are responsible for producing nearly all the nebular emission. The dynamic structure is best described by the wakes of dense "bullets" ploughing through the surrounding molecular gas. The jets appear to diverge from the region around IRc2 in all directions apart from the north-east quadrant. More information on the region – including temperature profiles for the most interesting features — should be obtained by observations in other H_2-sensitive wavelengths and by carefully directed high resolution spectroscopy.

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Combined Optical and Near-IR IRAC2 Photometry of the Bulge Globular Cluster NGC 6553

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The bulge region of our Galaxy contains a number of globular clusters whose study can provide important information about the history of the Galaxy formation conditions after the initial collapse of the spheroid. The age, dynamical and chemical conditions of the bulge are the crucial parameters to be investigated. Unfortunately, they are hardly observable in the optical wavelength due to the heavy extinction in the direction of the Galactic plane.

For these reasons we have started a systematic study of a sample of metal-rich clusters in the infrared using IRAC2 withe the new NICMOS3 detector 256 × 256 pixels, mounted at the MPI/ESO 2.2-m telescope at La Silla (Chile).

Here, we present the results of combined visual and near-infrared photometry in one of the most metal-rich globular cluster NGC 6553 ([Fe/H] ~ –0.2). The optical counterparts come from Ortolani, Barbuy and Bica (1990).

1. Introduction

NGC 6553 (α = 18h 05m 11s; δ = –25° 55' 06" (1950.0); $[Fe/H] = ^{+0.2}_{-0.4}$ (Ortolani et al., 1990) is a low-latitude galactic globular cluster belonging to the metal-rich cluster family. These objects are projected in the direction of the galactic bulge and form a unique homogeneous sample of bulge population, so the correct determination of their age is crucial for the determination of formation epoch of the inner bulge. Their peculiar c-m diagrams are dominated by blanketing effects giving anomalous tilted HBs and a turnover on the giant branches (Ortolani et al., 1990, 1991, 1992, 1993a, 1993b, Bica et al., 1991). Recently (Bertelli et al., 1994), derived a whole set of solar and super-solar metallicity models which reproduce these characteristics, a major step towards modelling metal-rich pop-

