

Vorticity in saturated solitons. Consequences for black holes?

Michael Zantedeschi
Tsung-Dao Lee Institute
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Work in collaboration with G. Dvali (MPP & LMU, Munich), J.S. Bermudez (IFAE, Barcelona), F. Kühnel (MPP, Munich), O. Kaikov (MPP, Munich)



李政道研究所
TSUNG-DAO LEE INSTITUTE



Motivation

Black hole Quantum N-portrait

[Dvali, Gomez '11]

- At the quantum level, there are indications that a black hole is a condensate of marginally bounded soft gravitons
- This offers a microscopic interpretation of the key-essential properties of a black holes

Question: When rotating, can black holes display vorticity analogously to their laboratory counterparts?

In Bose Einstein Condensates

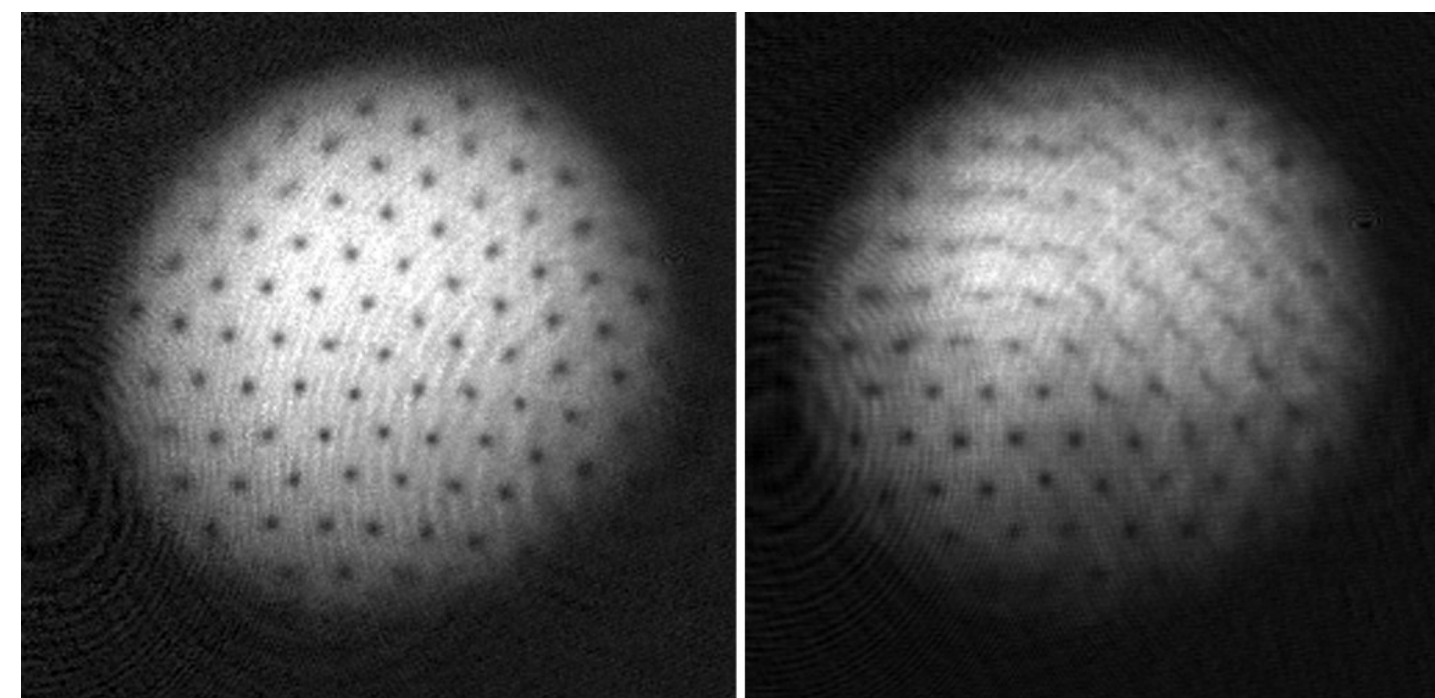


Fig. From J. R. ABO-SHAEER et al '01

Motivation

Universality of saturated configurations

Unitarity imposes an upper bound on the **maximal entropy** a localized configuration can attain

