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THE USEFULNESS OF 2MASS JHK_S PHOTOMETRY FOR OPEN CLUSTER STUDIES

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RESUMEN

Se utilizan datos en *JHK* para inferir el enrojecimiento y la distancia a cúmulos abiertos para los cuales son limitados los datos disponibles en el óptico. Se obtienen relaciones color-color y color-magnitud intrínsecos de la ZAMS con referencia a calibraciones existentes, estrellas estándar, tres cúmulos enrojecidos uniformemente: Stock 16, NGC 2362, y NGC 2281, y las enanas no-enrojecidas de las Hiadas. El método para inferir el enrojecimiento interestelar y la distancia a cúmulos abiertos escasamente poblados se aplica a Berkeley 44, Turner 1, y Collinder 419, cuyos resultados existentes están en conflicto con los inferidos a partir de los datos en *JHK*. Los últimos dos cúmulos son de especial interés: Turner 1 porque alberga a la Cefeida clásica con el período más largo de la Galaxia, y Collinder 419 porque yace en el complejo Cygnus X.

ABSTRACT

2MASS JHK_s data are used to infer the reddening and distance of open clusters for which limited optical data are available. Intrinsic ZAMS color-color and color-magnitude relations are derived with reference to existing calibrations, standard stars, three uniformly-reddened clusters: Stock 16, NGC 2362, and NGC 2281, and unreddened Hyades dwarfs. The method of inferring interstellar reddening and distance for sparsely-populated open clusters is applied to Berkeley 44, Turner 1, and Collinder 419, for which existing results conflict with those inferred from JHK_s data. The last two clusters are of special interest: Turner 1 because it hosts the Galaxy's longest-period classical Cepheid, and Collinder 419 because it lies in the Cygnus X complex.

Key Words: dust, extinction — Galaxy: open clusters and associations: general — Hertzsprung-Russell and C-M diagrams — methods: data analysis

1. INTRODUCTION

The introduction of CCD detectors to photometric studies of open clusters has led to significant improvements in the accuracy and precision of data for faint cluster stars observed previously via photoelectric or photographic techniques. The tradeoff is a low efficiency and associated steep wavelength dependence for such detectors in the blue-violet region, limiting photometric accuracy in the traditional ultraviolet filters: the Johnson system *U*-band and the Strömgren system *u*-band. Color corrections for observations in the ultraviolet become non-linear and multi-valued in that situation, particularly for hot stars that display a sizable Balmer discontinuity superposed on their continuum (see, for example, Moffat & Vogt 1977). Many recent open cluster studies have therefore been restricted to observations in the *BVRI* bands, or simply the *BVI* or *VRI* bands.

The intrinsic relations for OB stars and GK dwarfs in color-color diagrams restricted to such systems are nearly parallel to the reddening vectors for interstellar extinction (Caldwell et al. 1993), posing difficulties for establishing the reddening of cluster stars (see Carraro & Costa 2009). AF stars can be studied in such fashion (e.g., Turner et al. 2011), but that would limit photometric studies in *BVRI* to intermediate-age clusters with their main sequences consisting of unevolved $1 - 2\ M_\odot$ stars. Even in