

# The Distance to the ALFAZOAJ1952+1428 and KK246 galaxies.

L. Rizzi

W. M. Keck Observatory, Kamuela, HI 96743

[lrizzi@keck.hawaii.edu](mailto:lrizzi@keck.hawaii.edu)

and

R. B. Tully

Institute for Astronomy, University of Hawaii, Honolulu, HI 96822

and

E. J. Shaya

University of Maryland, Astronomy Department, College Park, MD 20743

Received \_\_\_\_\_; accepted \_\_\_\_\_

Not to appear in Nonlearned J., 45.

– 2 –

## ABSTRACT

TBD

*Subject headings:* TBD

## 1. Introduction

TBD

## 2. Observations

TBD

## 3. Tip of the Red Giant Branch

We derive the magnitude of the TRGB following the method described in Makarov et al. (2006). A parametric luminosity function is defined as:

$$\psi = \begin{cases} 10^{a(m-m_{TRGB})+b}, & m - m_{TRGB} \geq 0, \\ 10^{c(m-m_{TRGB})}, & m - m_{TRGB} < 0. \end{cases} \quad (1)$$

This function is then convolved with the completeness, uncertainty and photometric bias observational effects:

$$\varphi(m) = \int \psi(m') \rho(m') e(m|m') dm', \quad (2)$$

where  $\rho(m)$  is the completeness as a function of magnitude and  $e(m|m')$  is the error distribution function, both derived from artificial star tests. The error distribution function contains photometric uncertainty and photometric bias:

$$e(m|m') = \frac{1}{\sqrt{2\pi}\sigma(m')} \exp \left\{ -\frac{[m - \bar{m}(m')]^2}{2\sigma^2(m')} \right\}, \quad (3)$$

where  $\sigma(m)$  is the uncertainty and  $(\bar{m})$  is the bias.

To avoid uncertainties related to the choice of magnitude bins in determining the observed luminosity function, we construct a smoothed luminosity function following the prescription of Sakai et al. (1996). In summary, the discretely distributed stellar magnitudes are replaced by their corresponding Gaussian, following the expression:

$$\phi(m) = \sum_{i=1}^N \frac{1}{\sqrt{2\pi}\sigma_i} \exp \left\{ -\frac{(m_i - m)^2}{2\sigma_i^2} \right\}, \quad (4)$$

The first guess for the position of the TRGB is obtained by applying a Sobel edge-detection filter to the smoothed luminosity function.

#### 4. Equations used

##### 4.1. Reddening

Equations are from Schlafly & Finkbeiner (2011).

$$A_{F814W} = 1.526E(B - V) \quad (5)$$

$$A_{F606W} = 2.488E(B - V) \quad (6)$$

$$A_{F110W} = 0.881E(B - V) \quad (7)$$

$$A_{F160W} = 0.512E(B - V) \quad (8)$$

Derived from previous equations:

$$E(F110W - F160W) = 0.369E(B - V) \quad (9)$$

$$E(F606W - F814W) = 0.962E(B - V) \quad (10)$$

#### 4.2. Absolute magnitudes of TRGB

Equations derived from Rizzi et al. (2007).

$$M_{F814W} = -4.06 + 0.20[(F606W - F814W) - 1.23] \quad (11)$$

Equations derived from Wu et al. (2014).

$$M_{F110W} = \begin{cases} -5.02 - 1.41 \times [(F110W - F160W) - 0.95], & F110W - F160W \leq 0.95, \\ -5.02 - 2.81 \times [(F110W - F160W) - 0.95], & F110W - F160W > 0.95 \end{cases} \quad (12)$$

$$M_{F160W} = \begin{cases} -5.97 - 2.41 \times [(F110W - F160W) - 0.95], & F110W - F160W \leq 0.95, \\ -5.97 - 3.81 \times [(F110W - F160W) - 0.95], & F110W - F160W > 0.95 \end{cases} \quad (13)$$

