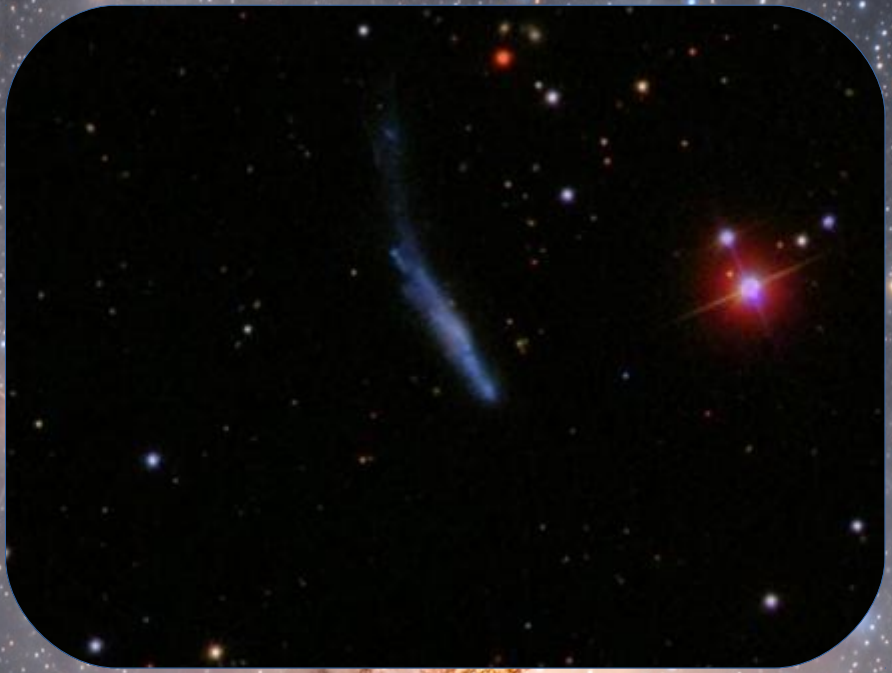
UGC 4722



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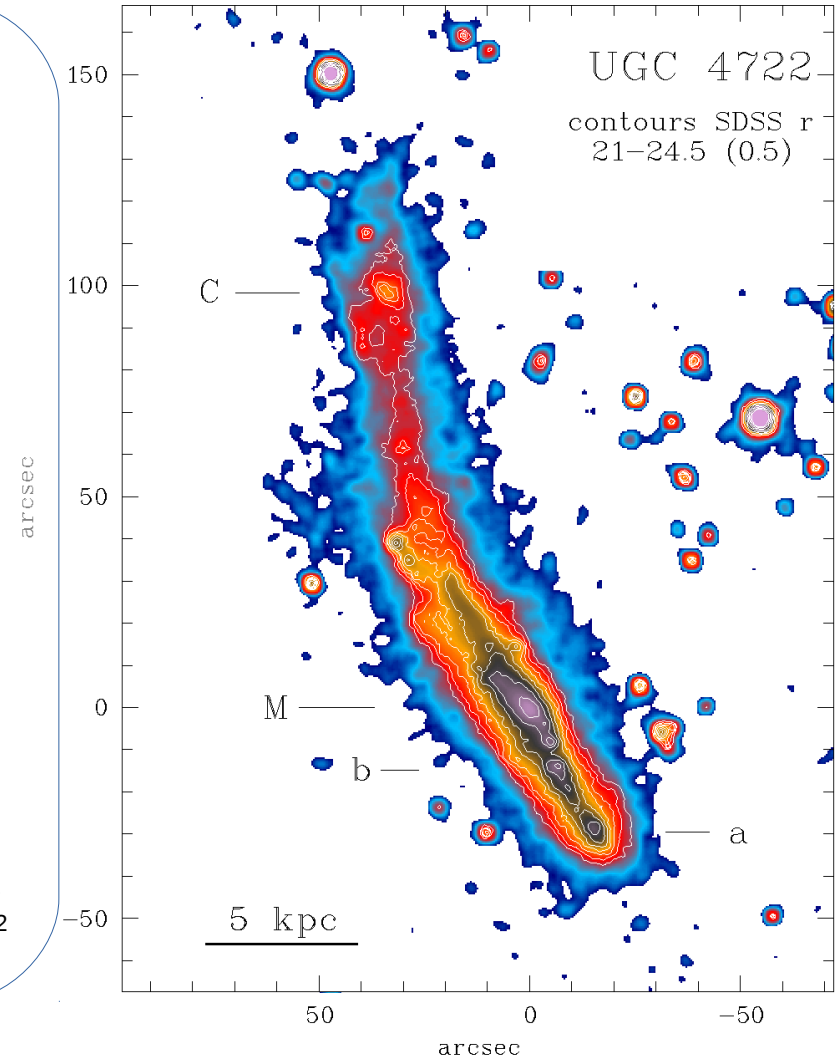
UGC 4722

- Dwarf LSB (-17.7388 in the SDSS *r* band) Sdm Galaxy; M ~ 10^9 $M_\odot$
- Disturbed morphology - clear signs of interaction
- Extremely isolated located in the Lynx-Cancer Void - one of the most isolated galaxies in the Local Supercluster
- Distance: 28.8 Mpc
- Very gas-rich ($M(HI)/L_B$ ~ 4.3 – Chengalur et al. 2015)
- Metal-poor (detached SF regions with Z_{gas} ~ 7.6) (Chengalur et al. 2015)

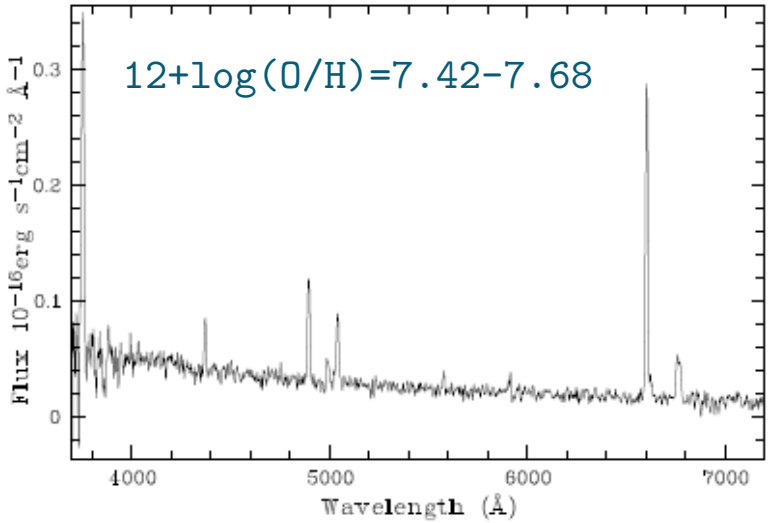
Labeled regions (from Chengalur et al. 2015):

