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PRESENTACIóN MURAL

The star cluster age-metallicity relationship in the Small Magellanic Cloud

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Abstract. We present CCD Washington photometry of 11 Small Magellanic Cloud (SMC) clusters for which age and metallicity estimates are provided. The 11 clusters are witnesses of the ~ 2 Gyr bursting formation episode, **according to their positions in the age-metallicity relationship (AMR).** We added these clusters to the largest known SMC cluster sample with ages and metallicities put into an homogeneous scale, and found that two enhanced formation episodes at $t \sim 2$ and 5-6 Gyr throughout the entire body of the galaxy, the absent of a metallicity gradient and a relative spread in metallicity for clusters older than ~ 7 Gyr comprehensively describe the SMC AMR. **In addition, based on** the statistics of **catalogued** and studied clusters, **we found** that a total of seven relatively old/old clusters have not yet studied, and even a smaller number is obtained if the cluster spatial distribution is considered. **A detailed version of this work can be seen in Piatti (2011, MNRAS, 418, L73).**

Resumen. Presentamos resultados sobre edades y metalicidades obtenidos a partir de fotometría CCD en el sistema de Washington para 11 cúmulos en la Nube Menor de Magallanes (NMM). Los 11 cúmulos resultaron ser testigos de un episodio de formación violento hace **unos** 2 mil millones de años, de acuerdo a su posición en la relación edad-metalicidad (REM). Incluimos estos cúmulos a la muestra más numerosa de cúmulos en la NMM con edades y metalicidades estimadas en una escala homogénea, y encontramos que dos episodios de formación violentos hace **unos** 2 y 5-6 mil millones de años en todo el cuerpo de la galaxia, la ausencia de un gradiente de metalicidad y una relativa dispersión de las metalicidades para edades mayores a 7 mil millones de años describen globalmente la **REM** de la NMM. **Además, en base a la estadística de los cúmulos catalogados y estudiados, encontramos** que un total de 7 cúmulos viejos no han sido aún estudiados, y un número menor obtenemos si **consideramos** sus distribuciones espaciales.**Una versión detallada de este trabajo puede verse en Piatti (2011, MNRAS, 418, L73).**

A comprehensive picture of the SMC AMR

In this study we present, for the first time, CCD Washington CT_1T_2 photometry **-obtained with the CTIO 4m Blanco telescope and the MOSAIC II camera attached-** of stars in the field of 9 unstudied SMC clusters, namely: B 39, 47, 112, BS 88, HW 22, 55, 67, K 38, and L 58, and two additional studied clusters (B 34 and NGC 419), which served us as control clusters for age and metallicity estimates. The analysis of the photometric data leads to the following main conclusions:

i) Colour-Magnitude Diagrams (CMDs) cluster features - mainly cluster **red clumps** and **main-sequence turnoffs** - turn out to be identificable when performing annular extractions around their respective centres, once they were cleaned from field star contamination. The cluster **centres** were derived from **Gaussian** function fits to the stellar distribution along the x and y directions using the STSDAS.NGAUSSFIT task. The fits also provide us with cluster radius which we used in order to perform circular extraction around the respective **centres.** The cluster CMDs cleaned from field contamination were obtained by applying the procedure described in Piatti et al. (2011).

ii) We estimated ages for the cluster sample using the δT_1 index, which measures the difference in magnitude between the **red clump and the main-sequence turnoff;** calibrated in terms of age by Geisler et al. (1997). On the other hand, we estimated clusters metallicities from the **standard giant branch technique (Geisler & Sarajedini 1999).** This technique consists in interpolating the observed **red giant branch into standard** iso-abundance lines which come from the red giant **branches** of clusters with well **known** metal abundance estimates. The resultant ages and metallicities for the control clusters are in excellent agreement with those previously published, thus confirming our present age/metallicity scale. We also confirmed the ages and metallicities derived for the remaining clusters by fitting theoretical isochrones of Girardi et al. (2002) to the cluster CMDs. The clusters are preferently located in the inner disk of the SMC, as can be seen in Fig. 1, where we also drawn ellipses with semi-major axis of 1, 2 and 4 degrees, respectively.

