Hot stars in young massive clusters: Mapping the current Galactic metallicity

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INTRODUCTION: The distribution of the chemical elements in the Galactic disk is a key issue for understanding the evolution of the Milky Way and other spiral galaxies. The ratio of the α-elements to Fe is an ideal tracer of the past star-formation history, due to their different origins and enrichment timescales. The source of Fe-peak elements are mainly low-mass stars, while α-elements are dominantly produced by massive stars. In this poster, we present our project to map the abundances in the Galactic disk using Young Massive Clusters (YMCs) as chemical probes.

WHY BLUE MASSIVE STARS?

The extreme luminosities of these objects make them detectable in the infrared even at distant and highly extincted regions of the Galactic disk. Also, the young ages of blue massive stars (<10 Myr) turn them into ideal tools for measuring the abundances of the surrounding interstellar medium where they were born recently.

WHY YOUNG MASSIVE CLUSTERS?

The stellar population of the host cluster provides two independent methods to find out the location within the Milky Way: via spectrophotometric distances and by fitting the radial velocity in the Galactic rotation curve.
The recent discovery of hundreds of YMC candidates in near-infrared surveys (e.g. Dutra & Bica, 2003, Mercer et al. 2005, Froebrich et al. 2007, Borissova et al. 2012) allows us to cover diverse regions of the Galactic Disk.