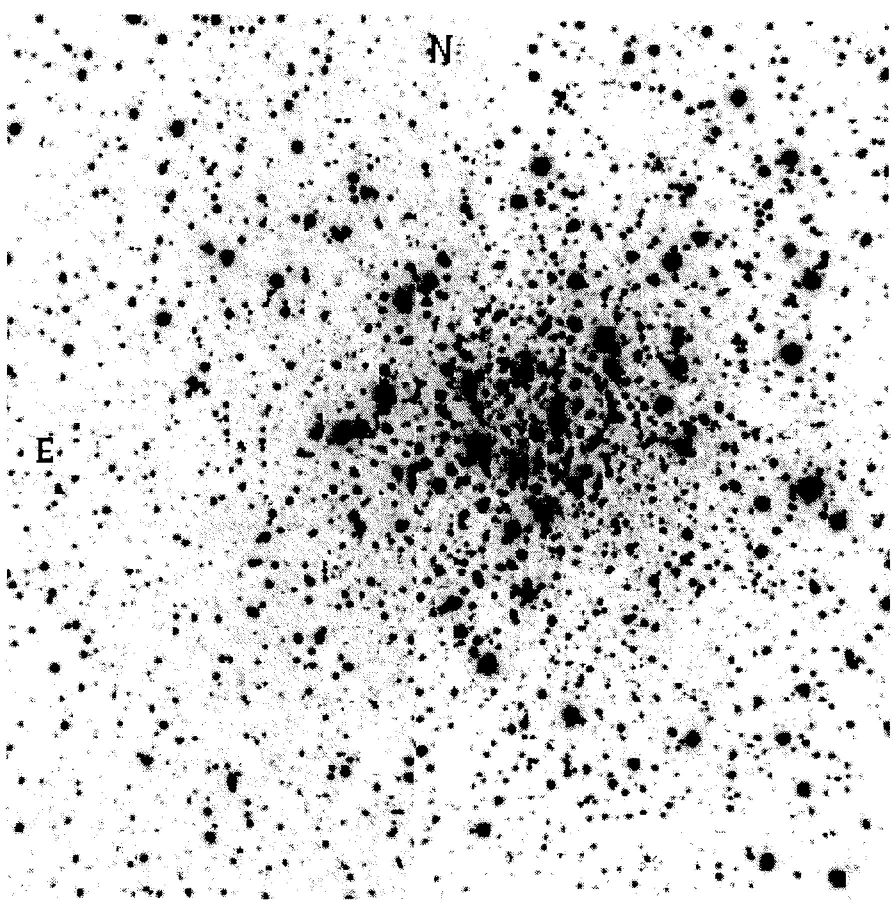

Figure 1: *NGC 6553 composite field as observed with IRAC2 0.5 arcsec/pixel mode, field size ~ 4 arcmin².*

