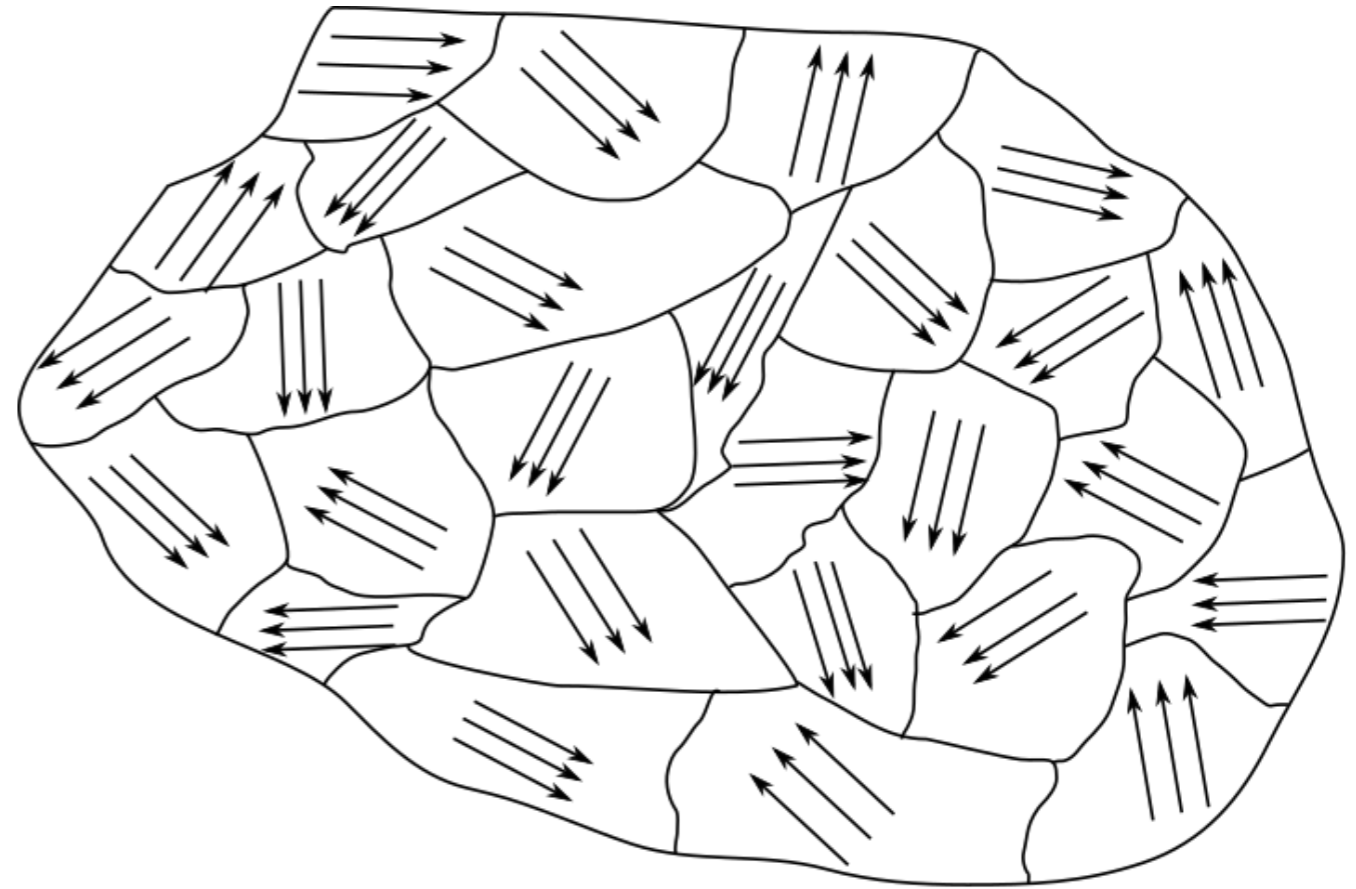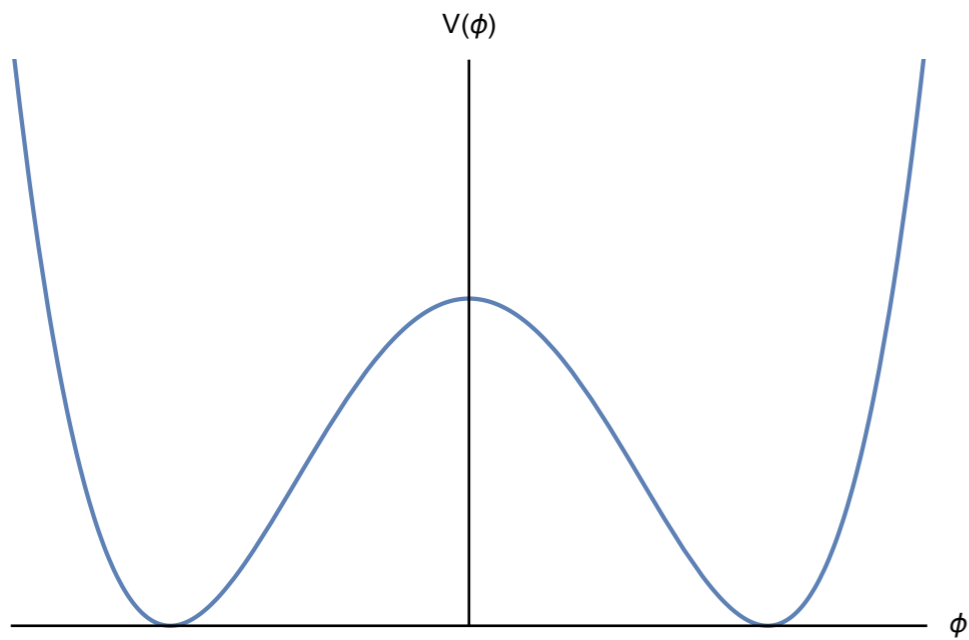# Domain walls
in curved spacetimes

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Marian Smoluchowski Institute of Physics

Jagiellonian University

Plan

- Domain walls

- Searching for domain wall transits

- Details of the simulation

- Results

- Summary

Domain walls

Reissner-Nordström black holes and thick domain walls

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Marek Rogatko[†]

Institute of Physics, Maria Curie-Sklodowska University, 20-031 Lublin, pl. Marii Curie-Sklodowskiej 1, Poland

We solve the equations of motion numerically for real self-interacting scalar fields in the background of a Reissner-Nordström black hole and obtain a sequence of static axisymmetric solutions representing thick domain wall charged black hole systems. In the case of an extremal Reissner-Nordström black hole solution we find that there is a parameter depending on the black hole mass and the width of the domain wall which constitutes the upper limit for the expulsion to occur.

Black holes escaping from domain walls

Antonino Flachi,[1,*] Oriol Pujolàs,[1,2,†] Misao Sasaki,[1,‡] and Takahiro Tanaka[3,§]

[1]*Yukawa Institute for Theoretical Physics, Kyoto University, Kyoto 606-8503, Japan*
[2]*Center for Cosmology and Particle Physics, Department of Physics, New York University, 4 Washington Place, New York, New York 10003 US, USA*
[3]*Department of Physics, Kyoto University, Kyoto 606-8502, Japan*

Previous studies concerning the interaction of branes and black holes suggested that a small black hole intersecting a brane may escape via a mechanism of reconnection. Here we consider this problem by studying the interaction of a small black hole and a domain wall composed of a scalar field and simulate the evolution of this system when the black hole acquires an initial recoil velocity. We test and confirm previous results, however, unlike the cases previously studied, in the more general set-up considered here, we are able to follow the evolution of the system also during the separation, and completely illustrate how the escape of the black hole takes place.

annalen der **physik**

The Global Network of Optical Magnetometers for Exotic physics (GNOME): A novel scheme to search for physics beyond the Standard Model

