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Black Holes are
Outta Sight



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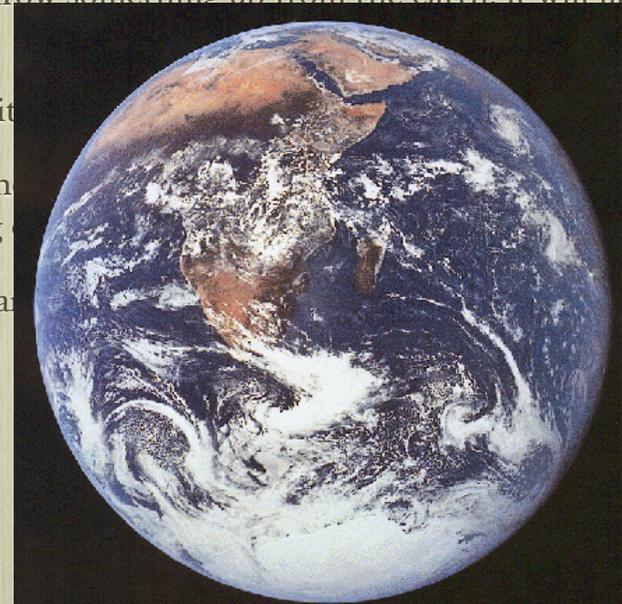
Black Holes

- Invented by?
- **Einstein**
- **Hawking?**
- Well, actually, **John Michell**, rector of Thornhill Church in Yorkshire
- geologist? philosopher? astronomer? Seismologist?
- Polymath.
- presented his ideas to the Royal Society in London in 1783.



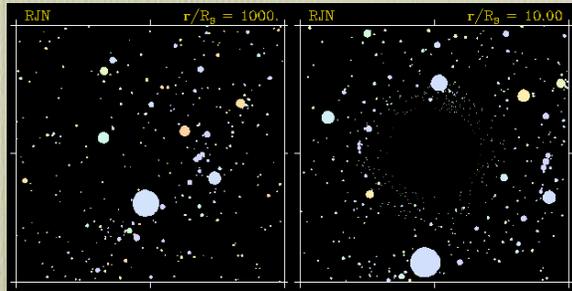
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- If we throw something up from the earth, it will fall back
- Throw it
- But if th
nothing
- If the ear
hole



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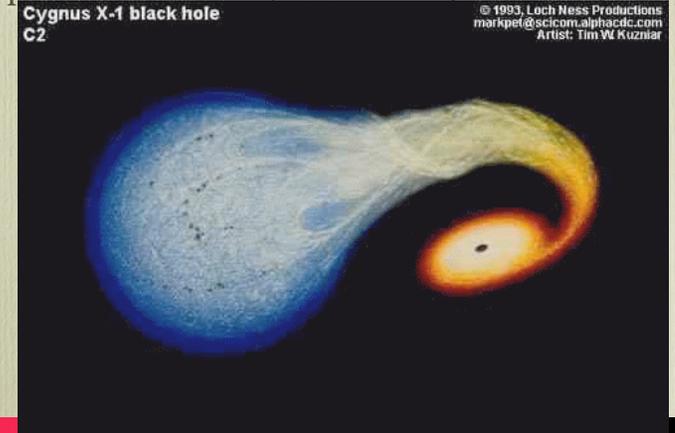
- One way to see a black hole: it's black!
- If we are really lucky...(or unlucky) as a gap in the sky



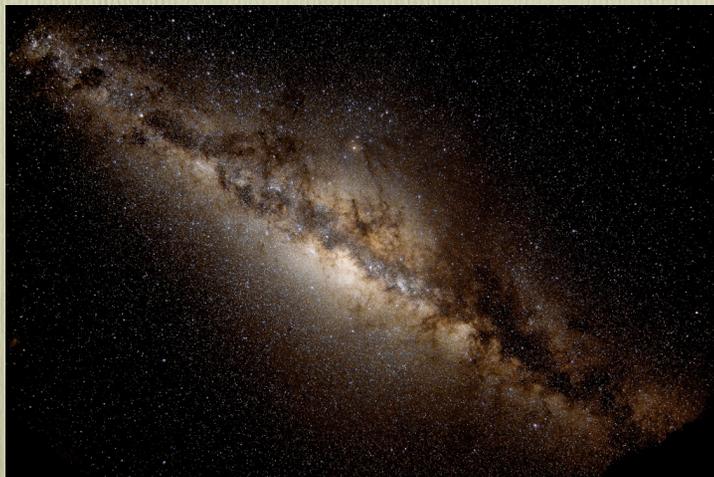
Too Close to a Black Hole
Credit & Copyright: Robert Nemiroff (MTU)<

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- Stuff falling in will become very hot and produce X-rays
- Cygnus X-1: visible star ~20 mass of sun
- Invisible object $M \sim 9M_{\odot}$
- Power output in X-rays is 10,000 x total power output by sun!



