The Chemo-dynamical structure of galaxies (resolved stellar populations: low resolution)

PI: E.Tolstoy

EScO: G.Battaglia / J.Liske
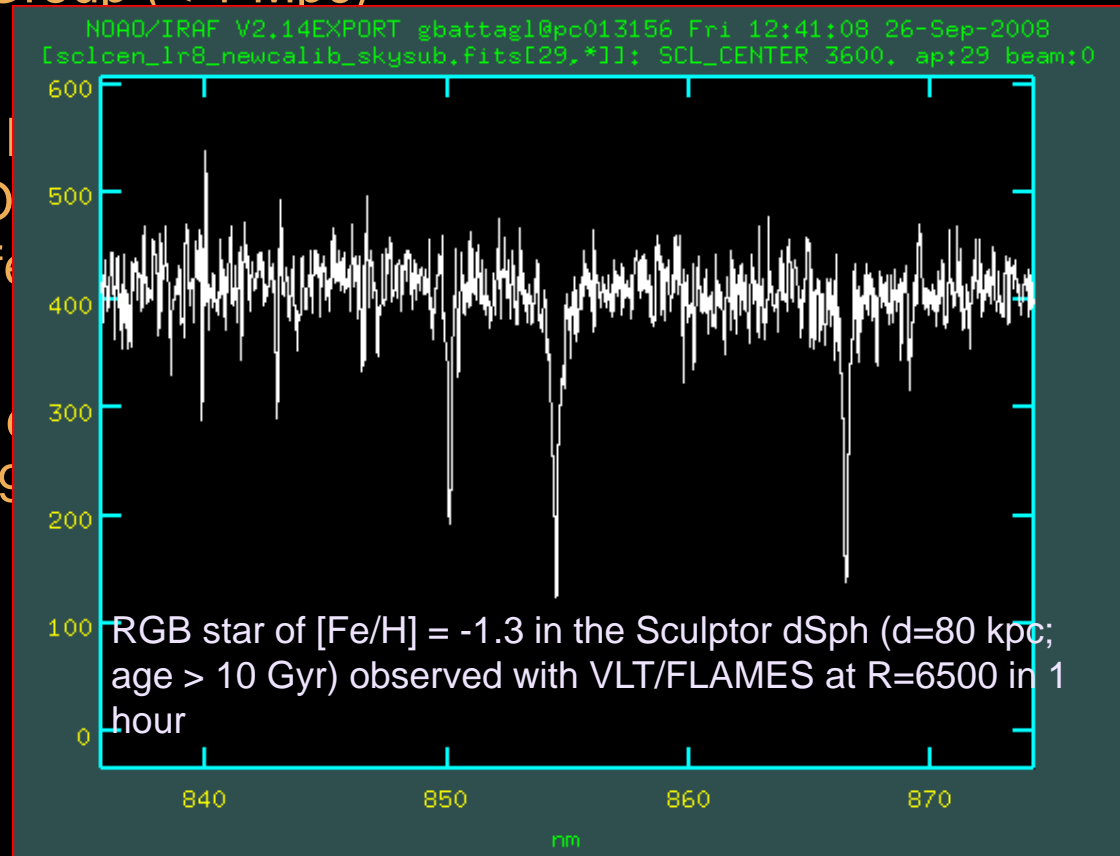
Abstract: Multi-objects spectroscopic survey of resolved stellar populations in a range of nearby galaxies, out to Virgo

Immediate objective

- Sample: Virgo cluster (17 Mpc), Sculptor group (2 Mpc), outskirts of the Local Group (< 1 Mpc)

- Hundreds of red giant branch (RGB) stars at different distances from the centre => MOS spectroscopy in objects at different distances and with different surface brightness

- [Fe/H] estimated from equivalent width of NIR CaII triplet lines -> spectral region (8000-9000 Å)

- R = 3000/6000

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- Sample: Virgo cluster (17 Mpc), Sculptor group (2 Mpc), outskirts of the Local Group (< 1 Mpc)

- Hundreds of red giant [...] from the centre => MO[...] distances and with diff[...]