Szymon Pustelny[1,2,], Derek F. Jackson Kimball[3], Chris Pankow[4], Micah P. Ledbetter[2,**], Przemyslaw Wlodarczyk[5], Piotr Wcislo[1,6], Maxim Pospelov[7,8], Joshua R. Smith[9], Jocelyn Read[9], Wojciech Gawlik[1], and Dmitry Budker[2,10]*

nature physics

LETTERS

PUBLISHED ONLINE: 17 NOVEMBER 2014 | DOI: 10.1038/NPHYS3137

Hunting for topological dark matter with atomic clocks

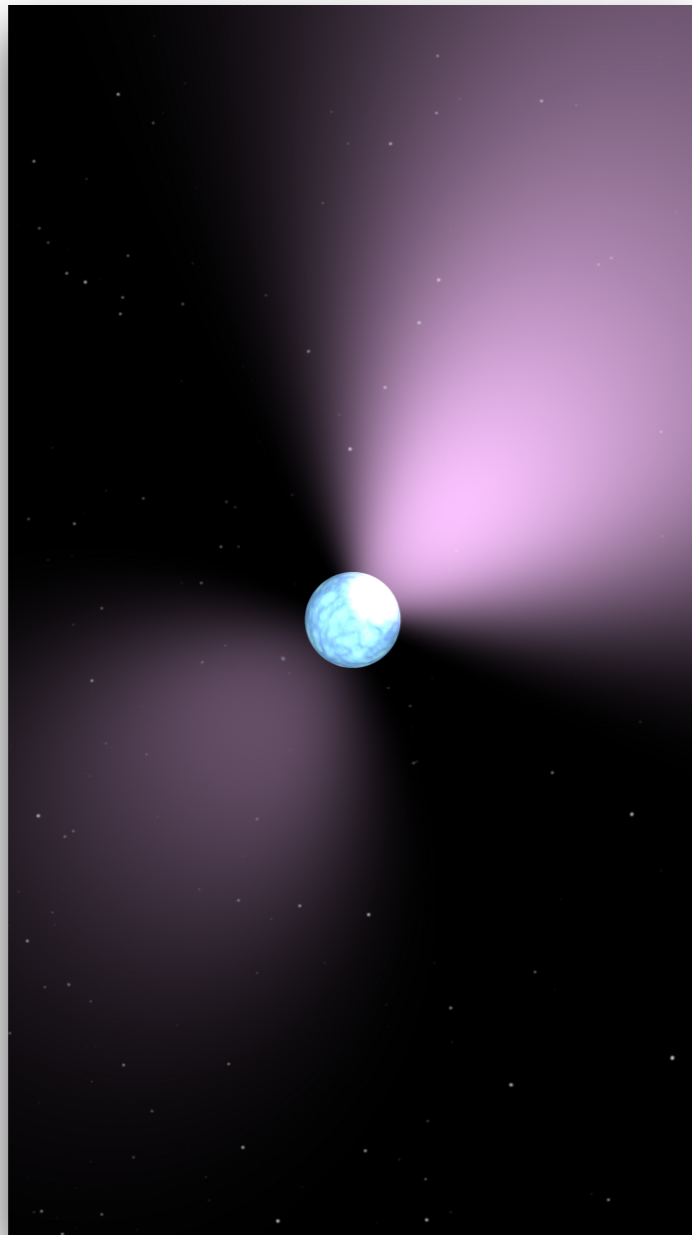A. Derevianko[1*] and M. Pospelov[2,3]

Terrestrial experiments
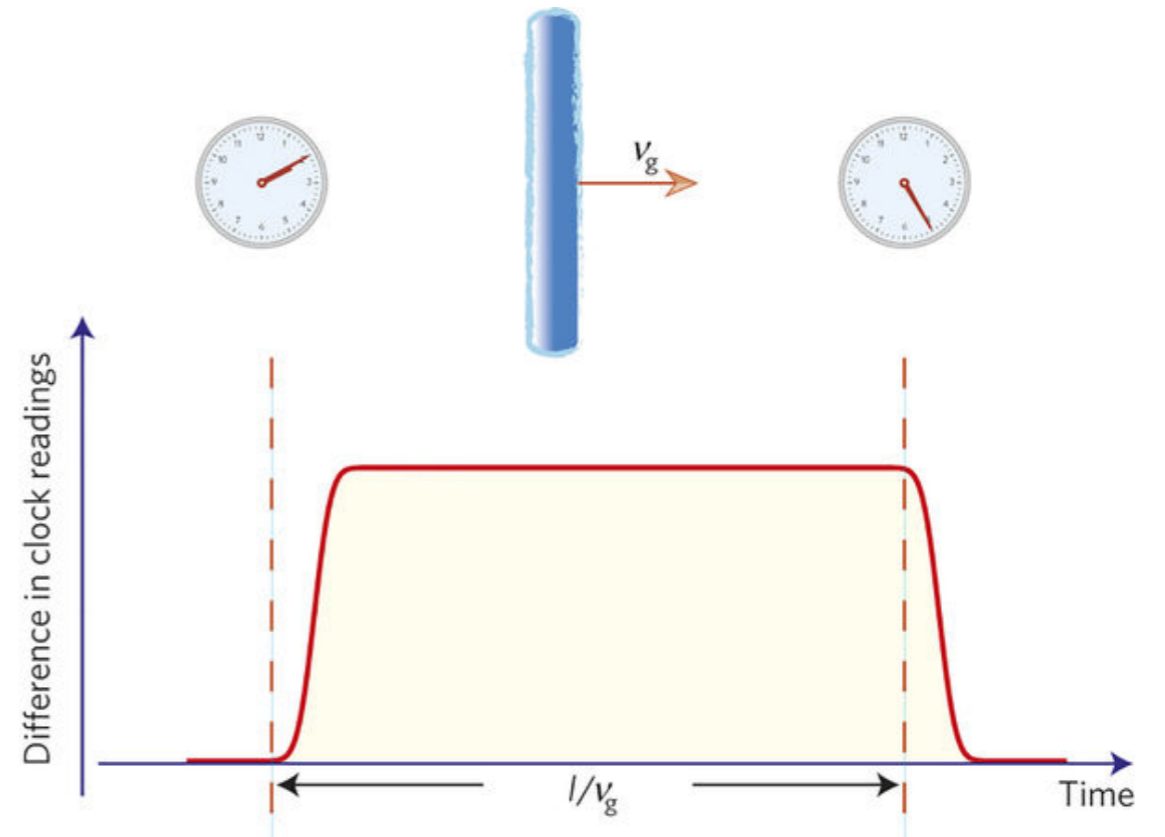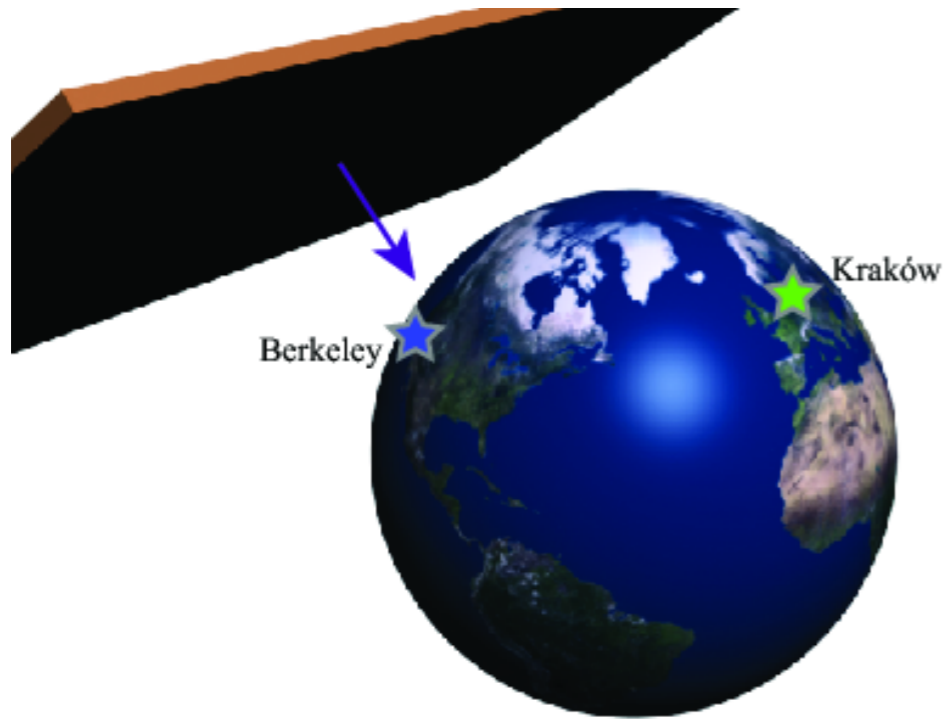
Global Network of Optical Magnetometers for Exotic Physics


