

TDG/TQ Pre-Data Predictions for the 2025 LHC Pb–Pb Campaign

Parameter-Locked Forecasts with Methods, Deviations, and Reference Geometry

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Abstract

This record lists *pre-data*, parameter-free predictions from the Time-Dilation Geometry / Timeless Quanta (TDG/TQ) framework for key Pb–Pb observables targeted by ALICE, CMS, ATLAS, and LHCb during the 2025 heavy-ion campaign. Each prediction is accompanied by its baseline comparator (hydrodynamics, pQCD, or clustering), method, numerical value, deviation, and geometric lock. No post-run adjustments will be made. All constants, curvature thresholds, and scaling laws originate from the companion theoretical work [1]. Artificial intelligence tools were used solely to assist in document structuring, LaTeX formatting, and reference consistency checks; all scientific reasoning and derivations are the author’s.

Reference Geometry and Core Framework

All scaling laws, curvature thresholds, and normalization constants used here are defined in detail in the companion theoretical paper:

J. Rouse, *Timeless Quanta: A Threshold Geometry for Mass, Entropy, and Time* (Version 3.0, 2025), Zenodo, DOI: [10.5281/zenodo.14693026](https://doi.org/10.5281/zenodo.14693026).

That paper establishes the single geometric lock:

$$r_c = 0.447 \text{ fm}, \quad \Theta_c = 1.62 \times 10^{38} \text{ m}^{-2}, \quad K = -1.93 \times 10^{47},$$

which remain fixed for all Pb–Pb predictions below.

Prediction Table (Baselines, Methods, Deviations, Lock-In)

| Collab. | Observable | Baseline | TDG/TQ Method | Prediction | Deviation | Lock-In |
|---------|---|---|---|---|------------------|------------------|
| ALICE | ZDC neutrons ($b < 2$ fm) | ZDC clustering (typical ablation model) | Curvature detachment at participant-spectator boundary; interface gradient exceeds Θ_c . | +35–45% yield vs. clustering | +35–45% | r_c, σ, L |
| ALICE | Elliptic flow v_2 vs. N_{trk} | Hydro (viscous, tuned η/s) | Coherence-break threshold halts anisotropy growth beyond Θ_c saturation. | 15–20% below hydro for $N_{\text{trk}} > 9\text{k}$ | –15––20% | r_c, σ |
| ALICE | Photon/ π^0 near $p_T \sim 1$ GeV/ c | Thermal photon baseline | Curvature-release bump from threshold relaxation of near-zero mode. | +5–8% local enhancement | +5–8% | r_c, Φ |
| CMS | Inclusive hadron R_{AA} (6–10 GeV/ c) | pQCD+hydro baseline | Curvature-amplified attenuation: path segments above threshold increase quenching. | 0.68 ± 0.03 | –0.05––0.10 | r_c, Φ, L |
| CMS | Z^0 -tagged jets | pQCD inclusive | Isolated vertex exposes full threshold loss; enhanced attenuation. | $R_{Z\text{-jet}} = 0.55 \pm 0.04$ | –0.10––0.15 | r_c, Φ |
| CMS | γ -tagged jets | pQCD | Lower curvature shadowing yields intermediate attenuation. | $R_{\gamma\text{-jet}} = 0.60 \pm 0.05$ | –0.05––0.10 | r_c, Φ |
| ATLAS | Dijet acoplanarity (30–50%) | Hydro+turbulence | High- Ξ curvature streaks broaden large- $\Delta\phi$ tails. | +10–15% tail excess | +10–15% | r_c, L |
| LHCb | Forward boson asymmetry ($\eta \sim 2\text{--}4$) | PDF+shadowing models | Coherence-threshold gradient across rapidity induces small bias. | Few-% asymmetry (sign-fixed) | Outside PDF band | r_c, Θ_c |

Verification Protocol

- **Parameter lock:** All values derive from constants fixed in [1]; no new fits or tunings.
- **Comparators:** Deviations are relative to typical hydrodynamic, pQCD, or clustering models cited in experimental heavy-ion literature.
- **Archival link:** Core geometry, constants, and derivations — [Timeless Quanta \(10.5281/zenodo.14693026\)](https://zenodo.org/record/14693026).

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References

- [1] J. Rouse, *Timeless Quanta: A Threshold Geometry for Mass, Entropy, and Time*, Zenodo (2025), DOI: [10.5281/zenodo.14693026](https://doi.org/10.5281/zenodo.14693026).