The Hunt for the First Black Holes in the Universe

Fabio Pacucci Yale University

> Place Time

The Final Destination

TRAILER: What is a black hole?

How do black holes form?

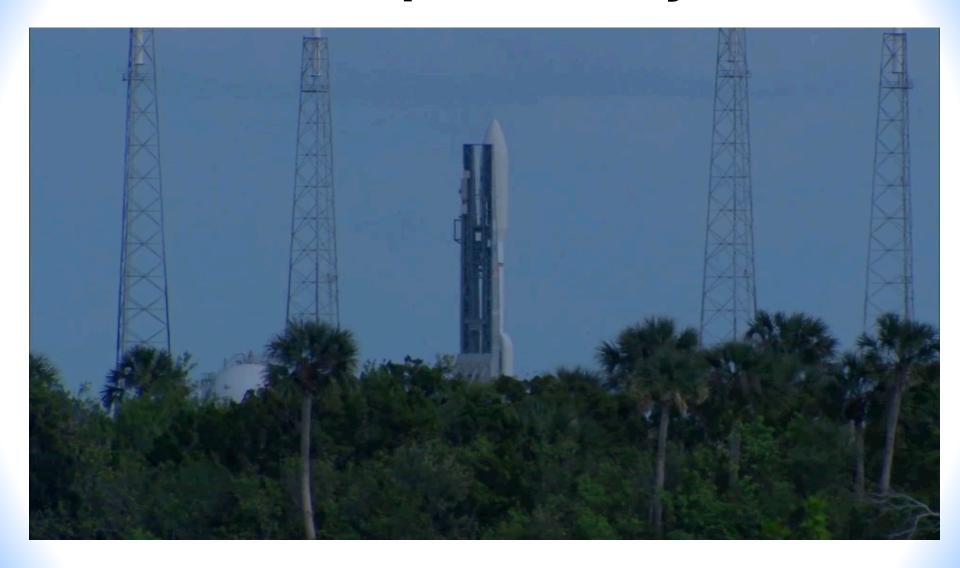
What kind of black holes are out there?

How did the first black holes in the Universe form?

Why are they important for the evolution of the Universe?

TRAILER

Escape velocity



Launch of the spacecraft New Horizons towards Pluto

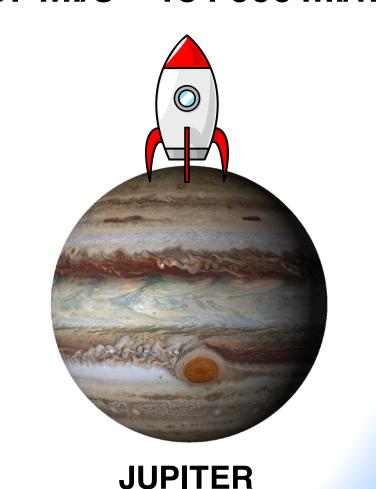
Escape Velocity

 V_f 6.8 mi/s = 25 000 mi/h

 V_f 37 mi/s = 134 000 mi/h



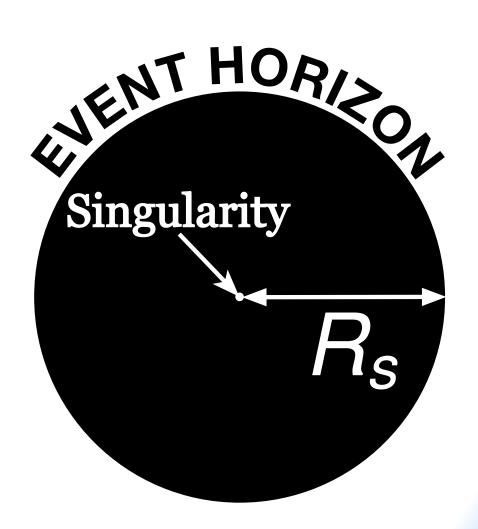
EARTH



What is a black hole?

