Violation of the Carter-Israel Conjecture and its Astrophysical Implications

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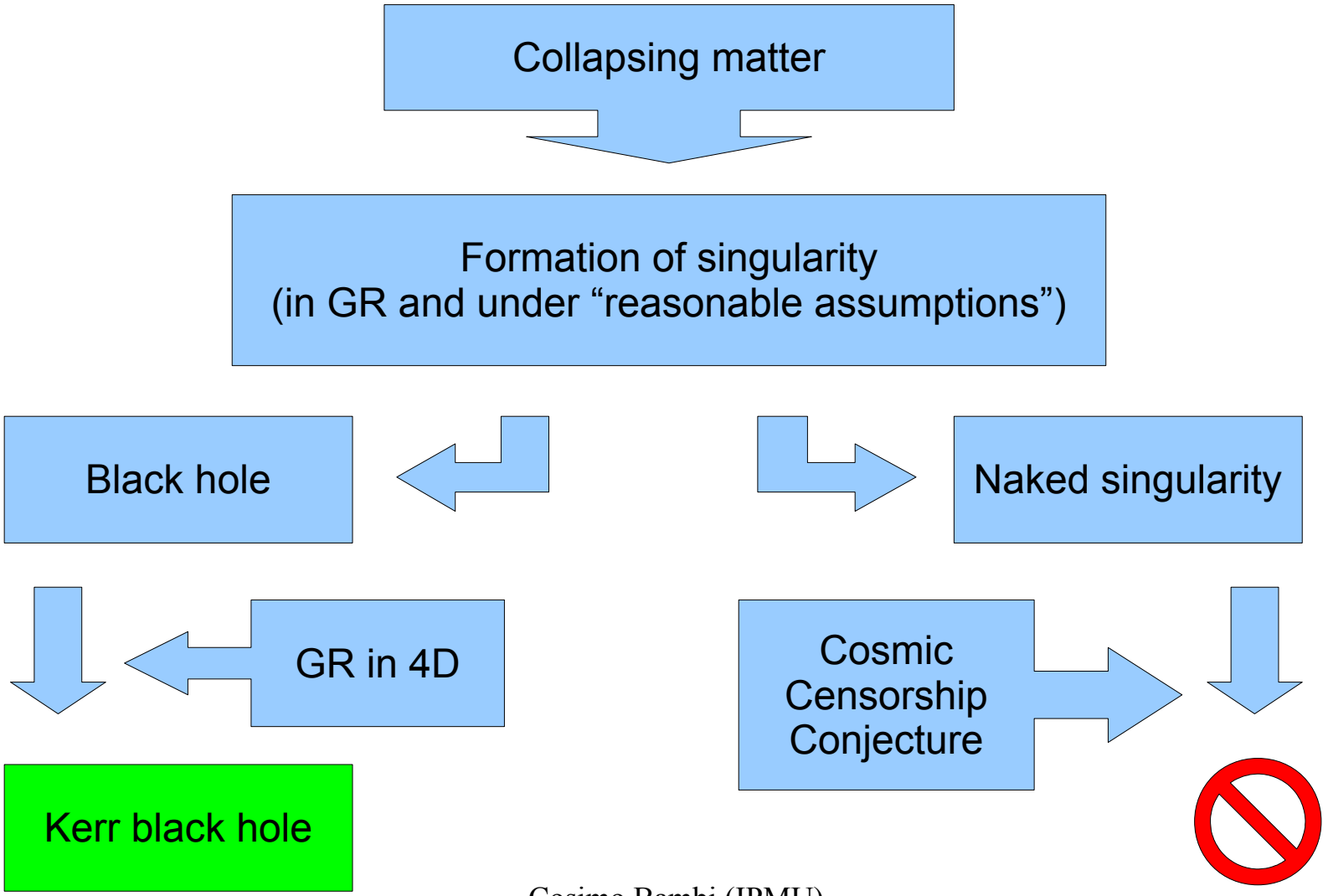
References

- **C. Bambi, K. Freese, T. Harada, R. Takahashi and N. Yoshida, Phys. Rev. D 80, 104023 (2009)**

- **C. Bambi, T. Harada, R. Takahashi and N. Yoshida, Phys. Rev. D 81, 104004 (2010)**