$$S \leq \text{Area} f^2 .$$

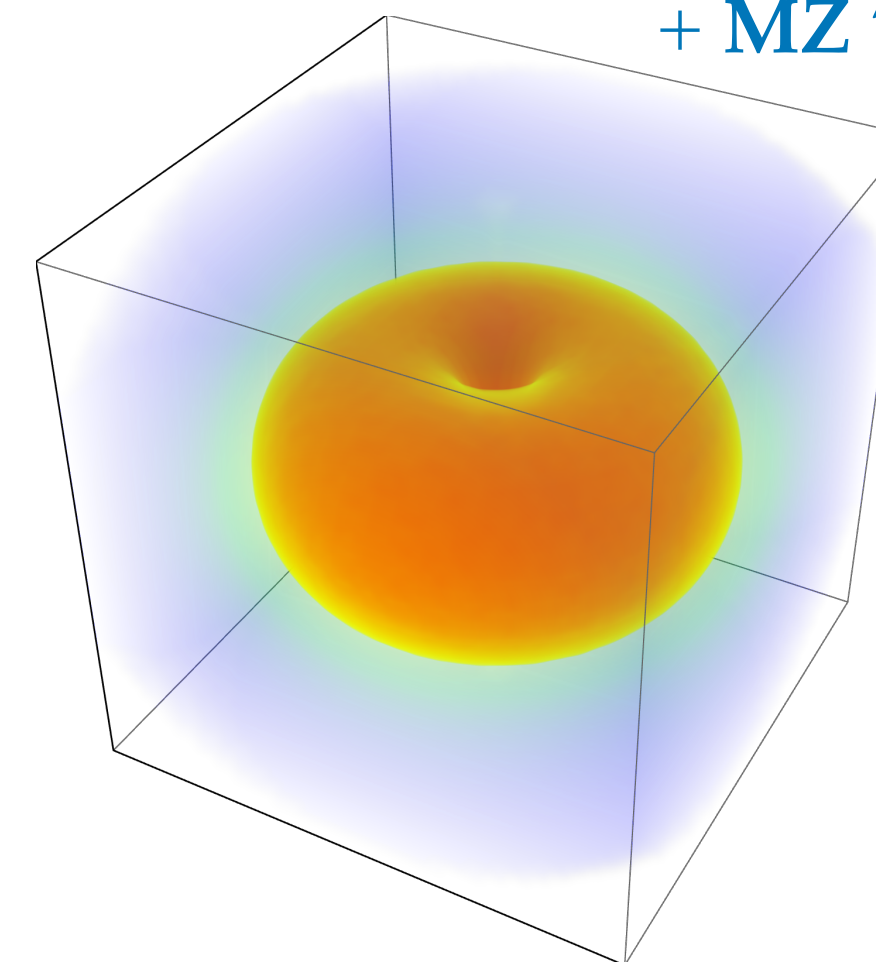
Objects saturating the above property are named **saturons** [Dvali '21]. Black holes are saturons under the identification $f \leftrightarrow M_{\text{Pl}}$.

Saturons can be built in renormalizable QFTs - e.g., **bubble in global $SU(N)$ symmetric theory.**

They display the key-essential properties of black holes.