For a black hole:

$$V_f \ge 186\,000\,{\rm mi/s}$$



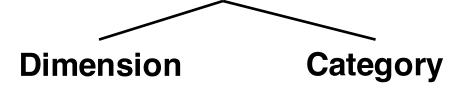
Identity card for a black hole

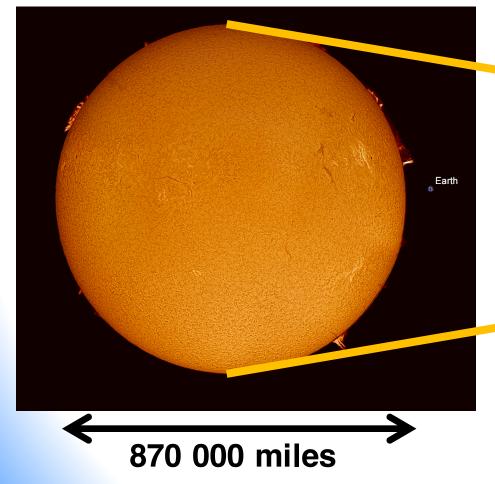
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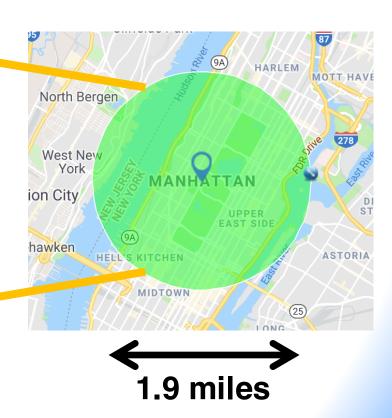