GPS.DM

Astrophysical effects
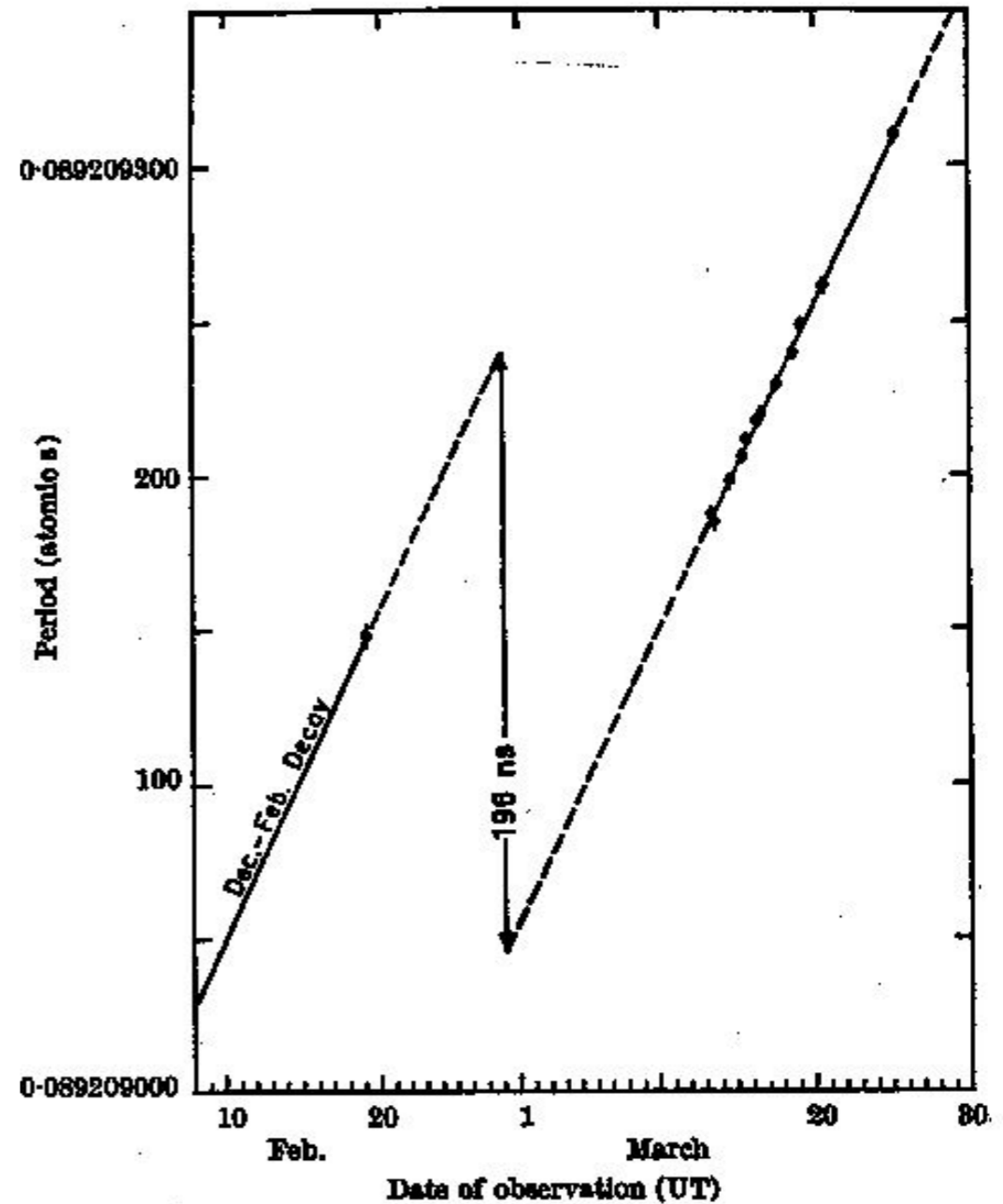
Details of the simulation

- ϕ^4 model

- Black hole with either angular momentum or charge

- Initially planar domain wall

- Axial symmetry (2D simulation)

- Crank-Nicholson method

- Kerr-Schild-type coordinates

- Minkowski solution as a boundary condition at the outer boundary

- Inner boundary of the domain below the outer horizon (no boundary conditions)

