

Friday, March 11, 2016

Reading for Exam 3, April 1:

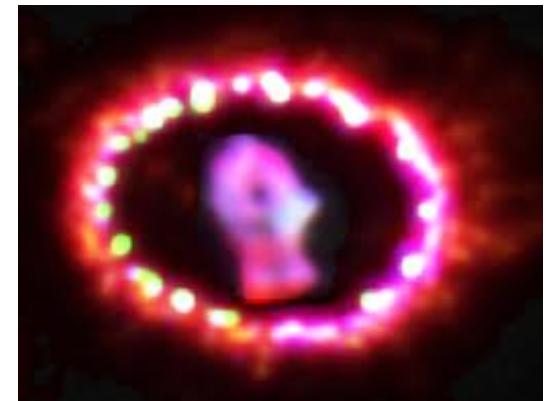
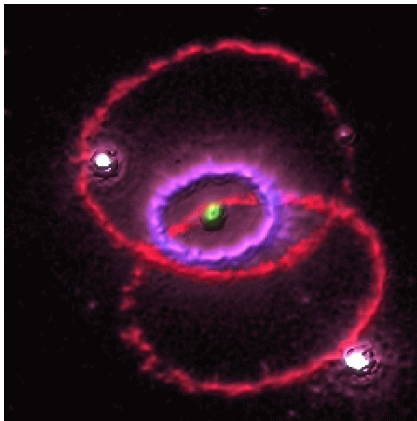
Chapter 7 (SN 1987A)

Astronomy in the news?

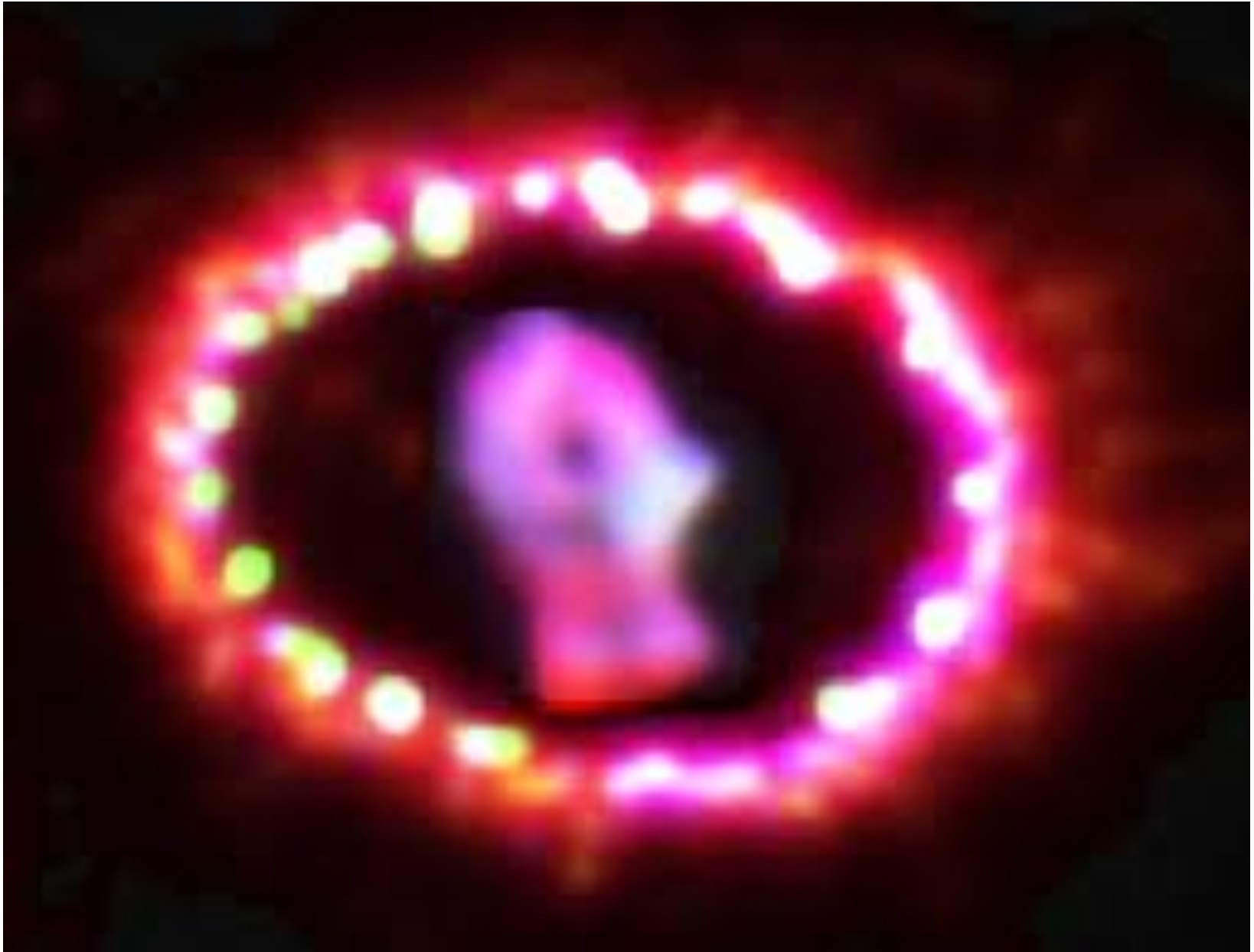
Sterile neutrinos, a type that would not even interact by the weak nuclear force, only with other neutrinos. Recent suggestion that detection of certain X-rays might be from the spontaneous quantum “decay” of sterile neutrinos. Sterile neutrinos are one candidate to comprise the Dark Matter (later).

