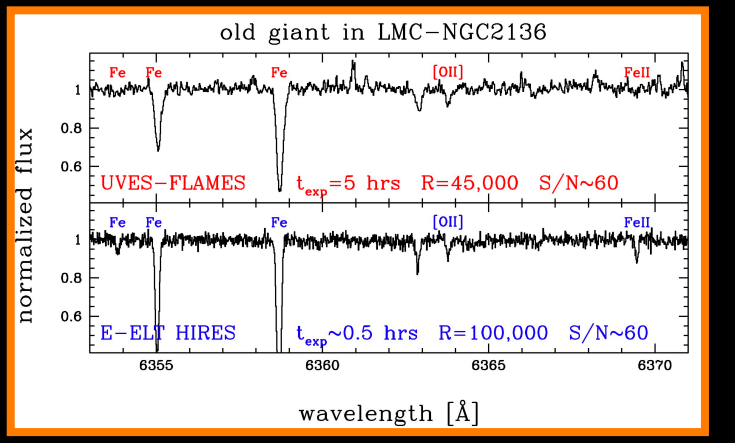
8-10m telescopes → EELT-HIRES

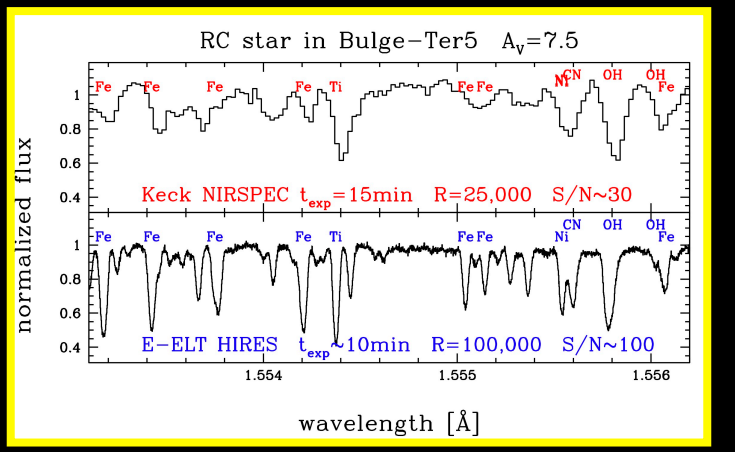


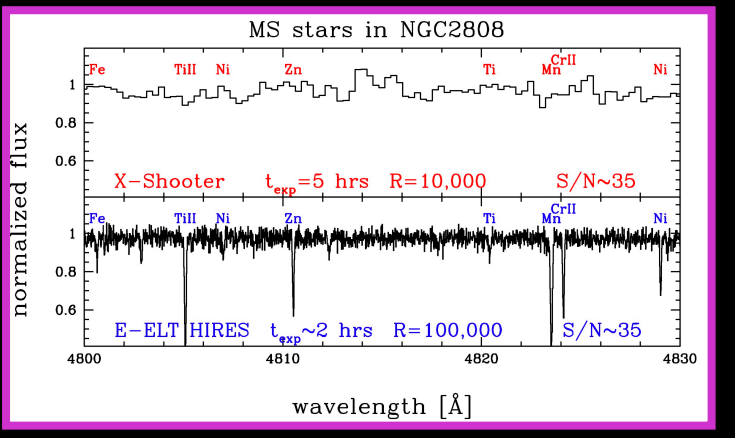
old giants
MCs → LG

red clump
MW → MCs

Pop II
MS stars
low → high R







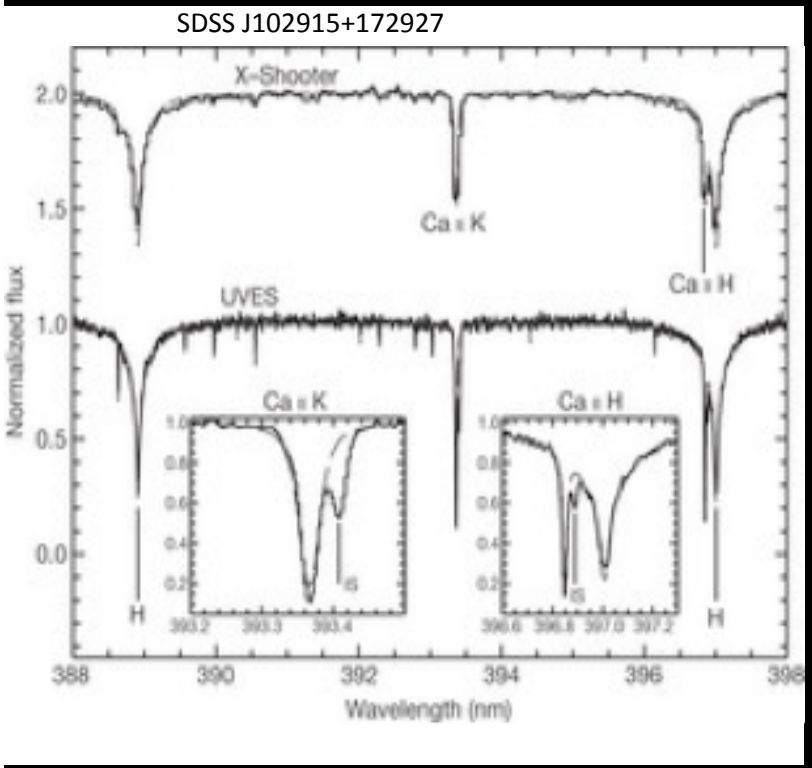
Galactic archaeology

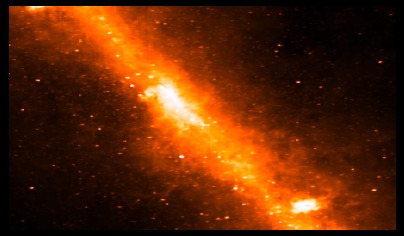
first stars, oldest SPs

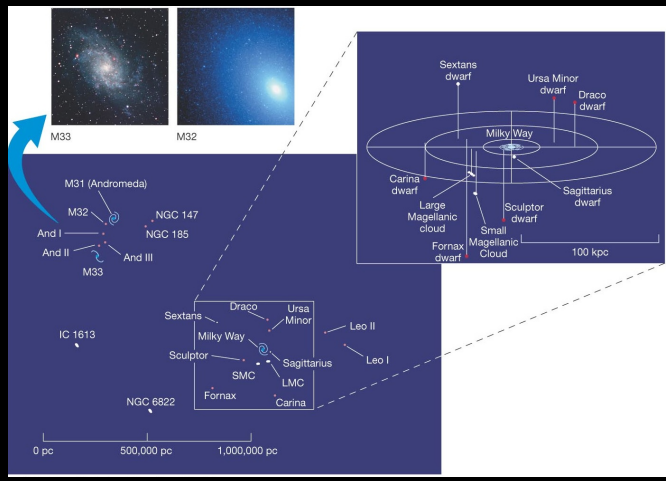
8-10m Galactic halo

EELT-HIRES : bulge and LG