- **C. Bambi and N. Yoshida, coming soon**

The Carter-Israel Conjecture



Kerr black hole

- **2 parameters: the mass M and the spin J (or a = J/M)**

- **Position of the horizon:**

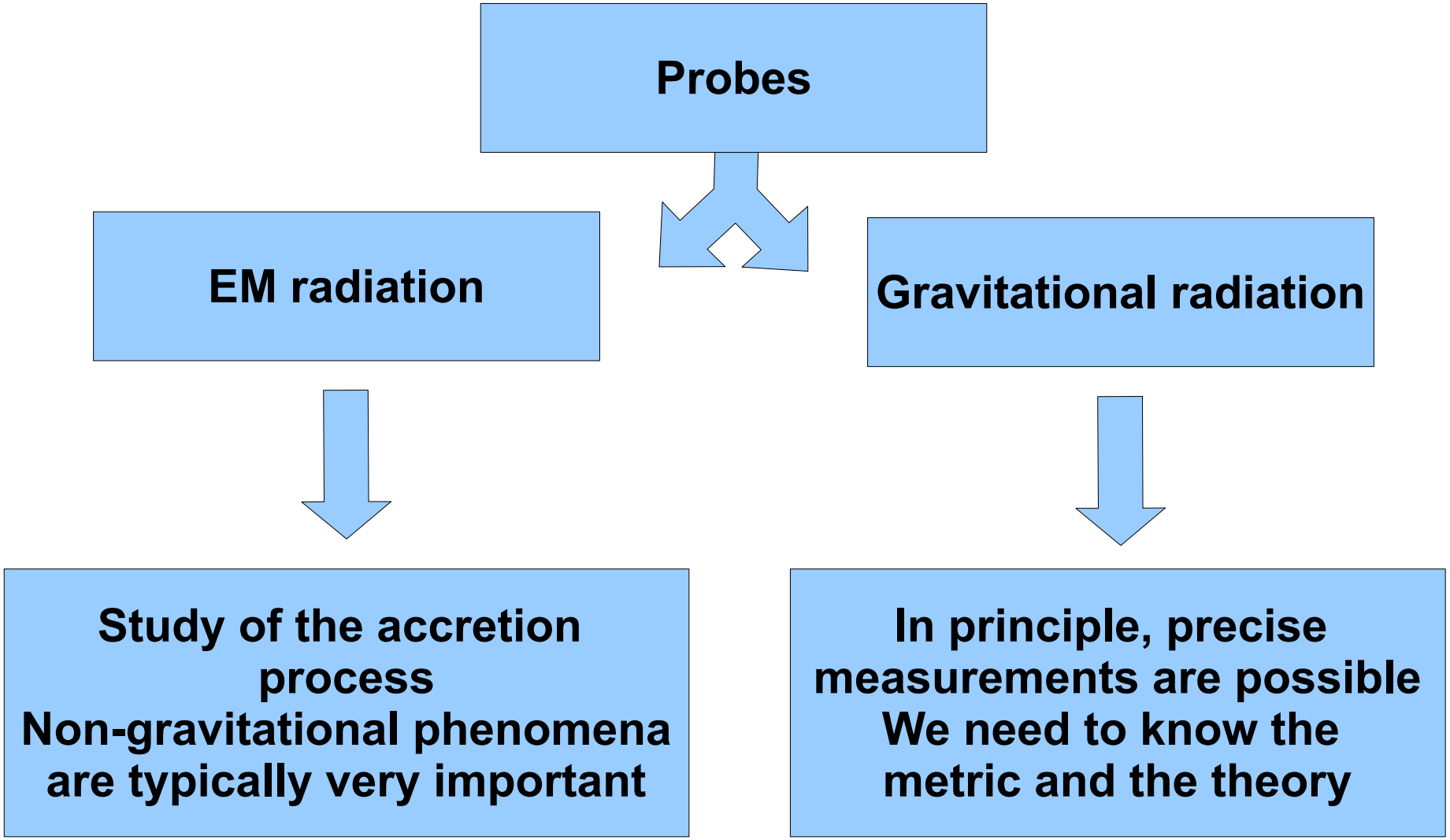
$$r_H = M + \sqrt{M^2 - a^2} \quad \Rightarrow \quad M > |a|$$

Motivations to go beyond the Carter-Israel Conjecture

- **We know several counterexample violating the Cosimc Censorship Conjecture (D. Christodoulou, Commun. Math. Phys. 93 (1984) 171; A. Ori & T. Piran, Phys. Rev. D 42 (1990) 1068; P.S. Joshi & I.H. Dwivedi, Phys. Rev. D 47 (1993) 5357; D. Christodoulou, Annals Math. 140 (1994) 607; I.H. Dwivedi & P.S. Joshi, Commun. Math. Phys. 166 (1994) 117; S.S. Deshingkar, I.H. Dwivedi & P.S. Joshi, Phys. Rev. D 59 (1999) 044018; etc.)**

- **Space-time singularity => New physics**

Tests of the Carter-Isreal Conjecture



The Kerr bound

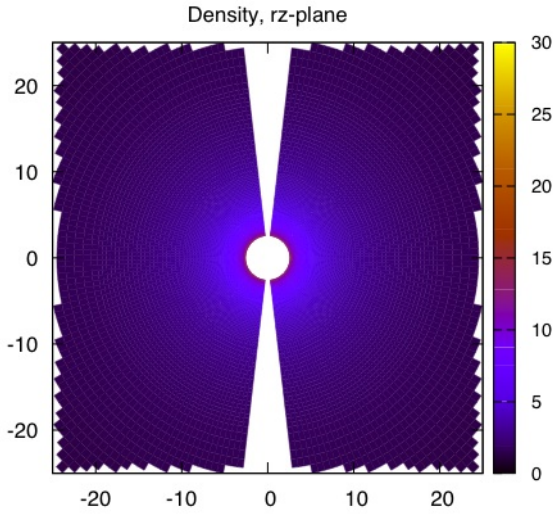
- **For a Kerr black hole $|a| < M$**

- **If we find a massive a compact object with $|a| > M$, the final product of the gravitational collapse cannot be a Kerr black hole or at least the Kerr solution is not the only viable option**