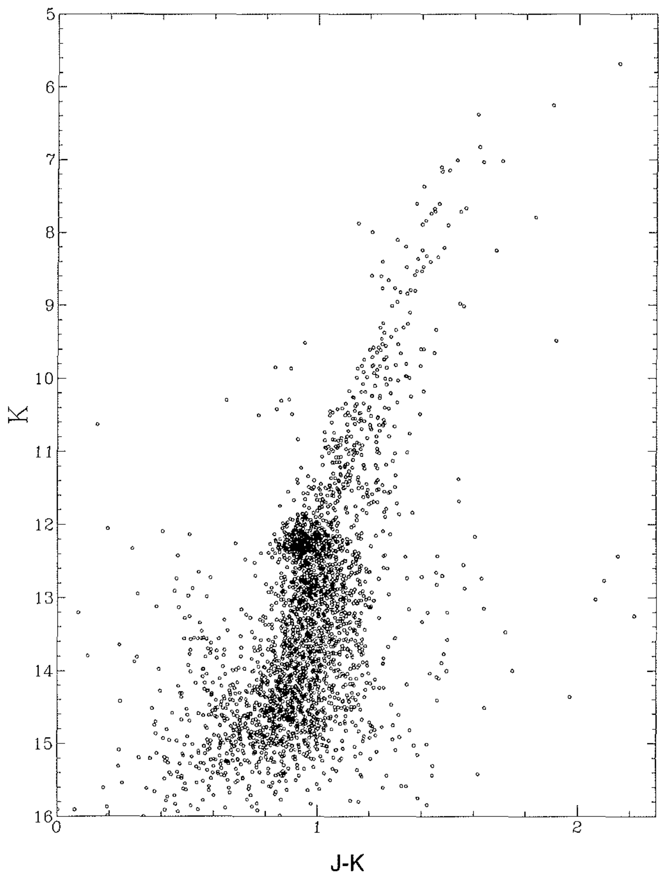

Figure 2: *(K, J–K) CMD of NGC 6553.*

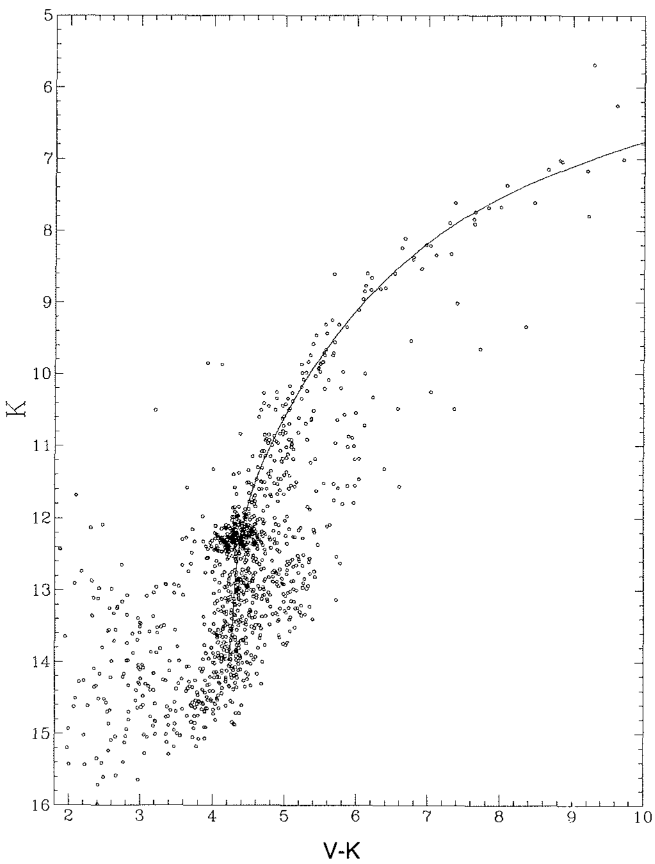

Figure 3: *(K, V–K) CMD of NGC 6553.*

ulations. One of the major problems seems to be the transformation from the theo-retical to the observational plane due to the heavy blanketing effect in the BVRI photometric data.

So, it is clear that IR photometry, much less affected by line and molecular band absorptions, can improve the current theoretical research in this field. For bulge stars, the infrared colours JHK are the best suited also because the extinction is much lower in the IR than in the optical bands, so that all uncertainties connected to the reddening plus blanketing effects determination are less important.

Moreover, combining optical and IR data, it is possible to obtain very useful colour indices, like the V-K which is an excellent indicator of effective temperature (T_e), being relatively insensitive to metallicity and having a long wavelength baseline and line-free continuum fluxes (Guarnieri et al., 1991; Ferraro et al., 1993).

The importance of this study is thus manifold: besides the information on temperatures for stars observable in high (or medium-low) resolution spectroscopy, or determined via the so-called "Infrared Flux Method" (Blackwell and Shallis (1977), Blackwell et al. (1980), Arribas and Martinez Roger (1987)), dating reddened clusters, estimating their red-dening and distance (consequently the globular system structure will be better known), check CMDs of some extremely reddened clusters and derive their properties are crucial points in determining the proto-Galaxy conditions after the initial collapse of the spheroid.

2. Observations and Data Reductions

Infrared observations have been carried out the night of June 11, 1992 using the ESO Rockwell NICMOS3 (HgCdTe, 256 × 256 pixels) infrared camera IRAC2 (cut-off wavelength at 2.5 μm, Moorwood et al., 1992) mounted on the MPI/ESO 2.2-m telescope at La Silla (Chile), at image scales of 0″.27 and 0″.49 for both standard J (1.25 μm) and K (2.19 μm) filters. Through each filter, we obtained a high-resolution image (first magnification value) of the cluster centre, and four partially overlapping images covering a ~ 2′× 2′ square region centred on the cluster core (second magnification). The total field covered is ~ 4 × 4 $arcmin^2$ (see Figure 1).

Separate sky frames located at ~ 10′ from the cluster centre were also observed, in each filter and magnification, for sky subtraction purpose. All images are the average of 60 frames of 1 second integration time. The observations were carried out with seeing < 1.4″.

The whole set of data has been analysed using the package for crowded fields photometry ROMAFOT (Buonanno et al. 1979, 1983).

Eight SAAO standards (kindly provided by Dr. Ian Glass) were observed during the run and most of them on at least two positions of the array. The calibration curve and all the details regarding the standard stars have already been published in Ferraro et al., 1993.

The optical BVRI sample, coming from Ortolani, Barbuy and Bica (1990), has been tied to the IR coordinate system using a linear interpolation and a comprehensive catalogue of 1196 BVRIJK stars has been created.

3. The Colour-Magnitude Diagrams

Figures 2 and 3 present the CMDs (K, J–K), and (K, V–K) for all the stars of the sample with the mean ridge lines superimposed. The (V, V–K) is shown in Figure 4 while Figure 5 shows the (V, V–I) diagram from Ortolani et al., 1990 containing only the stars in common with the infrared photometry.