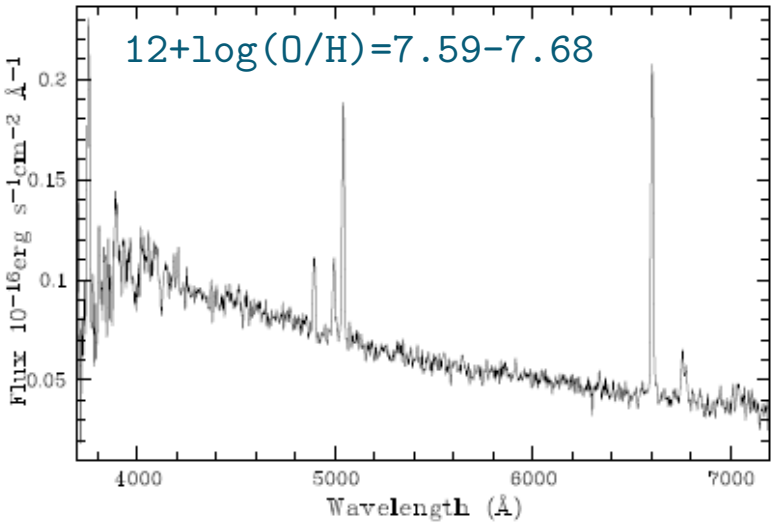
- M – center of the stellar continuum
- a, b – intense Hα regions
- C – relic of a minor merger candidate

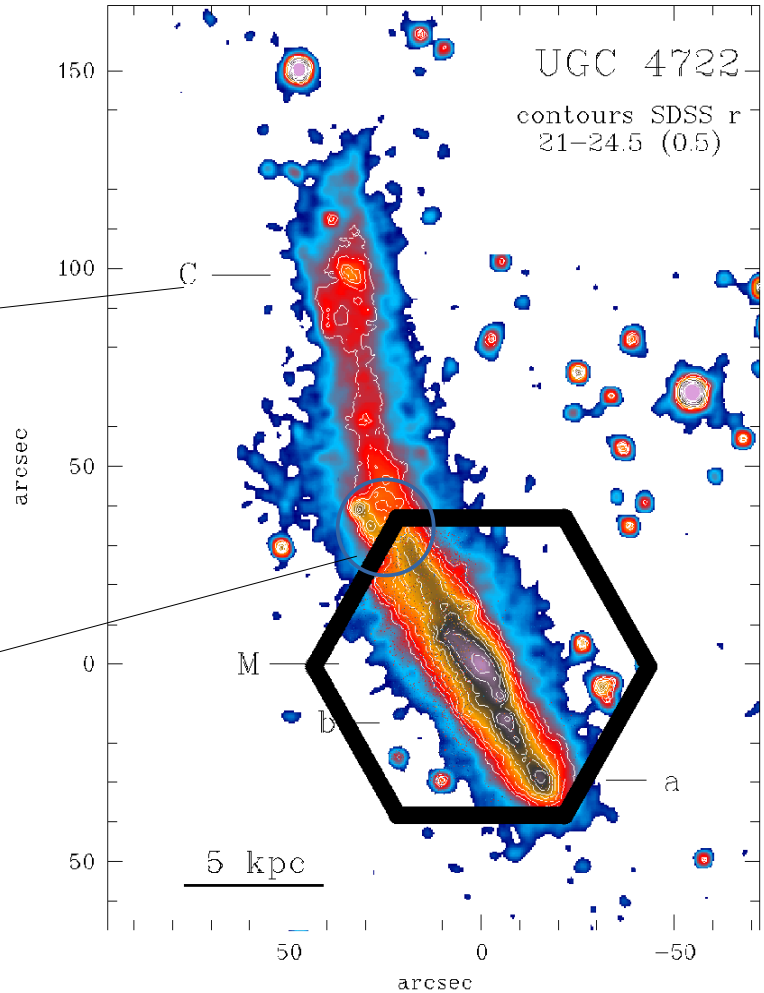
Image: stacked & adaptively smoothed SDSS *gri* imaging. Contours: galactic extinction corrected levels from 21 to 24 mag/arcsec^2 in steps of 0.5 mag.



UGC 4722







Chengalur et al. (2015) determine the metallicity of one detached HII region and of region C, which they interpret as the relic from a recent minor merger.

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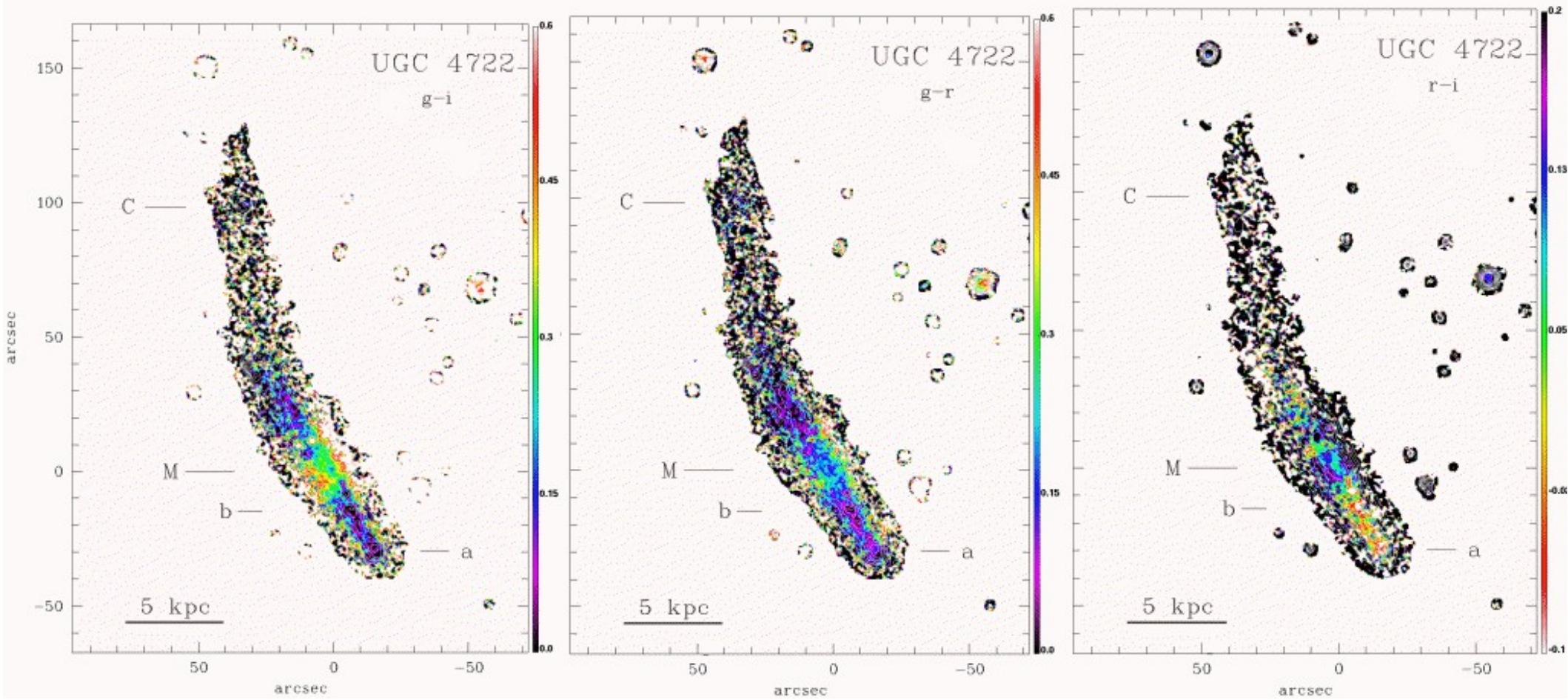
SDSS Color maps



Color maps *g-i* (left-hand side), *g-r* (center) and *r-i* (right-hand side) computed from SDSS PSF equalized images. Average colors in regions a, b, M and C: *g-i* = 0.01, -0.01, 0.3, -0.08; *g-r* = 0.1, 0.06, 0.18, 0.07, respectively. The respective colors in the low-surface brightness (LSB) periphery are in the range 0.3-0.6 and 0.3-0.4 mag.

