Strong neutrino cooling by cycles of electron capture and β^- decay in neutron star crusts

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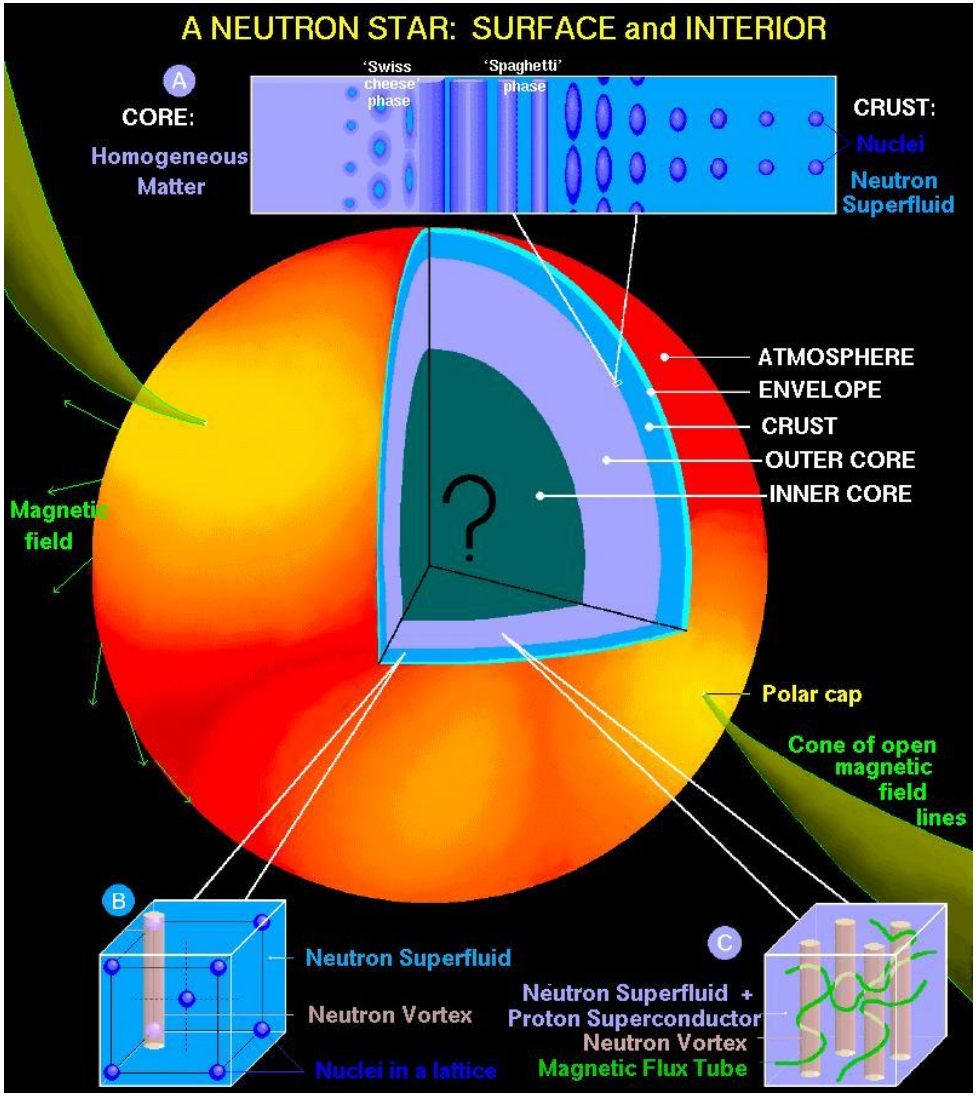
Physics 802
5 May 2015



- **What effect does the presence of Urca shells in the neutron star crust have?**
- Neutrino luminosity leads to energy loss
- Urca shell cooling predicted in the neutron star crust
- Decouples the deep crust from the surface layers

Image from: http://www.astro.umd.edu/~miller/Images/NStarInt.jpeg

- Urca shell: Mixed region of electron capture and β^- decay
- Transitions between low-lying states: $E_x \leq kT$
- Large cooling rates from highly deformed nuclei
- Composition dependant on thermonuclear burning at the surface