G. Dvali, '21; G.Dvali, O. Kaikov, J. Bermudez, '21,
+ MZ '24

- Useful theoretical laboratories
- Predict new features, such as vorticity



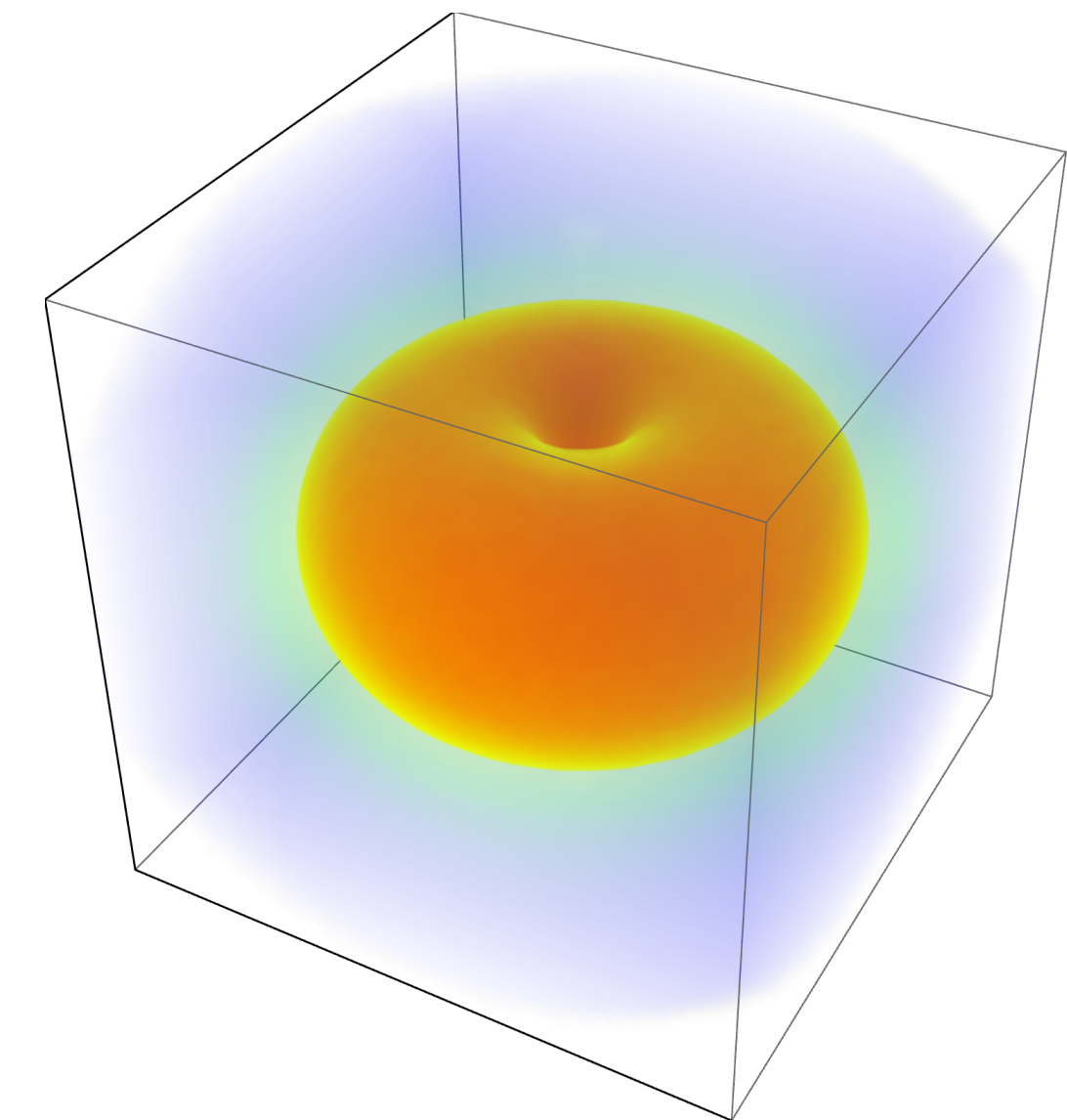
Saturon bubble with winding integer number $n = 1$

MZ, '22

Vorticity in saturons

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	Saturation bubble	Black hole
Maximal spin	S $n \sim \mathcal{O}(1)$	S_{BH}