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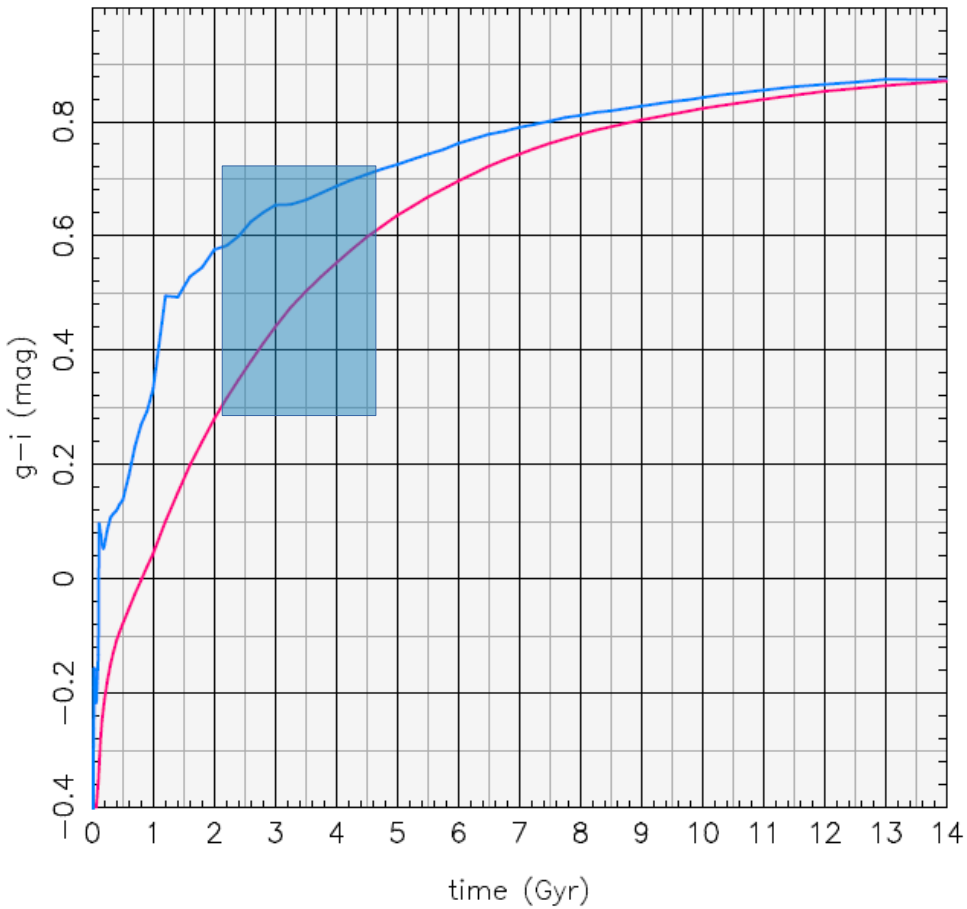
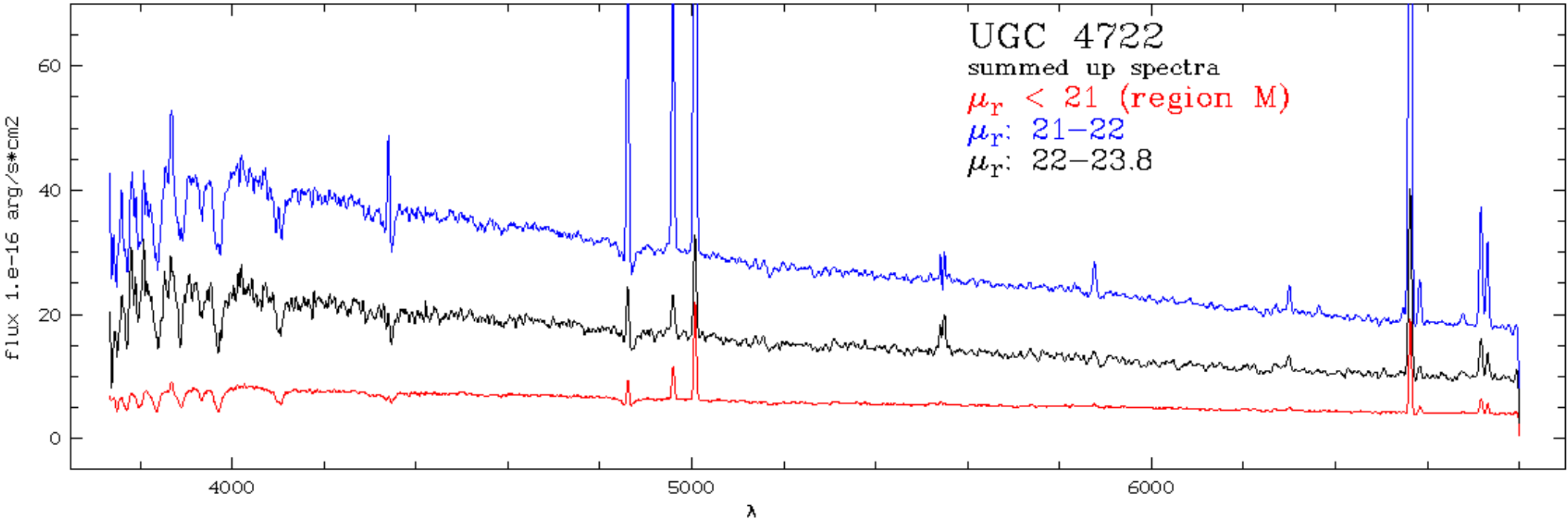
SDSS Color maps



Predictions from the evolutionary synthesis code Pegase 2.0 for an **instantaneous burst** and **exponentially decreasing SFR** with an e-folding time of 1 Gyr for purely stellar emission with constant metallicity 1/20 solar.
The observed g-i SDSS color of the low-surface brightness host are compatible with an age between ~2 Gyr and ~5 Gyr.

UGC 4722

Summed up spectra



Summed up spectra from CALIFA DR2 (V500 setup, with R~850) within the central high-surface brightness region M (red), in the surface brightness range μ = 21-22 *r* mag/arcsec^2 (blue) and μ = 22-23.8 *r* mag/arcsec^2 (black) show a blue spectral slope that is indicative of a photometrically dominant young (and ionizing) stellar component. Strong high-order Balmer absorption lines suggest significant star-forming activity over the past few hundred Myr.