#### 5. Results for ALFAZOAJ1952+1428

$$F814W_{TRGB} = 25.91 \pm 0.09 \quad (14)$$

$$(F814W - F606W)_{TRGB} = 1.34 \pm 0.08 \quad (15)$$

$$E(B - V) : 0.28 \quad (16)$$

$$F814W_{TRGB,0} = 25.49 \quad (17)$$

$$F814W_{Absolute} = -4.038 \quad (18)$$

$$(m - M)_0 = 29.53 \quad (19)$$

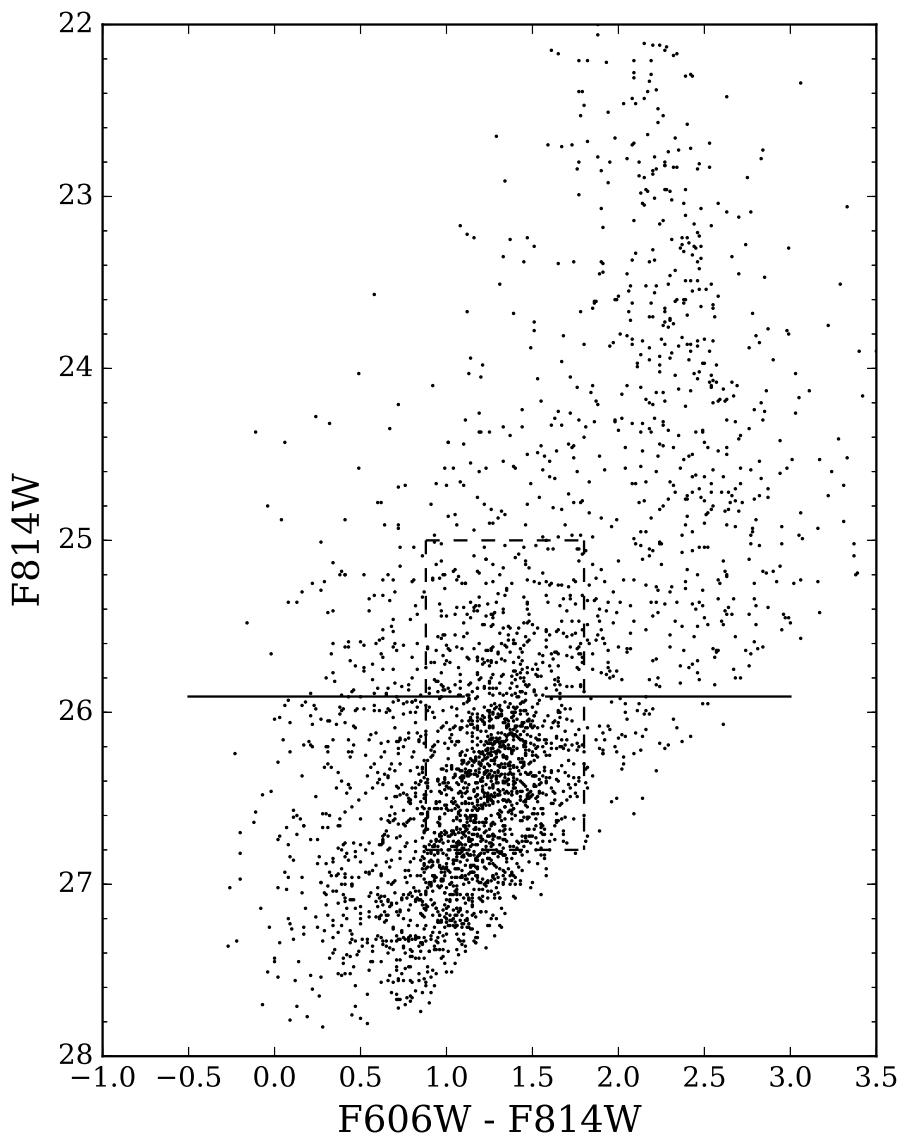


Fig. 1.— Color magnitude diagram.