- [Fe/H] estimated from [...] spectral region (8000-9[...]

- R = 3000/6000

NOAO/IRAF V2.14EXPORT gbattagl@pc013156 Fri 12:41:08 26-Sep-2008
[sclcen_lr8_newcalib_skysub.fits[29,*]]: SCL_CENTER 3600. ap:29 beam:0

RGB star of [Fe/H] = -1.3 in the Sculptor dSph (d=80 kpc; age > 10 Gyr) observed with VLT/FLAMES at R=6500 in 1 hour

Parameter space: objects

- Sample: Virgo cluster, Sculptor group, outskirts of the Local Group => distances from 1 Mpc to 17 Mpc

  (Distance mod: 24.56 [NGC205=> LG], 31.2 [NGC4621; M87=> Virgo])

- Ellipticals/spirals/dwarfs:

  a) Explore different surface brightness according to galaxy type and distance from the centre

     1,2,5 Reff => V surf.brightness 20.5, 22, 25 (M87), 20, 21.5, 24 (NGC4621); 21.5, 22.5, 26 (NGC205)

  b) Explore different stellar population mix: star formation, metallicity, alpha-abundance

     SSP: age = 13 Gyr old; [M/H]=-1; [alpha/Fe]=0

=> Code for stellar catalogue developed by J.Liske/E.Tolstoy

Parameter space: telescope/instrument

- Diameter = 30m, 42m (can be varied to other values)
- Central obstruction = 0.28 x Diameter
- Site = Paranal-like, High&Dry
- Airmass = 1.0
- Coating = Bare Al, Ag/Al (now taken into account only for telescope termal emission; transmission to be implemented)
- Transmission (telescope+instrument) = 0.2
- Wavelength range = 8000-9000 Å (CaII triplet)
- R = 3000, 6000 (can be varied to other values)
- Exposure time (anything; now 5h and 10h)
- Spaxel = 50 mas (single IFU or multi-field IFU?)

Methodology

- Produce stellar catalogue for the chosen stellar population, distance, surface brightness (see Joe's talk) in a spaxel

- For each star (logg, Teff, [M/H], [alpha/Fe]) find the appropriate synthetic spectrum in the Munari et al. (2005) library (R=20˙000)

- Redshift individual spectra according to stellar velocities

- Produce the integrated spectrum (R=20000)

- take into account atmospheric transmission; add atmospheric continuum, emission lines, thermal emission & telescope thermal emission

- Convolve to desired resolution and add noise (photon noise, read-out current, dark current)

Can we resolve stars? I

1 Re = 3.5 kpc **2 Re = 7 kpc** **5 Re = 18 kpc**

Ngc4621
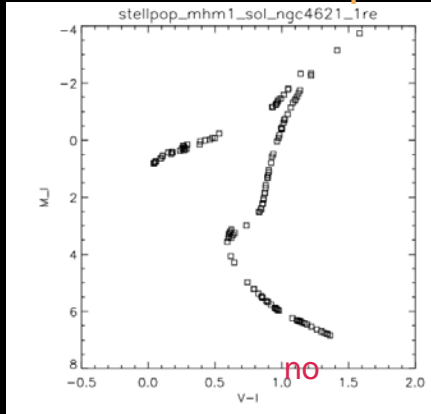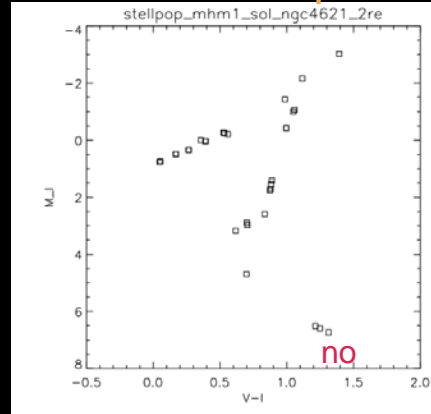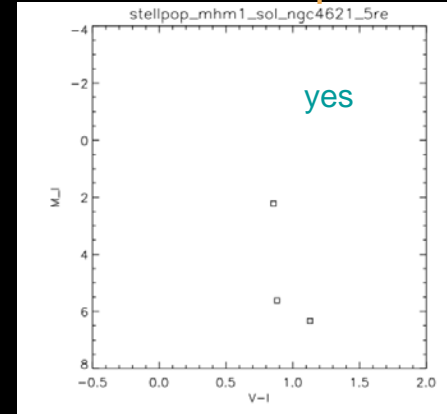
(Virgo)
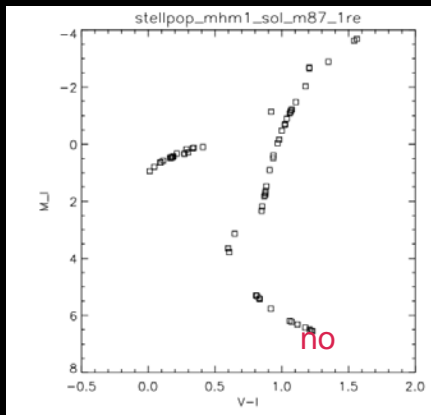
1 Re = 8.5 kpc **1 Re = 17 kpc** **1 Re = 43 kpc**