The moderately red *g-i* color in the LSB periphery (0.3-0.7 mag) suggests the presence of a more evolved (a few Gyr) stellar host.

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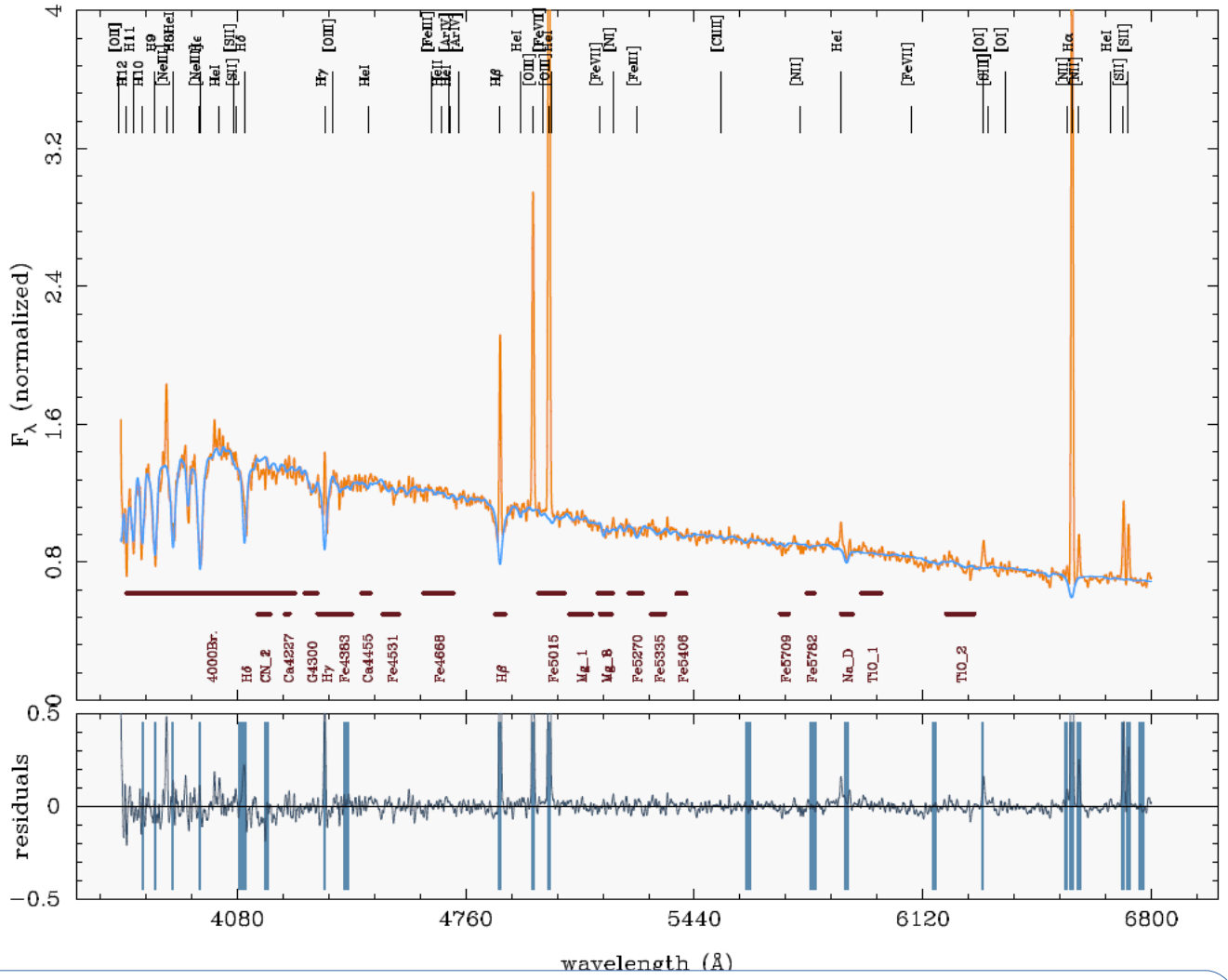
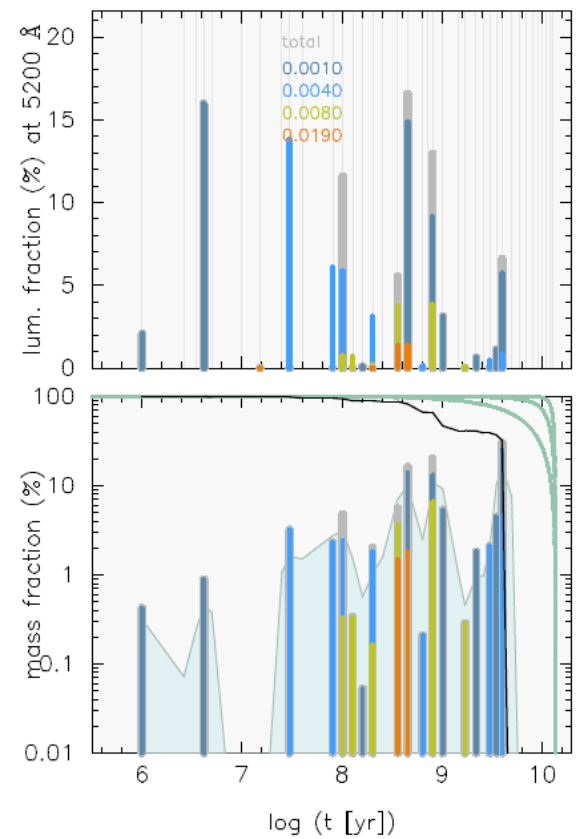
Star-formation Histories





L%(100 Myr): 37.61 | $M_{*1,2}$ (100 Myr)%: 6.8 / 5.7
L% (1 Gyr) : 88.08 | $M_{*1,2}$ (1 Gyr)% : 55.9 / 53.2
L% (5 Gyr) :100.00 | $M_{*1,2}$ (5 Gyr) % :100.0 /100.0

t*1/2 : 1.0 Gyr ago

L−weighted metallicity: 0.0031 ± 0.0012
M−weighted metallicity: 0.0029 ± 0.0042
L−weighted stellar age: 0.59 ± 0.24 Gyr
M−weighted stellar age: 1.79 ± 0.64 Gyr

$M_{*,\odot}$ formed: 0.2445E+03 × Ψ
$M_{*,\odot}$ now : 0.1824E+03 × Ψ
$\Psi = D_{Mpc}^{2} \times (f/10^{-17})$

Fit with Starlight of (a single spaxel) the brightest/central region of UGC 4722. It suggests a prolonged star formation history that started ~3-4 Gyr ago, with a luminosity- and mass-weighted age of ~0.6 and 1.8 Gyr, respectively, with one half of the stellar mass formed in the past 1 Gyr. The V band intrinsic extinction is moderate (~0.4 mag).