SDSS J102915+172927







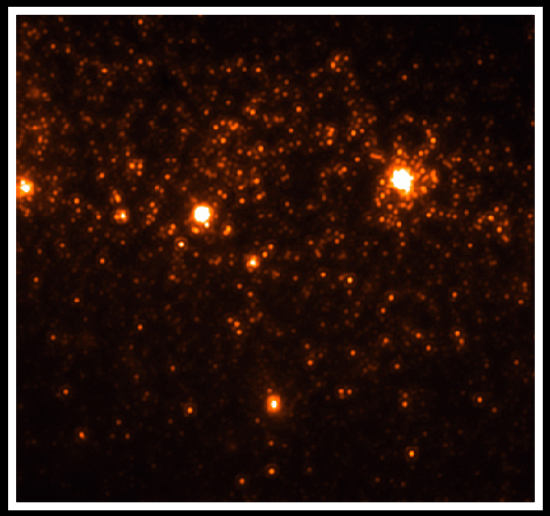
extra-galactic star clusters

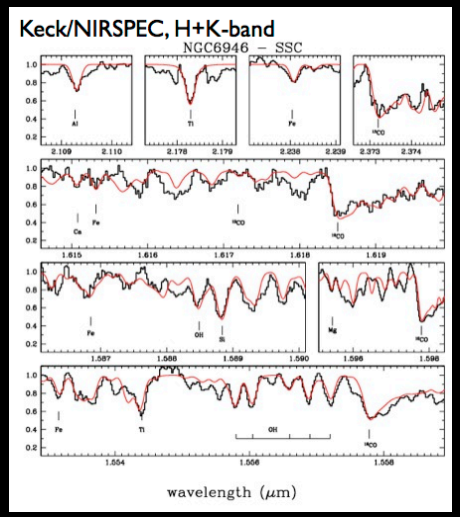
chemistry & dynamical mass from integrated spectroscopy

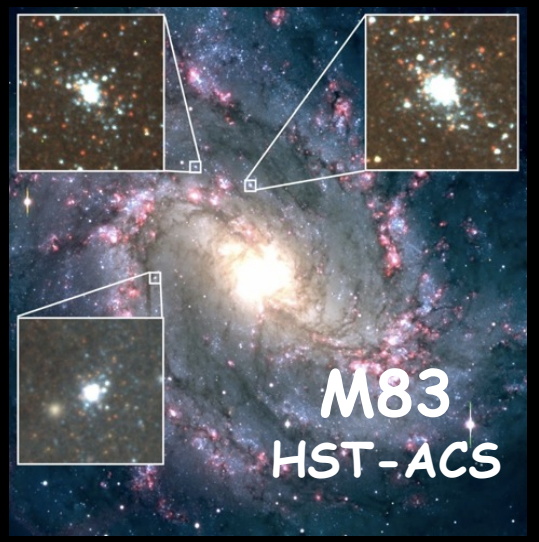
8-10m ➔ a few Mpc

EELT ➔ 20 Mpc

young super star clusters

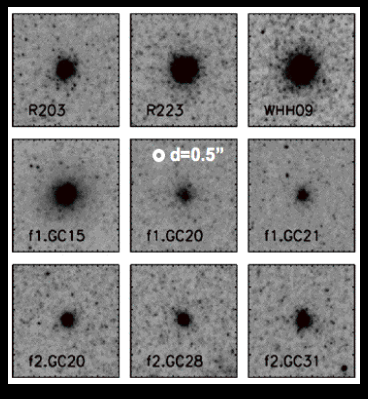




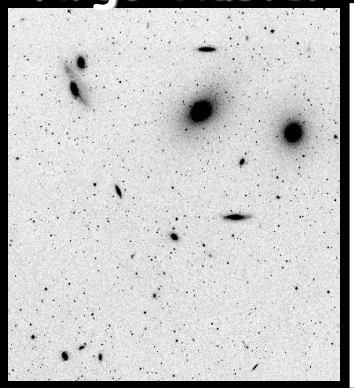


old star clusters

Centaurus



Virgo Cluster



M87