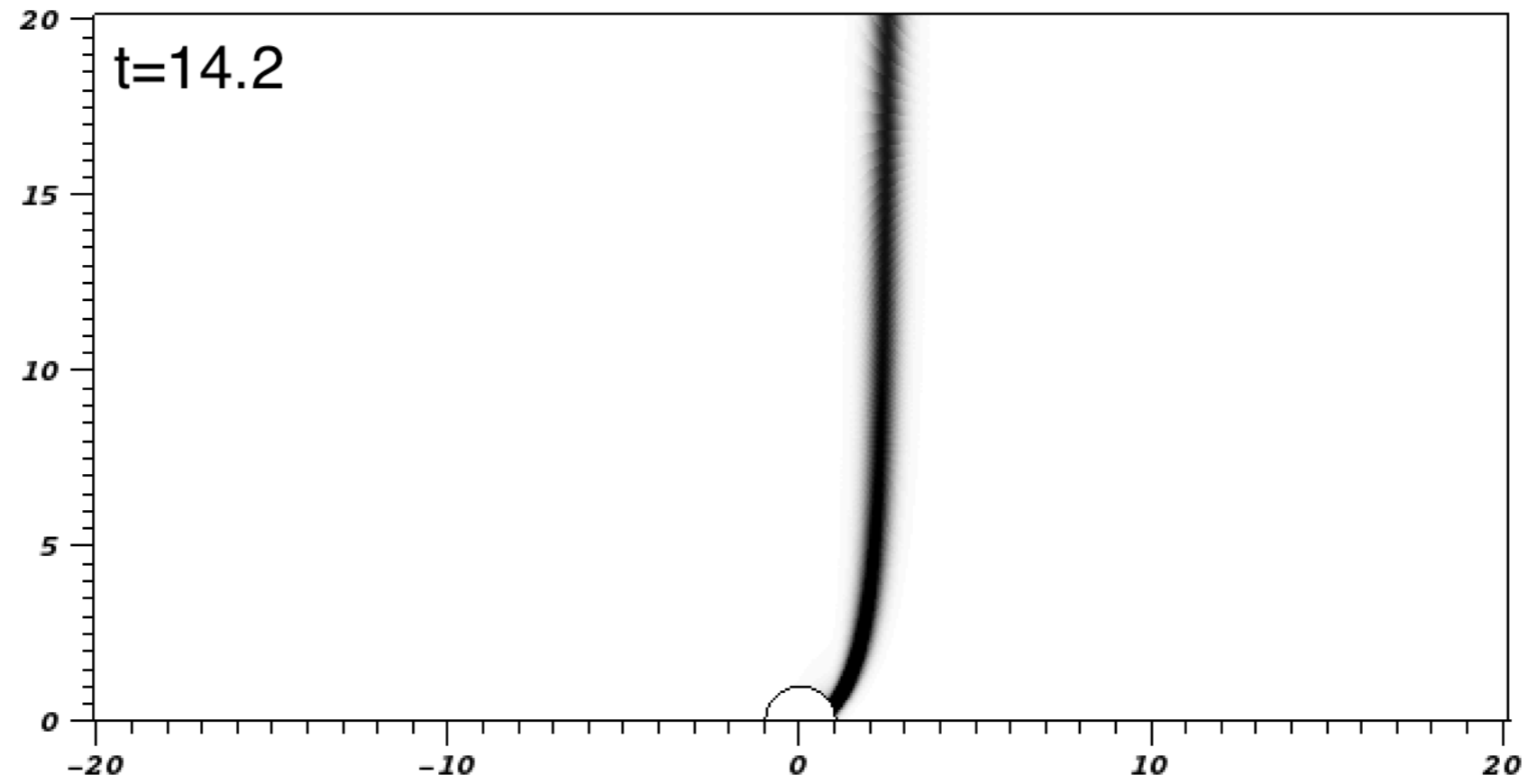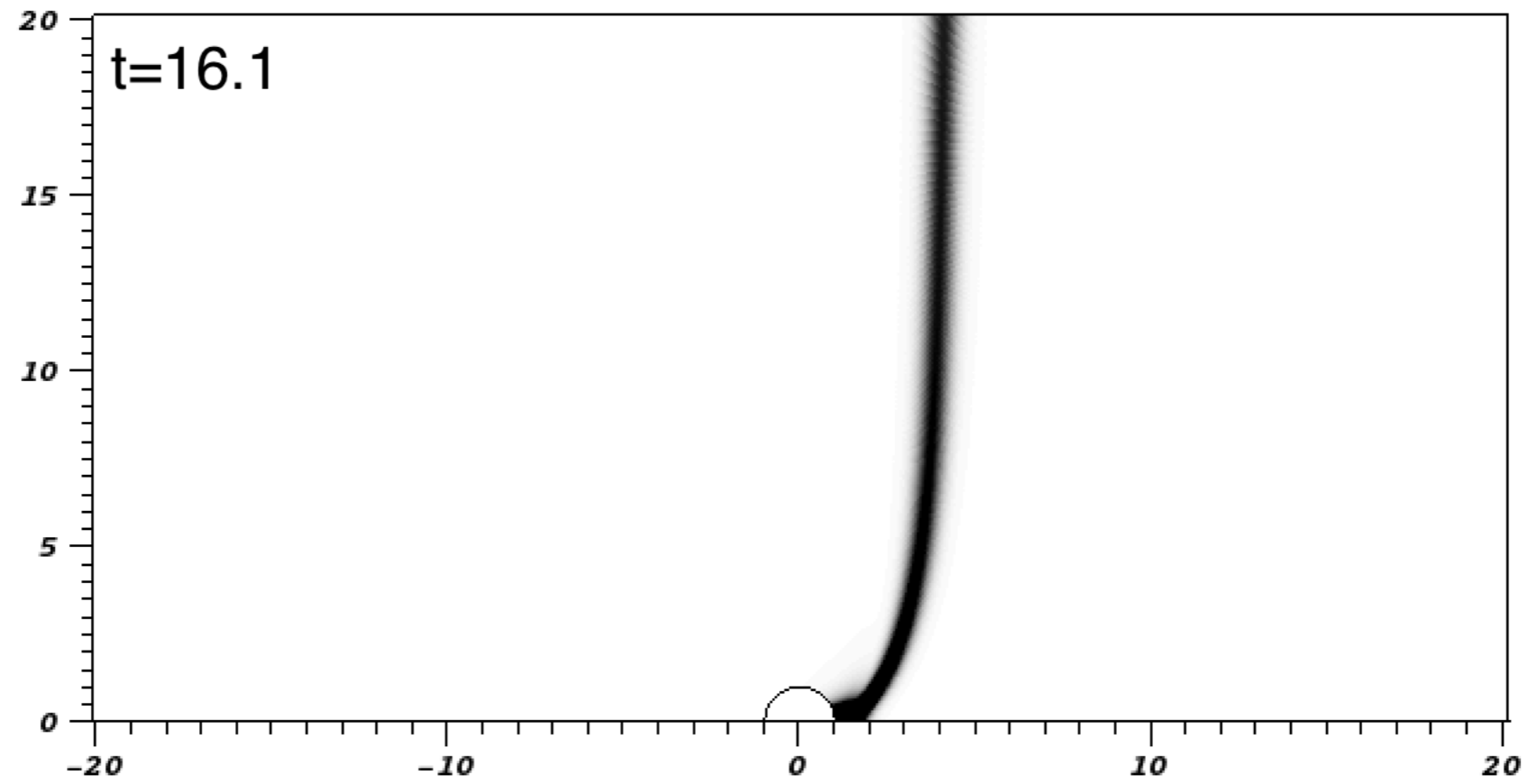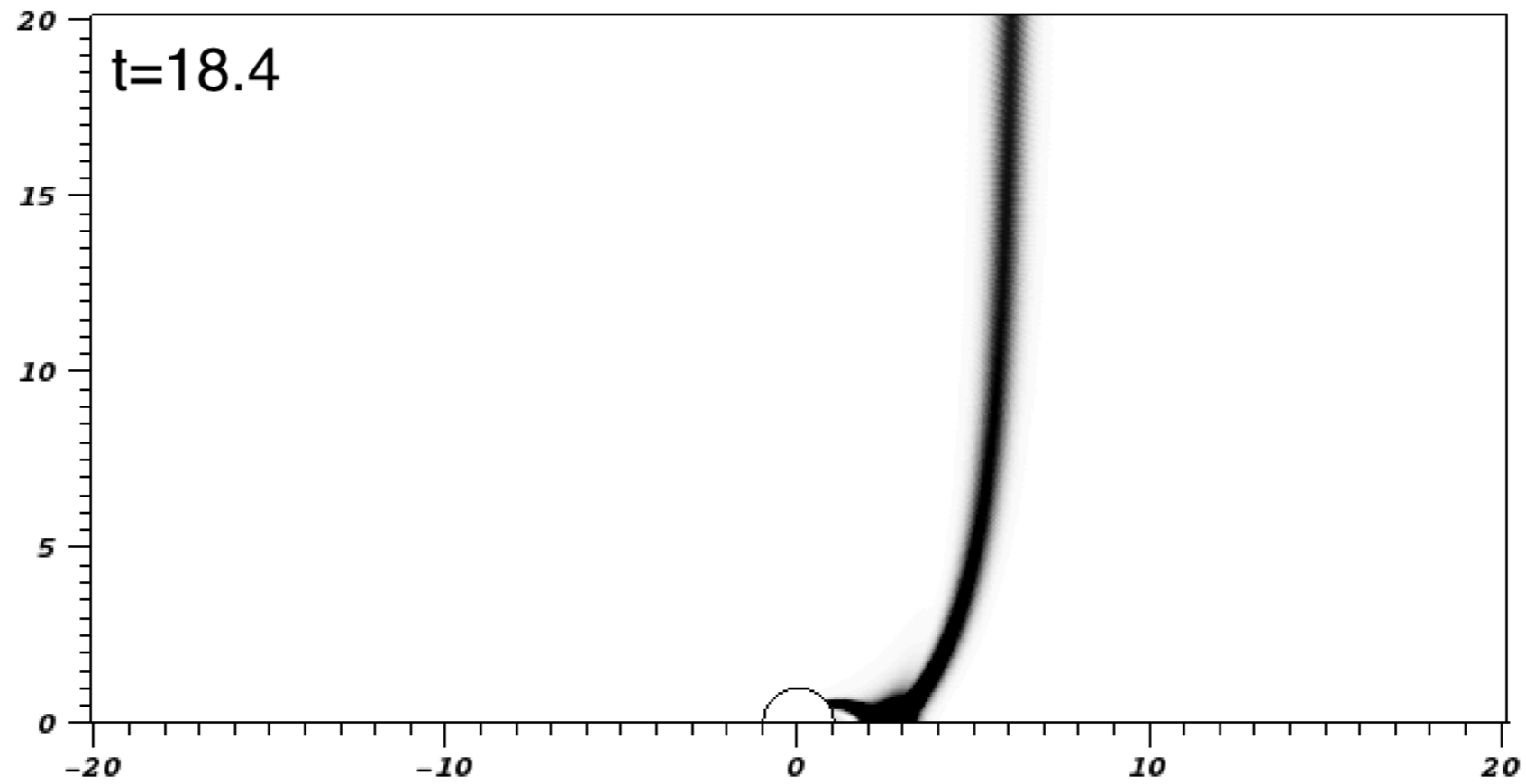- Causality under the horizon