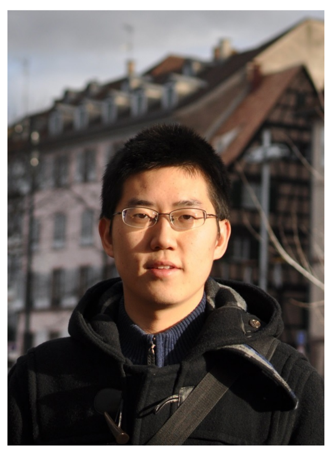

The Massive Stellar Population of W49: a Spectroscopic Survey

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Abstract

As a part of the LOBSTAR project (Luci OBservations of STARburst regions), which aims at understanding the stellar content of young star-forming regions, we present our first result on the high-mass stellar content of W49. Near-infrared imaging observations are obtained with LUCI at the Large Binocular Telescope (LBT) and SOFI at the New Technology Telescope (NTT). The K-band spectra (LUCI/LBT) of the candidate massive stars provide us with more reliable spectral types than photometry alone. 10 massive stars are identified as O-type stars. After the spectroscopic classification and applying proper extinction law, the objects can be placed in a Hertzsprung-Russell Diagram, with the effective temperature and bolometric correction estimated from stars of similar spectral type. With ISAAC near-infrared data, W49nr1 is discovered as a very massive star and, based on the K-band spectrum, classified as an O2-3.5If* star with a K-band absolute magnitude of -6.27±0.10 mag.