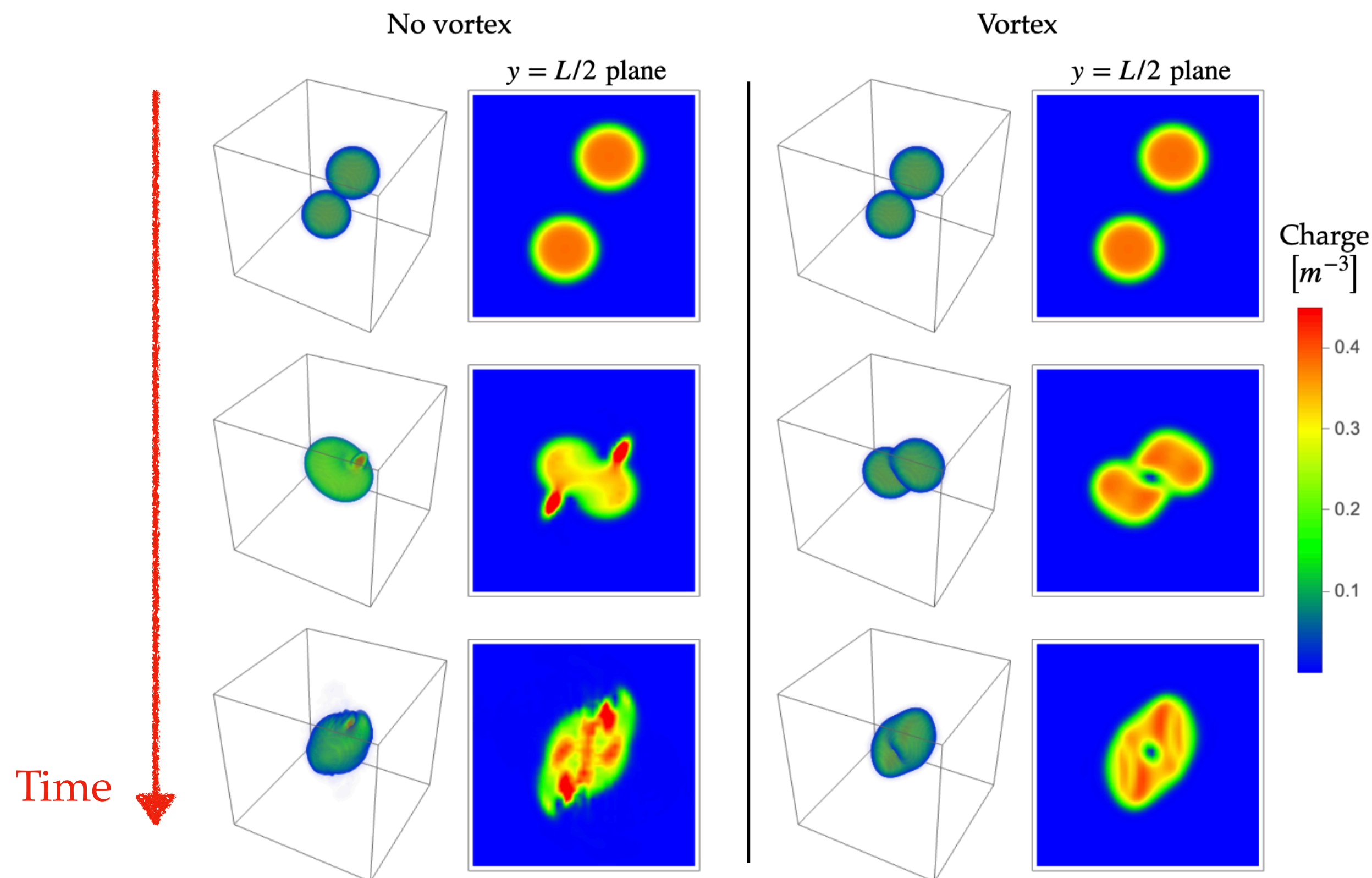
Profile for integer winding number $n = 1$

- **Saturation** of a renormalizable QFT and **black holes** obey the **same extremality bound** on spin
- **Microscopic interpretation of extremality bound** in terms of vorticity
- **Topological explanation** of the absence of Hawking (soft) radiation due to macroscopic integer nature of the vortex
- **Can vorticity be a property manifesting in highly spinning black holes?** If so, pheno consequences?

