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STEP - the SMC in Time: Evolution of a Prototype interacting dwarf galaxy

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Abstract. We present a project devoted to a comprehensive study of the Small Magellanic Cloud (SMC) and of the Bridge toward the Large Magellanic Cloud. We plan to use the VLT Survey Telescope (VST) to image 65 squared degrees on both targets to V$\sim$24.5 with S/N$\sim$10 in two years. These observations, in conjunction with HST and VLT data will allow us to study in detail the star formation history of the SMC and of the Bridge as well as (for the first time) the variable star populations of the latter object.

Key words. Galaxies: SMC – Stars: Color-Magnitude Diagram

1. Introduction

This survey is devoted to the investigation of the Small Magellanic Cloud body and the Bridge (towards the LMC) in order to study the different stellar populations of these systems down to the turn-off of the oldest stars. In particular this project can be divided in two related surveys. The first is a deep survey aimed at studying the star formation history (SFH) of the SMC and its stellar cluster component.

The field SFH will be obtained from the comparison between deep CM diagrams and proper population synthesis models (see Tosi

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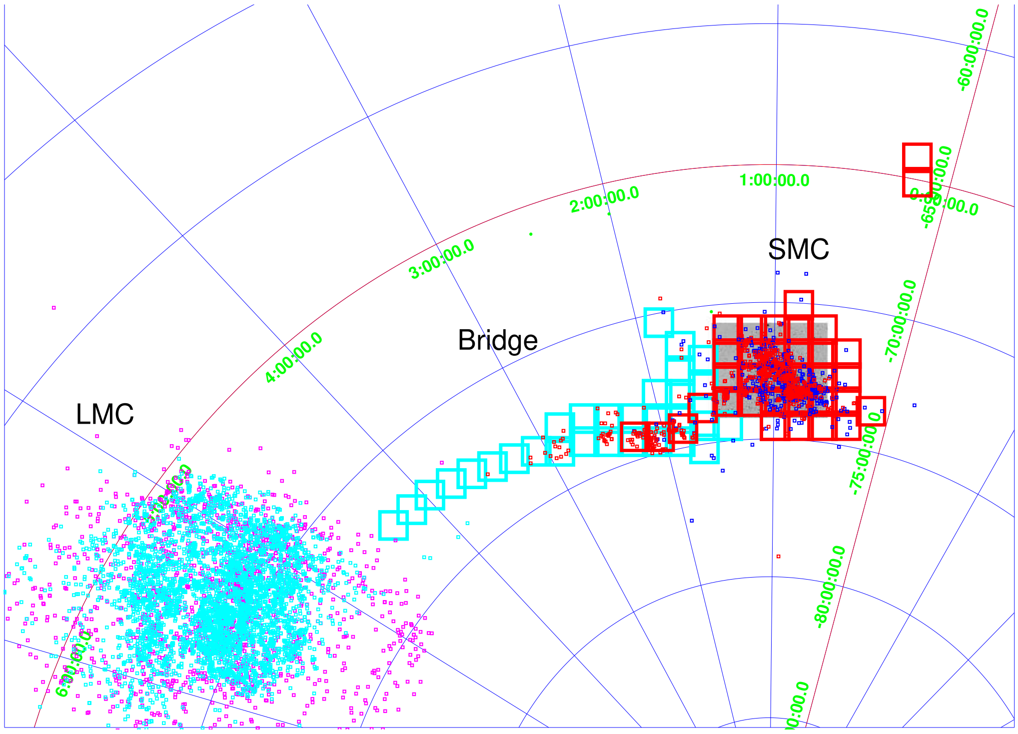

Fig. 1. VST pointings for the proposed survey: red and cyan boxes indicate the position of the exposures for the deep and shallow survey respectively. The extension of SMC and Bridge is outlined by means of their cluster (blue dots) and association (red dots) population. Similarly for the LMC but in this case the associations are in cyan and the clusters in magenta.

et al. (1991),Greggio et al. (1998)). Cluster observations will be used to understand if clusters and field stars experienced the same SFH. The second is a shallow survey aimed at investigating, for the first time systematically, the SMC Wing and Bridge and most of the hosted clusters, which will be studied through the construction of homogeneous CM diagrams. The structure and spatial distribution of the inter-Cloud populations of the Bridge will be investigated also by variable stars as population tracers, in particular those still unexplored in the Bridge. The project is strictly interlaced with complementary observing runs foreseen or already carried out with HST (deep and spatially resolved photometry). Also VLT observing time will be used for multiobject spectroscopy of selected candidates.

2. Survey Description

A more detailed description of the two related surveys mentioned in the previous section follows:

– **Deep survey:** in order to study in detail the SFH in SMC, we have to reach at least one magnitude deeper than the Turn-Off of the oldest stars. This means that we have to observe stars with B$\sim$ 25 mag, V$\sim$24.5 mag and i' $\sim$23.8 mag with S/N=10. We plan to use 30 pointings (1 pointing $\approx$ 1sq.degree) to cover the Bar and a large part of the Spheroid of the SMC, as well as Shapley's Wing. Additional 5 pointings will be placed as follows:
1) 3 sq. degree on the Bridge in a region rich of OB associations;

2) 2 sq.degree in the direction of the Magellanic Stream (see red squares in Fig 1).
Fields overlapping with the HST pointings will be observed first, to provide a mutual calibration test, useful both for future VST photometry and for ACS crosschecks.

- **Shallow survey:** in order to study the stellar populations of the Bridge using the variable stars as tracers, we need time series photometry. We plan to obtain 30 phase points in V and 10 in B and i' on 30 squared degrees to identify and study variables down to the magnitude of the RR Lyrae stars, B~20 mag, V~19.5 mag, I~18.5 mag, with S/N=100. Periods will be derived in the V band and the corresponding template curve will be fitted to the B and i' data to obtain precise colors. By co-adding individual images we shall be able to reach BVi' magnitudes as deep as in the body of SMC, although with a lower S/N ($\sim 5-10$). The pointings will be properly placed along the Bridge in order to cover its entire displacement toward the LMC (see cyan squares in Fig. 1 pointings).

We estimate that a total of about 170 h (gray/bright time) of VST imaging obervations will be sufficient to complete the survey(s). We plan to carry out these observations in two years.

2.1. *Follow up with VLT*

Spectroscopic follow-up with FORS2 and FLAMES@VLT is planned for abundance determinations and radial velocity measurements of selected stars. In particular, the VLT is requested for fine abundance and radial velocity analysis of the variable stars, which would put stringent constraints both on the age-metallicity relation in the field and on the actual line-of-size depth of the SMC. The latter is known to have a roughly spheroidal distribution, but its size is still unknown. Pulsating stars with periods, amplitudes, metallicities and radial velocities derived with these sets of data will provide a robust definition of the SMC structure and depth.

References

Greggio et al. 1998, ApJ 504, 725
Tosi et al. 1991, AJ 102, 905