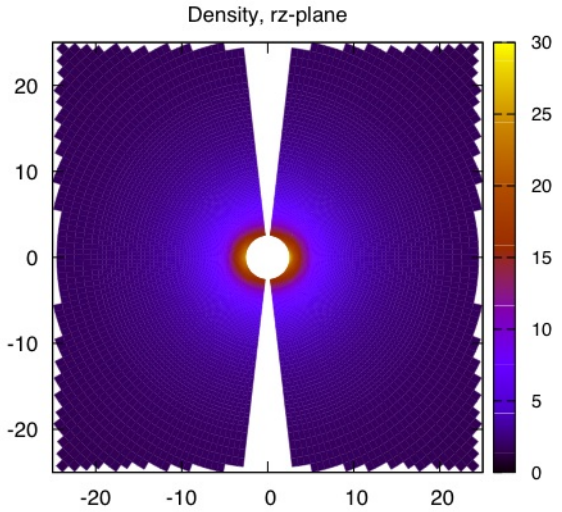
- **The accretion process is determined by $|a|$**

Accretion process

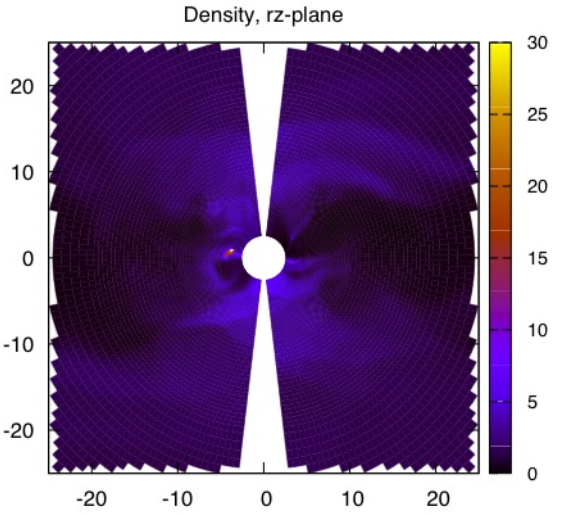
Black hole-like accretion



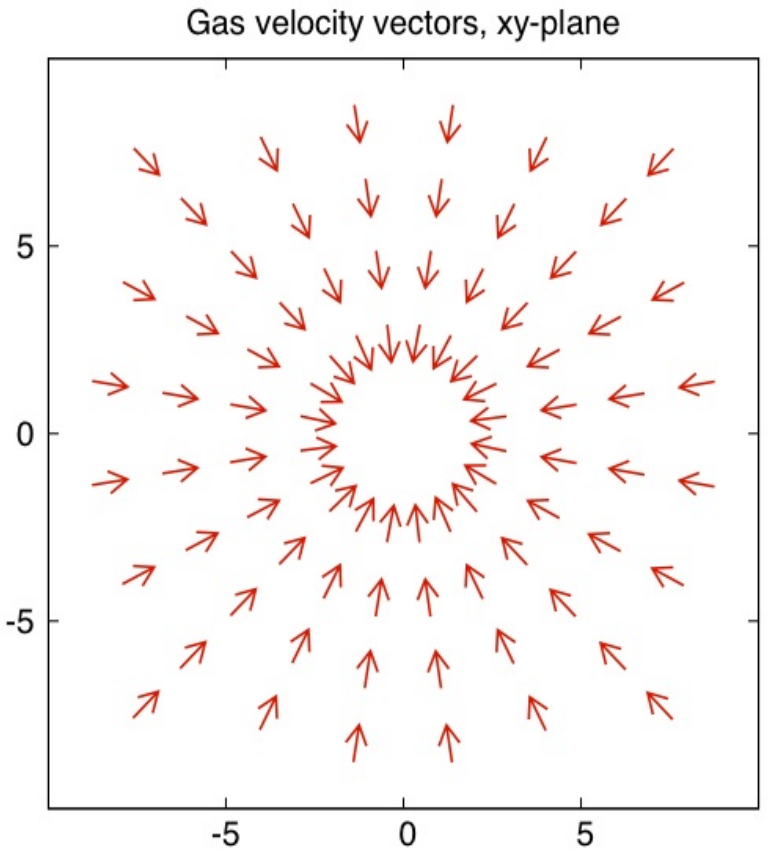
Intermediate state