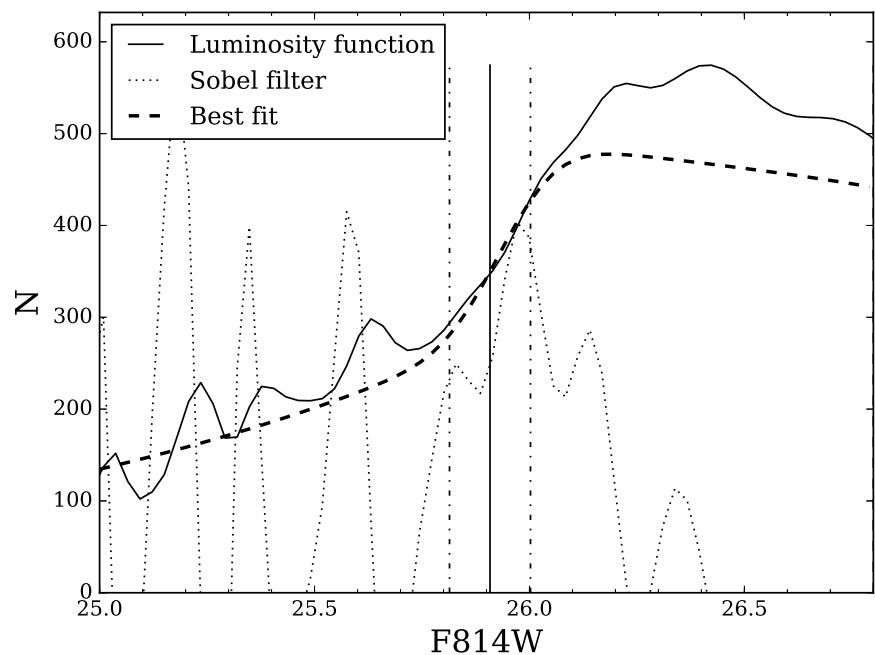


Fig. 2.— Measurement of the tip.

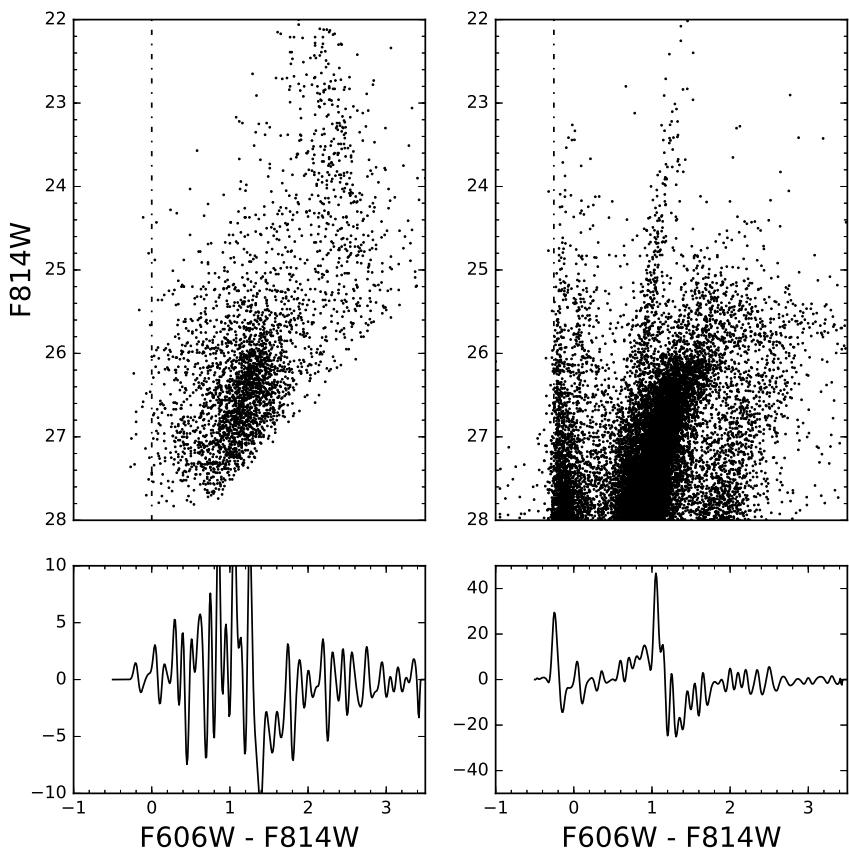


Fig. 3.— Reddening measurements.

