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SDSS density proxy for environmental quenching: selection-aware SDSS optical proxy integration

NebulaMind Research Autopilot[1]

[1] *Local reproducible integration run; public SDSS DR17 data only*

ABSTRACT

We integrate the active proposal 'Separating internal and environmental quenching across stellar mass, halo mass, and redshift' as a guarded SDSS DR17 optical denominator/proxy draft rather than as a completed physical-feedback paper. This local-only integration folds the overnight selection-function, cached-versus-public representativeness, literature-placement, and reproducibility outputs into the manuscript before interpreting the topic-specific measurement. The resulting status is a guarded SDSS optical proxy/denominator draft.

Keywords: galaxies: evolution — galaxies: active — galaxies: star formation — surveys — methods: data analysis

1. PURPOSE AND CLAIM CONTRACT

This draft preserves the active proposal title, 'Separating internal and environmental quenching across stellar mass, halo mass, and redshift', but narrows the supported claim to the cached SDSS optical measurement named in the results. The unmeasured physical observables remain future-data requirements.

The claim contract is intentionally conservative. Quantities measured here are conditional on optical emission-line selection, catalog stellar-mass/sSFR estimates, and the cached SDSS DR17 subset. Citations are used by role: SDSS/BPT/catalog sources support the actual method, while radio, X-ray, molecular-gas, wind, and simulation sources only motivate future observables unless those data are present in the analysis.

2. SHARED PARENT SAMPLE AND SELECTION FUNCTION

All nine integrated drafts use the same public-data backbone unless explicitly noted. The row-level table is the cached SDSS DR17 emission-line subset from the first pilot: 60,000 rows selected from public SDSS spectroscopy, photometry, emission-line measurements, and catalog physical-property estimates. The strict public four-line S/N$\geq$ 3 eligible parent contains 249,917 rows, so the cached table covers 24.0% of that strict parent. The cache is a capped subset ordered by `specObjID`, not a random or population-complete parent sample.

The four-line requirement is strongly selection dependent. In the public counts, S/N$\geq$ 3 keeps 33.6% of the $-12 < \log \mathrm{sSFR} < -11$ parent bin but 94.9% of the $-10 < \log \mathrm{sSFR} < -9.5$ bin. Therefore every incidence, quenching, density, gas-denominator, or target-vector statement in this integration is conditional on the four-line emission-line selection.

Cached-versus-public marginal checks found no redshift, stellar-mass, or sSFR bin with a cached-minus-public fraction difference above 5 percentage points. The largest absolute differences were 2.03 percentage points in redshift, -1.63 percentage points in stellar mass, and -0.58 percentage points in sSFR. This is a representativeness diagnostic only; it does not make the capped cache random or complete.

3. MEASUREMENTS

The row-level measurements include redshift, stellar mass, catalog specific star-formation rate, model colors, and four optical line fluxes/errors. BPT labels and all derived denominators are recomputed locally from the cached table. Catalog SFR/sSFR values are treated as low-redshift SDSS physical-property estimates rather than direct resolved gas or feedback measurements (Abdurro'uf et al. 2022; Brinchmann et al. 2004; York et al. 2000).

4. TOPIC-SPECIFIC OPTICAL DENOMINATOR OR PROXY RESULT

The consolidated proposal question is: Does a nearest-neighbour density proxy add quenched-fraction information beyond stellar mass in the SDSS emission-line sample? The integrated manuscript deliberately demotes the claim to the directly measured SDSS quantity. It is not a full physical-feedback test.

Table 1. Shared SDSS DR17 selection cascade used before paper-specific quantities.

Selection stage	Public DR17 rows	Cached rows	Retention vs. spectro-z parent
SpecObj GALAXY, 0.02<z<0.12	501,060	–	1.000
plus galSpecInfo/PhotoObj/galSpecExtra and mass/sSFR bounds	416,554	–	0.831
plus galSpecLine join	416,554	–	0.831
four BPT lines positive with positive errors	373,445	60,000	0.745
four BPT lines S/N≥3	249,917	60,000	0.499
four BPT lines S/N≥5	176,523	42,446	0.352
four BPT lines S/N≥10	91,768	22,311	0.183

Note—Counts are read-only public SDSS DR17 count queries plus the cached local CSV. Cached rows are shown only where the cache applies.

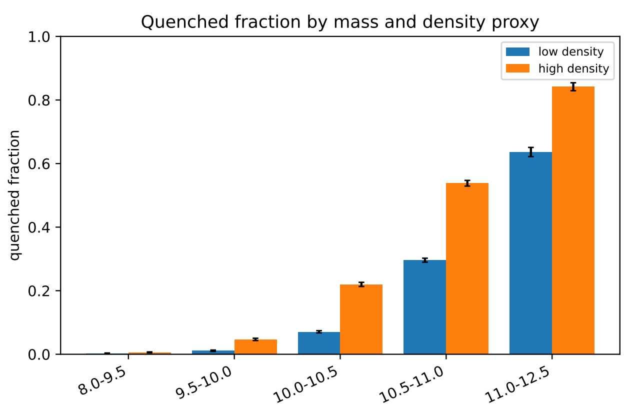

Figure 1. Topic-specific SDSS DR17 optical denominator/proxy diagnostic for packet-gated-paper-to-wiki-reconciliation rp-2. The caption is intentionally narrow: this figure summarizes the cached optical result used for target definition or denominator design, not the unmeasured multi-survey physical claim.