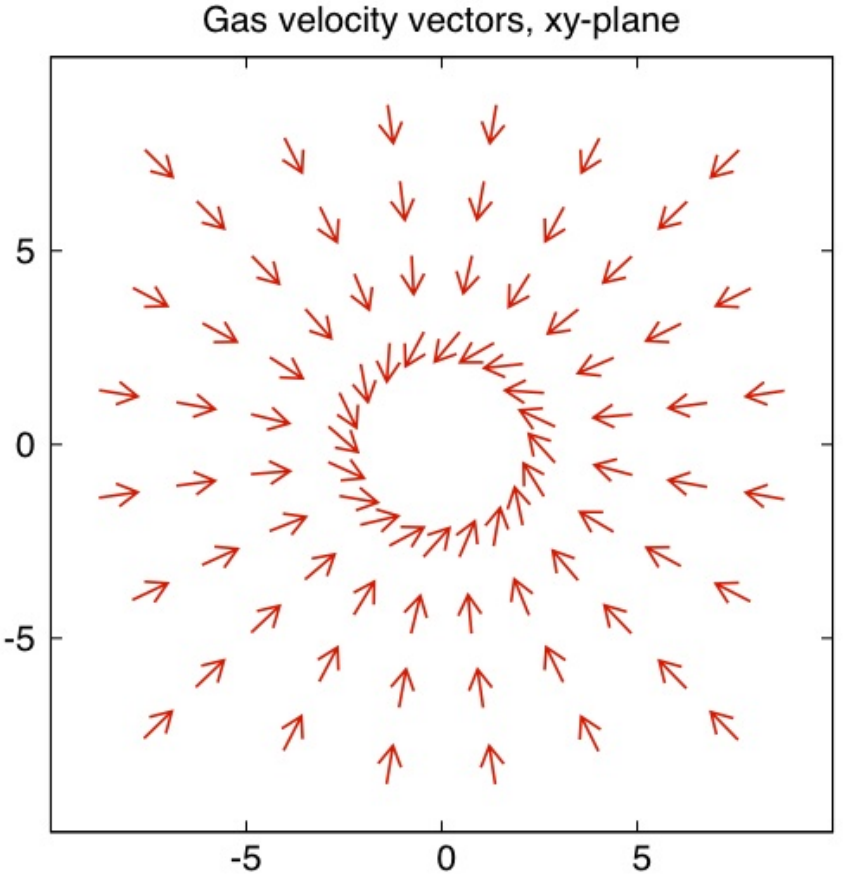


Super-spinar-like accretion

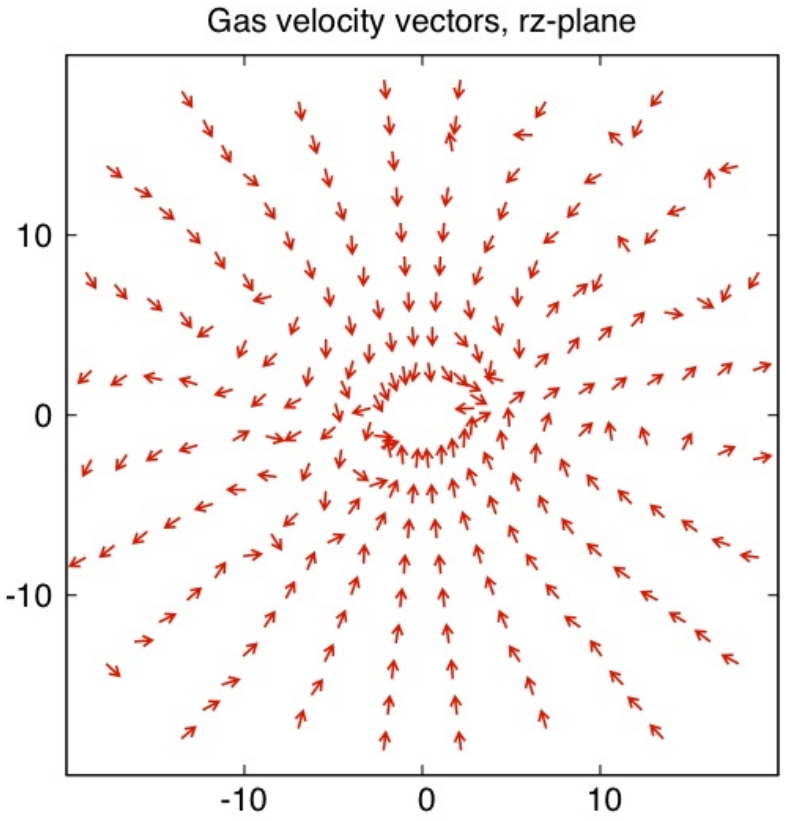


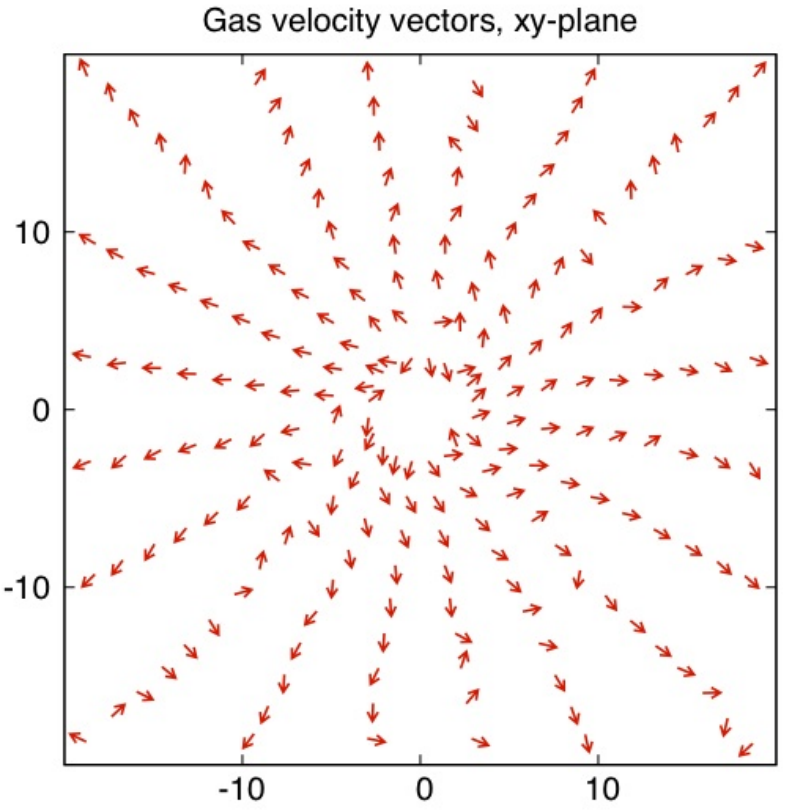
Accretion process onto objects with small or moderate spin parameter



