Uncrowding R 136 from VLT/SPHERE extreme adaptive optics

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This paper presents the sharpest near-IR images of the massive cluster R136 to date,
based on the extreme adaptive optics of the SPHERE focal instrument implemented on the ESO Very Large Telescope and operated in its IRDIS imaging mode.

The crowded stellar population in the core of the R136 starburst compact cluster remains still to be characterized in terms of individual luminosities, age, mass and multiplicity. SPHERE/VLT and its high contrast imaging possibilities open new windows to make progress on these questions.

Stacking-up a few hundreds of short exposures in J and Ks spectral bands over a Field of View (FoV) of 10.9" x 12.3" centered on the R136a1 stellar component, enabled us to carry a refined photometric analysis of the core of R136. We detected 1110 and 1059 sources in J and Ks images respectively with 818 common sources.

Thanks to better angular resolution and dynamic range, we found that more than 62.6% (16.5%) of the stars, detected both in J and Ks data, have neighbours closer than 0.2" (0.1").
%We found that more than 62.6% (16.5%) of the stars, detected both in J and Ks data, have visual companion closer than 0.2" (0.1").

The closest stars are resolved down to the full width at half maximum (FWHM) of the point spread function (PSF) measured by Starfinder.
Among newly resolved and detected sources R136a1 and R136c are found to have optical companions and R136a3 is resolved as two stars (PSF fitting) separated by 59Â±2 mas. This new companion of R136a3 presents a correlation coefficient of 86% in J and 75% in Ks.
The new set of detected sources were used to re-assess the age and extinction of R136 based on 54 spectroscopically stars that have been recently studied with HST slit-spectroscopy (Crowther et al. 2016) of the core of this cluster.

Over 90% of these 54 sources identified visual companions (closer than 0.2").
We found the most probable age and extinction for these sources are $1.8^{+1.2}_{-0.8}$ Myr, A_J=(0.45Â±0.5)mag and A_K=(0.2Â±0.5)mag within the photometric and spectroscopic error-bars.
Additionally, using PARSEC evolutionary isochrones and tracks, we estimated the stellar mass range for each detected source (common in J and K data) and plotted the generalized histogram of mass (MF with error-bars).

Using SPHERE data, we have gone one step further and partially resolved and studied the IMF covering mass range of (3 - 300) M_{\odot} at the age of 1 and 1.5 Myr. The density in the core of R136 (0.1 - 1.4 pc) is estimated and extrapolated in 3D and larger radii (up to 6pc).
We show that the stars in the core are still unresolved due to crowding, and the results we obtained are upper limits. Higher angular resolution is mandatory to overcome these difficulties.

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Comments:

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