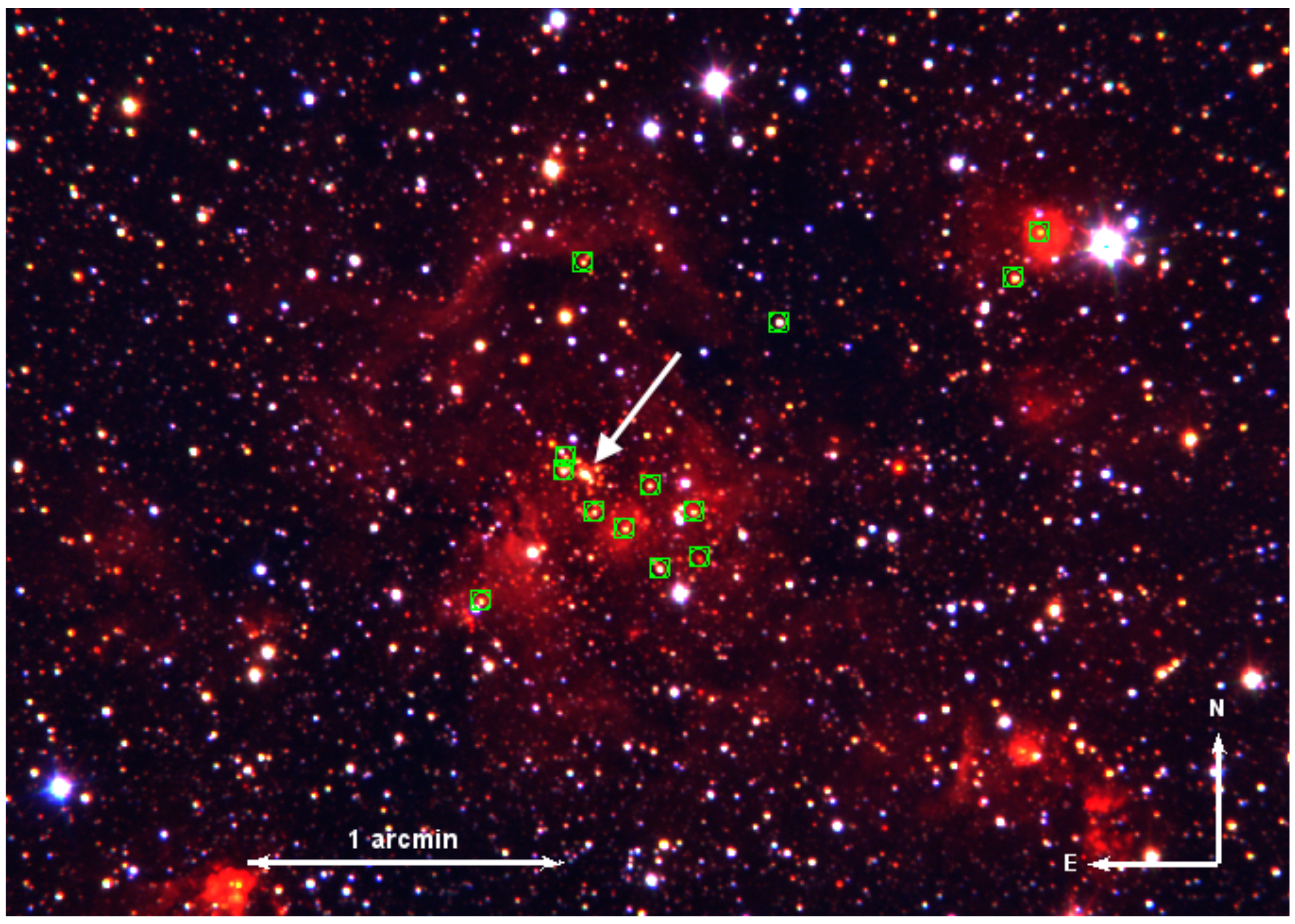

Figure 1. JHK three color image of the central area of W49. The location of classified O-type stars are indicated with green squares. The very massive star W49nr1 located in the center of the HII region is indicated with a white arrow.

Introduction

Stars form in regions ranging from large-scale associations to gravitationally bound clusters. In order to study their formation history we are carrying out a spectral survey of the stellar content of some of the most massive star formation complexes in our galaxy (e.g. Bik et al, 2012). In this poster we present the first results on starburst cluster W49 where 100s of candidates OB stars are found (Alves & Homeier, 2003). W49 is one of the most luminous and youngest HII regions in our Galaxy located at a distance of 11.11 kpc (Zhang et al. 2013). The region consists of over 40 ultra-compact HII regions as well as a more extended Giant HII region. A very massive star was found in the central cluster of W49 with over 100 solar masses (Wu et al. 2014) along with 10 O-type stars.

