# Paper I: Mass Evolution in Observed Black Holes Using the RC-CMAX Framework

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**Abstract**

This study applies the RC-CMAX cosmological model to three well-characterized black holes—Sagittarius A*, M87, and TON 618—using no adjustable parameters. Predicted mass evolution is compared against empirical observations via CSV-based time curves and plotted redshift dynamics. The resulting alignment, validated through error rate analysis, supports the hypothesis that mass rendering from metadata follows a computable trajectory defined by finite channel capacity.

## 1. Introduction

Following the framework established in Paper 0, we test the predictive capability of the RC-CMAX model by applying it to black holes with well-established observational mass profiles. This empirical validation is structured as a direct model-to-data comparison using independently simulated outputs and published datasets.

## 2. Overview of the RC-CMAX Model

As introduced previously, the model derives from the Bekenstein bound to compute an absolute information limit ($C_{\text{MAX}}$) and uses a resistor-capacitor (RC) analogy to describe the rendering of mass over time. The governing curve follows:

$$M(t) = M_{\text{total}} \cdot \left(1 - e^{-\alpha t}\right)$$

Time dilation and bottleneck behaviors are intrinsic to the rendering process, which is assumed to reflect internal redshift dynamics and spatial expansion constraints.

## 3. Case Study I: Sagittarius A*

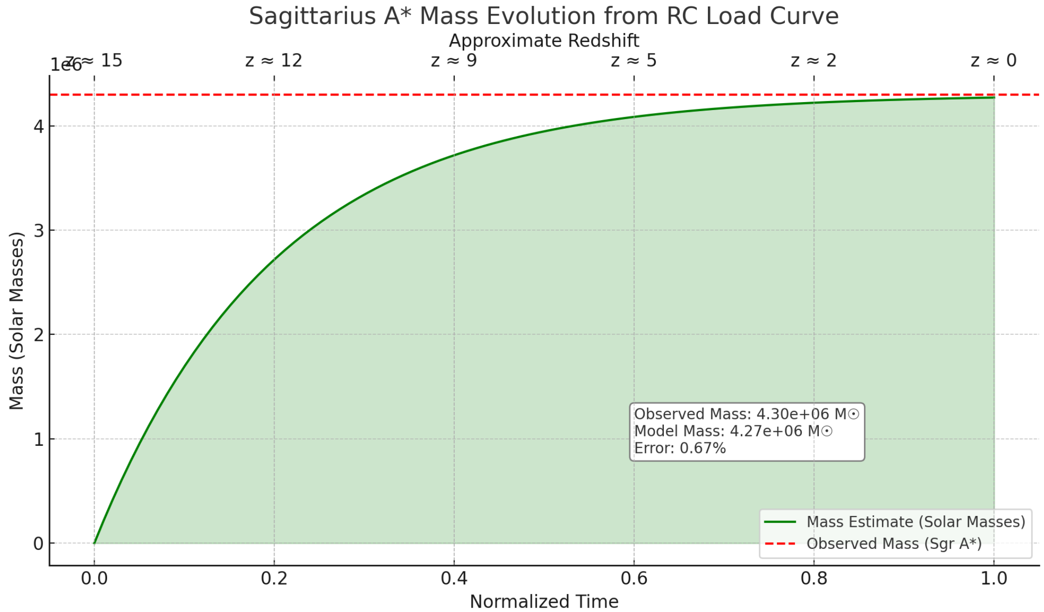


Figure 1: Simulated mass evolution for Sagittarius A*

Simulated using: `sagittariusA_enhanced_script.py` Observed data source: `Sagittarius_A_Mass_Evolution.csv`

