The R136 star cluster dissected with *Hubble Space Telescope*/STIS. I. Far-ultraviolet spectroscopic census and the origin of He II λ 1640 in young star clusters

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SUMMARY AND CONCLUSIONS

- LMC/30 DorのR136付近のFUV STIS/MAMAの分光観測の結果
- [52x2 arcsec] x 17 --→ 0.85 pc (3.4arcsec)
- m_{F555W} < 16.0 magの57個の天体のうち90%のスペクトルを提供(<0.5pc of R136a1)
 -プラス8個の近傍の天体@R136b (O4 If/WN8)
- CIV 1548-51 --→ 52個のearly-type starのwind velocity (including 16 O2-3)
- 今回初めて分光分類 --→ 3個のWN5 (a1, a2, a3)、2個のO supergiants (a5, a6)、3つのO dwarf (a4, a7, a8)
- HR図 --→ age = 1.5 (+3.3/-0.7) Myr
- integrated UV spectrum --→ この輝線の大部分は、100Msunの星起因
- HeII 1640の存在は、IMFのupper massが100Msunまで伸びていることを示唆

2. OBSERVATIONS

- VU spectroscopy
-- long-slit HST Imaging Spectroscopy (STIS)
-- far-UV Multi-Anode Microchannel Array (MAMA)
-- 52 x 0.2 arcsec slit x 17 pointings (figure 1)
-- spectral coverage : 1150-1700A (0.6A/pixel)
-- R=1250 @ 1500A
-- plate scale = 0.024 arcsec/pix
-- slit length ~ 25 arcsec
-- NAMA exposure combination: STISTOOLS package
-- wavelength correction : CALSTIS
----> 最大で+/-2pix (1.16A)の不定性
----> FUV flux : factor of 2
-- extraction : MULTISPEC
- Optical spectroscopy (G430M & G750M)
-- 52 x 0.2 arcsec slit x 17 pointings
-- λλ3793-4849A & λλ6482-7054A
-- pixel scale = 0.28 & 0.56 A/pix,
-- R=7700 & 6000 @ 4400A & Hα

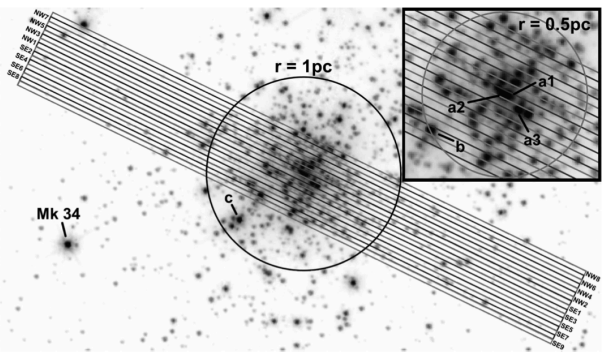

Figure 1. *HST*/STIS slits (52 arcsec × 0.2 arcsec) superimposed upon an F336W WFC3/UVIS image of R136 (de Marchi et al. 2011), oriented with north up and east to left, together with a circle of radius 4.1 arcsec (1 parsec) and identification of the acquisition star Melnick 34. The active slit length for MAMA observations is the central 25 arcsec. The zoom highlights the central region, including identification of individual slits and the integrated R136a cluster (2.05 arcsec radius circle, centred upon R136a1 equivalent to 0.5 parsec at the distance of the LMC).

▲図1 : Slit configuration & position (4.1″ = 1 pc)