imposed during the discretisation
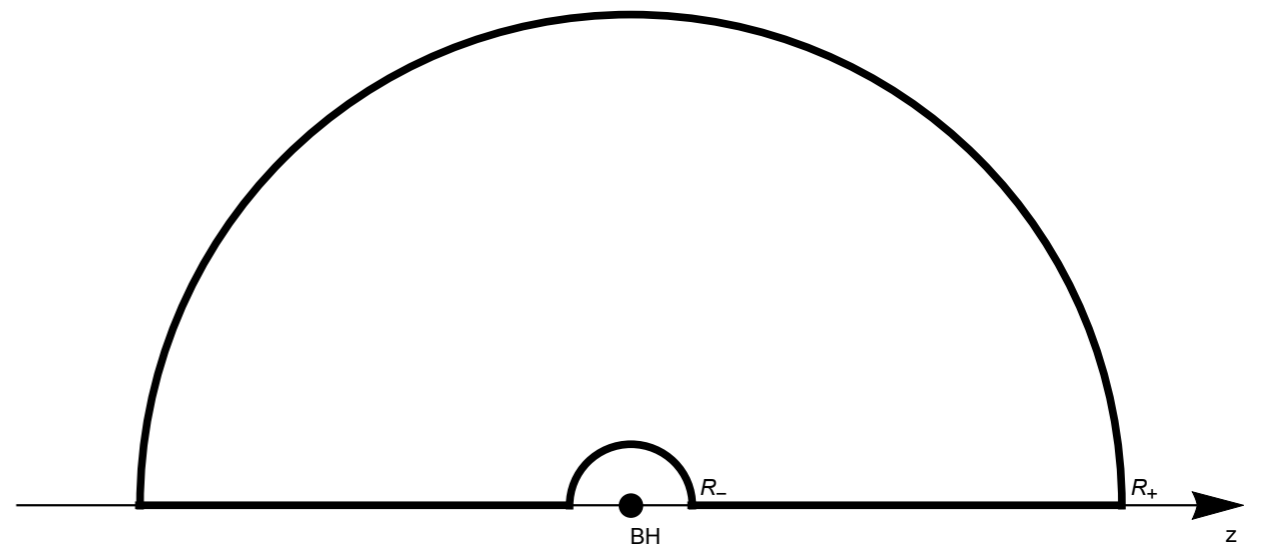
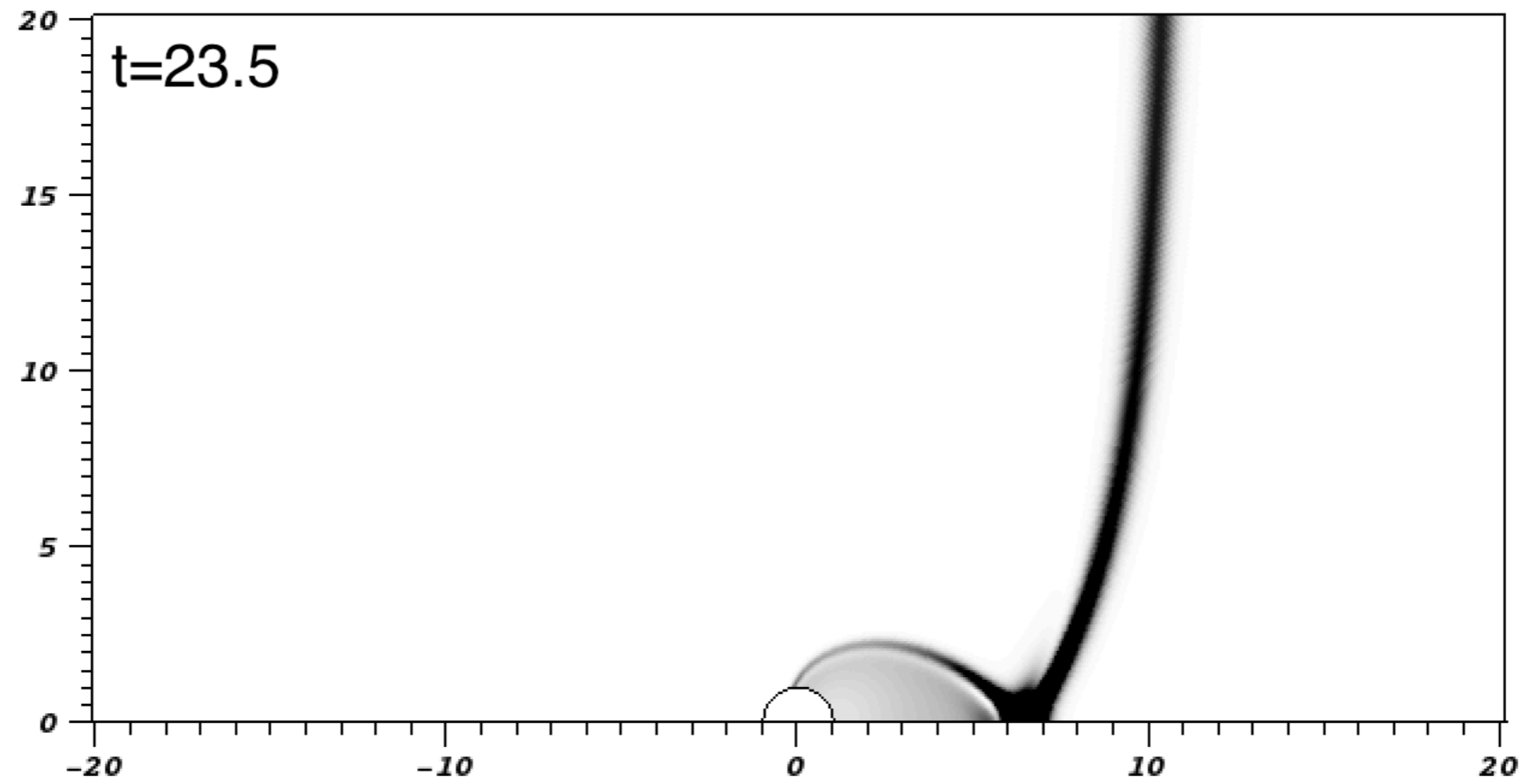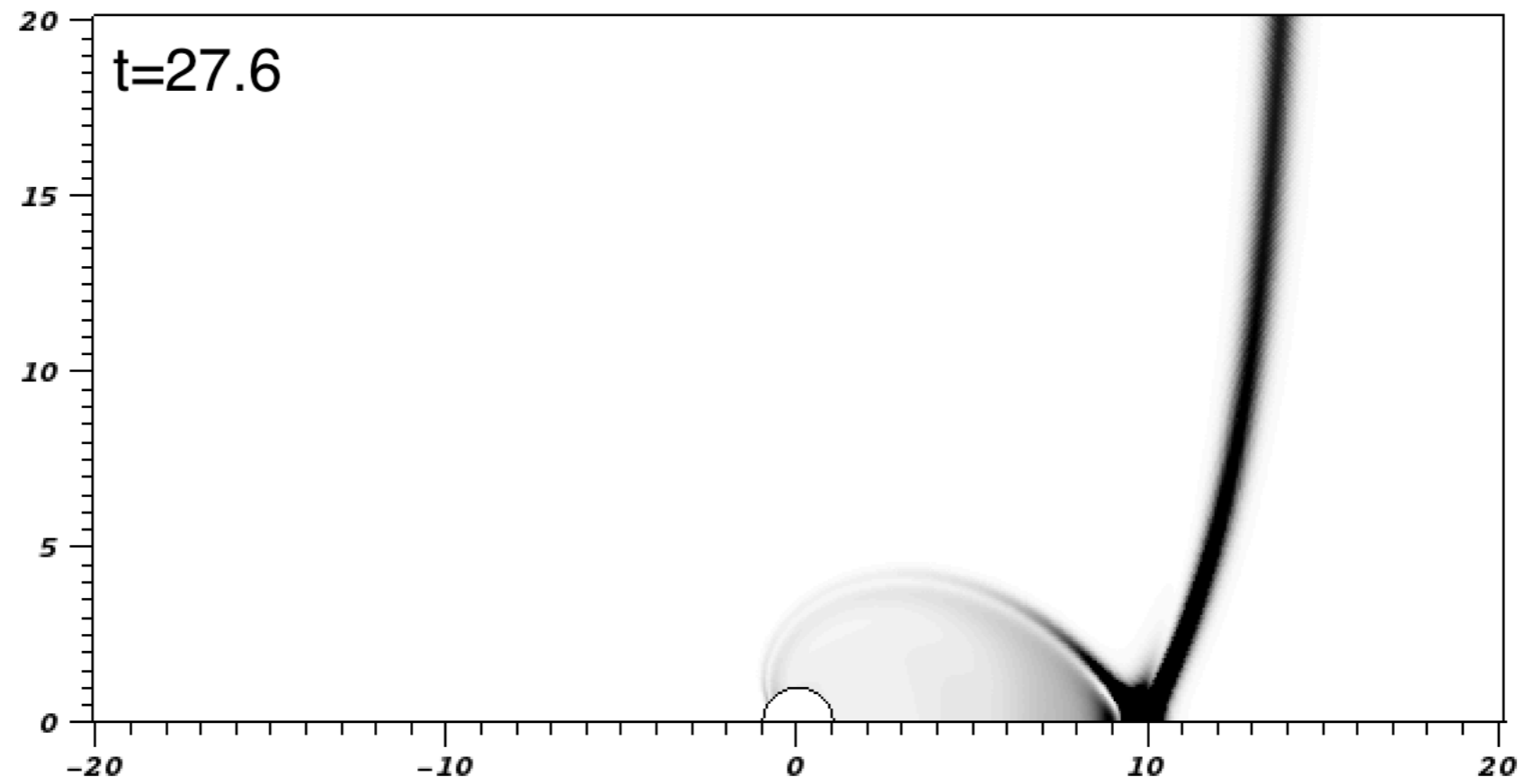