M87

(Virgo)
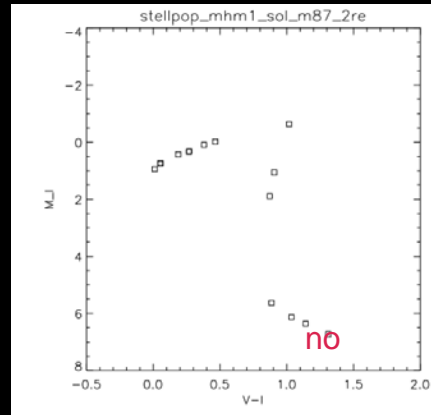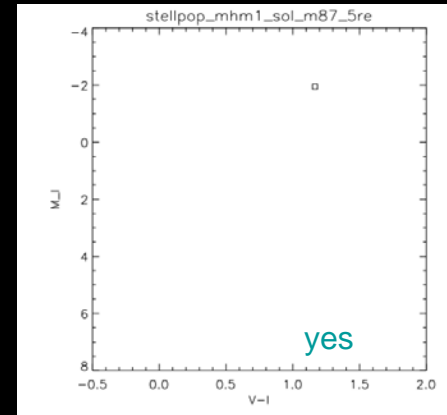
For NGC205 there are no stars even in the centre -> we can resolve individual stars (1 per spaxel). Obviously we'll need to choose RGB stars to target from the photometry (to optimize where to point the IFU)
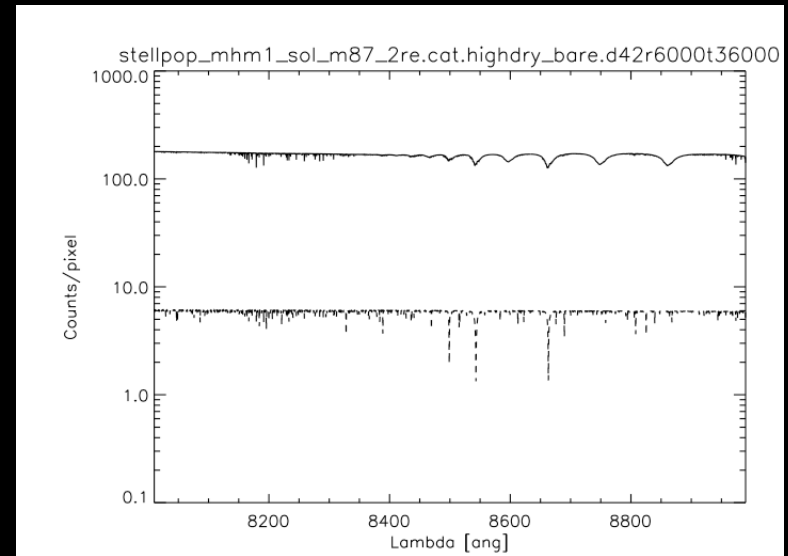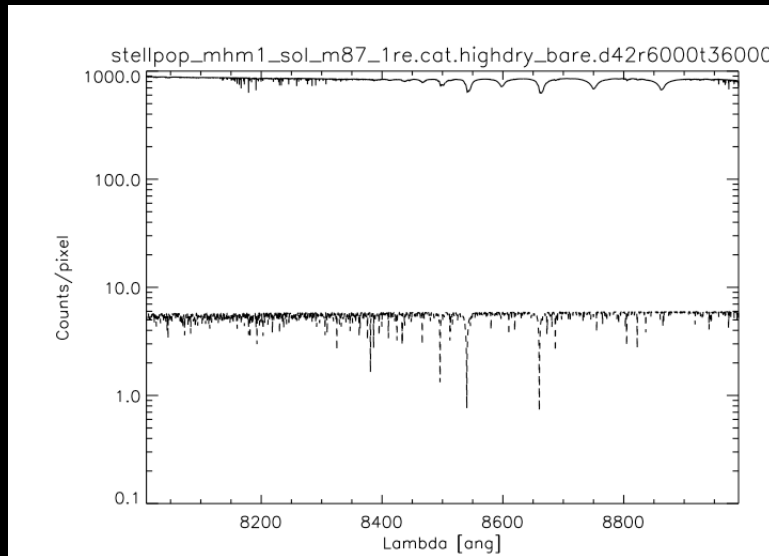
Can we resolve stars? II