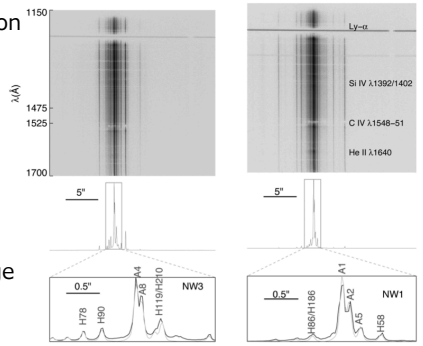

Figure 2. (Top): 2D spectral data set for NW3 (left) and NW1 (right) slits, oriented such that the λλ1150–1700 dispersion axis runs from top to bottom (horizontal line near top is geocentral Ly α emission, oscuiting bar lies to the right of each image) and the (25 arcsec = 6.2 pc) spatial axis is oriented from left (SW) to right (NE). Prominent (stellar plus interstellar) absorption features include Lyα (top) and C IV λ1548–51 (bottom); (centre): collapsed spectral image for NW3 (left) and NW1 (right) between λλ1475–1525 (bottom) 2.5 arcsec (0.62 pc) zoom of collapsed spectral image for NW3 (left) and NW1 (right) indicating the dense cores, resolving R136a1 and a2, and R136a4 and a8, respectively, together with MULTISPEC fits (faint grey line).

▶図2 : NW3とNW1の分光image
上 : Ly-alpha, CIVの吸収線
下 : componentsに分解

3. Spatially Resolved FUV Spectroscopy

3.1 UV morphology of O stars in the LMC : Appendix A1-11
3.2 UV morphology of O stars in R136
3.3 Wind velocities for R136 stars
3.4 Physical parameters for R136 stars
3.5 Age and masses of individual stars in R136
3.6 R136 cluster age and mass
3.7 Census of very luminous stars in 30 Doradus

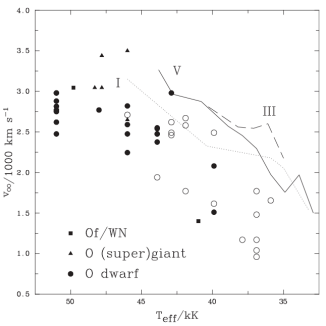

図9 : Wind velocities vs stellar temperature

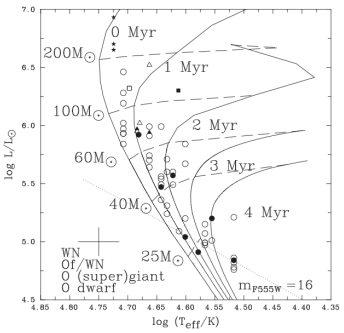

図10 : HR diagram

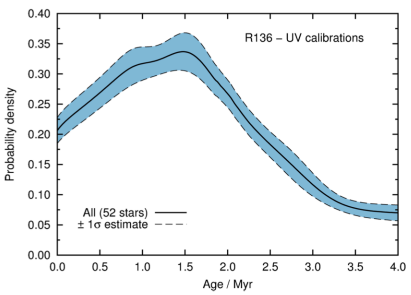

図11 : Probability density distribution of the apparent ages
-→ 1.5+0.3/-0.7 Myr

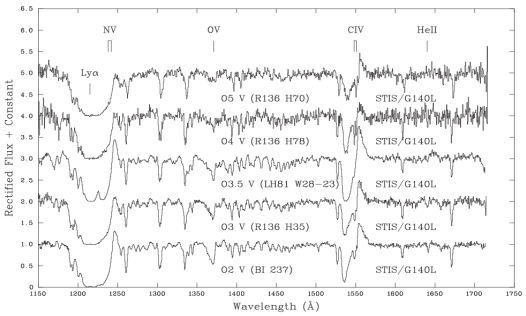

Figure A1. Ultraviolet morphological progression of O2–5 dwarfs, showing strong, broad O v λ1371 absorption at O2–3, together with strong P Cygni N v λλ1238–42 and C iv λλ1548-51. O v weakens at O3.5 and disappears at O4, while C iv P Cygni weakens at O5.

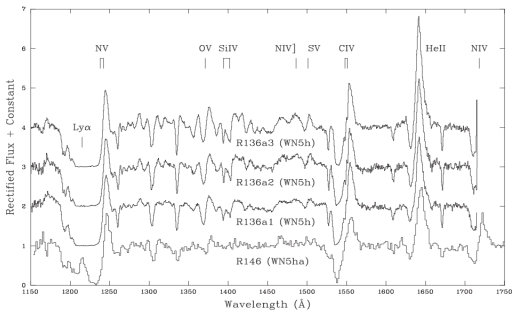

Figure B1. *HST*/STIS ultraviolet spectroscopy of WN stars in R136, together with an LMC template WN5 star R146 (Brey 88=BAT99-117, IUE SWP/LORES).