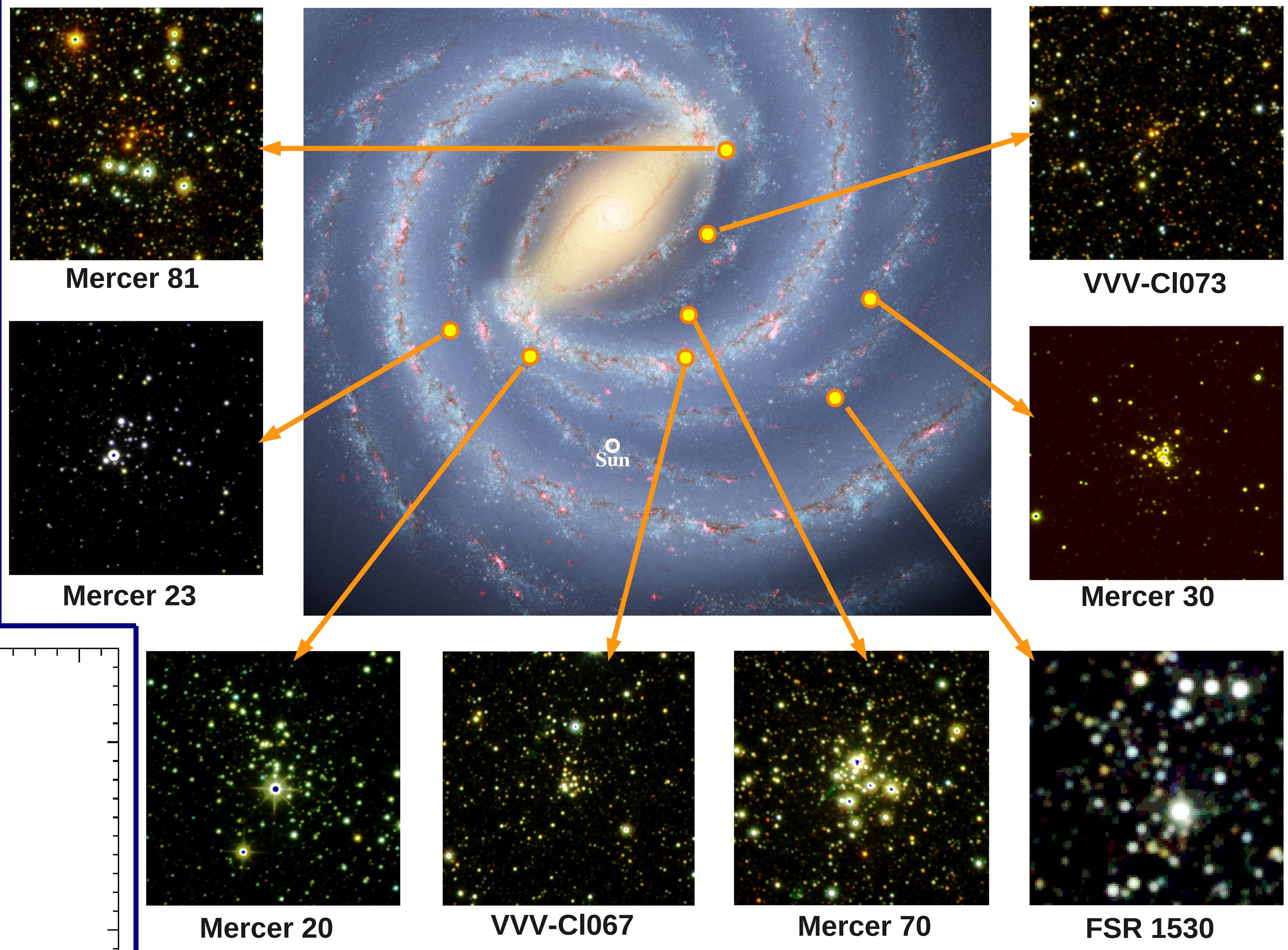

Fig. 1. RGB (= JHK) compositions of the YMCs we are using as chemical probes and their locations in the Galactic disk. Images were taken from the following public surveys: 2MASS (for FSR1530), UKIDSS (for Mercer 20/23) and VVV (for the remaining clusters). In every case, north is up and east is left, and the field of view is 2'x2'. The Milky Way sketch is taken from Churchwell et al. (2009).

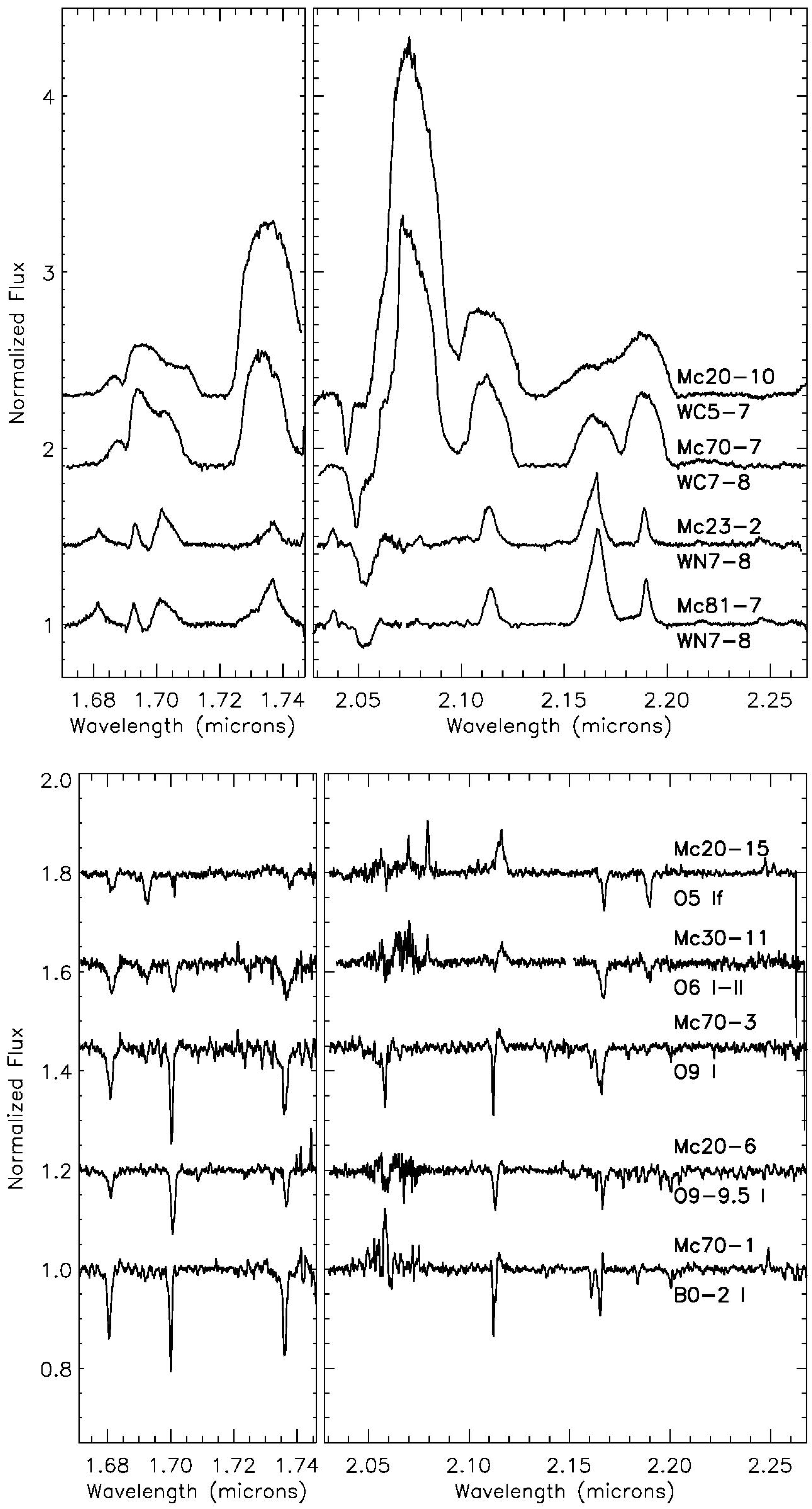

Fig. 2. A representative sample of H- and K-band spectra of cluster members, showing the diversity of Wolf-Rayet stars (upper pannel) and OB supergiants (bottom). Notice the different flux scales.