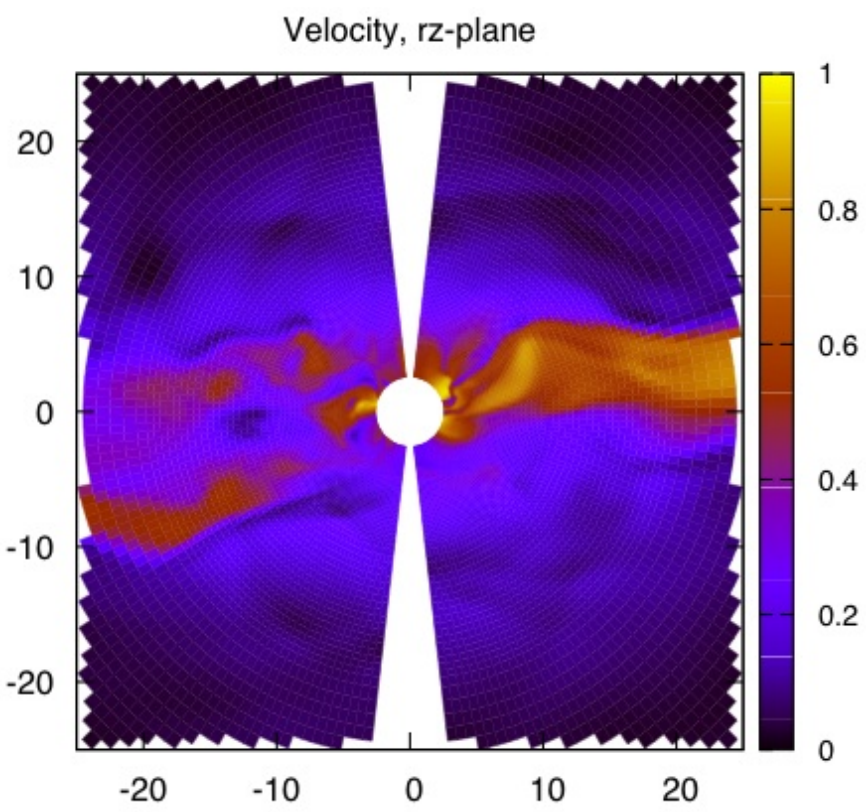


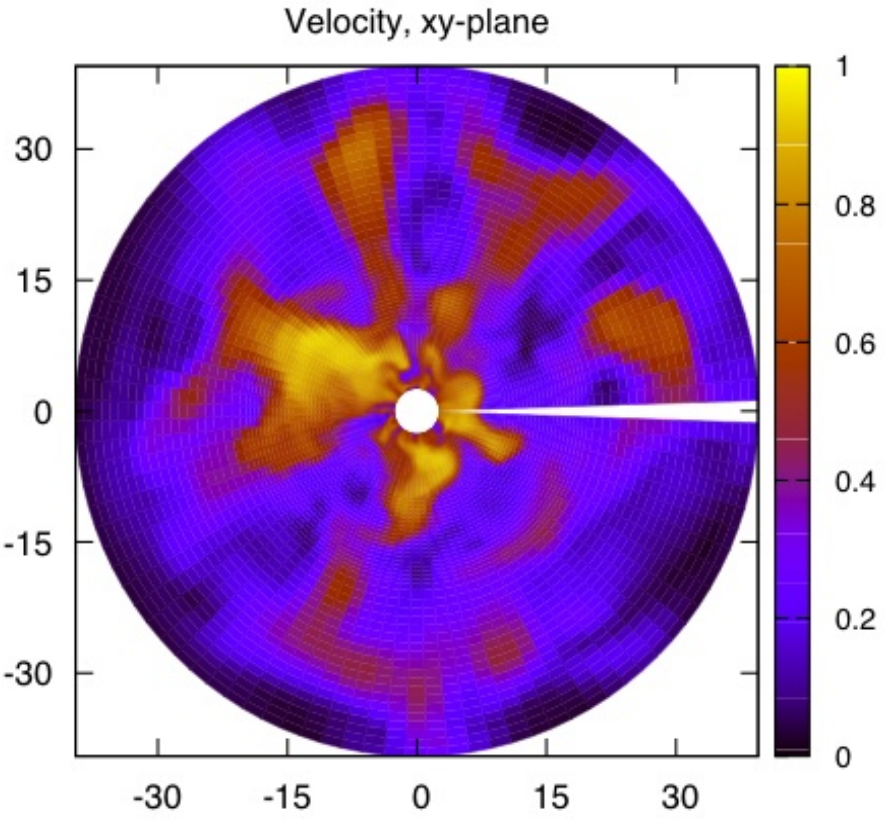
Accretion process onto objects with large spin parameter