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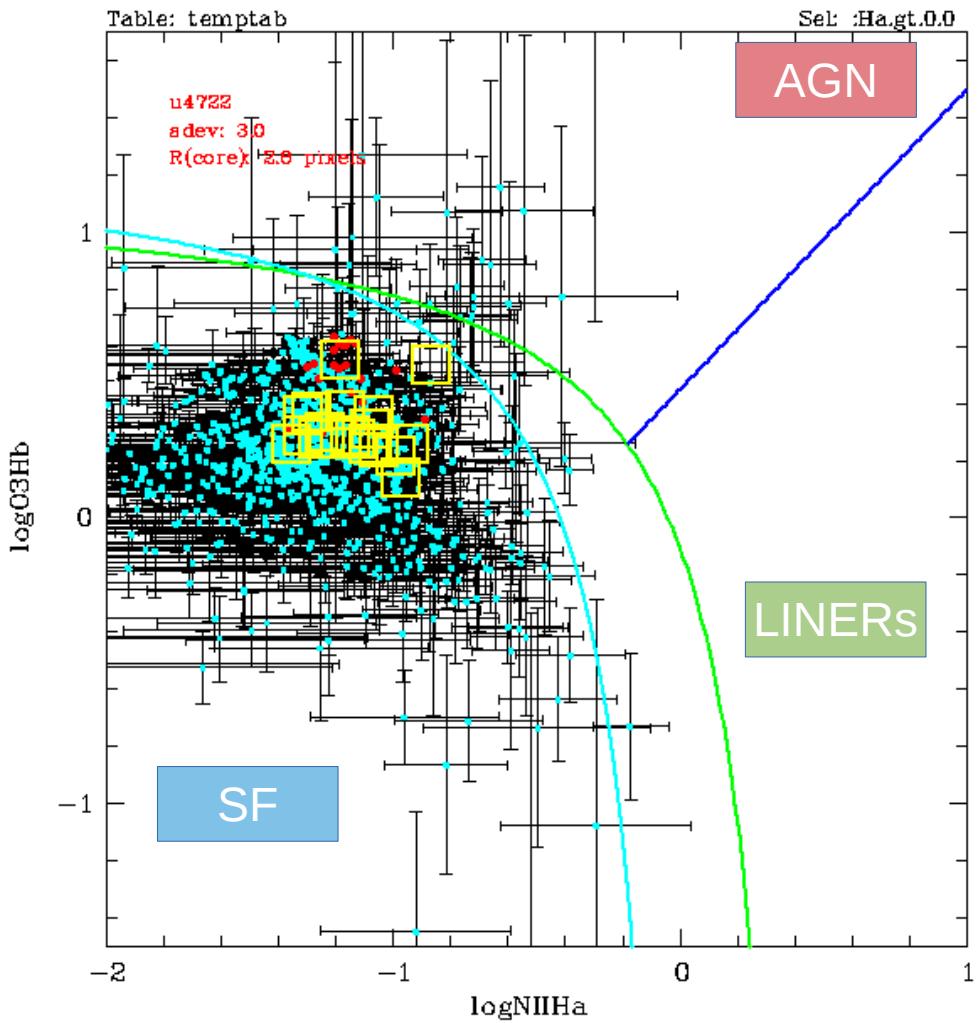
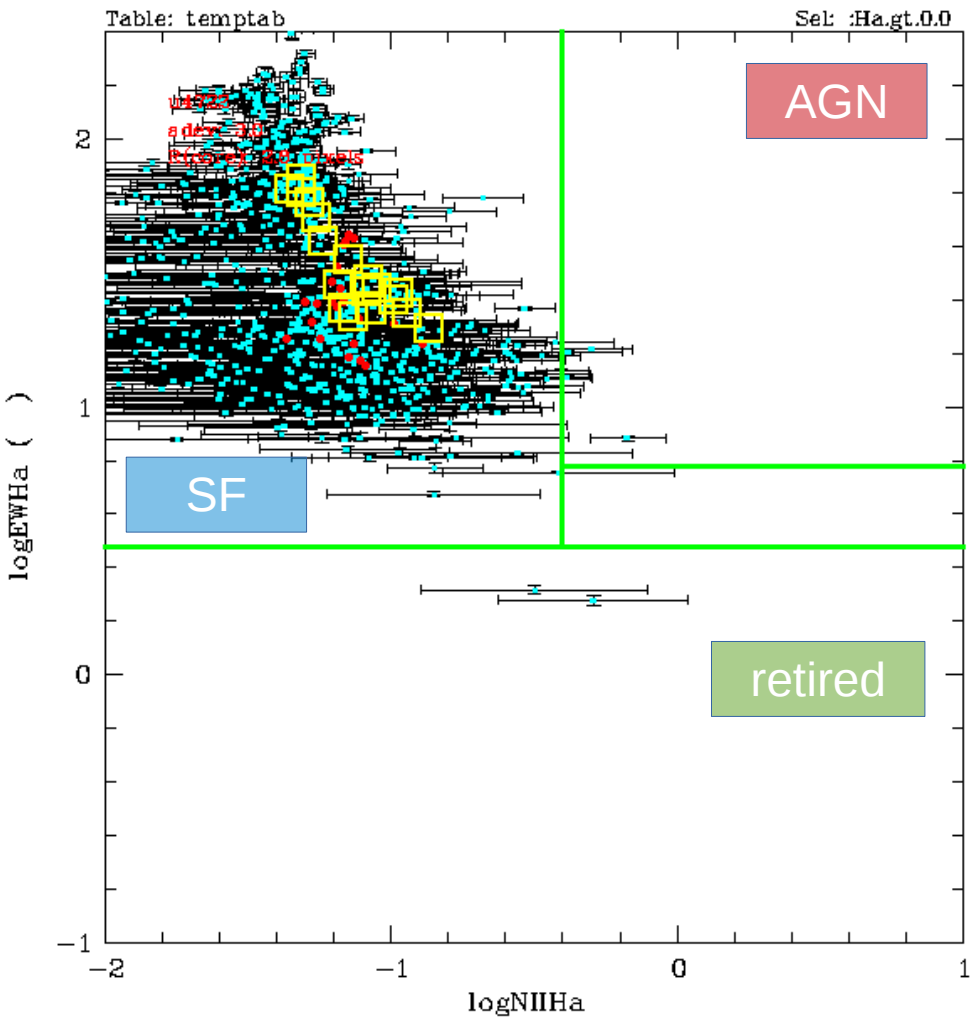
Diagnostic diagrams





Dots: single spaxel determinations; Squares: average within isophotal annuli (isan). Both diagnostic diagrams indicate high star-forming activity. (left -hand side: BPT diagrams; right-hand size: Cid Fernandes et al. 2010)

