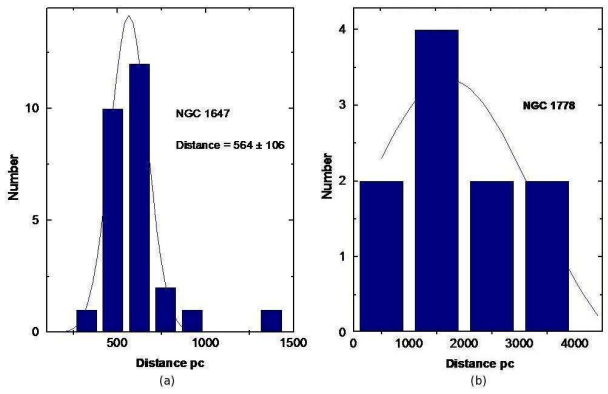

Fig. 3. Histogram of the distances for the stars in the direction of (a) NGC 1647 and (b) NGC 1778. The thin line is a Gaussian fit to the data.

NGC 1778 (Figure 3b), it is not possible to identify a cluster in that direction. We compared the distances obtained photometrically with those derived from studies of proper motions and Hipparcos (1997). However, only two stars in NGC 1647 were observed by Hipparcos; the first star is NGC 1647 15 (HIP 22122), with a parallax 1.66 mas, equivalent to a distance of 602 pc. This distance is consistent, within the error, with 682 pc, a distance that we determined photometrically. The second star observed by Hipparcos is NGC 1647 94 (HIP 22185), with a parallax 3.52 mas, equivalent to a distance 284 pc. This distance is smaller than that determined with photometry (395 pc). However, is still closer than the rest of the stars. For NGC 1647, stars which are members of the cluster are listed un the last column of Table 5; the criterion for those stars is a one sigma deviation from the average.

Once the membership is established, the age can be estimated by first calculating the effective temperature of the hottest stars. These temperatures are determined by plotting the location of such stars on the theoretical grids of LGK86, after evaluating the unreddened colors (Figure 2) for a solar chemical composition. We have considered this metallicity because, although no metallicity has been reported for NGC 1647, the cluster is located within 1.5 kpc from the Sun, i.e., at galactocentric distances where no substantial radial metallicity gradient has been detected (see e.g., Andrievsky et al. 2002). Thus, we can adopt the solar abundance of heavy elements for the cluster and neglect metallicity corrections.

Star 3 is the star with the highest temperature, but based on the distance, we concluded that it does not belong to the cluster. The next hottest star is star 55 because, even though there are several stars with effective temperature of 13000 K, that star has the most negative value of $(b-y)_0$. Hence, given the calibrations of Meynet et al. (1993) for open clusters, a log age of 7.98 ± 0.23 (i.e. 9.54×10^7 yr) is found from the relation $\log \text{age (yr)} = -3.6 \log T_{\rm eff} + 22.956$, which is valid in the range [3.98, 4.25] of $\log T_{\rm eff}$ (with a precision of 3×10^{-3}).

In the case of NGC 1778, Hipparcos (1997) also observed only two stars in the cluster. The first star is NGC 1772 5 (HIP 23904), which has a negative parallax, -0.59 mas, because the true parallax is smaller than the error. The second star is NGC 1778 2 (HIP 23894), which has a parallax of 2.84 mas, equivalent to a distance of 352 pc, very different from 1247 pc, the distance that we determined. In Table 5 we can see that there is a wide spread in the distances determined by different authors, but Joshi et al. (1975) propose that the difference is due to the fact that they used a revised value of 6.1 for the reddening coefficient R for NGC 1778 (Johnson 1968) because R varies significantly with longitude and galactic extinction in the region $100^\circ < l < 220^\circ$. This value differs from the usually accepted value of $R = 3$, but NGC 1778 has galactic coordinates $l = 168^\circ.88$ and $b = -2^\circ.00$.

5. CONCLUSIONS

New $uvby-\beta$ photoelectric photometry has been acquired for 35 stars of the open cluster NGC 1647 and 16 stars of the open cluster NGC 1778. For NGC 1647, unreddened indexes in the LGK86 grids allowed us to determine the effective temperature of the hottest star as 13000 K. We found a mean distance to the cluster of 564 ± 106 pc, which corresponds to a distance modulus of 8.75 ± 0.09 and a reddening $E(b-y) = 0.32 \pm 0.02$, which, through the relation $E(b-y) = 0.9E(B-V)$, gives a color excess of $E(B-V) = 0.35$ mag. These results are in good agreement with the parameters reported by other authors (Table 1).

In the case of NGC 1778, we were unable to determine whether a cluster in that direction exists or not. NGC 1778 observations include only 16 bright stars and, due to observing limitations, have not reached the cluster MS which is fainter. The determined distance to the stars represented in the histogram (Figure 3b) does not show any clustering of stars. Consequently, we do not have statistically significant data to derive any conclusion regarding this cluster, but based on an earlier and deeper photometric study, it is clear that NGC 1778 is an open star cluster.