The mass of a black hole

The mass determines

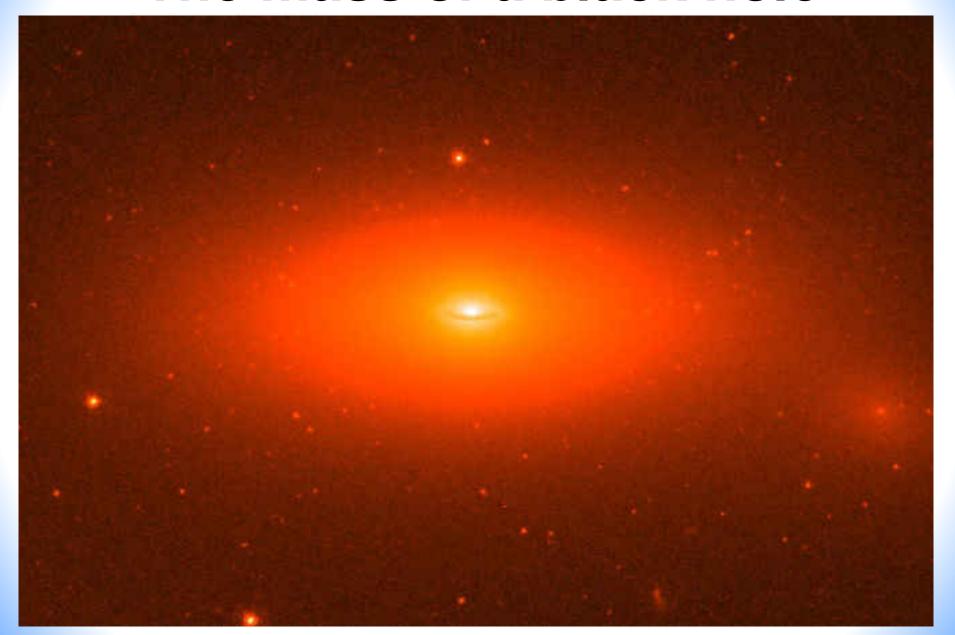






TRAILER

The mass of a black hole



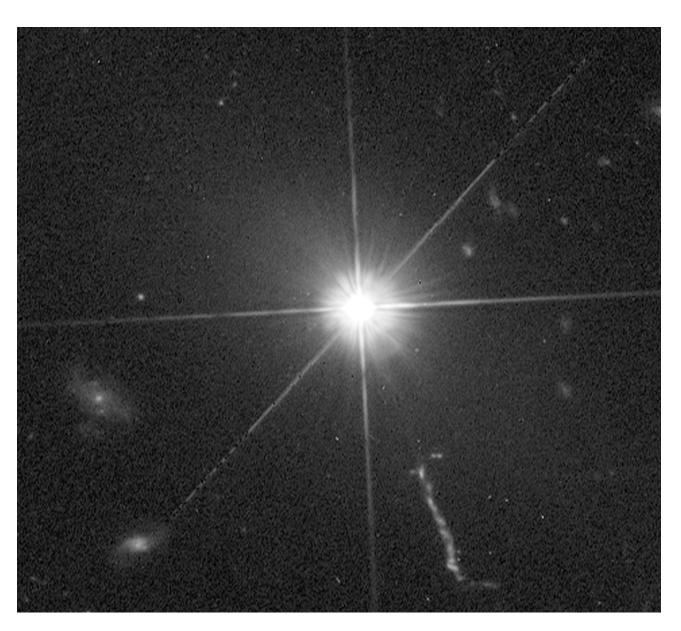


The spin of a black hole

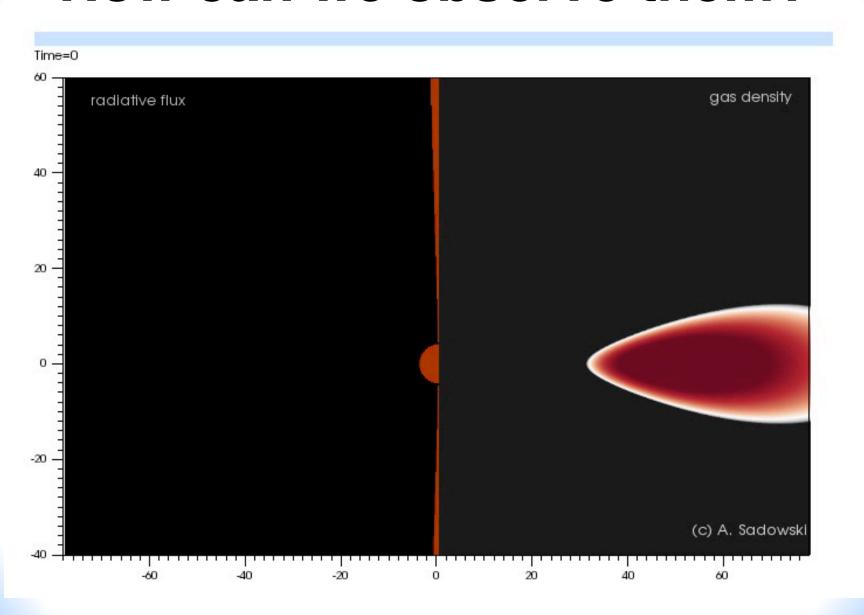




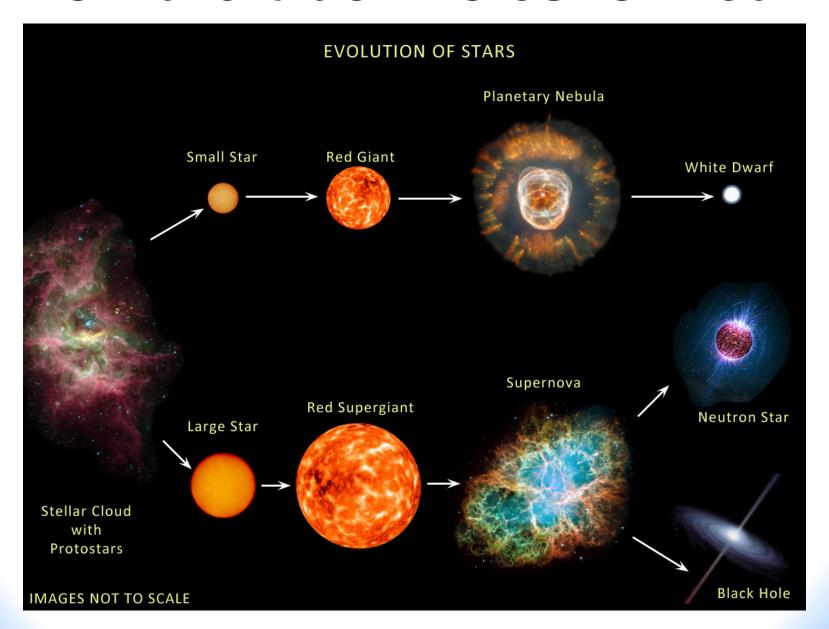
How can we observe them?