iii) When examining the behaviour of the cluster ages and **metallicities** with the cluster positions in the galaxy we found that for clusters located in the outer disk (semi-major axis $>$ 4 degrees), a relative spread in both quantities prevails. Such a dispersion in metallicity does not allow us to infer the existence of a spatial metallicity gradient (see Fig. 2). Moreover, the dispersion in the cluster chemical compositions is also exhibit by clusters older than $\sim$ 7 Gyr, as Fig. 3 shows, which are also distributed in the outer disk of the galaxy. The [Fe/H] spread could be caused by old clusters formed from a primordial not-well mixed gas cloud.

iv) Fig. 3 depicts the resultant AMR for the studied clusters (red symbols), where we also included clusters from the literature (open symbols) which also have ages and metallicities put into the same **age-metallicity** scale. As can be seen, the AMR is composed by two enhanced formation processes, one at $t$$\sim$2, and another at 5-6 Gyr. On the other hand, although the bursting star formation history modeled by Pagel & Tautvaišienė (1998) appears to tightly reproduce the observed cluster AMR, we should note that the cluster burst occurred at 5-6 Gyr is not predicted by the model. This is beacuse they did assume that there was not any star formation since the galaxy was formed unil the well-known burst at 3 Gyr.

v) Based on the statistics of cataloged and studied clusters we estimated the number of old and relatively old clusters that have **not been studied** yet. Our result shows that we should expect to identify a total of 7 relatively old/old clusters not studied yet within those cataloged by Bica et al. (2008). At first glance, such a number of unstudied clusters does not appear to strongly change the observed AMR (Fig. 3), even less if we consider their spatial distribution in the different elliptical rings.

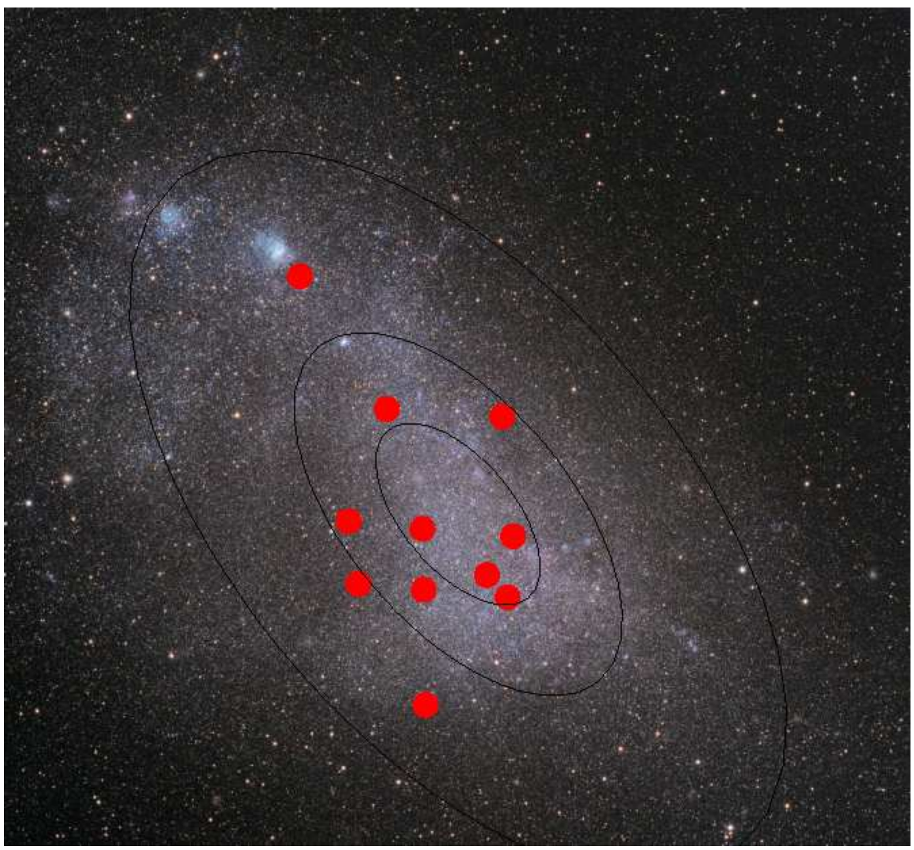

Figure 1. Relative positions of the studied clusters in the field of the SMC **(red dot).**

