## Galaxies statistical evolution from redshift 1.2 to 4 : a network view from SDSS and DESI survey

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I present an unsupervised classification study of 800,000 spectra from SDSS DR16 and DESI DR1 survey from redshift 1.2 to 4. The spectra were divided into 23 redshift bins corresponding to 160 Myr, corrected for cosmological dimming, de-redshifted, and standardized (Z-score). I used Gaussian mixture models in a latent discriminant subspace to find classes and sub-classes (FisherEM). The sub-classification was optimized thanks to diversity criteria arising from information theory (Leinster-Cobbold Index). The different classes were subsequently linked with FisherEM to form a network graph of galaxy species.

The unsupervised classification process produces about 1500 classes containing thousands to few spectra. Most small classes correspond to high-mass/continuum galaxies. The z-score standardization and sub-classification exhibit massive galaxies. Galaxies with various continuum slopes and emission/absorption features are revealed. The network graph synthesizes the information while links are interpreted as evolutionary relations.

This unsupervised statistical evolution method is a great synthesis tool (about 4 order) but foremost opens new prospects to galaxy evolution with a new classification scheme that could be used with supervised learning later on.