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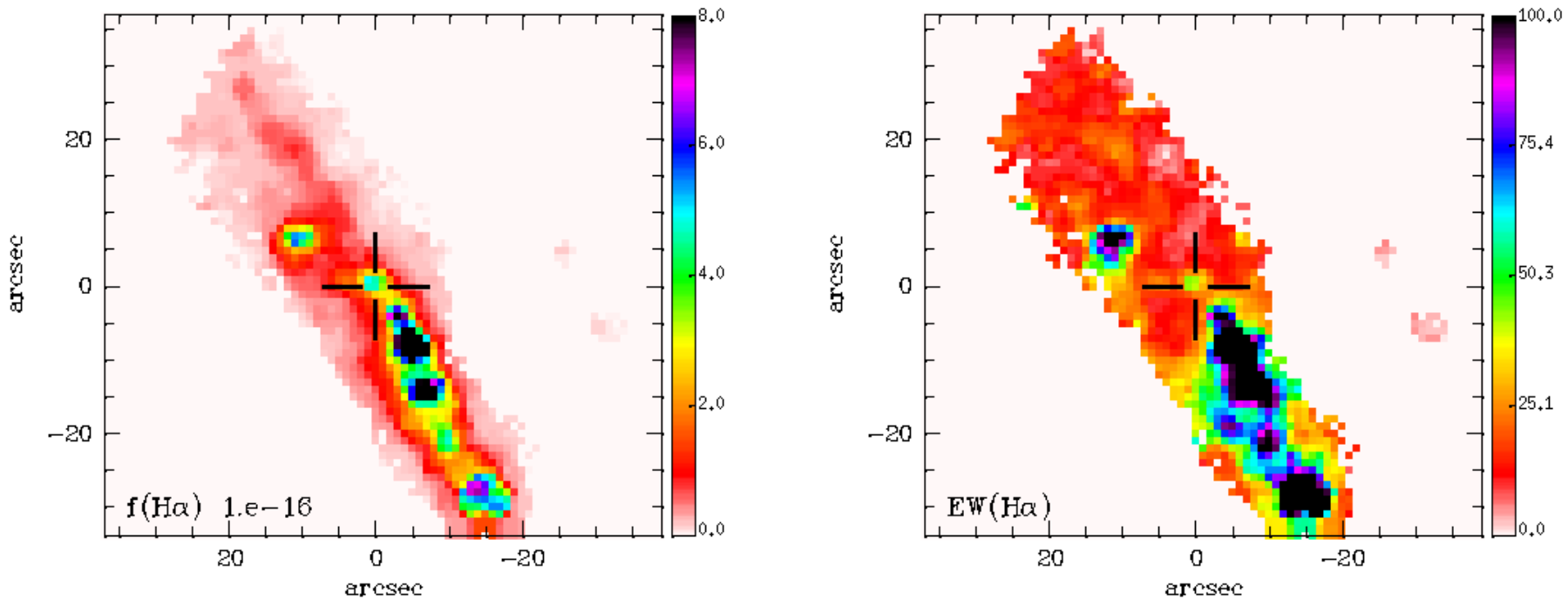
Hα distributions



Hα flux (left-hand side) and EW (right-hand side; contours: EW(Hα) from 40 Å to 250 Å in steps of 30 Å); cross: region M. Both maps permit to identify highly active star-forming regions.

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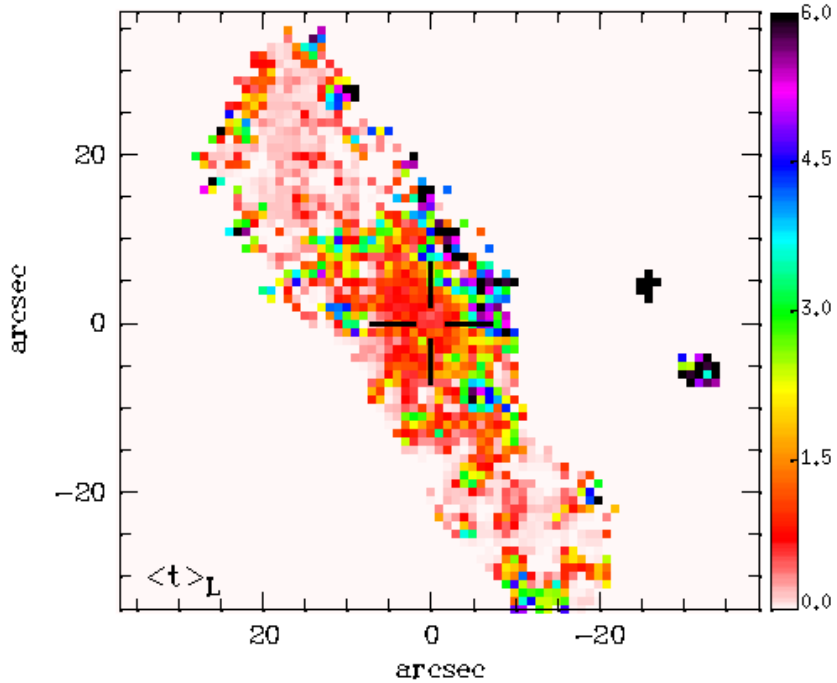
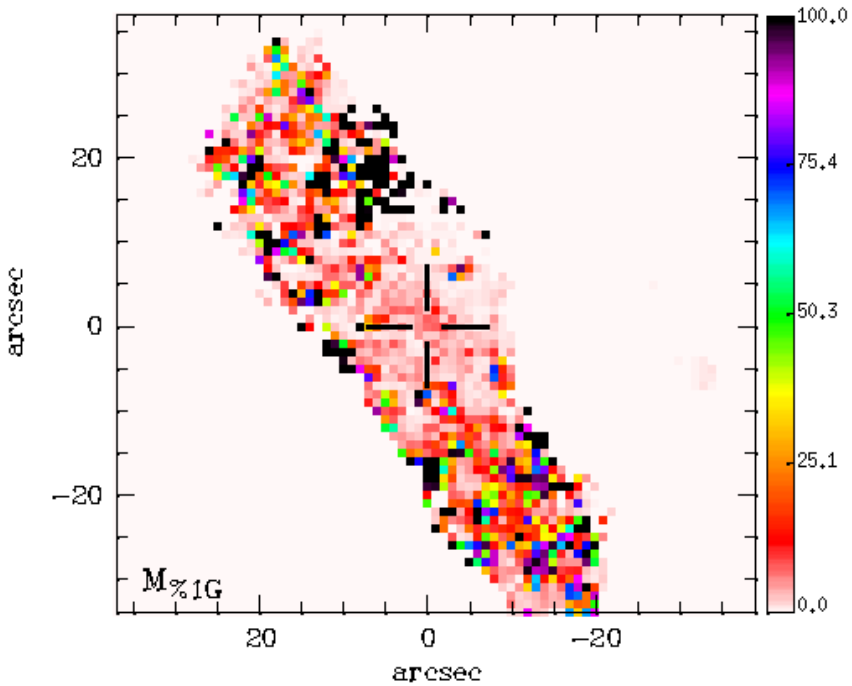
Luminosity weighted stellar age





Luminosity weighted stellar age (left-hand side) and mass fraction of stars younger than 1Gyr (right-hand side). According to these results the stellar populations of UGC 4722 are relatively young having formed a substantial fraction (~1/3 in region M) of its present-day stellar mass at a late cosmic epoch.

