MAD Science Demonstration Proposal
Title: Unveiling a new Milky Way Globular Cluster.

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Abstract: Globular clusters (GC) provide a unique sample to investigate various aspects of the early star formation history in the Galaxy. In recent years up to 5 new globulars were discovered thanks to infrared mapping of heavily obscured disk regions. We propose to obtain deep JHK observations of a *strong* GC candidate, located in the Galactic disk (at $A_v \sim 5.5$). The detection of the old (~ 10 Gyr) main sequence turnoff (MS-TO) will allow the *immediate and firm* identification of a new Milky Way GC. The data-set will provide an accurate determination of the cluster reddening, distance and, most importantly, age (via the MS-TO detection and isochrone comparison).

Scientific Case: The past few years have witnessed an increased interest in the missing GC population, that is hidden in and along disk/bulge line of sights. Part of the problem lies in the heavy absorption that affects such objects. Moreover, low-luminosity GC often show a depleted red giant branch (hence very few bright objects) that makes their identification even more difficult. A complete census of the GC sample is fundamental in re-constructing the early formation epoch of the Milky Way, in particular that regarding the formation mechanism(s): infall from the halo and/or merging episodes.

In this regards, the 2MASS survey has allowed the identification of the two new globulars 2MASS-GC01 and 2MASS-GC02 (Hurt et al. 2000). On the other hand, Ortolani et al. (2000) identified ESO 280-SC06 as a halo GC that is projected on the disk and Kobulnicky et al. (2005) discovered GLIMPSE-C01 from an inspection of Spitzer Space Telescope images. Our group is conducting a systematic study of GC candidates and have recently reported the discovery of a new GC entry (AL 3, Ortolani et al. 2007). It is an inner bulge GC with an intermediate metallicity ([Fe/H]$\sim -1.3 \pm 0.25$) and an extended blue horizontal branch. This proposal aims at the probable detection of yet another hidden GC.

Targets and integration time:

Target	**RA**	**DEC**	**Filter**	**Magnitudes**	**Total integration time** (sec)	**Field** (arcmin)
Object 1	08 40 25	−44 43 20	J	J=13-19	$8s \times 24 = 192$	2
Object 1	08 40 25	−44 43 20	H	H=13-19	$8s \times 24 = 192$	2
Object 1	08 40 25	−44 43 20	Ks	Ks=13-19	$8s \times 24 = 192$	2
Sky 1	08 31 24	−44 34 33	J	J=13-19	$8s \times 24 = 192$	2
Sky 1	08 31 24	−44 34 33	H	H=13-19	$8s \times 24 = 192$	2
Sky 1	08 31 24	−44 34 33	Ks	Ks=13-19	$8s \times 24 = 192$	2

Guide stars list and positions:

Target	$\mathbf{RA}''_{rel}$	$\mathbf{DEC}''_{rel}$	**V Mag**
GS1-Object 1	+30	−39	12.7
GS2-Object 1	+8	+47	13.6
GS3-Object 1	+4	−40	12.2
GS1-Sky 1	+36	+21	11.7
GS2-Sky 1	+3	+49	11.6
GS3-Sky 1	−31	−37	12.7

Time Justification: 2MASS color-magnitude diagrams of the GC candidate clearly show the red HB clump at $K \sim 13.8$. Relying on deep JK diagrams of other globular clusters (NGC6528 Momany et al. 2002) we expect that the old MS-TO will be located at $K \sim 17.5$. To firmly establish the detection of the MS-TO we need to sample stars at $1-2$ magnitudes below this level (i.e. $K \sim 18.5-19.5$). Since ~ 10.0 *min.* are sufficient to reach $K \simeq 20.5$ with a S/N of ~ 3, we expect that our proposed observing strategy (~ 3.2 *min.*) is sufficient to reach $K \sim 19.0$ with a $S/N \geq 3$. The absorption in the JHK bands is relatively large (1.4, 0.9 and 0.6 mag. respectively). Typical crowding conditions in GC imply the need for apposite *Sky* images. This field is also fundamental in accounting and subtracting the disk population. Thus, we request ~ 20 min. for observing both the cluster and a nearby *Sky* fields. To these we add 20 min. for acquisition and 12 (2×6) minutes for the grid dithering mode (for both the Object and the Sky pointings), a total of ~ 1 hour. Lastly, the GS magnitudes are taken from the GSC2.2 catalog.