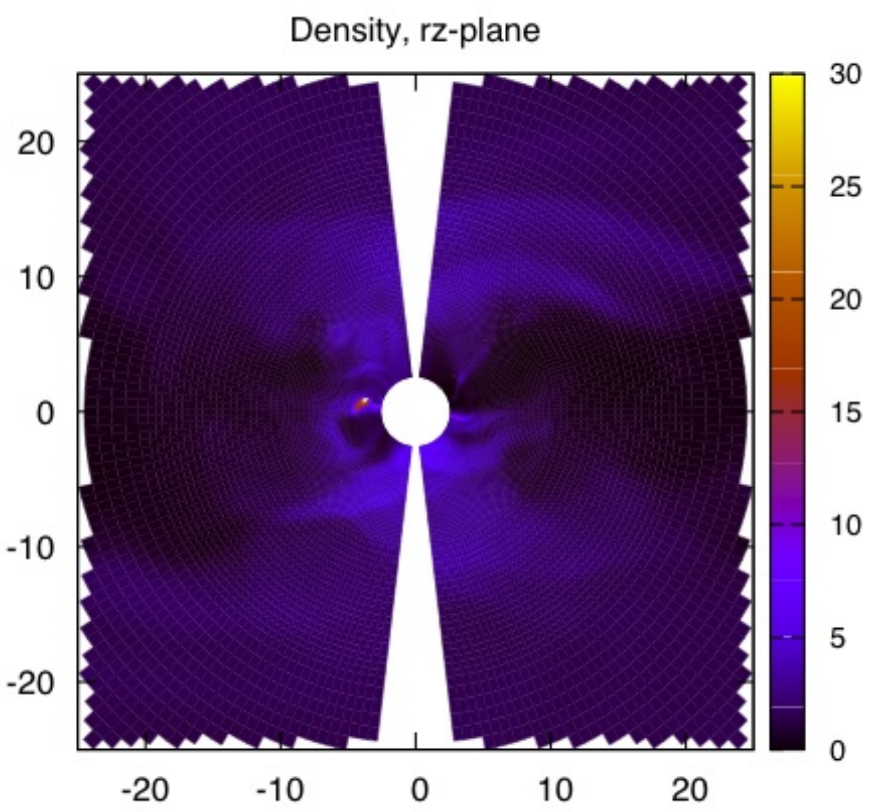


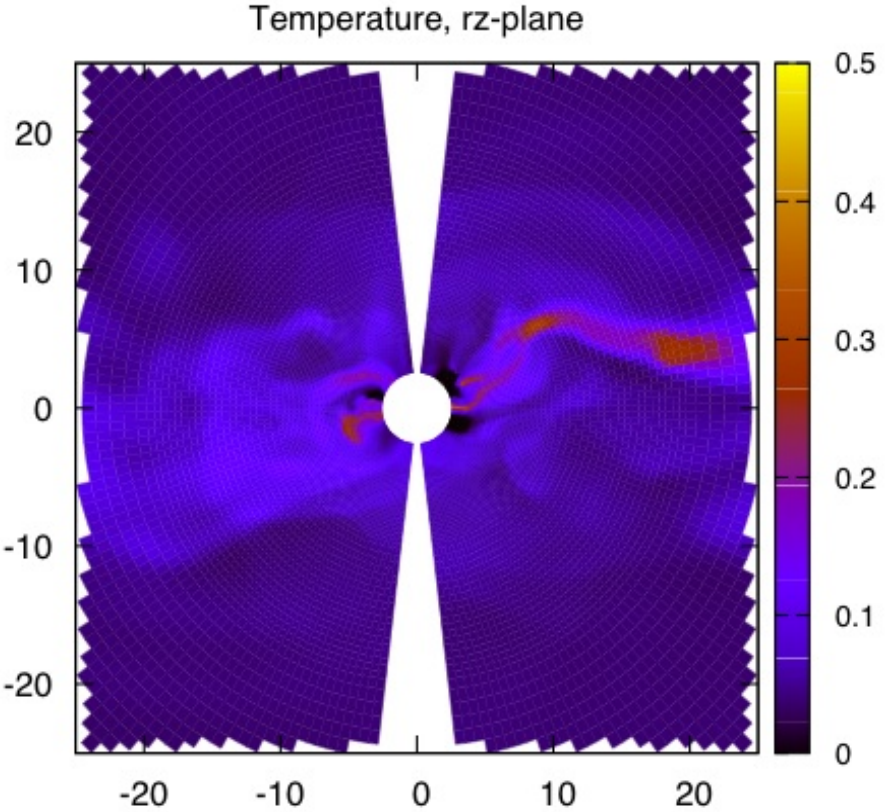
Accretion process onto objects with large spin parameter