Vorticity in saturons

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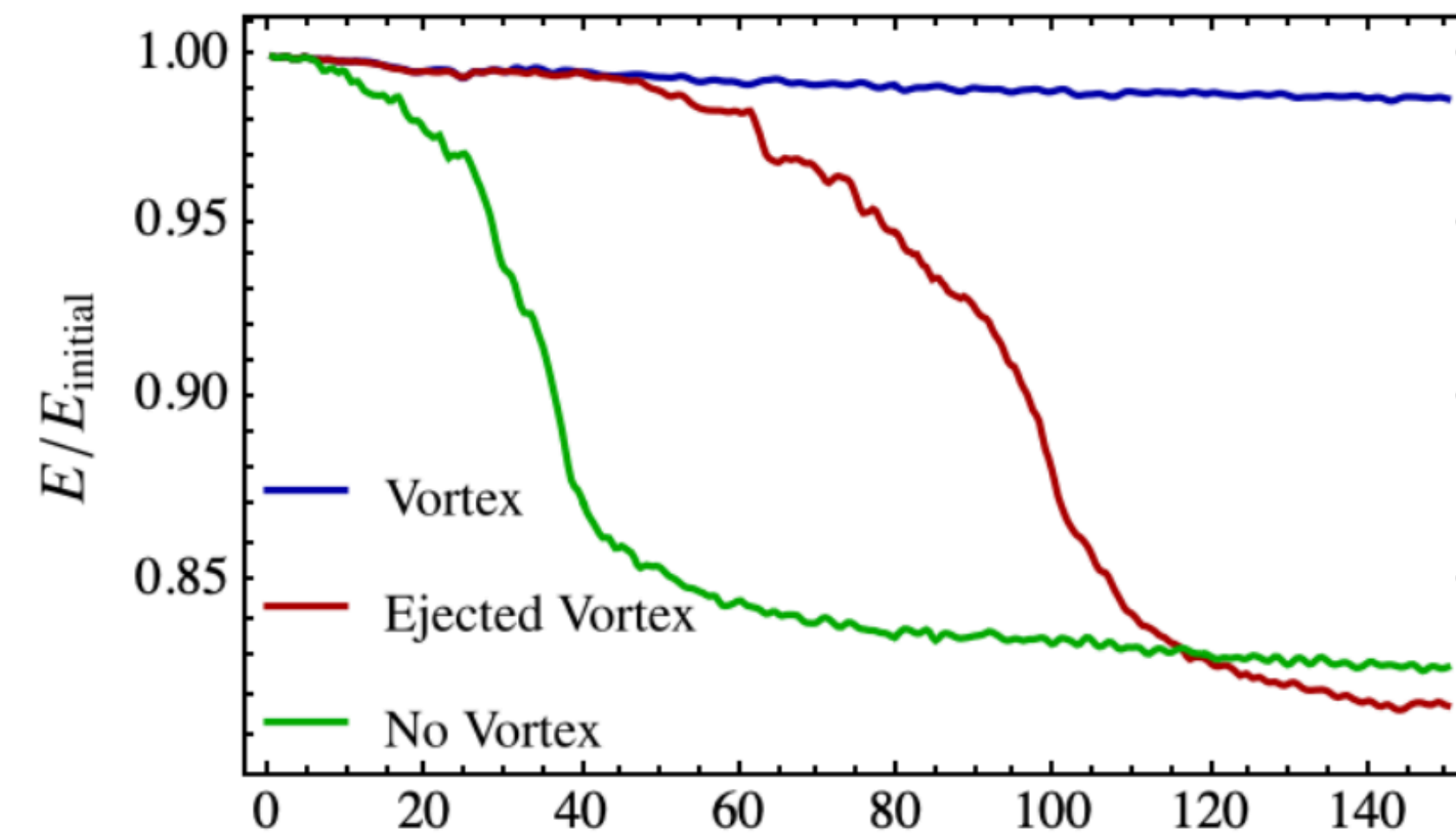
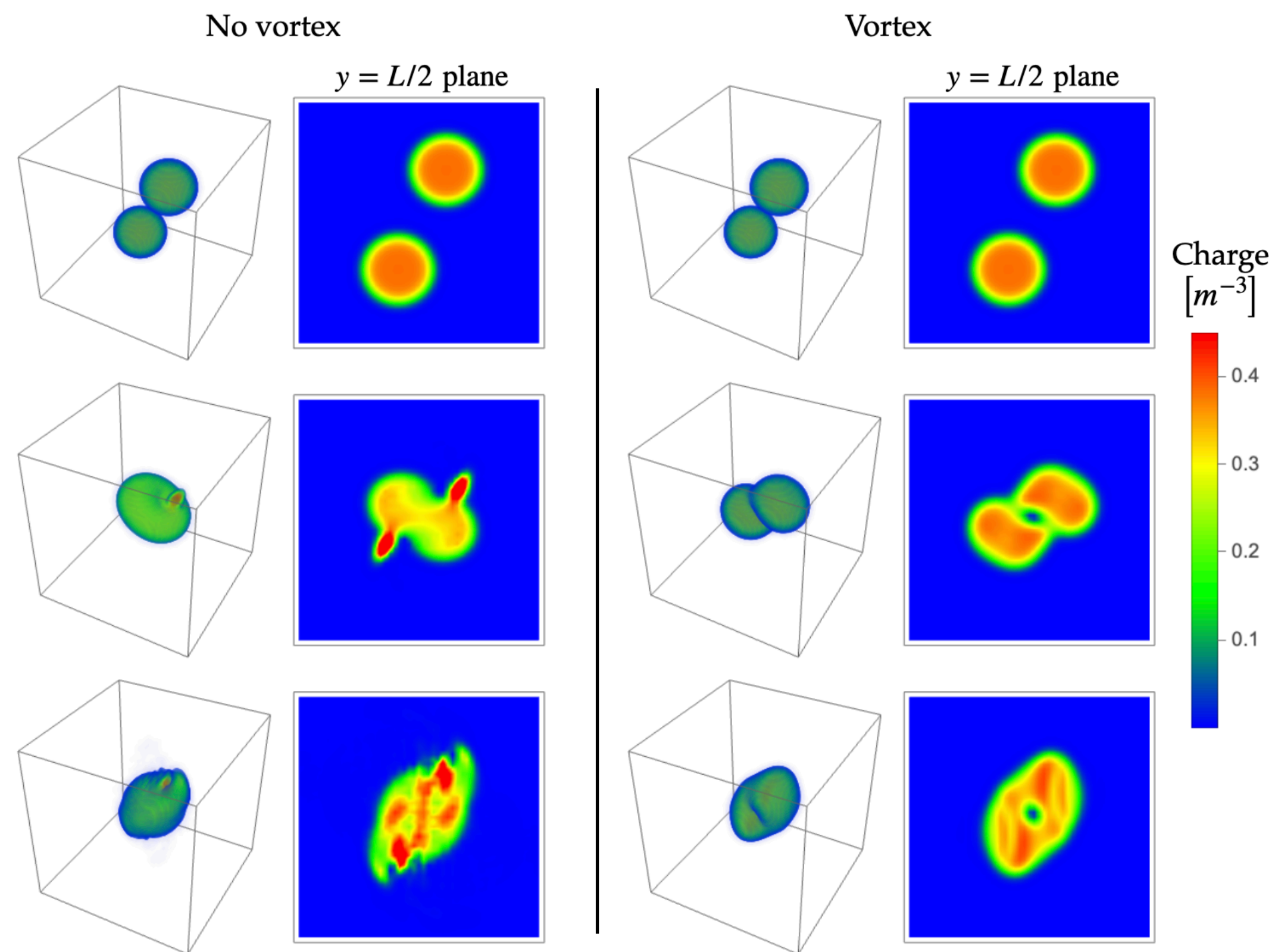
Example: Study the impact of vorticity in saturated configurations. Could similar features emerge in black hole mergers?



Vorticity in saturons

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Example: Study the impact of vorticity in saturated configurations. Could similar features emerge in black hole mergers?



If a vortex localizes in black hole mergers, a similar interference could lead to macroscopic deviations in the gravitational radiation, with clear, macroscopic smoking guns [**MZ**, in progress]