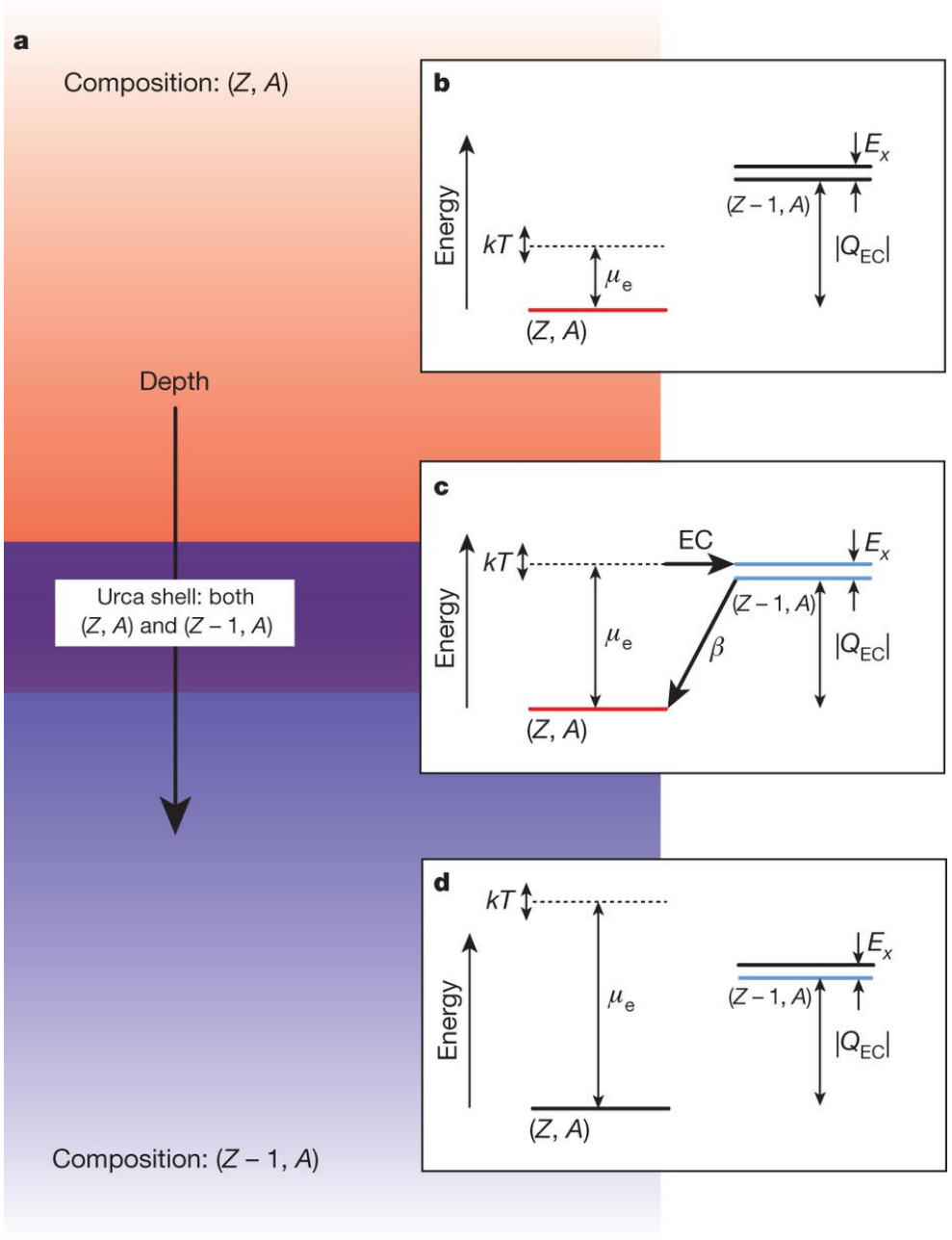


Image from: Schatz et al, 2014

- Temperature inversion
- Minimum T at the location of the Urca shell
- Heat sink in the crust
- Evidence: light curves decaying faster than predicted