Contribution of brightest red giant branch (dashed line) star to total spectrum (solid line)

(example: M87; R=20˙000)

<div align="center">1 Re   2 Re</div>

At the considered surface brightness, the EW of CaT lines in the total spectrum is unlikely to be representative of the individual brightest giant

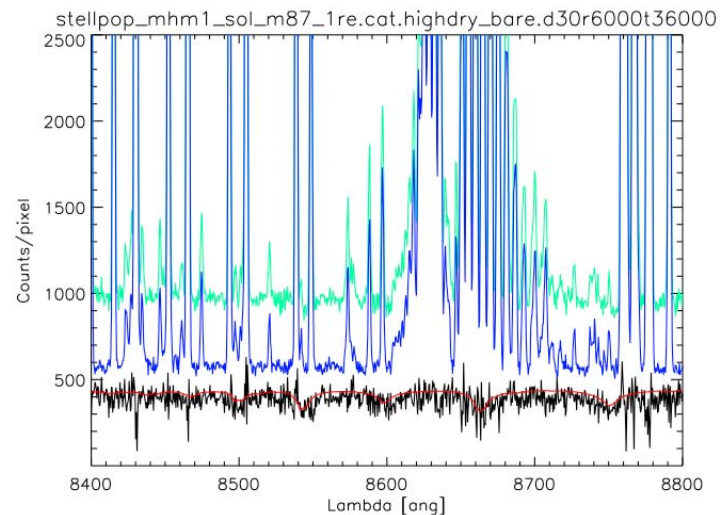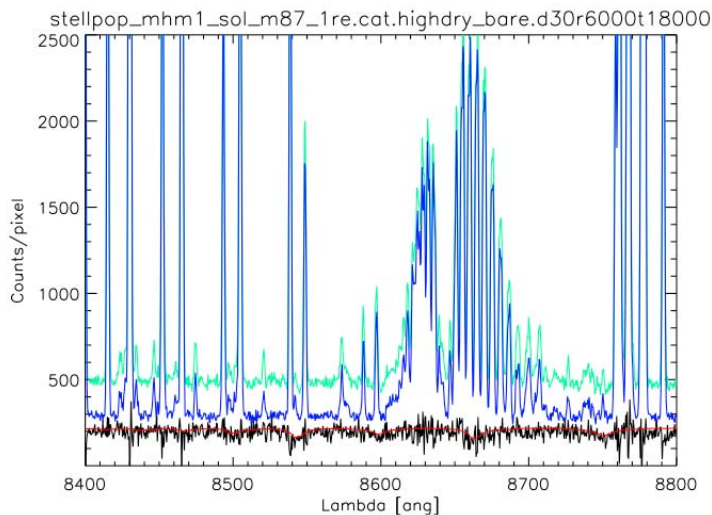# Site & atmospheric transmission