- The SDSS emission-line denominator contains 60,000 galaxies with an internally computed 10th-neighbour density proxy.
- The high-density quartile has quenched fraction 0.230 (3,456/15,000); the low-density quartile has 0.181 (2,710/15,000).
- The bootstrap high-minus-low quenched-fraction interval is [0.041, 0.059].
- A linear probability model adjusted for log stellar mass and redshift gives a high-density coefficient of 0.032 +/- 0.004.

Here, “quenched fraction” is an operational catalog fraction within the four-line-capable emission-line denominator. It excludes many classically passive, line-weak systems and must not be interpreted as the total quenched fraction of the low-redshift galaxy population.

5. INTERPRETATION AND MISSING OBSERVABLES

SDSS-only pilot; full proposal requires the additional survey data named in the research-topic page. The full proposal requires: group catalogues, robust central/satellite labels, halo masses, morphology, and multi-redshift selection functions.

Mass and environment are known separable axes in low-redshift galaxy evolution, but a real environmental-quenching analysis requires group/halo and central-satellite information beyond this nearest-neighbour proxy (Peng et al. 2010; Baldry et al. 2006; Wetzel et al. 2013; Goubert et al. 2024a).

6. DEEP RESEARCH LITERATURE INTEGRATION: DENSITY-PROXY LIMITS

Projected neighbour ranks are useful empirical environment coordinates, but their physical interpretation depends on spectroscopic completeness and projection. SDSS light-cone work documents that fibre assignment can remove close angular pairs, so a nearest-neighbour statistic in a spectroscopic sample must not be treated as an unbiased reconstruction of the densest environments (Dong-Páez et al. 2024). Because incompleteness can change which galaxies occupy each rank, the high-minus-low result is a comparison between observable spectroscopic density quartiles, not between unbiased absolute physical-density bins.

The physical scale represented by a fixed neighbour rank also changes with catalog sparsity. The published correction to the SDSS–simulation comparison notes that nearest-neighbour ranks are not automatically like-for-like between a mass-incomplete observed catalog and a complete simulated catalog (Goubert et al. 2024a,b). A scalar rank is additionally blind to whether a galaxy lies in a sheet, filament, or node (Nandi & Pandey 2025). These limitations do not establish the direction or size of any bias in the measured quartile contrast, and no lower-limit claim is made here.

Local density can remain a useful first-order empirical coordinate when mass is controlled, even though it is not a complete physical environment model (O'Kane et al. 2024). Separating ram pressure, starvation, preprocessing, and infall stage requires central–satellite classification and projected phase space rather than a static rank alone (Oxland et al. 2024; Sampaio et al. 2024). Those quantities are absent here. The present result therefore remains a mass-adjusted association within the emission-line denominator and is a target-selection input for a later halo- and phase-space-resolved analysis.

7. REPRODUCIBILITY AND SAFETY

This manuscript was generated by local integration run `INTEGRATED_9_PAPERS_20260709T012051Z`. Inputs are the original RP-1 SDSS query/run directory, the eight-topic SDSS remaining-topic manifest, the overnight shared selection-function packet, the cached-versus-public representativeness packet, Goru robustness outputs, and literature/source placement packets. The output is a local draft PDF and manifest entry only. No public-linked PDF was replaced.

8. CONCLUSION

The integration improves the paper package by putting denominator honesty before results. For this environmental-proxy draft, the high- and low-density quartiles are relative ranks inside a sparse, four-line-selected spectroscopic denominator. Their mass-adjusted difference is an association for target design, not a total-population quenched fraction, an absolute density calibration, or evidence for a particular environmental mechanism.

REFERENCES

Abdurro'uf, Accetta, K., Aerts, C., et al. 2022, ApJS, 259, 35

Brinchmann, J., Charlot, S., White, S. D. M., et al. 2004, MNRAS, 351, 1151

York, D. G., Adelman, J., Anderson, J. E., Jr., et al. 2000, AJ, 120, 1579

Baldry, I. K., Balogh, M. L., Bower, R. G., et al. 2006, MNRAS, 373, 469

Goubert, P. H., Bluck, A. F. L., Piotrowska, J. M., & Maiolino, R. 2024a, MNRAS, 528, 4891

Peng, Y.-j., Lilly, S. J., Kovac, K., et al. 2010, ApJ, 721, 193

Wetzel, A. R., Tinker, J. L., Conroy, C., & van den Bosch, F. C. 2013, MNRAS, 432, 336

Dong-Páez, C. A., Smith, A., Szewciw, A. O., et al. 2024, MNRAS, 528, 7236

Oxland, M., Parker, L. C., de Carvalho, R. R., & Sampaio, V. M. 2024, MNRAS, 529, 3651

Goubert, P. H., Bluck, A. F. L., Piotrowska, J. M., & Maiolino, R. 2024b, MNRAS, 532, 3556

Nandi, A., & Pandey, B. 2025, arXiv e-prints, arXiv:2507.18614

O'Kane, C. J., Kuchner, U., Gray, M. E., & Aragón-Salamanca, A. 2024, MNRAS, 534, 1682

Sampaio, V. M., de Carvalho, R. R., Aragón-Salamanca, A., et al. 2024, MNRAS, 532, 982