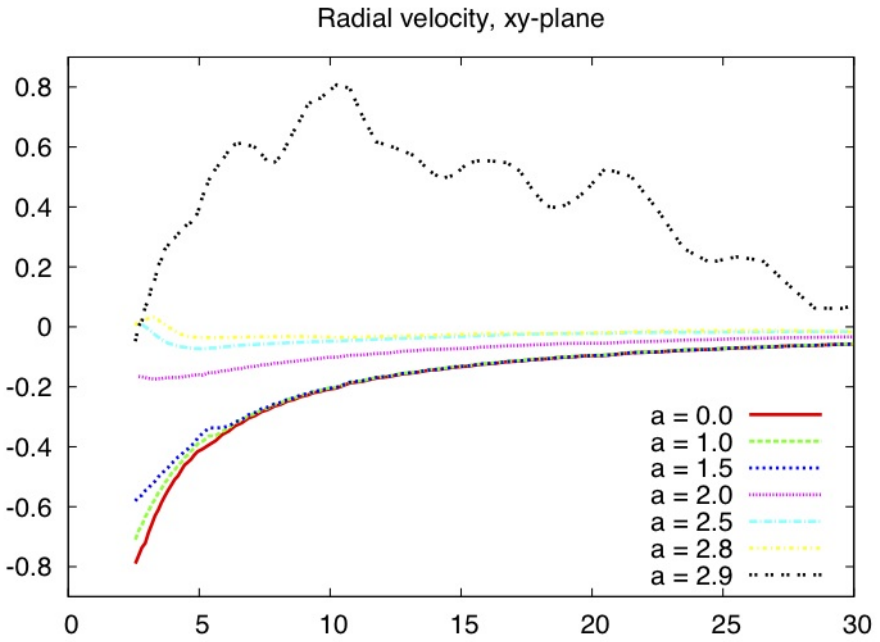


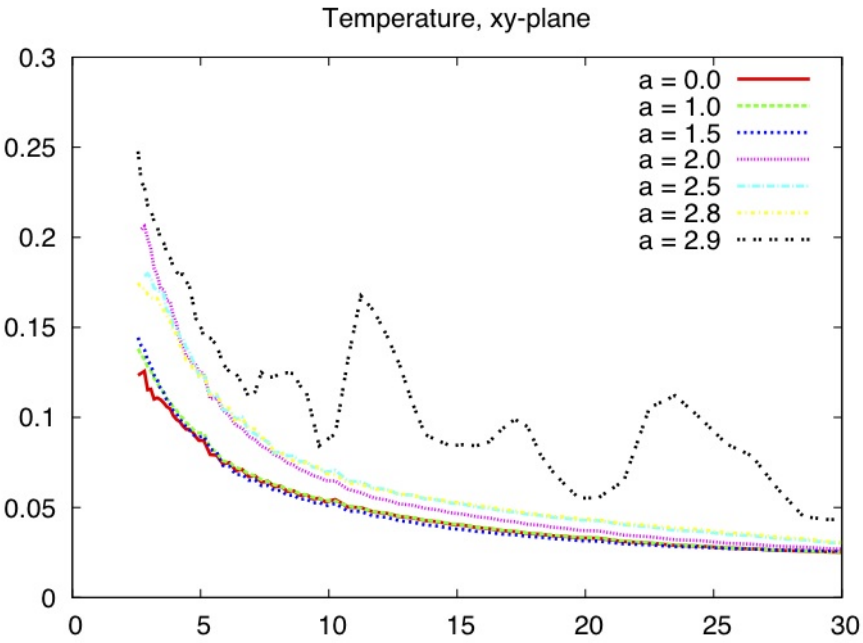
Accretion process onto objects with large spin parameter