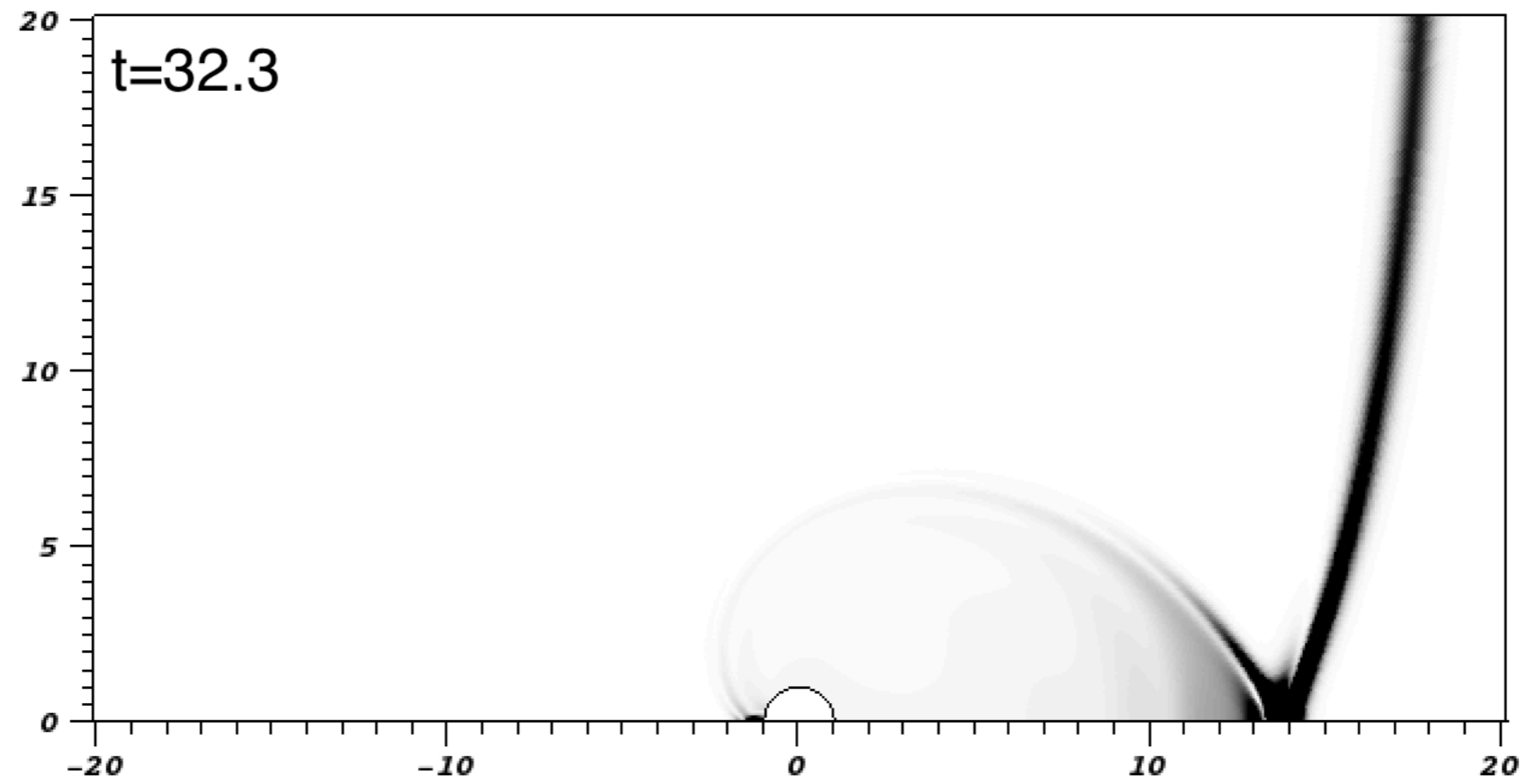# Results
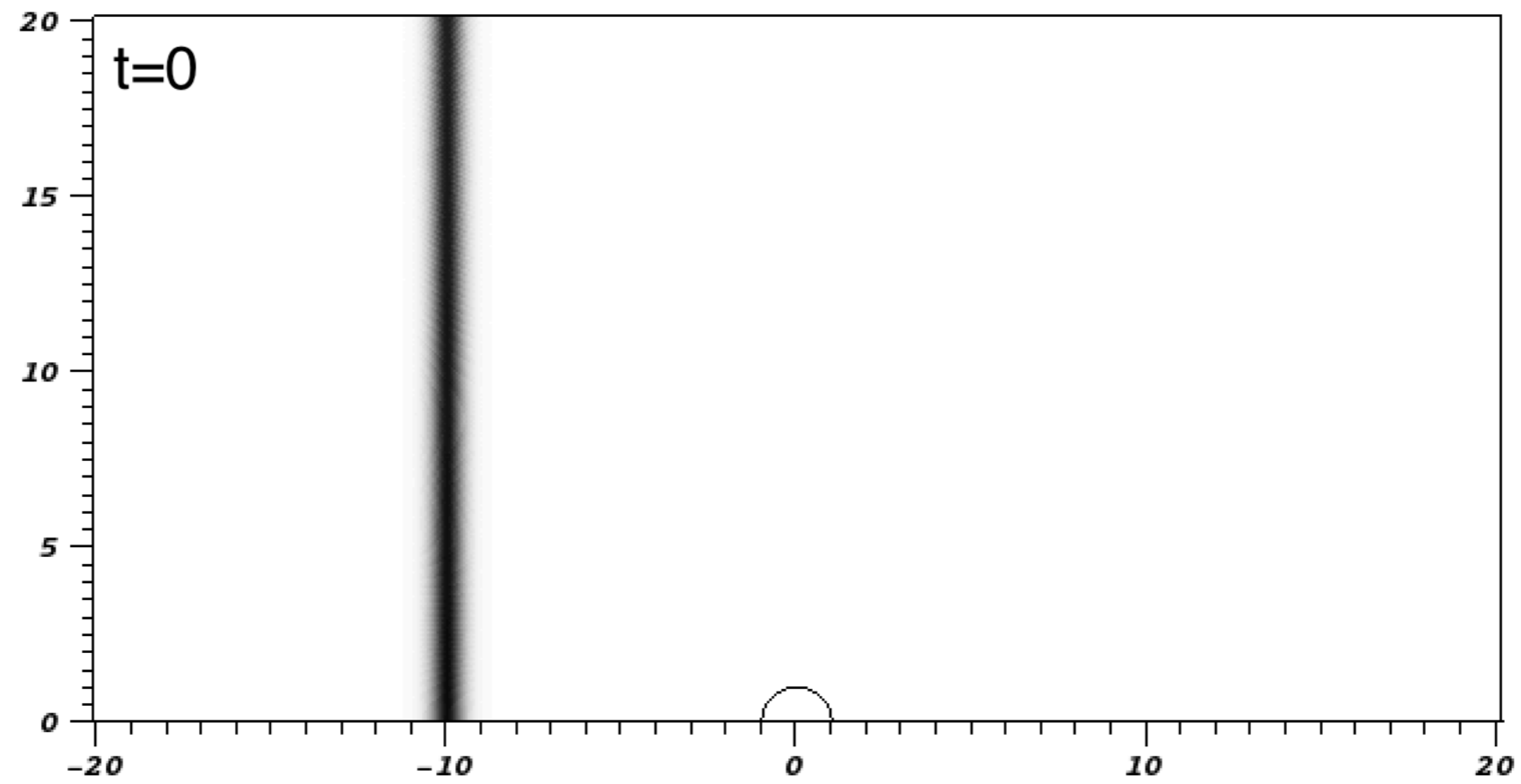
Results
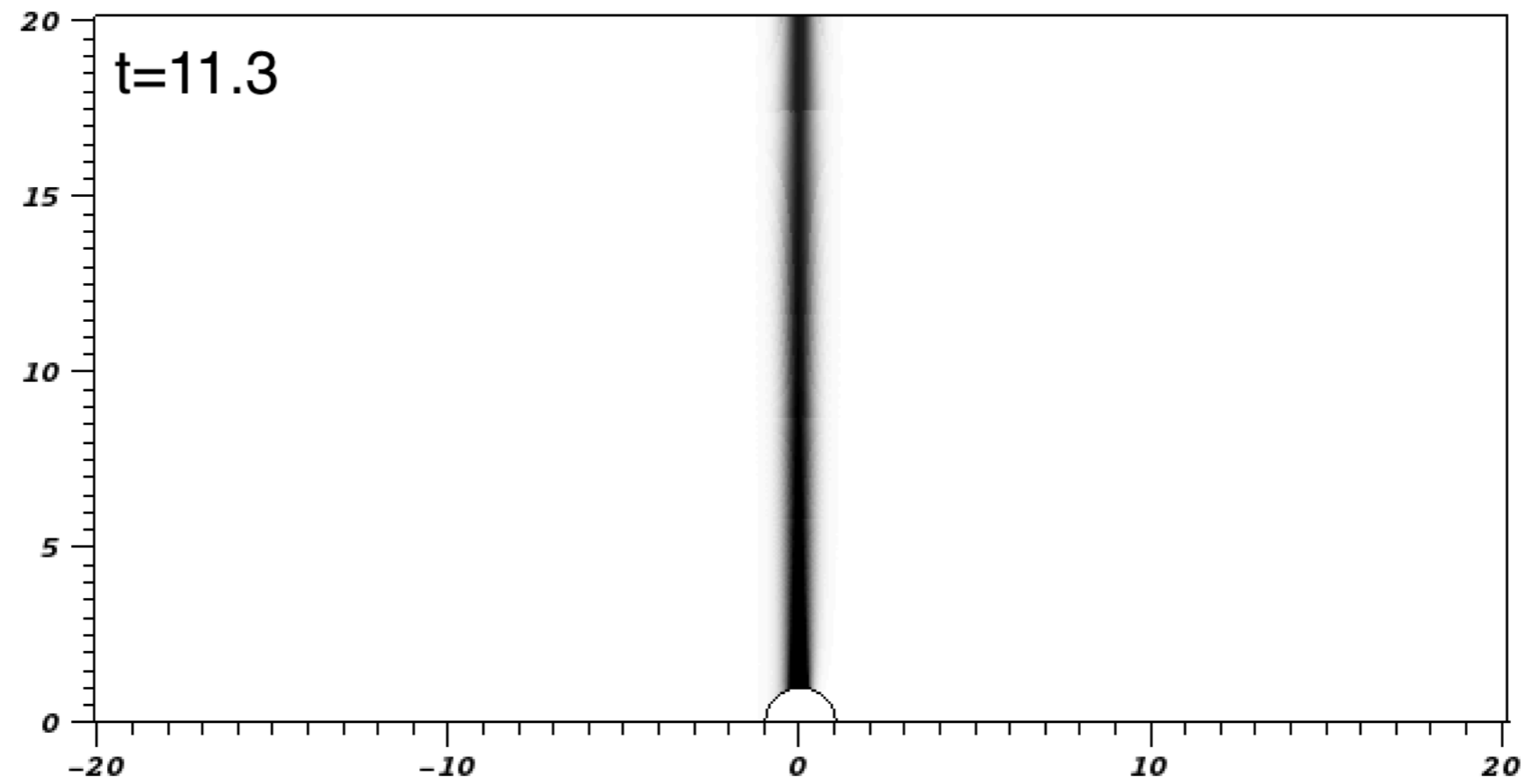
Results