1. References

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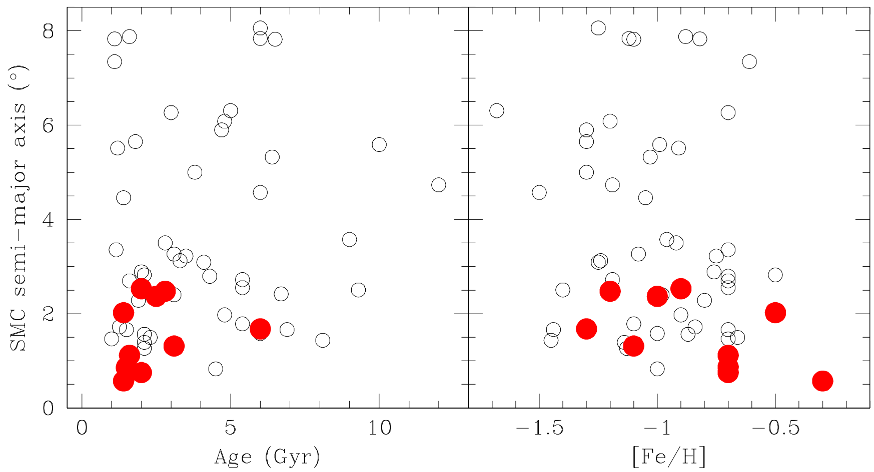

Figure 2. Cluster age (left) and metallicity (right) distributions. **Red and open circles correspond to the present and previously studied cluster samples.**

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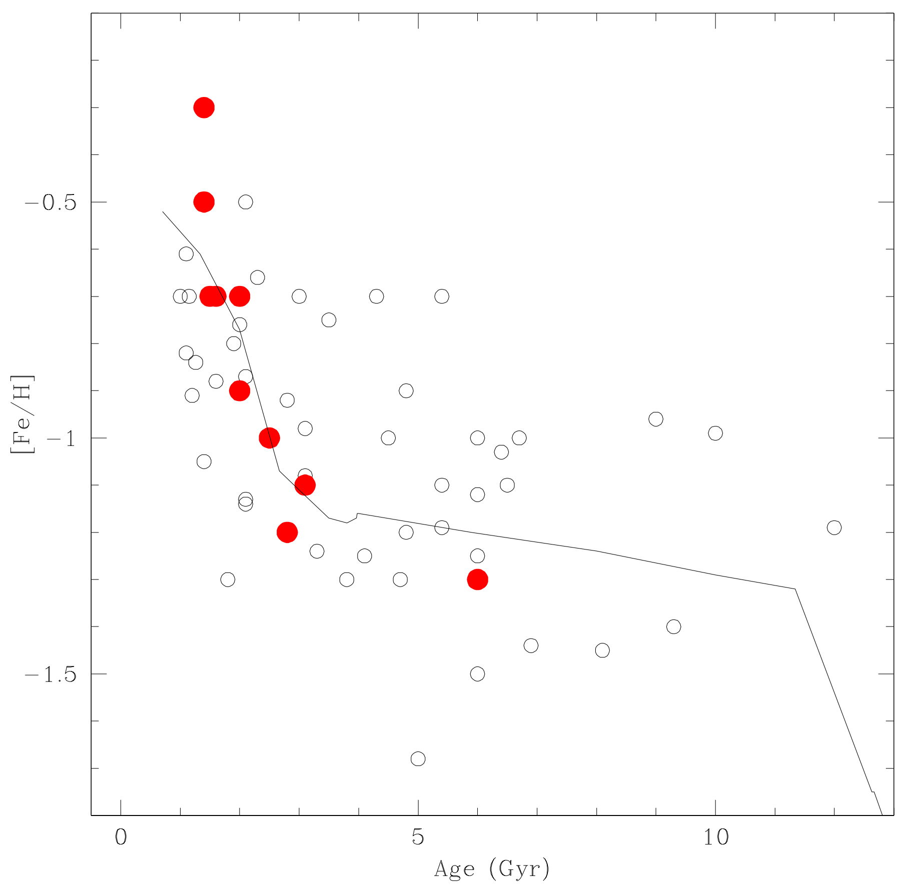

Figure 3. The AMR for the SMC star cluster system. Symbols are as in **Fig. 2.**