### 5.1. Results for KK246

$$F110W_{TRGB} = 24.92 \pm 0.06 \quad (20)$$

$$F160W_{TRGB} = 23.84 \pm 0.03 \quad (21)$$

$$(F110W - F160W)_{TRGB} = 0.86 \pm 0.09 \quad (22)$$

$$E(B - V) : 0.67 \quad (23)$$

$$F110W_{TRGB,0} = 24.33 \quad (24)$$

$$F160W_{TRGB,0} = 23.50 \quad (25)$$

$$F110W_{Absolute} = -4.93 \quad (26)$$

$$F160W_{Absolute} = -5.81 \quad (27)$$

$$(m - M)_{F110W,0} = 29.26 \quad (28)$$

$$(m - M)_{F160W,0} = 29.31 \quad (29)$$

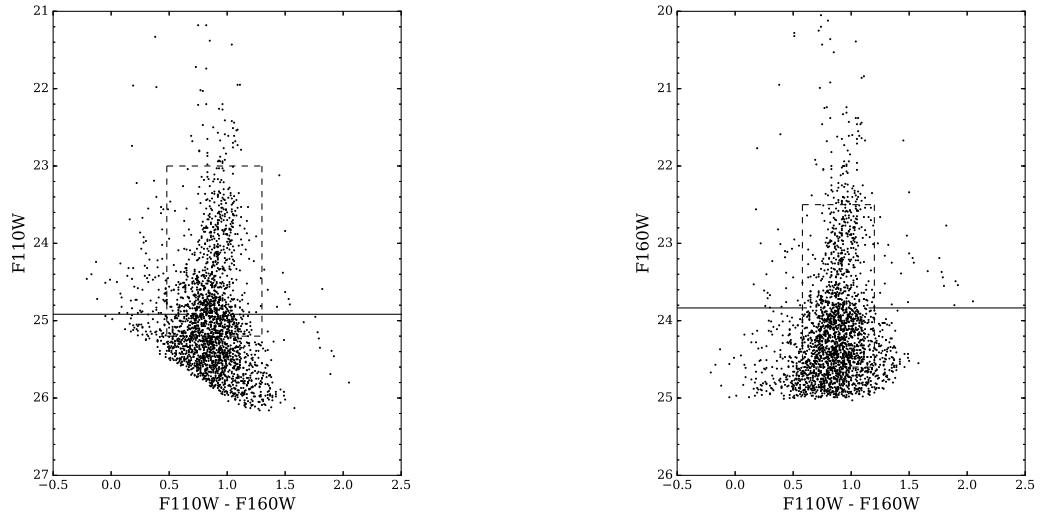


Fig. 4.— Color magnitude diagram.

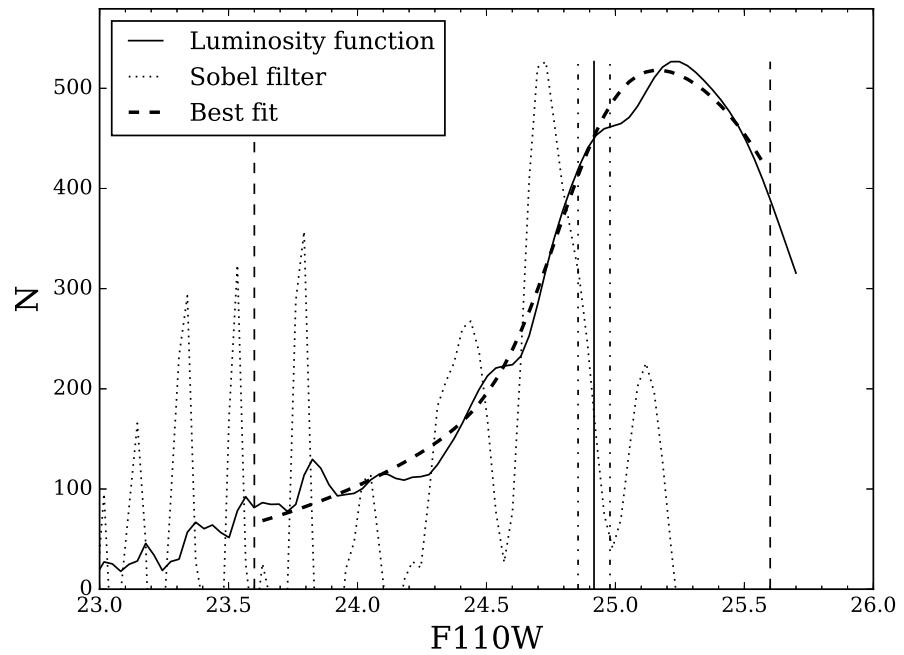


Fig. 5.— Measurement of the tip in F110W.