These diagrams confirm the peculiar nature of NGC 6553 with a very red, compact horizontal branch also in the IR diagrams. The giant branch is well defined in the whole extension up to K ~ 6; a parallel redder and lower sequence is also visible in all the diagrams. Further investigations will confirm if this feature is due to a differential reddening or to the background field. The steep giant branch

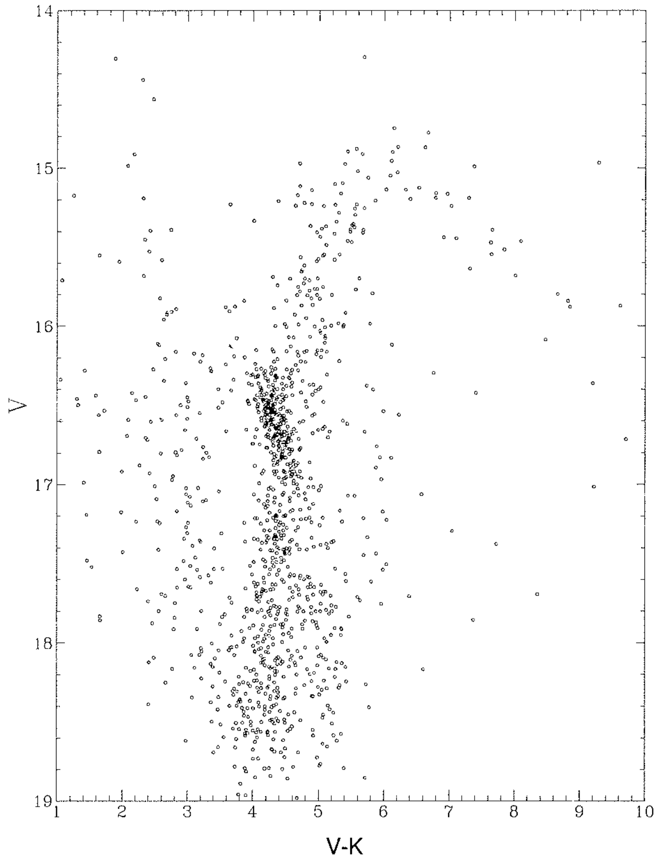

Figure 4: *(V, V–K) CMD of NGC 6553.*

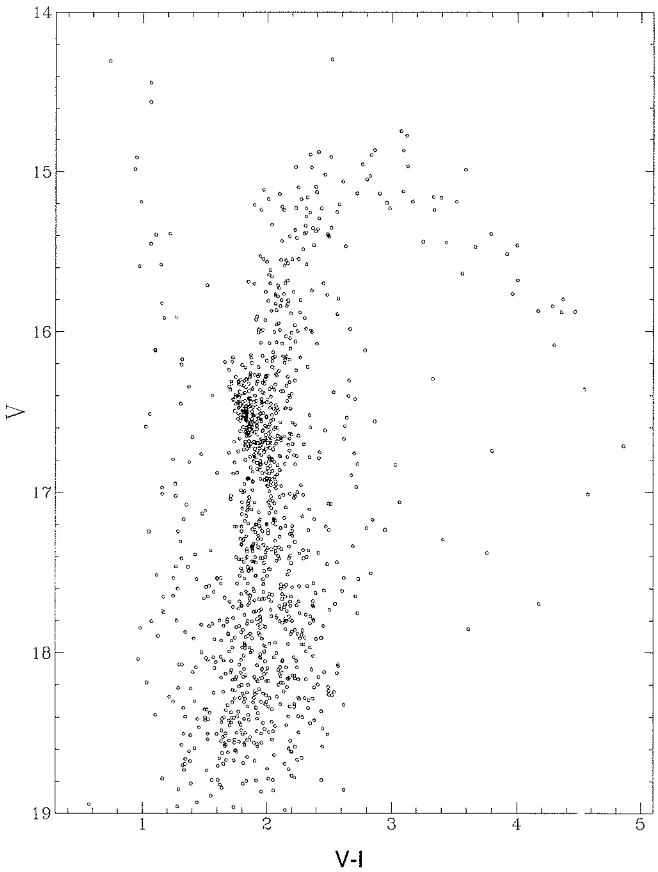

Figure 5: *(V, V–I) CMD of NGC 6553.*

in the IR diagrams shows that the use of IR colours greatly reduces the blanketing effects of the cool stars in metal rich clusters. The horizontal branch in Figure 2 can be localised at about K = 12.25 mag and V–K = 4.35. This measure is much more accurate than the luminosity level obtained using optical CMDs where it appears strongly tilted. From these values V_{HB} = 16.60 is deduced in a good agreement with Ortolani et al., 1990. Assuming M_V^{HB} = 0.8 for [Fe/H] = –0.2 (Fusi Pecci, F., private communication) we get a distance modulus of 13.35 corresponding to d = 4.8 Kpc from the Sun.