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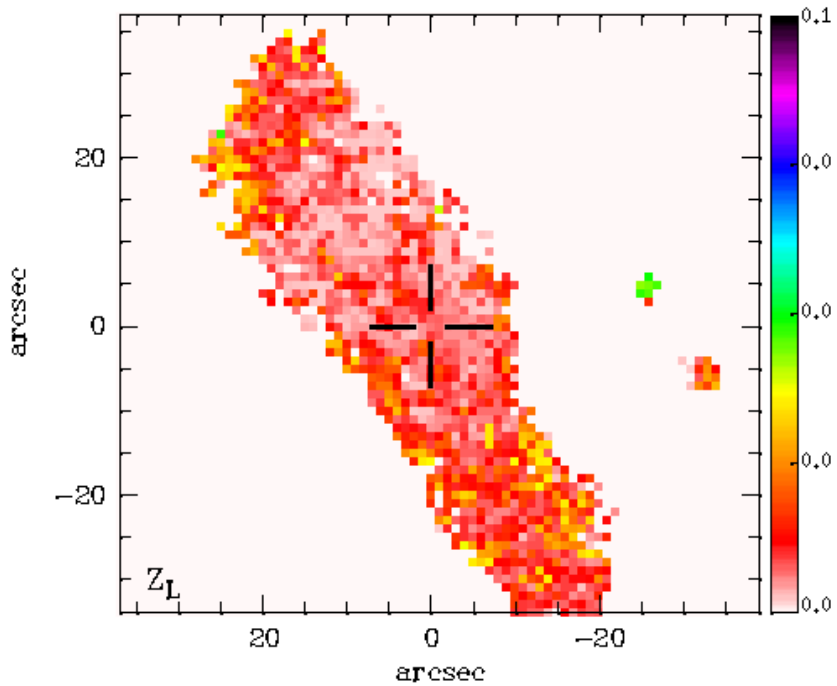
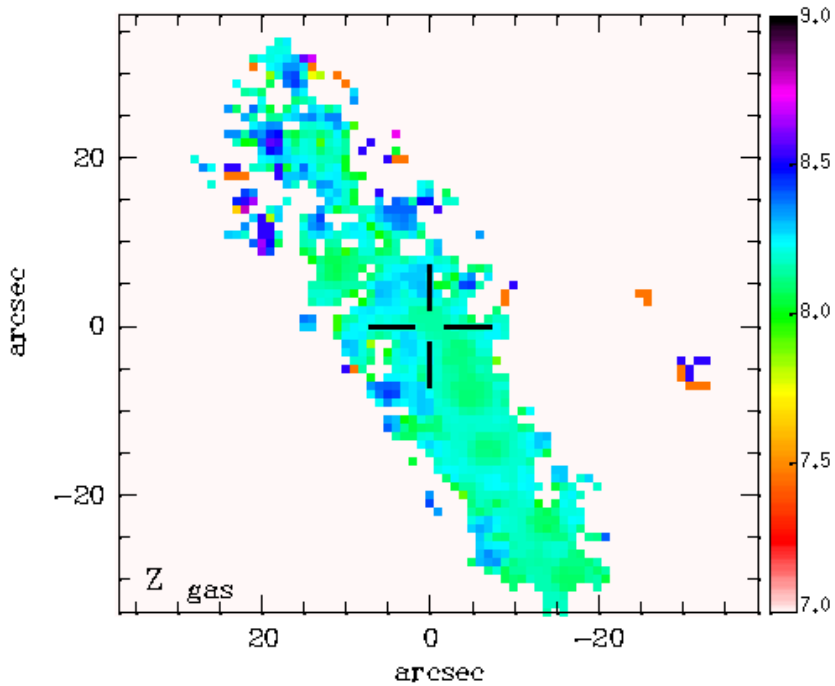
Luminosity weighted stellar and gas-phase metallicity





Luminosity weighted stellar metallicity (left-hand side) and gas-phase metallicity (right-and side). The map on the left indicates a metal-poor (~ 0.01) stellar component. The map on the right presents moderately low values for the gas-phase metallicity derived with SLM (from ~ 8 to ~ 8.6; e.g. : homogeneous distribution – Lagos et al. 2009).

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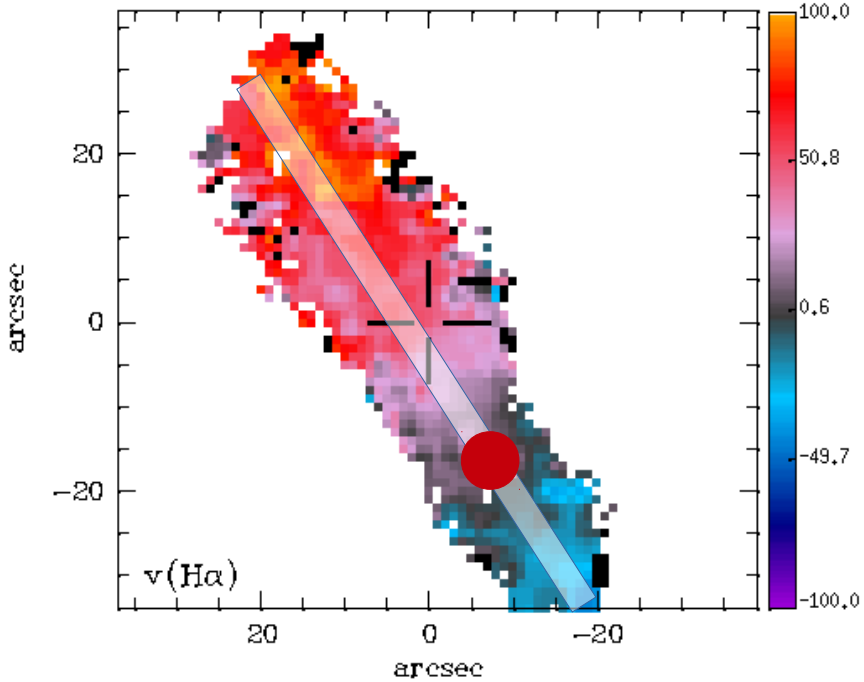
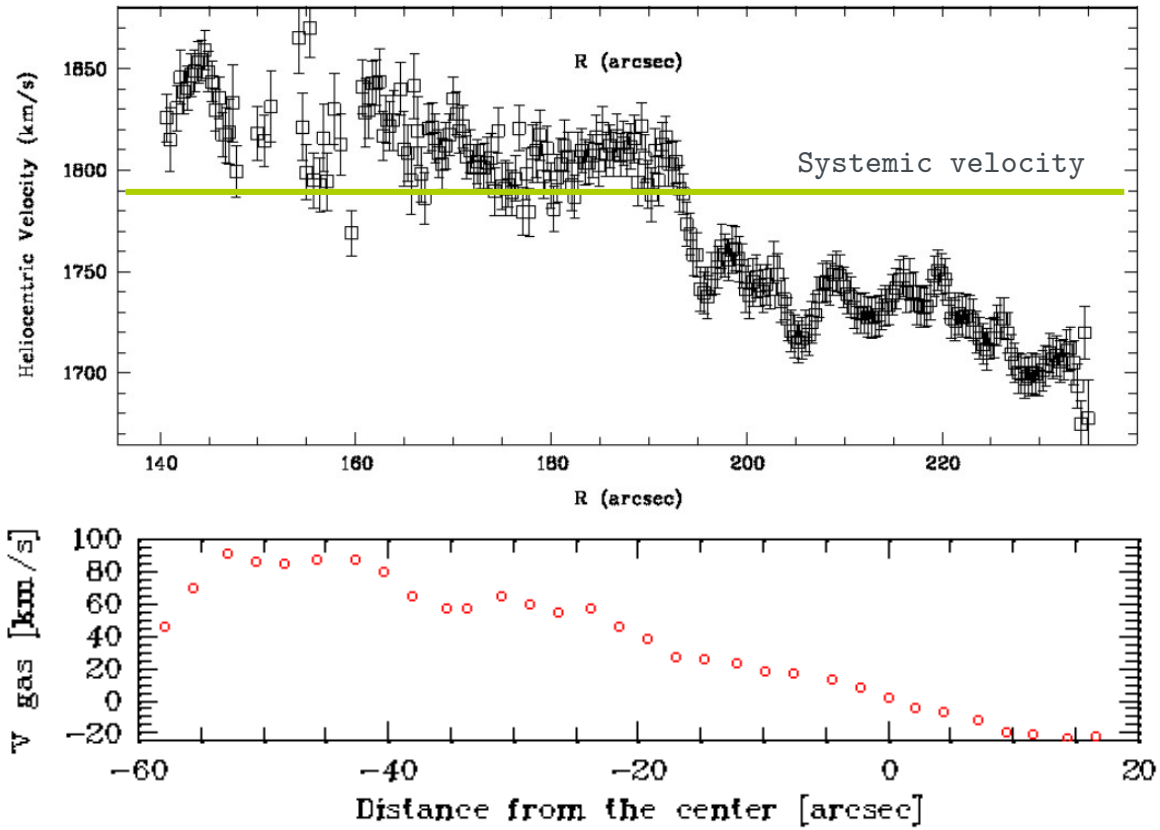
Hα and HI (Chengalur et al. 2015) velocity