High&Dry

Paranal-like

D=42m
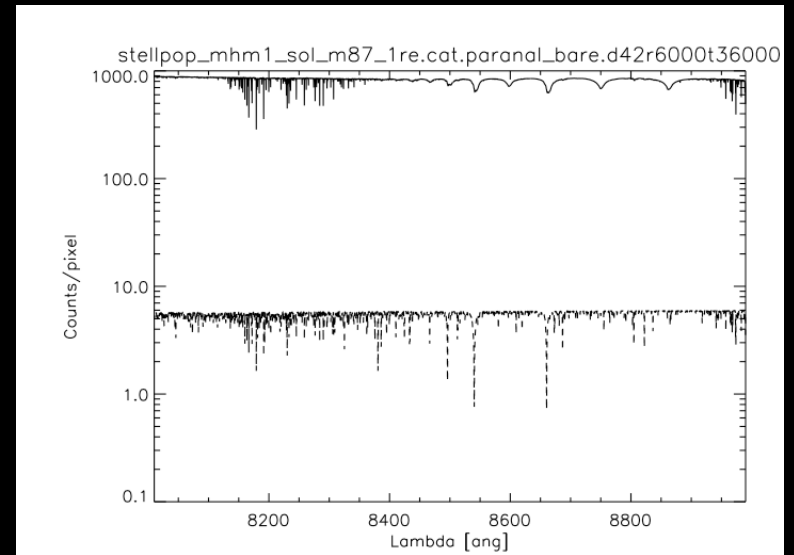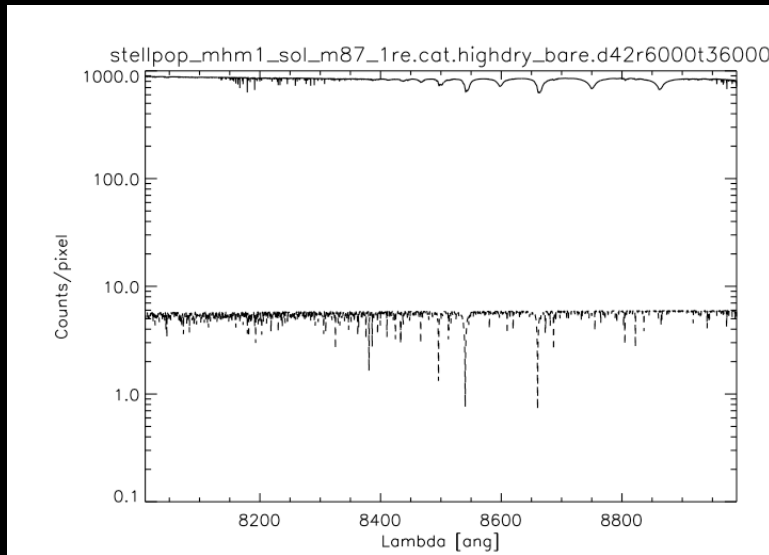
Atmospheric transmission not important in CaT region (8450-8700 Å)