Spectroscopy

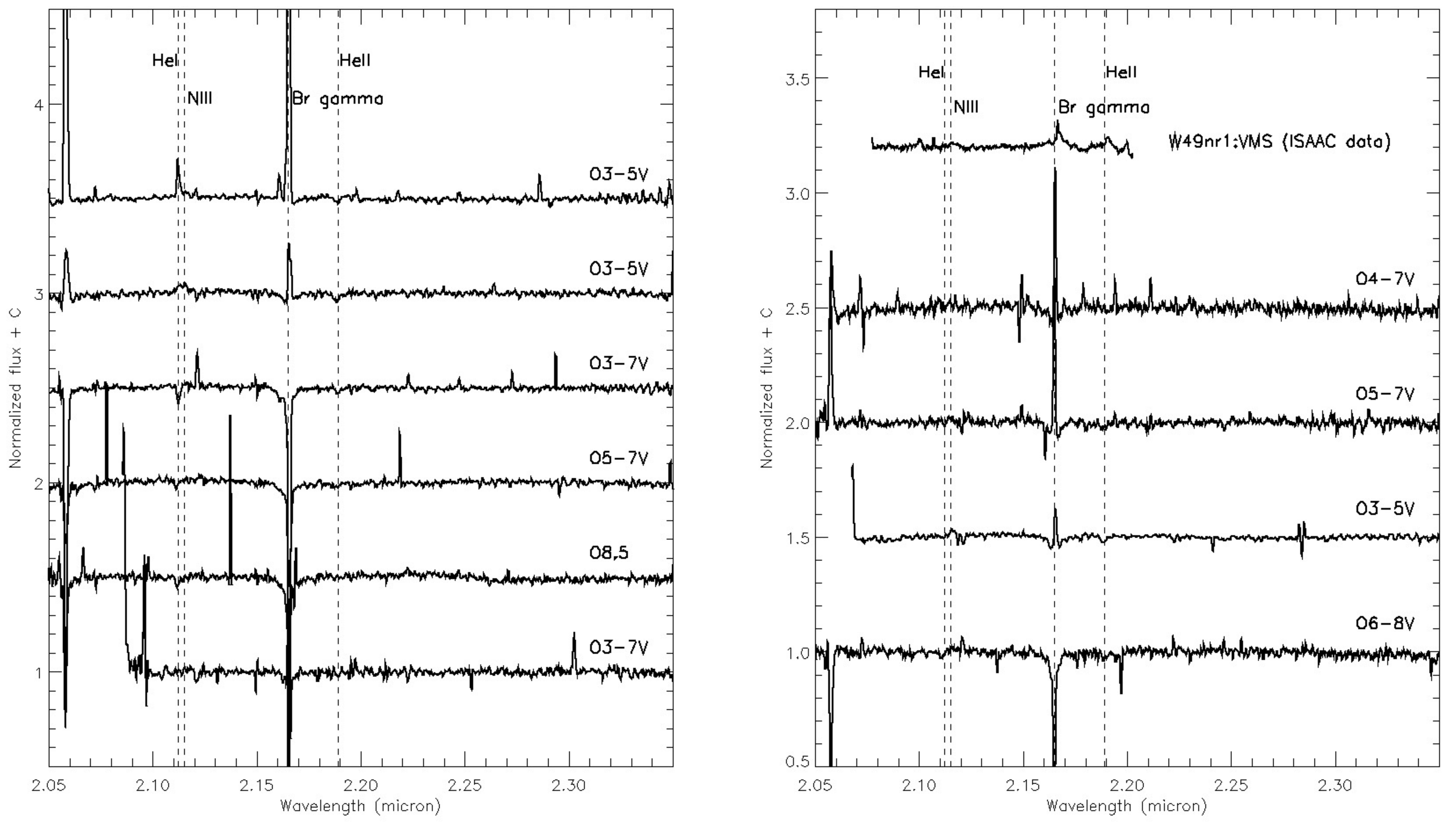

Figure 2. The telluric corrected (and continuum-normalized) K-band LUCI/LBT spectra of O-type stars found in W49 as well as the K-band ISAAC spectrum of W49nr1. Annotated with the dashed line are the spectral features which are important for classification of the stellar spectra.

The K-band spectra of the possible O-type stars are dominated by broad absorption lines of Brγ (2.16 μm), HeII (2.189 μm), NIII (2.116 μm) and HeI (2.11 μm). The narrow emission (or absorption) component of Brγ is a residual of the nebular subtraction. The broad absorption has a photospheric origin, while the narrow component is emitted by the surrounding HII region. The spectra are compared with high-resolution reference spectra of optical classified O stars from Hanson et al. (2005) to determine the best matching spectral type.

The K-band spectrum of W49nr1 is dominated by broad emission lines of Brγ (2.16 μm), HeII (2.189 μm), NIII (2.116 μm) and NV (2.10 μm). The He II and NV lines are indicatives of an early spectral type (Hanson et al. 2005). The broad emission profiles imply an origin in the stellar wind. These properties suggest similarities with the spectral classes O2-3.5If*, O2-3.5If*/WN5-7 ("slash" stars) and WN5-7 stars (Crowther & Walborn 2011).

