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A key tool to probe Euclid spectroscopy: Spectro-Photometric simulations of galaxies to unravel NISP's capabilities

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To investigate the Euclid Near Infrared Spectrometer and Photometer (NISP) capabilities, Spectral Energy Distribution (SED) models of galaxies located at $0.3 \leq z \leq 2.5$ have been constructed, simulated using the TIPS simulator of the NISP red grism, and analyzed focusing on emission lines measurements.
These simulations will enable evaluating the spectroscopic survey performances of the Euclid mission and confirming that the slitless NISP spectrometer will match the requirements in terms of detection limits for the continuum and nebular emission lines.
The construction of the SEDs to be provided to the simulator consists in computing a continuum using the Bruzual & Charlot(2003) models, calling out best-fit SED parameters available in the publicly released catalogs from the Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey (CANDELS), namely the BARRO2019 (Barro et al. 2019) covering the Great Observatories Origins Deep Survey North field (GOODS-N) and the COSMOS2015 (Laigle et al. 2016). The nebular emission Balmer, [NII]λλ6584,6549, [OII]λλ3727,3729, [OIII]λλ5007,4959, [SII]λλ6731,6717, [SIII]λλ9531,9069 and Paschen lines are added making use of calibrations available in literature. We refer to common tools and indicators for emission lines analysis such as the Star Formation Rate (SFR), the Baldwin-Phillips-Terlevich (BTP) diagram, the Mass-Metallicity Relation (MZR) and photoionization models. The emission lines are then integrated to the continuum accounting for the calculated velocity dispersion of each galaxy. A photometric and spectroscopic comparison and calibration of the constructed SEDs with observational data is then applied to ensure a realistic sample distribution of the fluxes calculated. The 1D simulated spectra are obtained using the Euclid official reduction pipeline. The simulated spectra are analyzed making use of the Python package specutils. These simulations are part of the Euclid Consortium pre-launch efforts to characterize systematics through an end-to-end analysis.
We provide a confirmation of the detection limit specifications for the continuum (i.e. H(AB) $\geq$19.5 mag) and emission lines (i.e. Flux $\geq 2 \times 10{-}16$ erg cm-2 s-1 for the Euclid Wide Survey configuration and of Flux $\geq 6 \times 10{-}17$ erg cm-2 s-1 for the Deep Field survey configuration. We also provide an estimate of the NISP spectral resolution and its dependance on morphological parameters (e.g. Disk size) and present an analysis stacking spectra located at $1.8 \leq z \leq 1.95$, attesting the great potential of the method in confirming redshift determination, a crucial aspect for the Euclid mission.

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