Goal:

To understand the nature and importance of SN 1987A for our understanding of massive star evolution and iron core collapse.



## Recent Hubble Image of SN 1987A



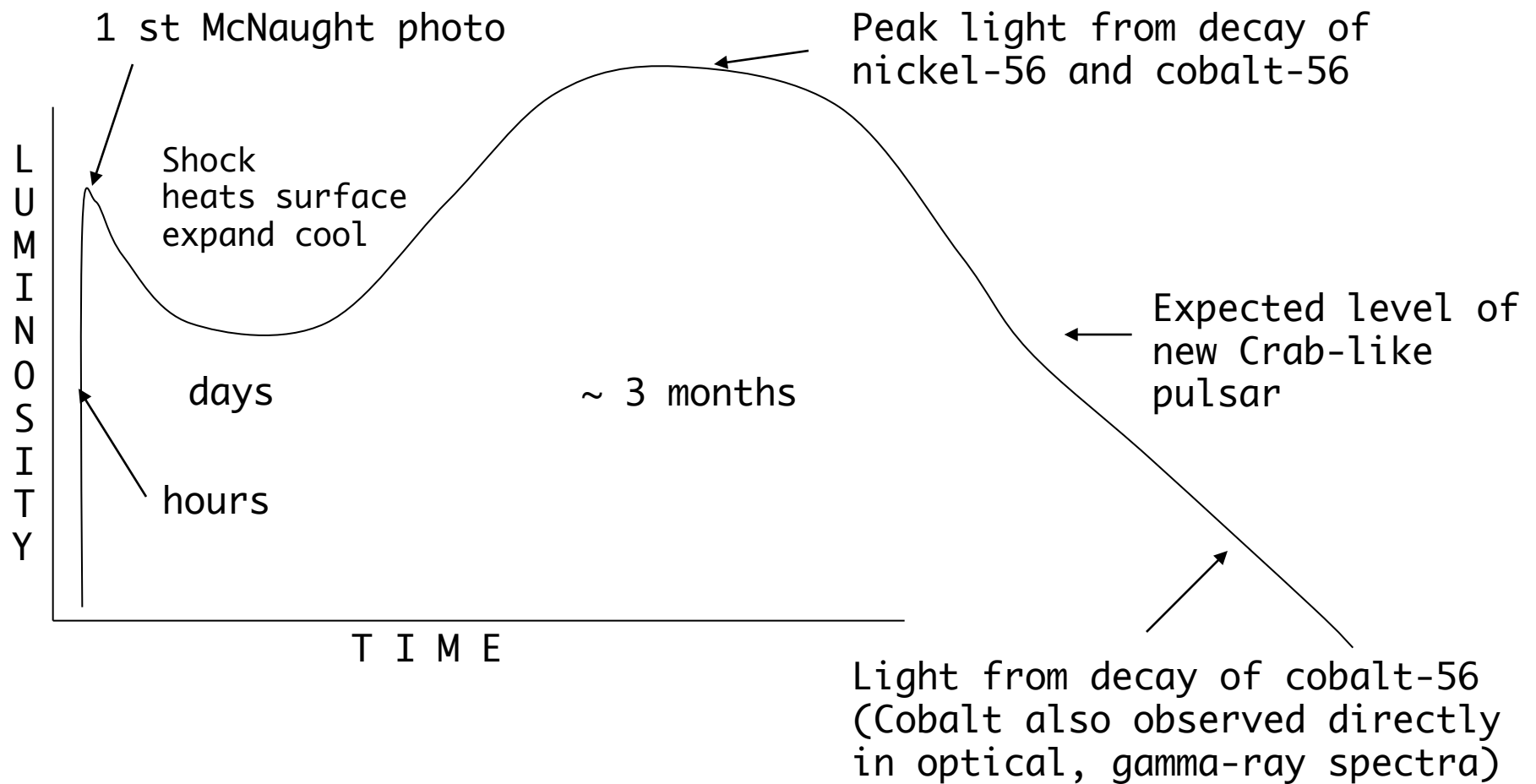
The single most important thing about SN 1987A is that we detected the neutrinos!

*It was definitely a core-collapse event*

$10^{57}$  neutrinos emitted, most missed the Earth. Of those that hit the Earth, most passed through since neutrinos scarcely interact.

About 19 neutrinos were detected in a 10 second burst.

*170,000 year history of humanity!*



SN 1987A had a rather peculiar light curve because it was a relatively compact blue supergiant, not a red supergiant (not sure why, maybe in binary system), brief shock heating, rapid cooling by expansion, no plateau, subsequent light all from radioactive decay.

## One Minute Exam

What was the most important thing about SN 1987A in terms of the basic physics of core collapse?

➡ It exploded in a blue, not a red supergiant

← It was surrounded by three rings

↑ It produced radioactive nickel and cobalt

↓ Neutrinos were detected from it

Saw neutrinos, neutron star must have formed and survived for at least 10 seconds.

If a black hole had formed in the first instants, neither light nor neutrinos could have been emitted.

No sign of neutron star since despite looking hard for 29 years.

Whatever is in the center of Cas A, most likely a neutron star, is too dim to be seen at the distance of the LMC, so SN 1987A might have made one of those (probably a neutron star, but not bright like the one in the Crab Nebula).

Also possible that after explosion and formation of neutron star, some matter fell back in and crushed the neutron star to become a black hole.

Dim neutron star or black hole? Still do not know.

End of Material for Exam 3



Neutron stars

Alone and in binary systems

Reading Chapter 8 - Sections 8.1, 8.2, 8.5, 8.6, 8.10