Another approach, not dependent on the data, makes use of the new Padua isochrones (Bertelli et al., 1994). For an age of ~ 14 Gyr, the mean level of the horizontal branch is at M_K = –1.45, that is a dereddened distance modulus of 13.4 or about 4.8 Kpc, in excellent agreement with the above determination.

Figure 6 relates the dereddened colour$(J\text{-}K)_0$ to the $(V\text{–}K)_0$, superimposed are the giant stars in 47 Tuc observed by Frogel et al., 1981 (filled circles). The sequence for the field giants (solid line) is from Frogel et al., 1978. There is a clear shift to a higher $(V\text{-}K)_0$ values of the NGC 6553 points compared with 47 Tuc, while the locus of the field stars fits very well. If the shift is only an effect of metallicity (Ferraro et al., 1994, Bertelli et al., 1994) this indicates a nearly solar abundance for NGC 6553.

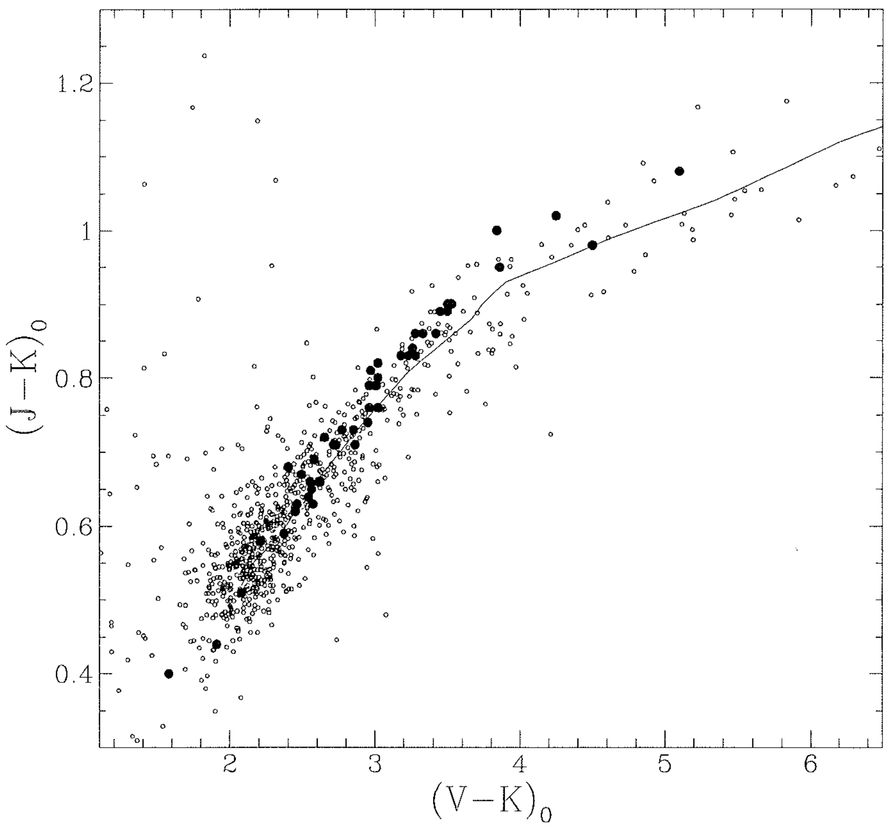

Figure 6: $(J\text{–}K)_0$ vs. $(V\text{–}K)_0$ CMD of NGC 6553. Superimposed are the giant stars in 47 Tuc observed by Frogel et al., 1981 (filled circles). The sequence for the field giants (solid line) is by Frogel et al., 1978.