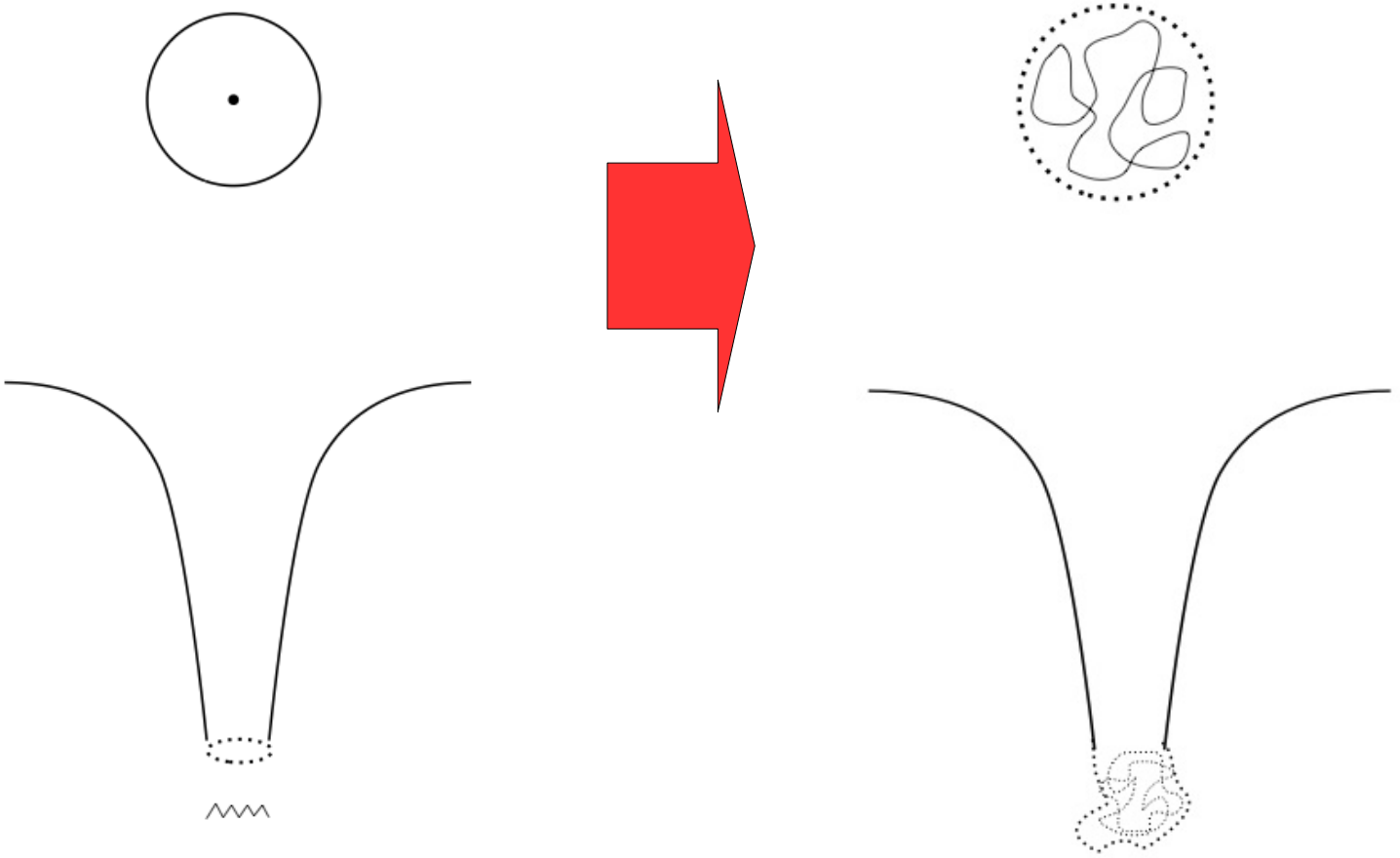
Transitions between different kinds of accretion





Conclusions

- **In the standard picture, the final product of the gravitational collapse is a Kerr black hole (M, a, $|a| < M$). This is the Carter-Israel Conjecture**
- **Neither the theory nor the observations can confirm the Carter-Israel Conjecture**
- **If we find a massive and compact object with $|a| > M$, the Carte-Israel Conjecture can be violated**
- **For $|a| > M$, the accretion process can be very different. The observation of equatorial outflows can be used to test the bound $|a| < M$**
- **Future studies: accretion process onto very deformed objects**

An example: the fuzzball picture

Classical black hole **Fuzzball black hole**