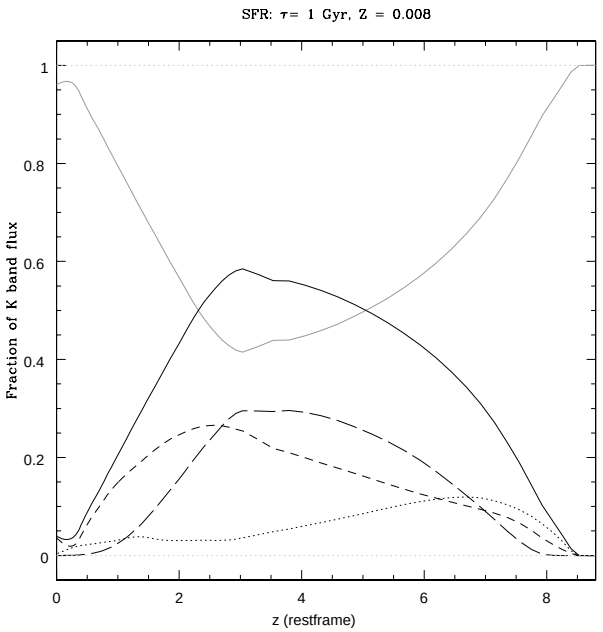

Fig. 7. Fraction of light contributed by TP-AGB stars and the "rest" of the stars (gray line) in the K-band as a function of redshift in the rest frame of the galaxy for a CB11 model built for the Chabrier (2003) IMF, an exponentially decaying star formation rate with $\tau =$ 1 Gyr, and $Z = 0.008$. The contribution of all, the O-rich, the C-rich, and the Super Wind (SW) phase TP-AGB stars is shown as black solid, short dashed, long dashed, and dotted lines, respectively.

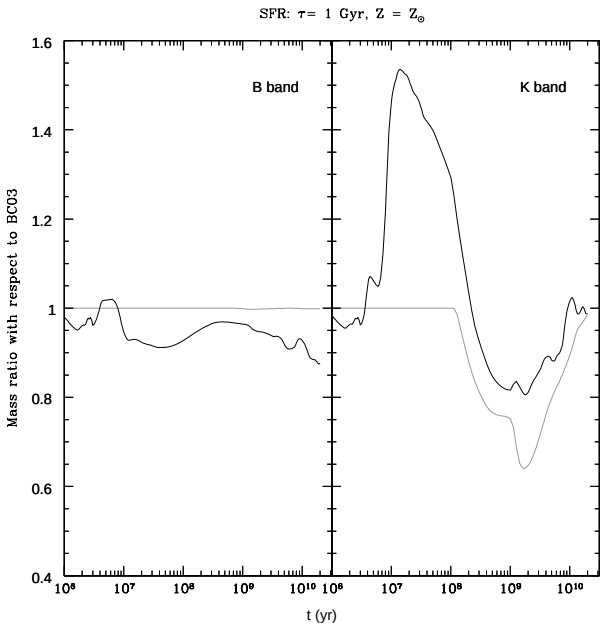

Fig. 8. Ratio of the stellar mass determined from the CB11 and CB07 models with respect to the BC03 model for a given B-band (left frame) and K-band (right frame) galaxy luminosity as a function of time. The black solid line represents the CB11/BC03 ratio. The gray solid line corresponds to the CB07/BC03 ratio. All models used in this figure were built for the Chabrier (2003) IMF, an exponentially decaying star formation rate with $\tau = 1$ Gyr, and $Z = Z_{\odot}$.

observations and basic theory. It is fair to say that the answers to distant galaxy problems will come from understanding nearby stars. So far, we have collected more photons from distant galaxies than from nearby stars. Population synthesis models can get better only if the ingredients that go into them get better. Most of the current uncertainties in these models come from uncertainties in our understanding of critical stages in evolutionary tracks, and from missing either observed or theoretical spectra of stars in relevant evolutionary phases.

3.1. *Basic things that we do not know well enough*

• Distance to star clusters needed for calibration of stellar evolution models to a higher precision than at present. These errors translate into errors in the age of galaxies or other stellar populations dated using synthesis models.

• Physical properties of more stars distributed all over the HR diagram: mass, Teff, radius, chemical abundance, chemical anomalies.

• Complete stellar spectral libraries that fill the current gaps (TP-AGB, EHB, Blue stragglers, etc.) in as wide a wavelength range as possible and with a good flux calibration. Figure 10 shows in a pictorial manner the wavelength coverage of most of the spectral libraries available in the literature and in common usage in population synthesis models today.

• Model stellar atmospheres that can be used instead of the observed spectra mentioned in the previous point, including complete line lists and the right geometry and kinematics. These libraries should be studied in detail and calibrated against the observations as was done by Westera et al. (2002) for the BaSeL 3.1 data set.

• Evolutionary tracks or evolutionary prescription for EHB stars: frequency of these stars, their lifetimes, dependence of these quantities on metallicity.

• The role of mass loss and rotation in stellar evolution and in the spectrophotometric properties of stars subject to different amounts of mass loss and rotation.

• Effects of dust on the spectra of individual stars. Interplay between mass loss and dust content.