New Catalog of HII Regions in M31

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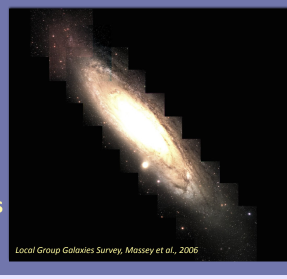
Overview

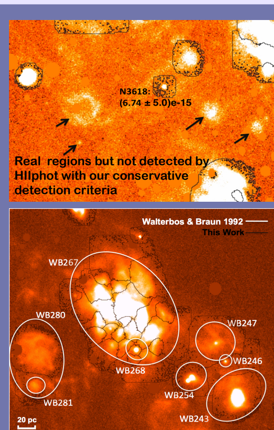
We present a new catalog of H II regions in M31 using the Nearby Galaxies Survey (Massey et al. 2006) data. The full disk of the galaxy (~24 kpc from the galaxy center) is covered. Our catalog is 5 times fainter than Walterbos & Braun's (1992) which covered only North-East half of the galaxy. New catalog contains 3691 regions in total and is sensitive to detect HII regions created by individual B0 stars.



HIIphot

HIIphot is an IDL code, performing photometry of HII regions in external galaxies (Thilker et al., 2000)

S/N = 10
F ≈ 10^{-16} erg cm^{-2} s^{-1}
L = 10^{34} erg s^{-1}, B0 star
Min size = 8 pixel ≈ 7.8 pc at D=0.78 Mpc (twice the PSF-FWHM)



Sample comparison between our catalog and WB92. Black lines show the borders determined by *HIIphot* and white ellipses show the same regions in WB92.

Total Luminosity and Star Formation

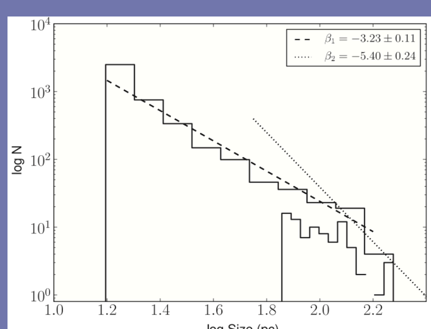
No giant HII Regions for M31:
M31's Brightest: $L_{H\alpha}$= 1.6×10^{38} erg s^{-1}
LMC, 30 Doradus: $L_{H\alpha}$= 1.5×10^{40} erg s^{-1}
(The most luminous HII Region in the Local Group)

$L(H\alpha)_{tot}$ = 5.6×10^{40} erg s^{-1}
(Extinction Corrected)
Contains 65% Diffused Ionized Gas contribution
Suggests a SFR=0.42 $M_\odot$ yr^{-1}

Data	Method	SFR ($M_\odot$ yr^{-1})
Tabatabaei & Berkhuijsen (2010)	extinction corrected H_α	0.27–0.38
Kang et al. (2009)	UV SF regions, 400 Myr avg	0.6–0.7
Barmby et al. (2006)	Infrared 8μm Luminosity	0.4
Williams (2003)	Optical photometry	∼ 1
Walterbos & Braun (1994)	extinction corrected H_α	0.35

Size Distribution

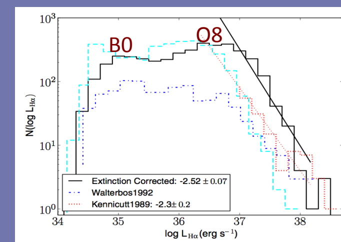
The right bottom corner histogram shows only larger regions (D > 70 pc) with 1/3 smaller bins. The dashed line presents the best power-law fit for D < 130 pc and dotted line presents the larger end (D > 130 pc)



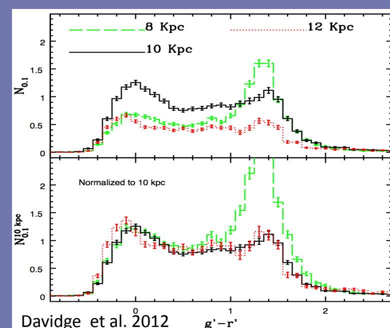
There is a sharp fall for regions larger than 100-120 pc where is the transition between single OB star regions and blends of multiple regions

Luminosity Function: Evidence for a Recent Starburst or Collision

Bimodal LF suggests a starburst between 15 and 20 million years ago or a recent collision with a companion galaxy

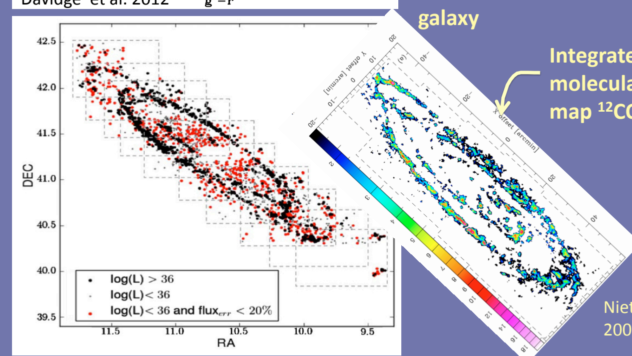


In agreement with UV (Kang et al. 2006) and recent CFHT (Davidge et al. 2012) observations



The LFs of main sequence stars in internal regions suggest SFR was 2 – 3 times higher in recent 10 Myr than during the past 100 Myr.

The distribution of evolved red stars is not azimuthally symmetric, which might be the consequence of interactions with a satellite galaxy



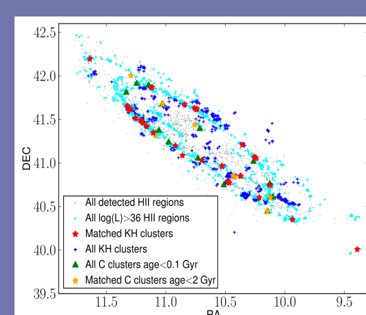
Integrated molecular gas map ^{12}CO(1-0)

Nieten et al. 2006

Higher luminosity regions nicely trace the arms (creating a O6-7 peak in LF) while *Lower* luminosity regions fill the inter-arms (second peak at B0) as well with higher concentration toward center, but there is not enough gas to form young massive stars. The dynamical travel time from arms (≈40 Myr) is larger than 24 Myr evolution time of the regions. A fraction of inter-arm stars are older population with higher star formation rate

Matching with Stellar Clusters

Only 7 young clusters (age<2 Gyr) from the Caldwell (2009) catalog were matched within a 10" (~ 38 pc) neighborhood (typical size of the Caldwell clusters).



43 HII regions matched with the Krienke & Hodge (2007) HST list within a 4" neighborhood (the typical size of the new KH clusters and the minimum size of our HII regions).

Extrapolation suggest 4370 matches. It is a reasonable correlation between young stellar clusters position and HII regions

References

Azimlu M., Marciniak R. & Barmby P., 2011, AJ 142, 139
Caldwell N., et al., 2009 AJ 137, 94
Davidge T. J., et al., arXiv:1203.6081v1
Kang Y., Bianchi L. & Rey S.C., 2009 ApJ, 703, 614
Krienke O. K. & Hodge P.W., 2007 PASP, 119, 7
Massey P., et al., 2006 AJ, 131, 2478
Nieten et al., 2003, A&A, 543, 459
Thilker D. A., Braun R., Walterbos R. A. M., 2000 AJ, 120, 3070
Walterbos R. A. M. & Braun R., 1992 A&AS, 92, 625