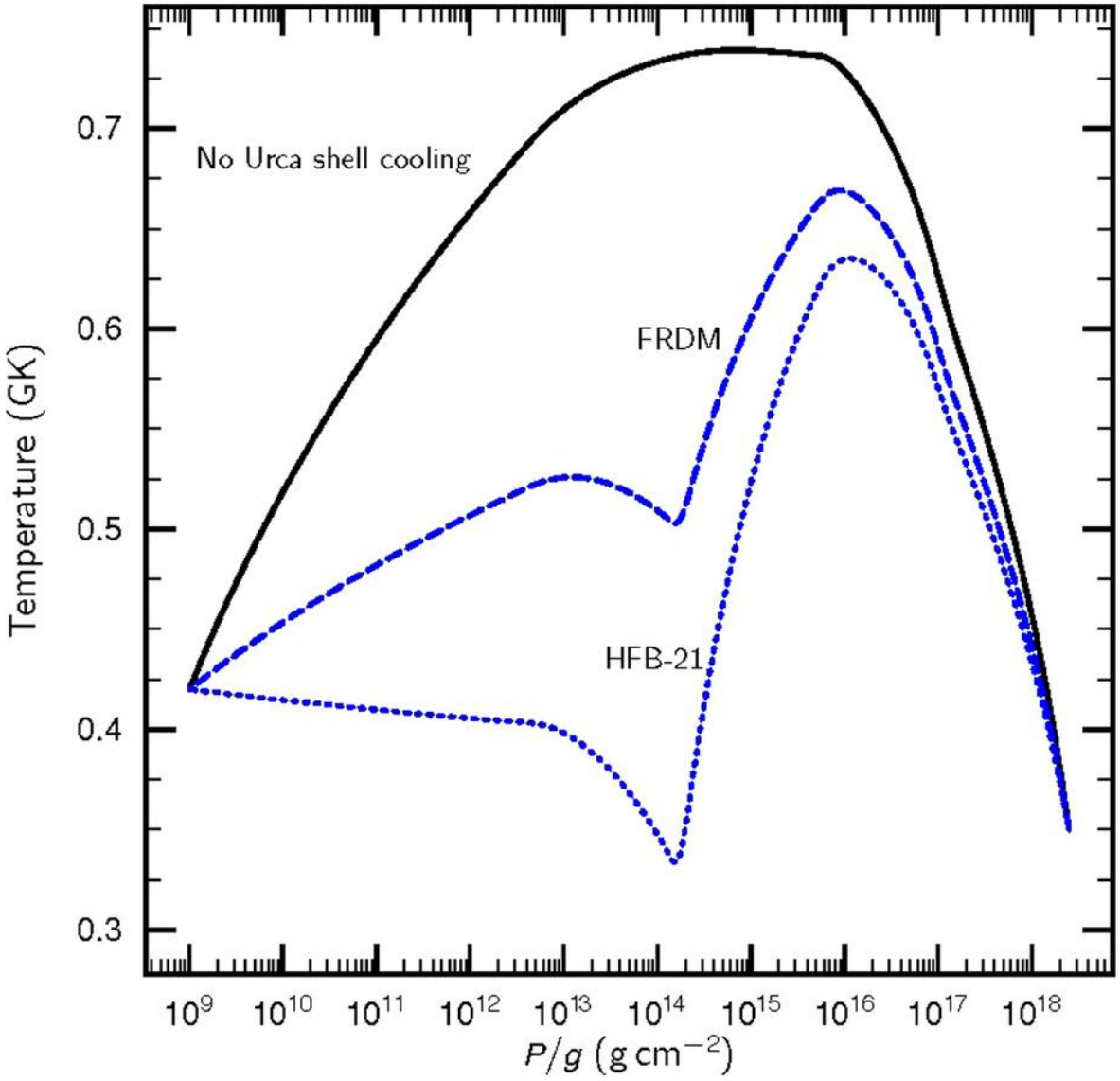


Image from: Schatz et al, 2014

- References
  - H Schatz et al, “Strong neutrino cooling by cycles of electron capture and β^- decay in neutron star crusts”, *Nature* **505**, 62–65 (2014) doi:10.1038/nature12757

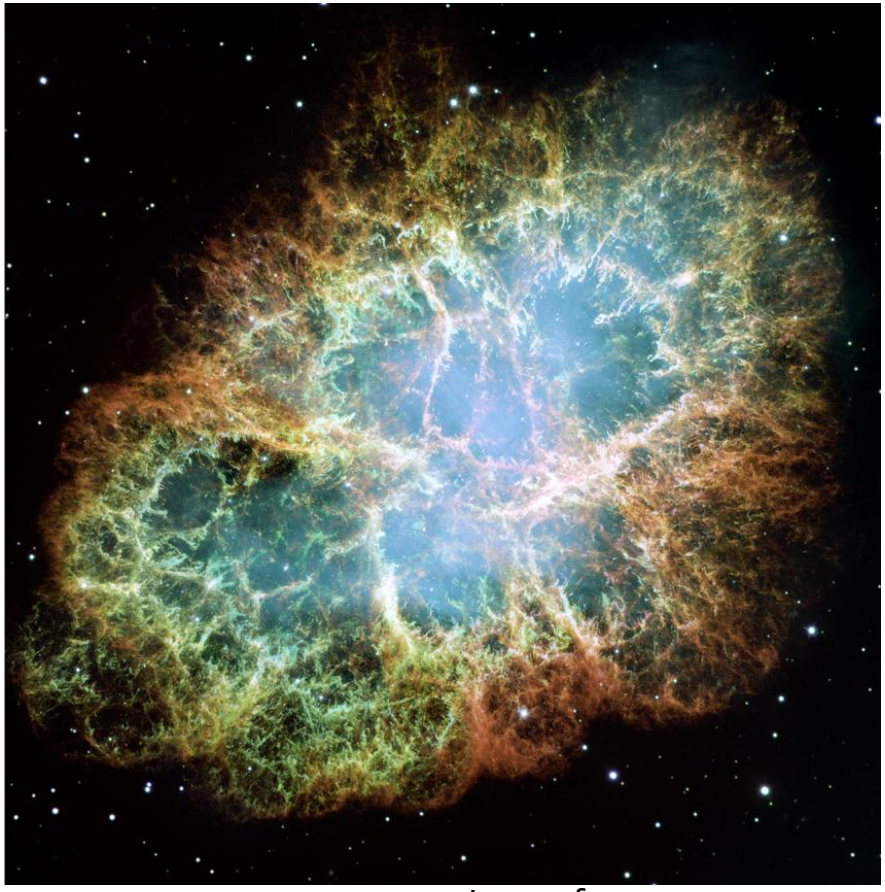


Image from:
https://news.slac.stanford.edu/sites/default/files/images/image/neutron-star-st.jpg