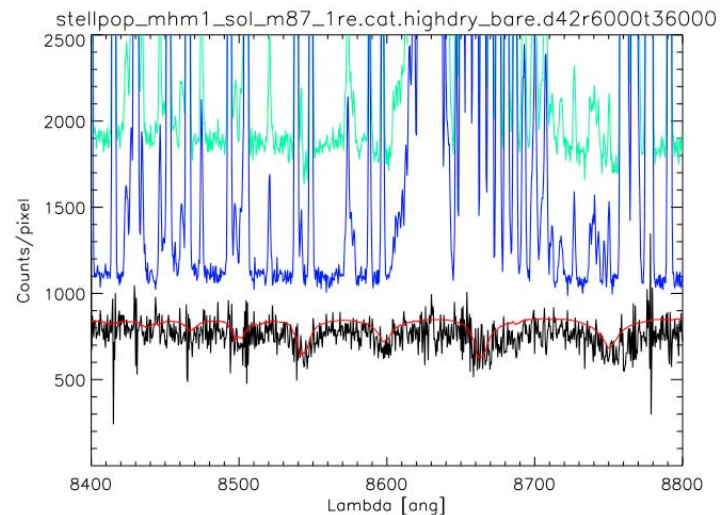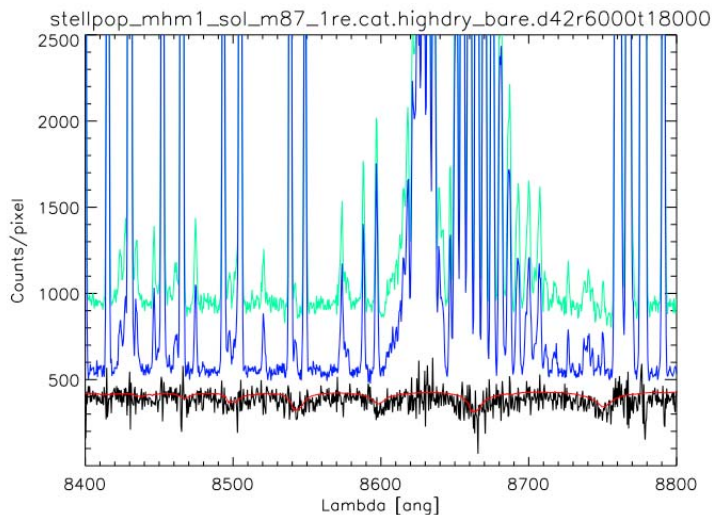
D and Exp.time (High&Dry)
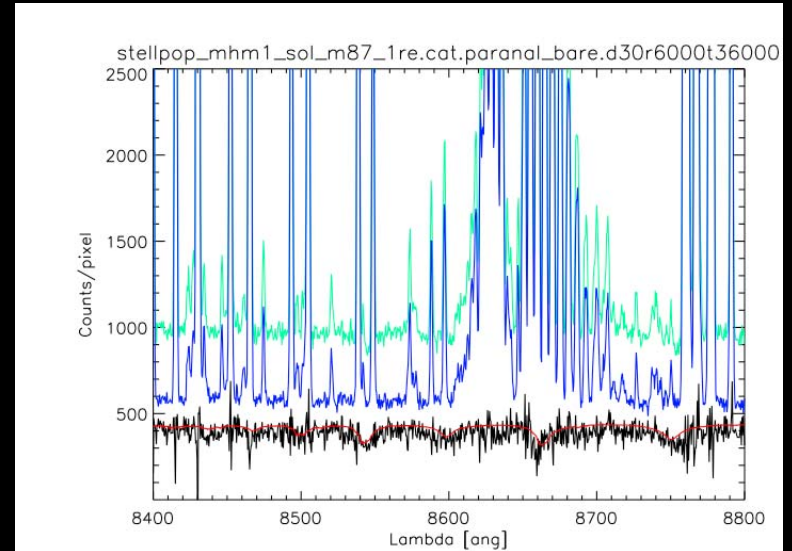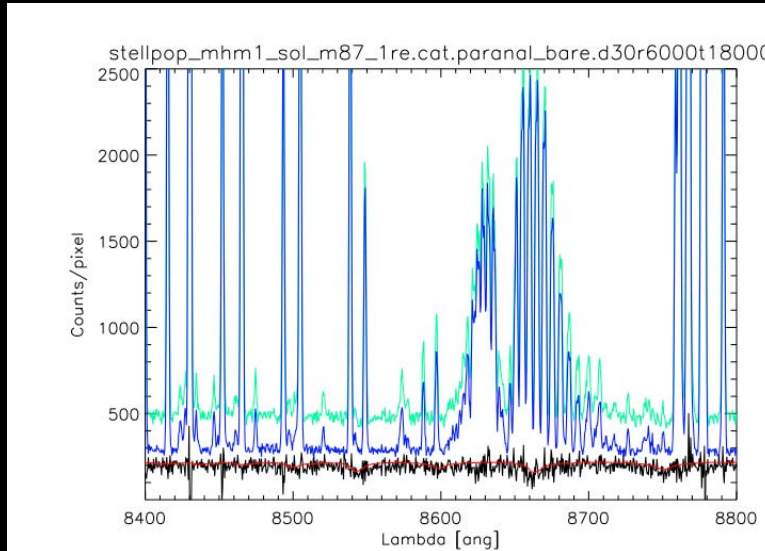