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Results
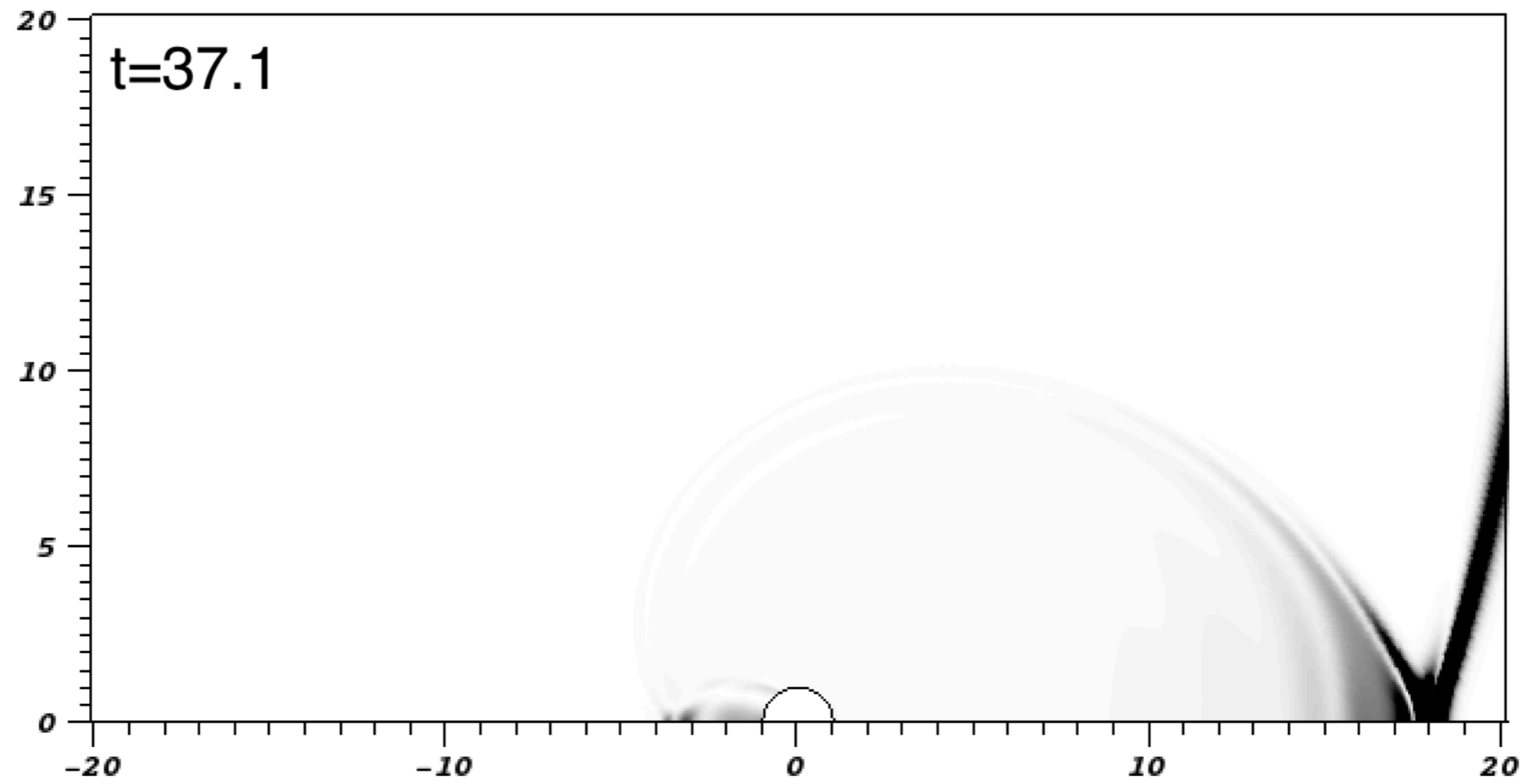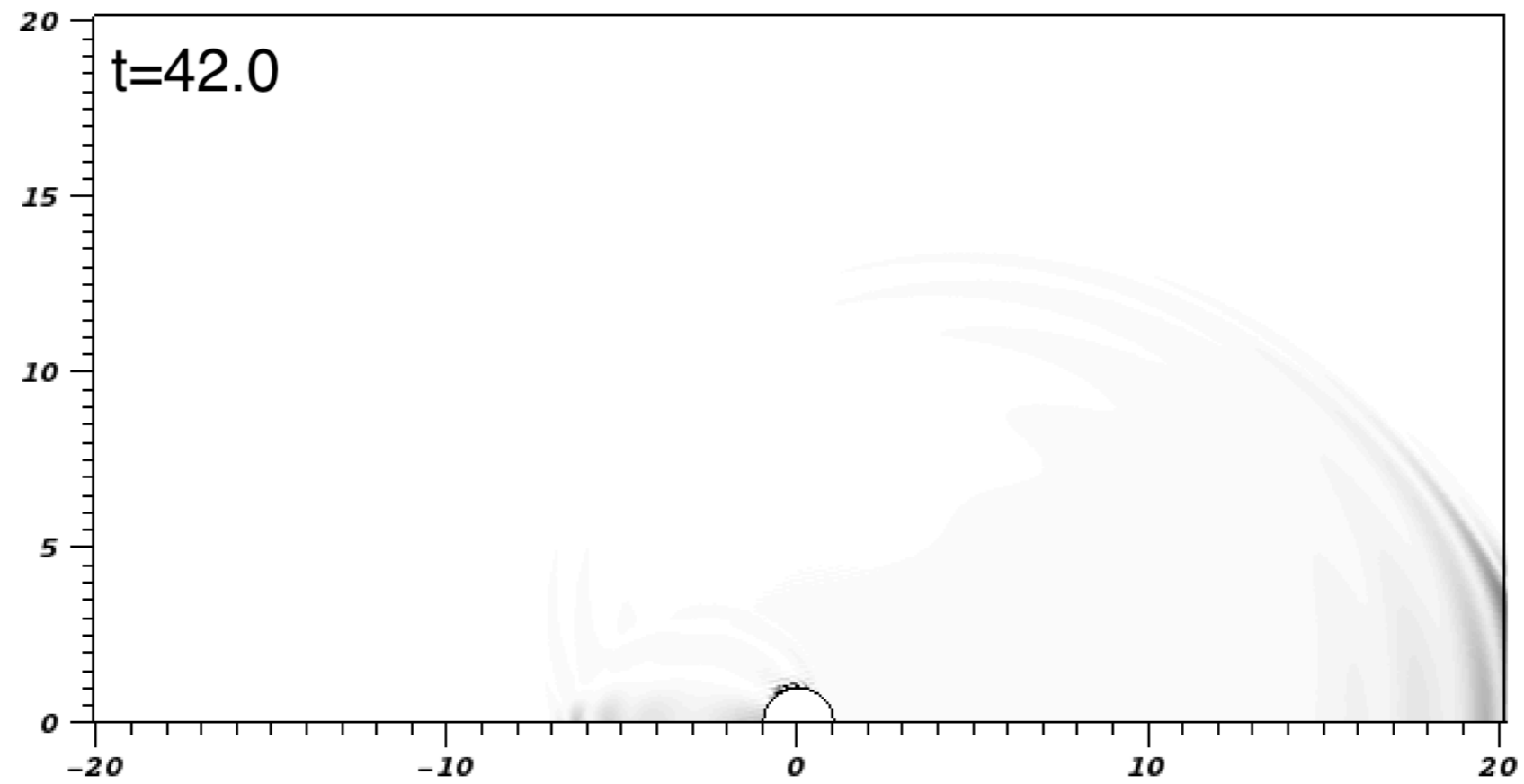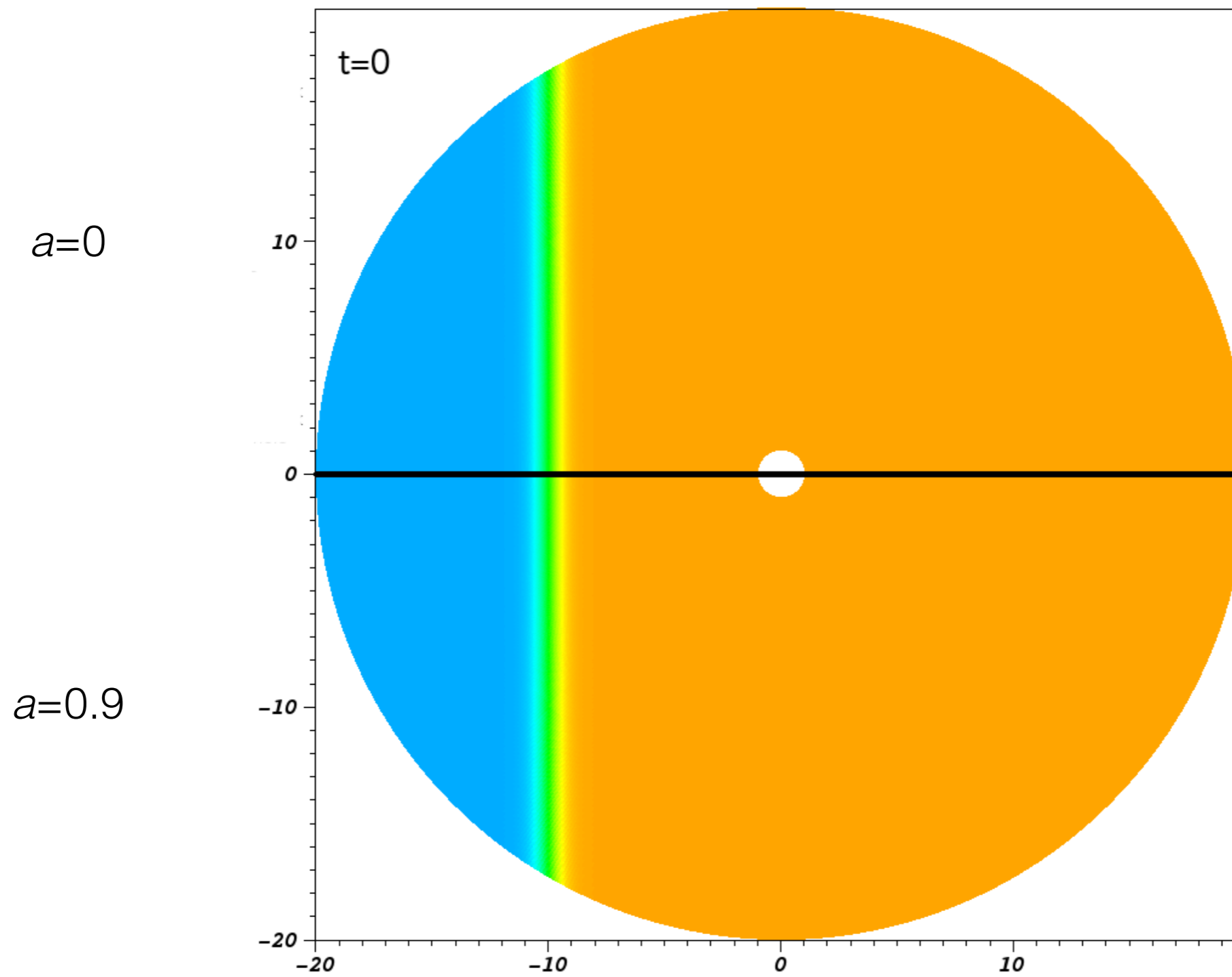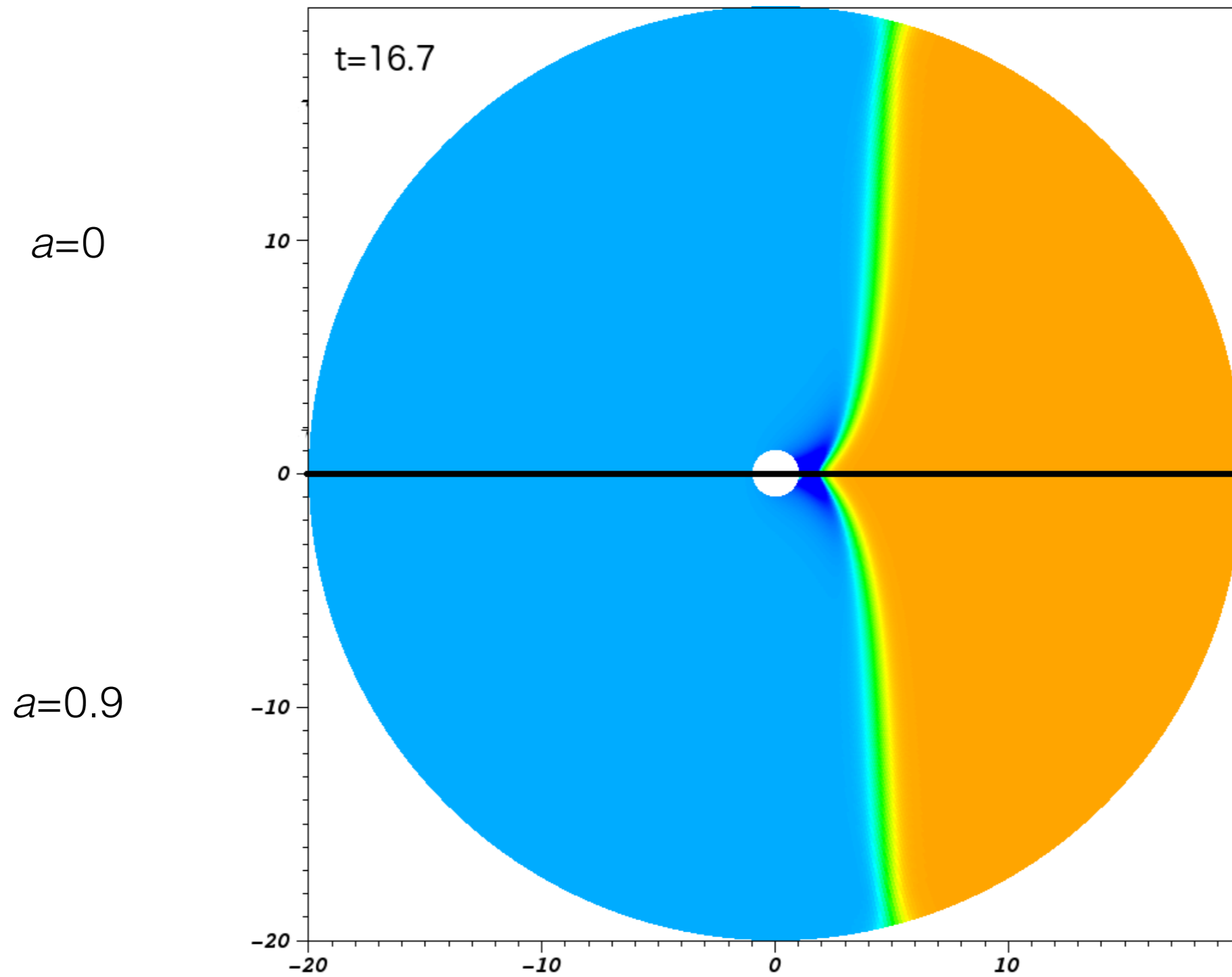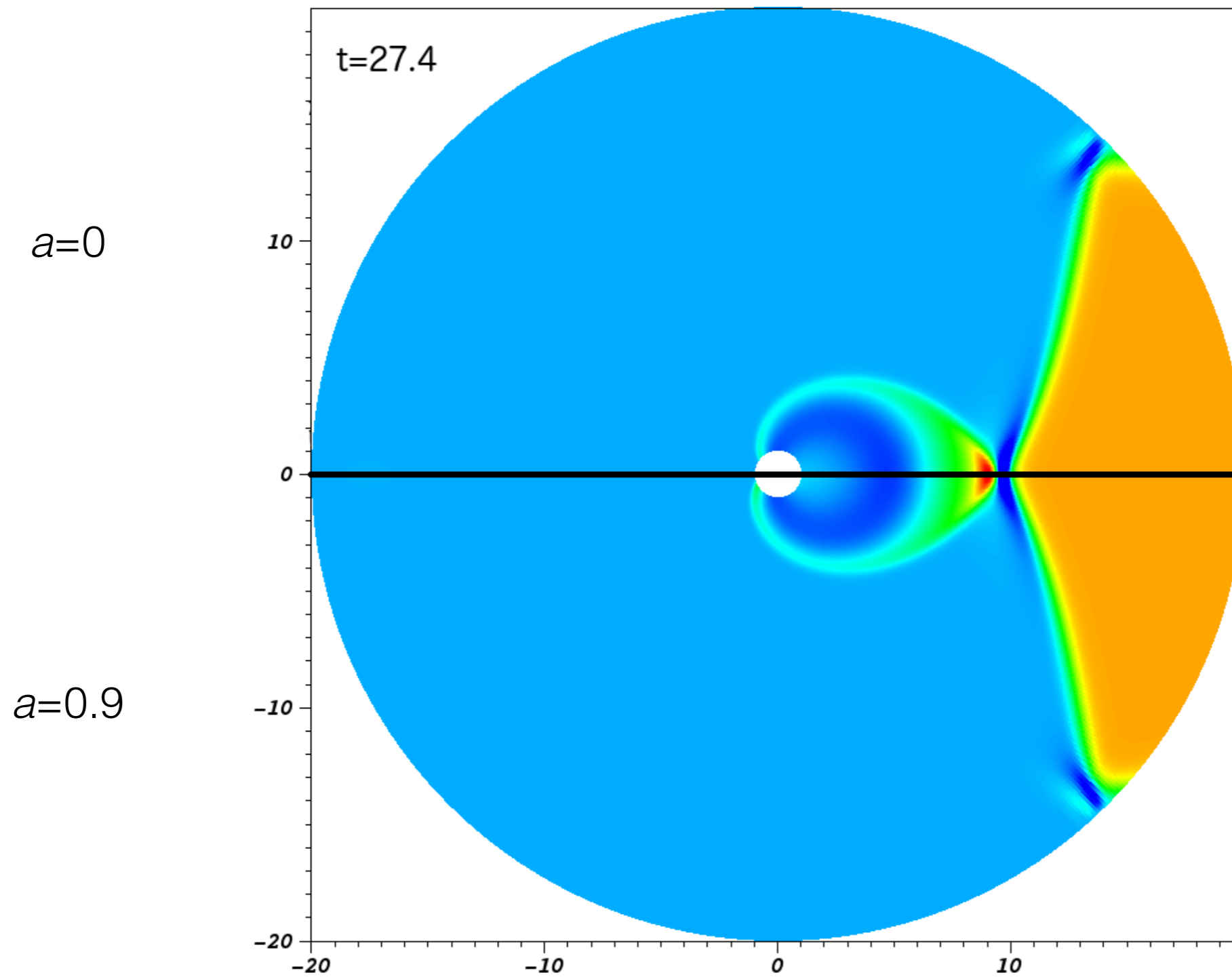
Results

Results

Results

Results

Summary

- Domain wall transits are an active area of research.

- There exist observational campaigns, both terrestrial and astrophysical.

- Domain walls seem to be stable under the black hole transits

- Angular momentum of the black hole have a little impact on the results

Thank you for your attention

- S. Pustelny et. al. *The Global Network of Optical Magnetometers for Exotic physics (GNOME): A novel scheme to search for physics beyond the Standard Model*, Annalen der Physik **525**, 659 (2013)

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- R. Moderski, M. Rogatko, *Reissner-Nordström black holes and thick domain walls*, Phys. Rev. D **69**, 084018 (2004)

- A. Flachi et. al. *Black holes escaping from domain walls*, Phys. Rev. D **73**, 125