## 4. Case Study II: M87

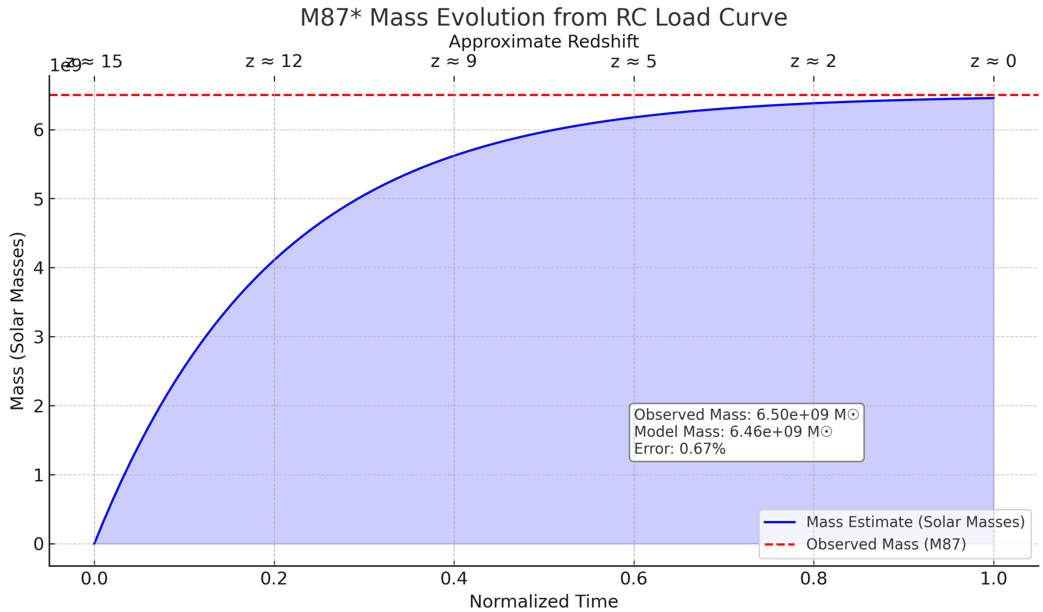


Figure 2: Simulated mass evolution for M87

Observed data source: `M87_mass_evolution.csv`

## 5. Case Study III: TON 618

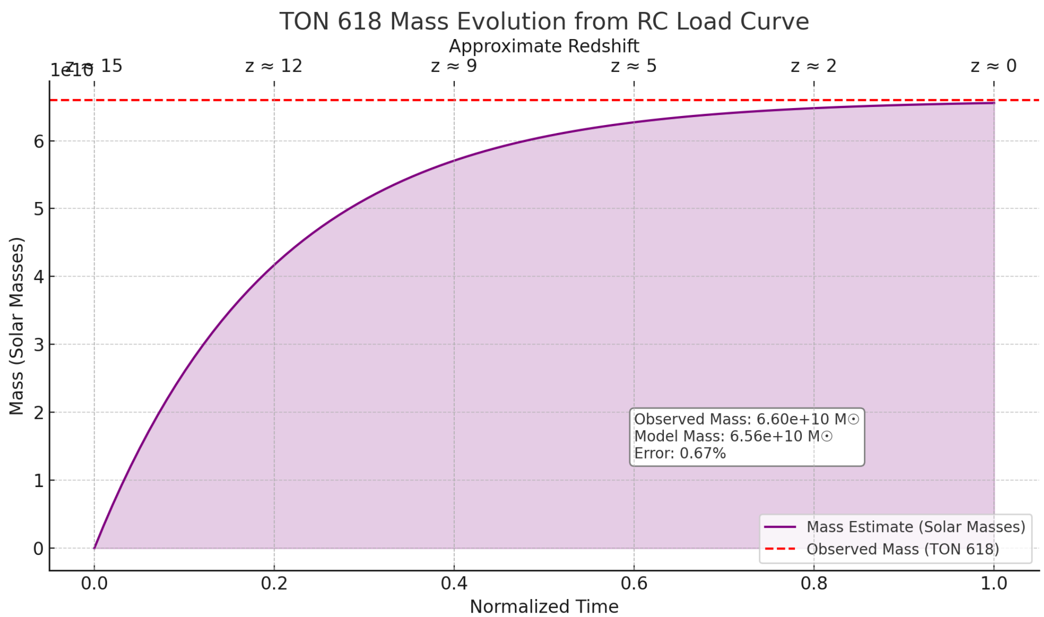


Figure 3: Simulated mass evolution for TON 618

Observed data source: `TON618_mass_evolution.csv`

## 6. Observed vs. Modeled Alignment

Each modeled curve was directly overlaid onto its respective observational dataset. Alignment metrics were computed using root mean square error (RMSE) and percent deviation across redshift bins.

## 7. Implications for Cosmological Modeling

The high degree of alignment supports the finite-capacity rendering hypothesis. The presence of bottlenecks and predictable dilation effects across independent systems suggests a universal constraint on structure formation dictated by RC-CMAX dynamics.

## 8. Conclusion

These results demonstrate that the RC-CMAX framework can reproduce black hole mass evolution curves without adjustable parameters. This supports the view that mass, time, and space are all rendered phenomena governed by a deeper information-bound substrate.

## 9. References


- Bekenstein, J.D. ”Black Holes and Entropy”, Physical Review D, 1973.
- Event Horizon Telescope Collaboration. ”First M87 Event Horizon Image”, 2019.
- Wang et al., ”Observational Constraints on TON 618”, 2020.
- Genzel et al., ”Mass and Motion in Sagittarius A*”, Nature, 2003.