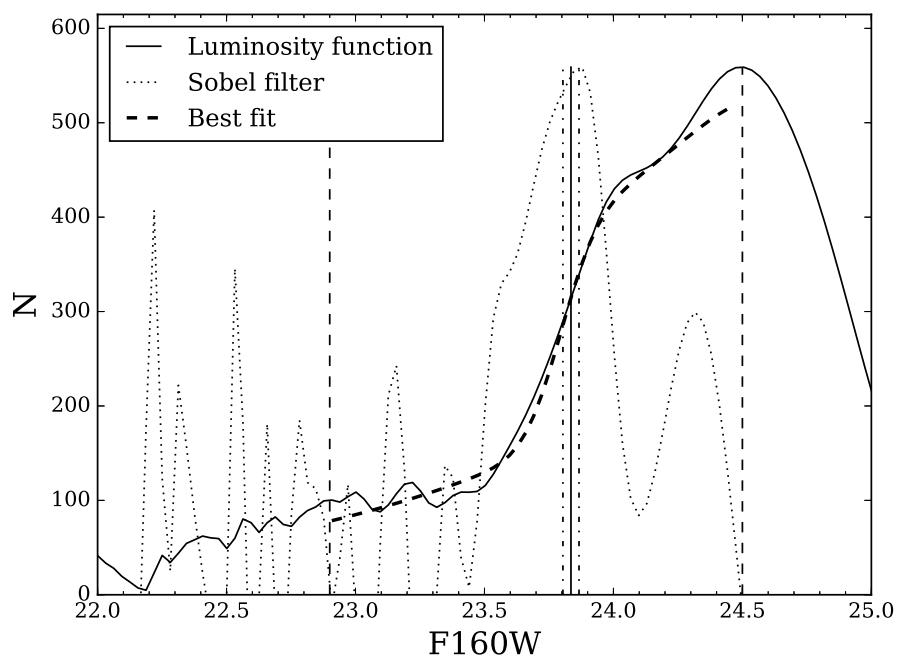


Fig. 6.— Measurement of the tip in F160W.

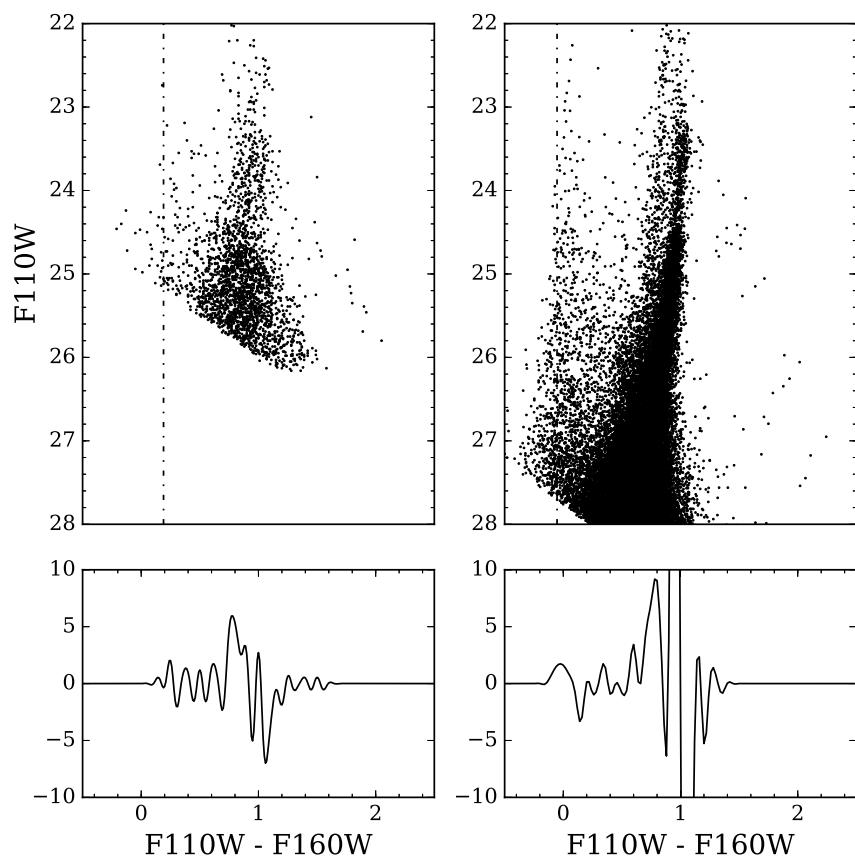


Fig. 7.— Reddening measurements.

## REFERENCES

- Makarov, D., Makarova, L., Rizzi, L., et al. 2006, AJ, 132, 2729
- Rizzi, L., Tully, R. B., Makarov, D., et al. 2007, ApJ, 661, 815
- Sakai, S., Madore, B. F., & Freedman, W. L. 1996, ApJ, 461, 713
- Schlafly, E. F., & Finkbeiner, D. P. 2011, ApJ, 737, 103
- Wu, P.-F., Tully, R. B., Rizzi, L., et al. 2014, AJ, 148, 7