Spacetime Resistance IV:

Normalized Exact-Interior Sequences with Supporting Notes

David & Ara

14 October 2026

Abstract

We continue the fixed-scale Kretschmann formulation of Spacetime Resistance by normalizing piecewise-polytropic equations of state inside the exact-interior integrator. Sequences are obtained in which a 1.4 solar-mass star has radius approximately 12 km. Maximum masses in the same sequences lie near 3 solar masses under the single critical curvature already fixed by neutron-star compactness. Additional polytropic freedom does not remove the residual. The exterior remains exactly Schwarzschild. Supporting notes collected in the appendices record the conservation residual, the slow-rotation post-processing path, the cosmological regularization, and a pre-registered protocol for future dynamical integrations. Papers II and III are unaltered.

1 Setup

The resistance term and the exact static-spherical Kretschmann scalar are those of Spacetime Resistance III:

$$\rho_{\rm eff} = \frac{\rho}{1 + \beta K/K_{\rm crit}}, \tag{1}$$

with K the full interior expression. Piecewise polytropes are integrated at fixed β and $K_{\rm crit}$. No additional scales are introduced. The exterior solution remains identically Schwarzschild.

2 Sequences

Systematic variation yields a stable window (geometric units):

- $R(1.4\,M_\odot) \approx 11.5$–$12.8\,\mathrm{km}$
- $M_{\rm max} \approx 2.7$–$3.1\,M_\odot$

Representative sequence ($K_l \approx 160$, $K_{\rm crit} \approx 1.1 \times 10^{-2}$, $\beta \approx 1.05$):

ρ_c (geo)	R (km)	M ($M_\odot$)
0.004	13.3	2.95
0.008	12.6	2.89
0.015	12.4	2.87
0.030	12.3	2.87
0.060	12.3	2.87

A three-piece trial and a softer high-density variant both returned maximum masses $\gtrsim 3.0\,M_\odot$. The residual is attributed to the fixed critical curvature.

3 Comparison with approximate-K results

The exact-interior sequences remain compatible with a $\sim 12\,\mathrm{km}$ radius for $1.4\,M_\odot$ once the equation of state is normalized, confirming that the upgrade from approximate to exact K does not destabilize the models.

4 Discussion

The normalized sequences place a canonical $1.4\,M_\odot$ star near 12 km while preserving the exterior Schwarzschild geometry and the cosmological regularization of Paper III. The maximum mass near $3\,M_\odot$ is a reproducible outcome of fixed K_{crit} under piecewise-polytropic matter.

5 Outlook

Substitution of a tabulated nuclear EOS, or a dynamical integration under the protocol of Appendix D, can be performed without modification to the resistance term or to Papers II and III.

A Conservation Residual

From any finished solution the residual

$$\mathcal{R}(r) = \frac{dP}{dr} + \frac{(\rho_{\mathrm{eff}} + P)\big(m + 4\pi r^3 P\big)}{r^2\big(1 - 2m/r\big)}$$

must vanish to truncation error. The test uses only existing output.

B Slow-Rotation Post-Processing

The exterior is exactly Schwarzschild, so the first-order frame-dragging equation is the standard one. The moment of inertia follows by post-processing the existing ρ_{eff} profiles. No new parameters are introduced.

C Cosmological Regularization

The identical resistance term produces a maximum in ρ_{eff} and a nonsingular FLRW evolution. No additional parameter is required.

D Pre-Registered Collapse Protocol

Evolve first with fixed K_{crit}. If $K_{\text{peak}} \geq 10^4 K_{\text{NS}}$ (or is still rising), activate

$$K_{\text{crit}}(K) = K_0 \left(1 + \gamma \frac{K}{K_0}\right)^{-1}$$

and increment γ until a plateau appears. Initial data, polar/areal gauge, output columns and termination condition are fixed in advance. Both outcomes are reported.

Repository: www.mashibavah.com