The details concerning data acquisition and reduction, and the full astrophysical discussion will be published in a separate paper (Guarnieri et al., 1994).

Acknowledgements

We would like to thank the ESO organization for the allocation of observing time and for giving us the chance to be the first IRAC2 users. We also thank Hans Gemperlein for the help during the observing run. MDG acknowledges the Università and Osservatorio Astronomico of Torino for their support.

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Observations of the Shoemaker-Levy 9 Impacts on Jupiter at the Swedish-ESO Submillimetre Telescope

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1. Introduction

The SEST was one of the ten telescopes which were used at ESO for the observation of the encounter of comet Shoemaker-Levy 9 with Jupiter (West, 1994). The purpose of these millimetre observations was to search for molecular species which could have been injected or generated by the impacts. Carbon monoxyde was detected on July 23 on impact site G+Q+R+S through its J(2–1) line at 230 GHz. CO, which is normally present with a very low abundance in Jupiter's atmosphere, was likely formed by shock chemistry following the impacts. Difficulties in the reduction of the data prevented us from reporting these results with the other ESO preliminary results of this event in the September 1994 issue of *The Messenger*.

2. Observations

The observations at SEST were conducted from July 18 to 23, 1994. They were a part of a global strategy undertaken by a consortium of European, Canadian and US scientists in order to search for molecular species using millimetre heterodyne techniques. As a result of this strategy, observations of various molecules were made at the IRAM 30-m radio telescope in Spain (Lellouch et al.,1995), at the IRAM millimetre interferometer in France (Wink et al., 1994),with the James Clerk Maxwell Telescope in Hawaii (Marten et al., 1995), and at the SEST. The interest of millimetre heterodyne techniques for planetary observations is the high spectral resolution which allows the detection of narrow molecular lines formed in the stratosphere.

The SEST 15-m antenna is equipped with three heterodyne receivers working in the 80–116 GHz (3-mm receiver), 215–270 GHz (1.3 mm) and 320–360 GHz (0.8 mm) ranges. These receivers were used alternately, depending on weather conditions. We used as backends two spectrometers simultaneously with an 80-kHz resolution (0.1 km/s at 230 GHz) and a 1.4-MHz resolution. In order to reduce the effects of sky and receiver noise fluctuations, the observations were carried out using the "beam switching" method, in which the receiver alternately viewed the impact site and a reference beam position at 2' in azimuth. Because of the relatively large beam width of the telescope (half-power beam width of 15", 23" and 57" at respectively 346, 230 and 86 GHz) with respect to Jupiter's diameter (38" in July), we found it was not worth tracking exactly in position the impact sites. For the observations performed with the 3-mm receiver, the centre of the planet was pointed. For those at 1.3 and 0.8 mm, five beam positions regularly spaced on the Jupiter disk at the latitude of the impact sites (44° South) were defined for the observations. After the first observing days, each position generally encompassed several impact sites. Particular attention was given to the observation of the large impacts G, H, K, L, Q and R. 2-min scans were recorded.

The observations suffered from poor atmospheric conditions, with an opacity exceeding 0.5 at 230 GHz during the first 4 days. The weather was more cooperative on July 22 and 23, with opacities on the order of 0.35 and 0.25. On July 18, the J(3–2) and J(2–1) rotational lines of CO at respectively 345 and 230 GHz were searched for. Although the detection of millimetre lines of CO and HCN was announced at the IRAM 30-m and JCMT, the weather appeared too bad at ESO to allow detection of these species at SEST, and the three following days were mostly dedicated to an exploratory search of other species, namely ArH^+, ArH_3^+, SO_2, HC_3N near 245 GHz, and SiO (86 GHz) and HCO^+ (89 GHz). On July