Hα rotation velocity (left-hand side; the red dot marks the kinematical center of the ionized gas component), NE-SW Hα velocity distribution (right-hand side, top panel) from Chengalur et al. (2015) and NE-SW Hα velocity distribution (right-hand side, bottom panel), ranging between +91 and -23 km/s. The velocity measurements from Chengalur et al. (2015) are not corrected for the systemic velocity.

UGC 4722

Conclusions

- Very isolated and gas-rich dwarf galaxy; proposed to have suffered a recent minor-merger episode

- SDSS g-i colors indicate the presence of a comparatively young low-surface brightness stellar host with an age between 2 Gyr and 5 Gyr for an instantaneous and exponentially decreasing star-formation history.
- The evidence for a **young evolutionary status** is supported by spaxel-by-spaxel modeling of the CALIFA V500 data with Porto3D and Starlight. ~1/3 of the present stellar mass in the central region of the galaxy (M) has formed in the past 1 Gyr. Irregular stellar age patterns, yet evidence for decreasing age to the NW and SE tip of the galaxy (inside-out growth or result from an interaction?)

- The stellar and gas-phase metallicity is relatively uniform, a potentially important constraint for further investigating the minor-merger interpretation.
  No clear evidence for significantly lower gas-phase metallicity in regions of active star-forming activity.

- The ionized gas shows a relatively smooth velocity gradient along the major axis.
  However, the kinematical center of the ionized gas component does not coincide with the surface density maximum (M) of the stellar component. This spatial decoupling is an important constraint, as it could reflect a recent gas accretion event, eventually in support of the minor-merger scenario.

THANKS!!
GRACIAS!!

UGC 4722

HI map (Chengalur et al. 2015)

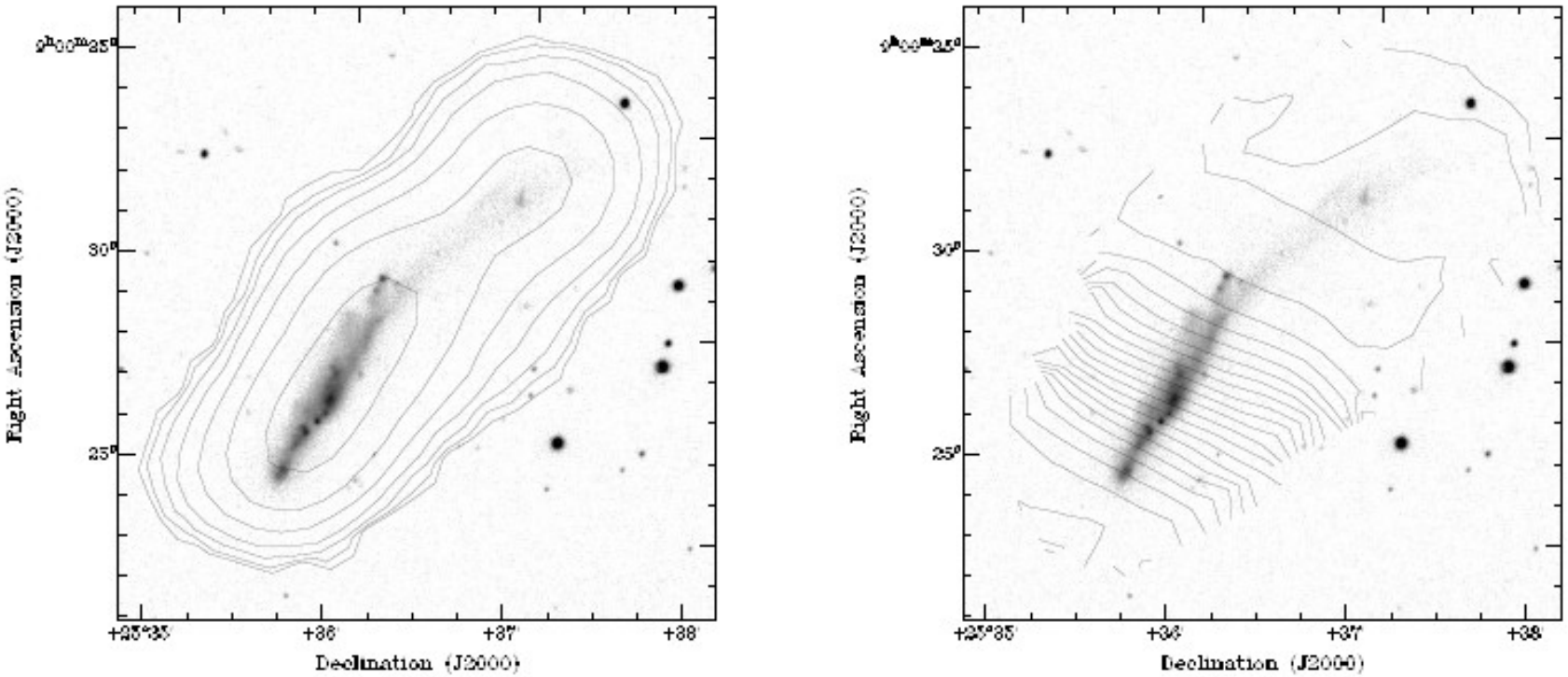


Figure 4. Left panel: Integrated HI emission from the UGC 4722 system at a resolution of ∼40″ (contours) overlaid on the SDSS g-band image (greyscales). The contours start at 2.5×10^{19} atoms cm^{-2} and are spaced a factor of 2 apart. **Right panel:** similar map, but for the velocity field. The iso velocity contours start at 1735 km s^{-1} and are spaced 5 km s^{-1} apart. The velocity increases smoothly from the SW to the NE.