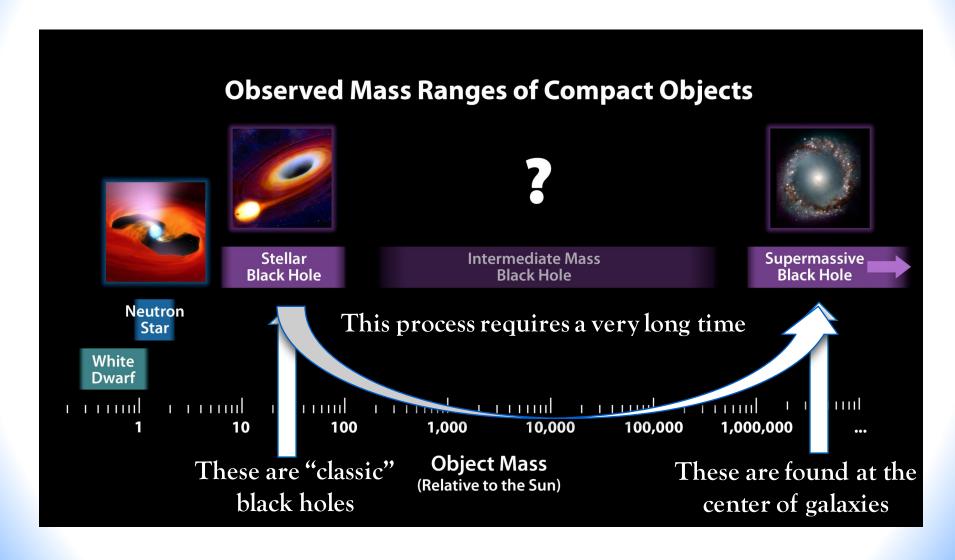
How can we observe them?



How are black holes formed?



Family portrait of black holes



FIRST BLACK HOLES

A brief history of Time

TIME

The first black holes formed here



First giant black holes

Peak of black hole activity

2 billion years

Now (13.7 billion years)

A "terrestrial" comparison

One day



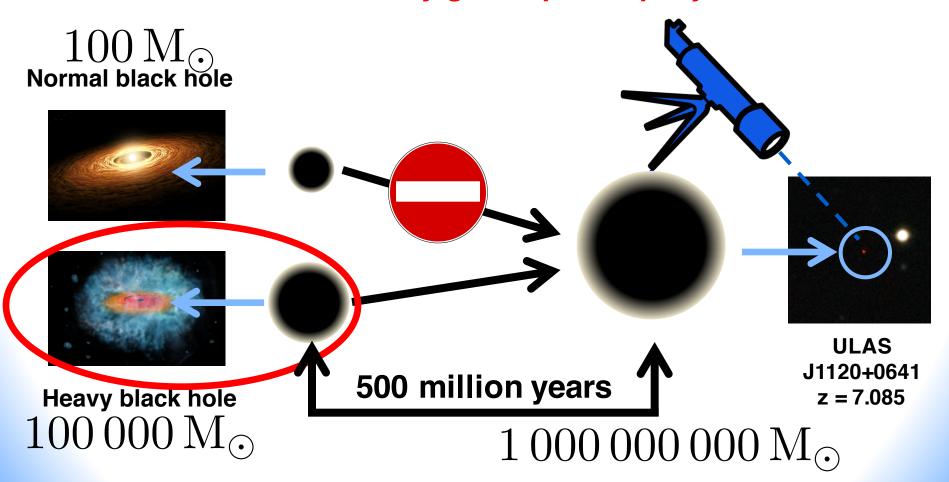
The day after



Something must be wrong...

Too big, too soon

Observations of super-giant black holes < 1 billion years after the Big Bang How did they grow up so rapidly?



Black holes and galaxies







Milky Way



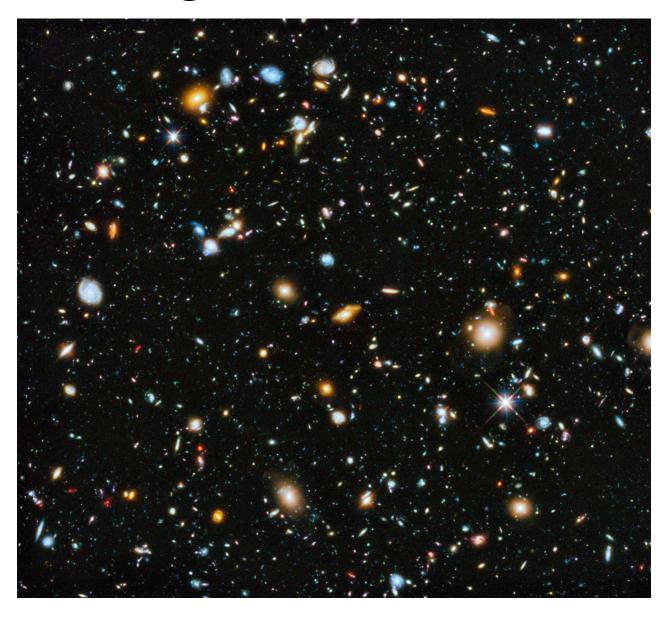
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IMPORTANCE

The building blocks of the Universe



The building blocks of the Universe



My research

- Predicts the light emitted by the first black holes
- Identified two black hole seed candidates