Exp. Time= 5h

Exp. Time= 10h

D= 30m
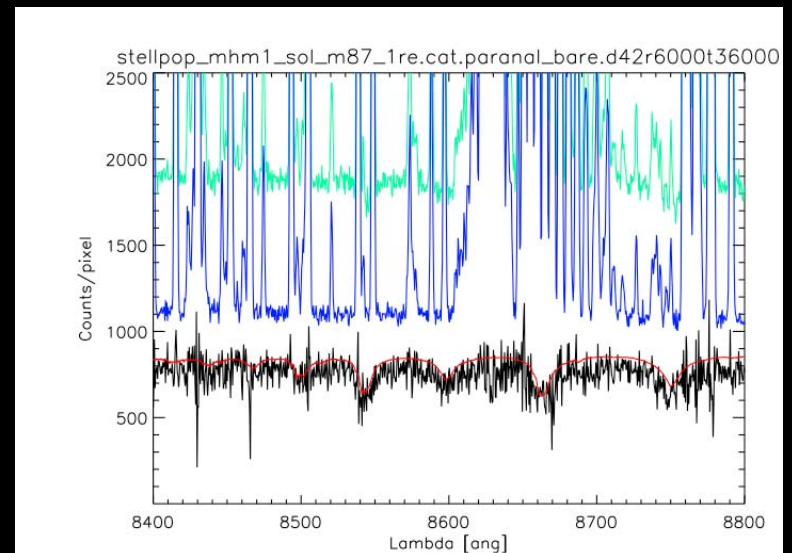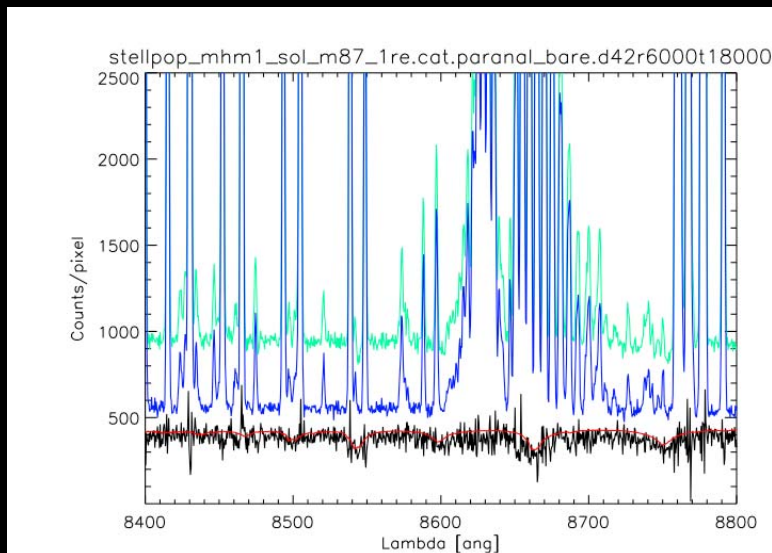
D= 42m

D and Exp.time (Paranal-like)

Exp. Time= 5h

Exp. Time= 10h

D= 30m

D= 42m

Preliminary conclusions

- Possible to resolve individual stars (~1 RGB in a spaxel) in a NGC205-like galaxy and in the outskirts (5 Reff) of ellipticals in Virgo

- At 1-2 Reff in ellipticals in Virgo the total spectrum does not appear representative of individual brightest RGB star

- Both site & atmospheric transmission do not considerably influence the results (beware, no PSF effects included yet!)