Stellar Populations as Building Blocks of Galaxies
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An optimized H_β index for disentangling stellar clusters and galaxy ages

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Abstract. We have derived a new H_β absorption index definition, which is fully optimized as an age indicator for old and intermediate-aged stellar populations. Rather than using stellar spectra, we employed theoretical SEDs at moderately high resolution for simple stellar populations of different ages and metallicities. The new index, which is virtually insensitive to metallicity, provides us with improved abilities for lifting the age-metallicity degeneracy, that affects the standard H_β Lick/IDS index definition. Among other advantages this new index does not require spectra of extremely high signal-to-noise and it can be easily applied to observations of faint galaxies or surveys data.

Keywords. galaxies, ellipticals, age-metallicity degeneracy

1. Introduction

Since stars are not resolved for distant stellar populations, one relies upon intergrated colours and spectra to obtain their fundamental parameters, such as ages or metallicities. However the integrated light of galaxies suffers the well-known age-metallicity degeneracy, making a galaxy to look redder because it is older or metal richer (Arimoto & Yoshii, 1986 or Worthey, 1994). Rather than colours, line strength indices should be able to break that degeneracy, but even the most popular age indicator, i.e., the Lick H_β index, does depend on metallicity, particularly for old stellar populations. Despite the fact that other age indicators based on H_γ feature have shown a large sensitivity to the age, their signal-to-noise requirement is extremely high or their dependence on resolution or velocity dispersion make them very difficult to be applied for a large number of targets (Jones & Worthey, 1995 or Vazdekis & Arimoto, 1999).

2. Approach for Defining a new Index

The standard Lick/IDS system of indices was defined using stellar spectra that were not flux-calibrated and had a resolution $\sim$ 8.4 Å FWHM . This forces us to smooth higher-quality galaxy spectra to match the resolution of the Lick/IDS system in order to employ the model prediction based on this system. We explore here the advantadge of the SSP

Table 1. H_β INDEX DEFINITIONS

	Blue Pseudocontinuum Å	Feature Å	Red Pseudocontinuum Å
$H_{\beta_{LICK}}$	4827.875 4847.875	4847.875 4876.625	4876.625 4891.625
H_{β_o}	4821.175 4838.404	4839.275 4877.097	4897.445 4915.845

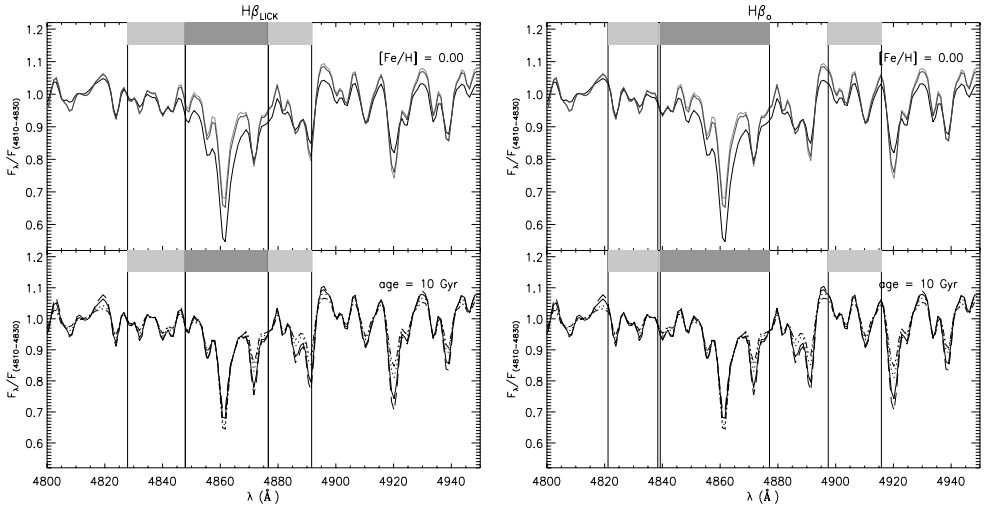

Figure 1. $H_{\beta_{LICK}}$ (*left panel*) and H_{β_o} (*right panel*) plotted on several SSP models. Up: Three SSP models of $[Fe/H]] = 0.00$ and ages = 5.6 Gyr, 10 Gyr y 15.9 (grey to black). Down:Four SSP models of age 10 Gyr and metallicities $[Fe/H] = +0.20$ (dash), +0.00 (solid), -0.38 (dot-dash) and -0.68 (dot-dash-dot). Basically, the improvement of the H_{β_o} definition is based on schewing the metal lines on the red-pseudocontinnum, mainly dominating in the $H_{\beta_{LICK}}$ one.

SEDs (Vazdekis, 1999 and Vazdekis, 2006) to derive a new index based on H_β feature suitable for an accurate age estimation, completly insensitive to the metallicity, with great stability against the smearing of this feature against variations of galaxy velocity dispersion or instrumental resolution, maximum stability versus wavelength shifts caused e.g., by galaxy internal rotation, recession velocity or non-accurate λ calibration. In Figure 1 and Table 1, we tabulate the limiting wavelength of the bandpasses of the $H_{\beta_{LICK}}$ and the new optimized definition for H_{β_o} feature.

3. Conclusion

We have define a new spectral index, H_{β_o}, based on H_β, robustly optimized for disentangling stellar clusters and galaxy ages and with a greater potential for lifting the age-metallicity degeneracy than the standard Lick definition, $H_{\beta_{LICK}}$. Since we are dealing with the popular absorption profile of H_β, the stability of the index versus spectral resolution or galaxy velocity dispersion is warrantied and observational spectra of high S/N are not requiered. This new H_{β_o} allows us to perform stellar population analysis in fainter galaxies, outer parts of objects or galaxies at high redshifts, avoiding the age-metallicity degeneracy.

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