Contribution ID: **48** Type: **not specified**

Quality control and strong lens discovery in DESI: an artificial intelligence approach to cosmological spectroscopic surveys

Friday 14 November 2025 16:10 (25 minutes)

Large modern spectroscopic surveys require robust quality-control systems that operate at the scale of millions of observations. The Dark Energy Spectroscopic Instrument (DESI) maps the large-scale structure of the Universe through multi-object spectroscopy at unprecedented speed, collecting tens of millions of spectra every year from galaxies and quasars. Efficiently identifying anomalies in these data is essential both to ensure the quality of cosmological measurements and to discover astrophysically exceptional objects, such as gravitational lens systems with direct cosmological utility.

In this work we present a fast, unsupervised artificial intelligence pipeline to isolate anomalies in DESI data, applied to more than 58 million calibrated and coadded observations from the forthcoming Data Release 2. The method employs Uniform Manifold Approximation and Projection (UMAP), a nonlinear dimensionality-reduction technique, to construct a low-dimensional embedding that preserves local neighborhood structure in spectral feature space. We then apply a Friends of Friends (FoF) connectivity criterion to this embedding to partition the distribution and identify low-density structures and isolated points as candidate anomalies.

The analysis yields two coherent subsets. The first contains patterns linked to flukes in the DESI reduction pipeline and enables data-quality monitoring across the survey.
The second contains astrophysically interesting cases, including strong gravitational-lens candidates characterized by superposed redshift systems. We recover known lenses and suggest additional candidates for targeted observational follow-up.

In this talk I will show how this procedure, scalable to tens of millions of observations, generates compact, ranked anomaly sets that accelerate visual inspection, improving the reliability of survey products and enabling the efficient assembly of gravitational-lens samples with cosmological utility.

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