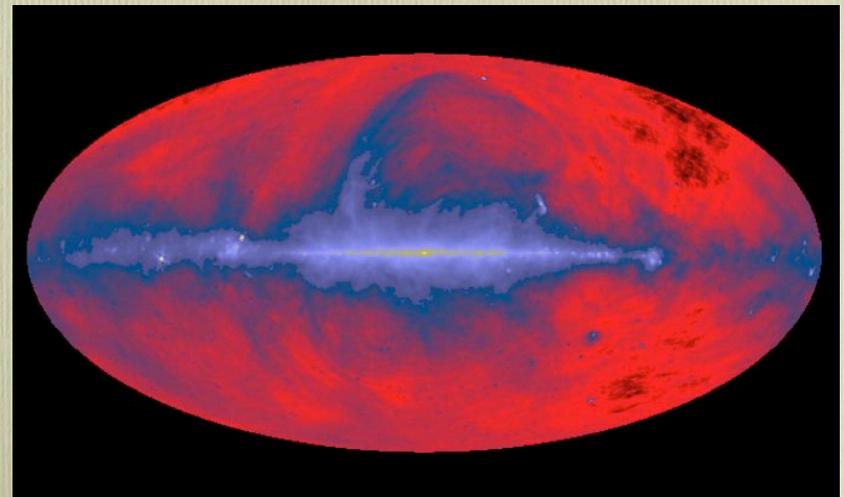
But there are much bigger black holes around



- This is the Milky way, showing the whole sky

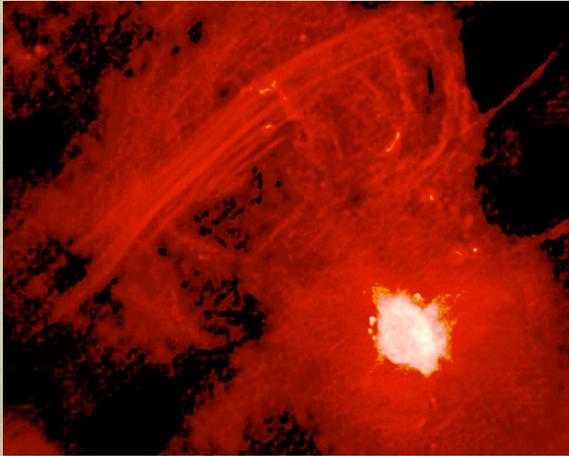
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- If we look at it with radio waves, see very intense source at centre



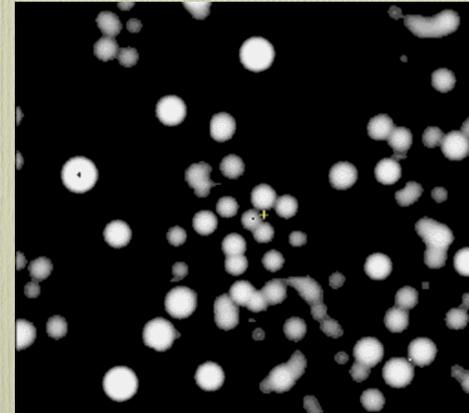
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- which gets brighter as we zoom in



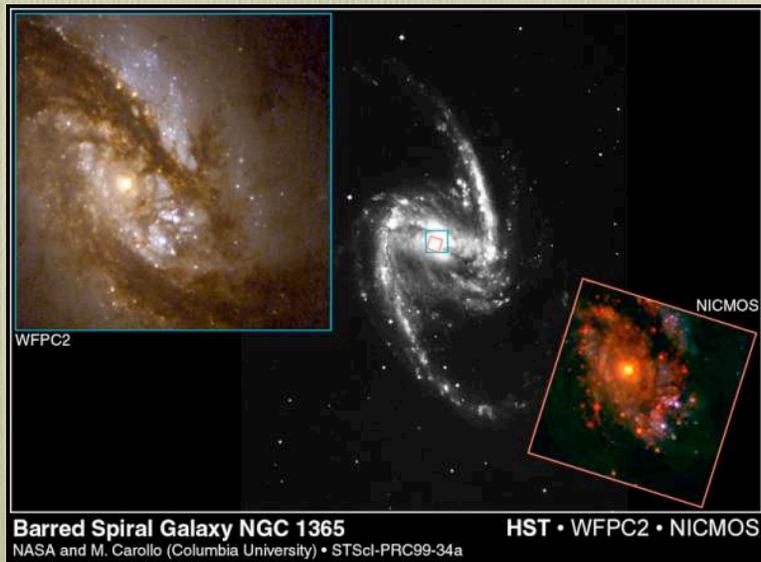
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- The stars there are swirling round something 10 million times as heavy as the sun



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- All galaxies seem to have a huge black hole at the centre

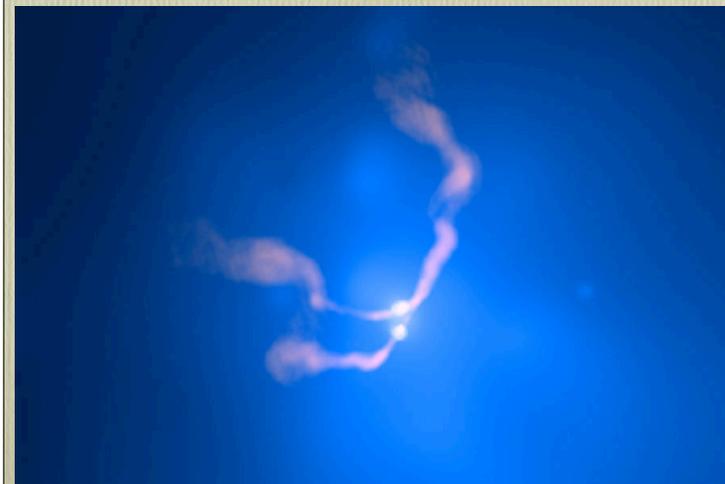


Barred Spiral Galaxy NGC 1365
 HST • WFCP2 • NICMOS
 NASA and M. Carollo (Columbia University) • STScI-PRC99-34a



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- And this is maybe where it is happening now:
- Two galaxies have collided and the black holes seem to be coalescing



3C75 X-rays
 from Chandra

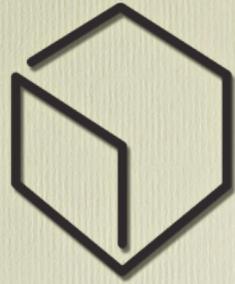


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- SO **if** they exist, the world has 3.4 or 5 or 6 dimensions
- Thanks to Don Monet, John Flynn for the invitation



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