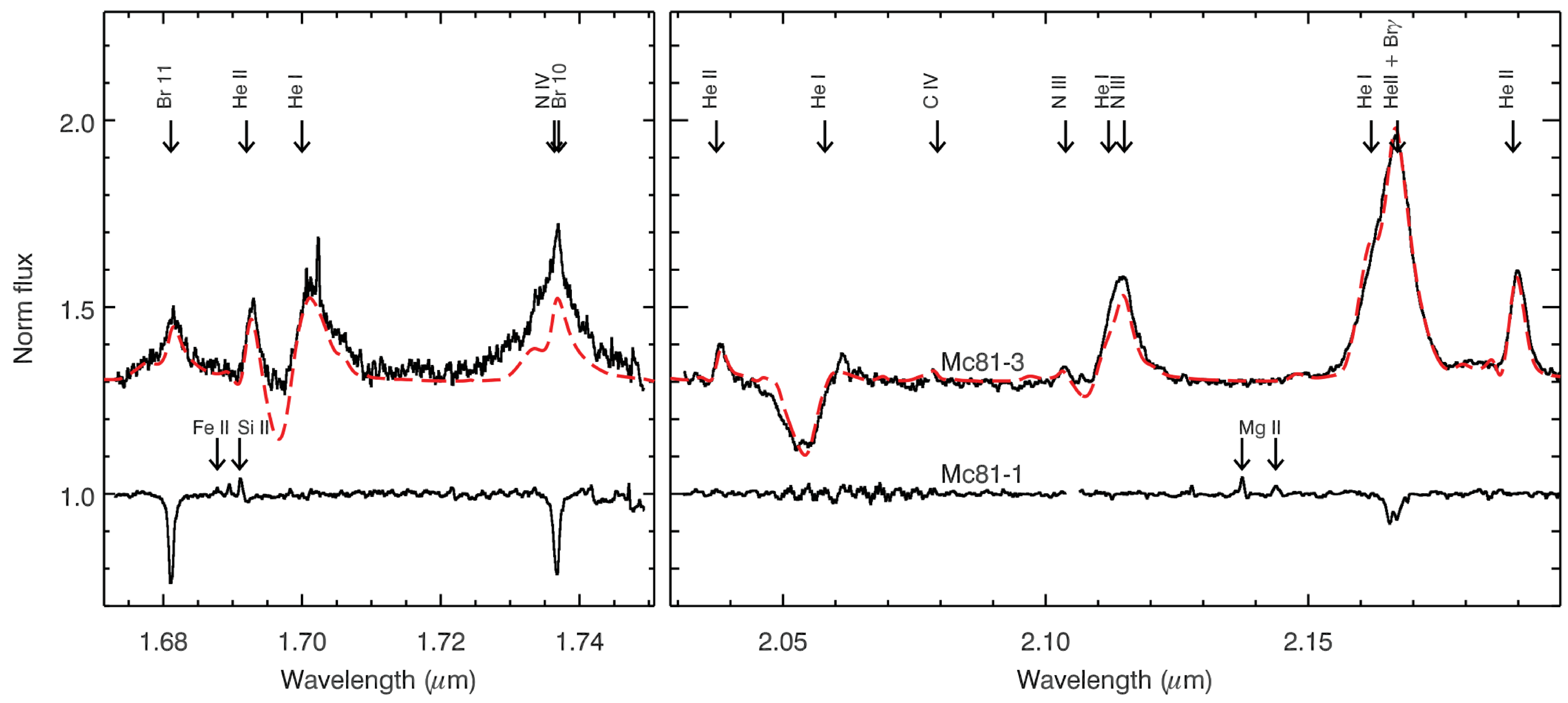

Fig. 3. H- and K-band spectra of two Mercer 81 cluster members, showing also a model (red dashed line) achieved with CMFGEN. Figure From Davies et al. (2012).

OBSERVATIONS: Our data consist of near-infrared, medium-resolution (R~2000 – 4000) spectra of 117 stars in the clusters showed in Fig. 1. Observations were made with ISAAC/VLT (ESO programs 083.D-0765 , 087.D-0957 & 089.D-0989) and SofI/NTT (091.D-0869). The ISAAC data are fully reduced and classified, resulting in 46 OB stars and 15 Wolf-Rayet stars. A representative sample is presented in Fig. 2 and Fig. 3. We expect to find more early-type spectra among our very recent SofI observations, which correspond to VVV-Cl073 & FSR1530.

ANALYSIS: We are currently in the process of modeling the early-type spectra with the CMFGEN code (Hillier, 1989; Hillier & Miller, 1998), to obtain physical and chemical properties. A model for the WN7-8 star Mc81-3 (Davies, de la Fuente et al. 2012) is shown in Fig. 3. Apart from the chemical abundances, wewill combine the analysis results for each cluster to find the distance accurately and obtain a chemical cartography of the Milky Way.

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