Hertzsprung-Russell Diagram

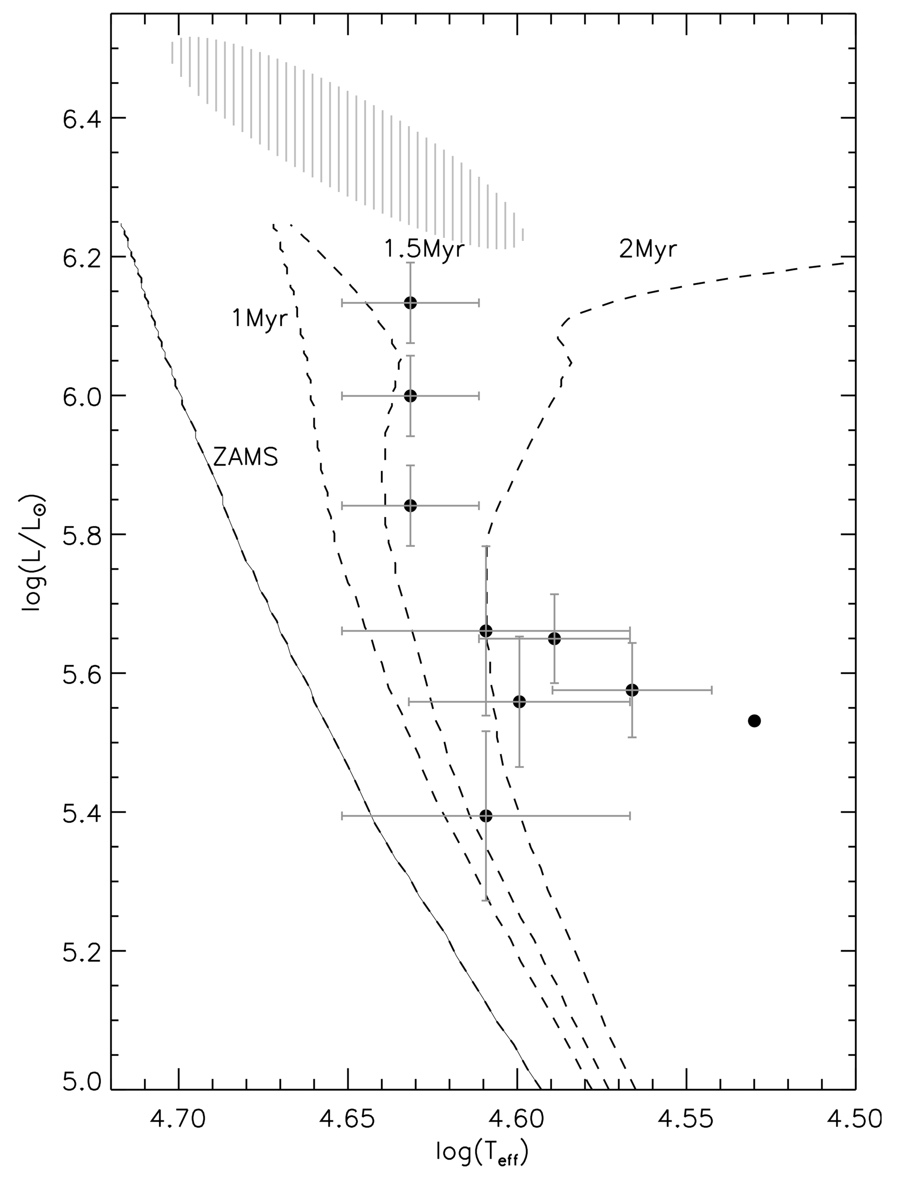

Figure 3. Hertzsprung-Russell Diagram with the locations of O stars of W49 and the possible location of W49nr1 marked as grey areas (as Teff and BCK are correlated, the likely locations of W49nr1 in the HRD is a diagonal ellipse.). After the spectroscopic classification, and applying the extinction law of Indebetouw et al. (2005), the objects are placed in Hertzsprung-Russell Diagram. The dashed lines represent the main-sequence isochrones from Lejeune & Schaerer (2001) for ZAMS, 1, 1.5 and 2 Myrs.

The basic parameters of this very massive star in the central cluster of W49 are summarized in the right table. As the extinction towards W49nr1 is very high, the choice of the extinction law can have a large effect on its mass and age. The age determination depends severely on the rotational velocity.

α(J2000) (h m s)	19:10:17.43
δ(J2000) (° ′ ″)	+9:06:20.93
J (mag)	16.57±0.18
H (mag)	13.47±0.12
K (mag)	11.93±0.10
EW(Brγ) (Å)	8.2 ± 1.7
EW(He II) (Å)	2.4 ± 0.7
EW(N III) (Å)	2.3 ± 1.0
EW(N V) (Å)	2.6 ± 0.9
Spectral type	O2-3.5If*
T_{eff} (K)	40,000 – 50,000
BC (mag)	-5.2 – -4.55
A_K (mag)	$2.9^a/2.6 - 3.5^b$
Initial mass ($M_\odot$)	$100 - 180^a/90 - 250^b$
Luminosity ($L/L_\odot$)	$1.7 - 3.1\times10^{6a}$ / $1.2 - 4.9\times10^{6b}$

Notes. [(a)] With extinction law of Indebetouw et al. (2005) [(b)] With varying extinction laws (see text).

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