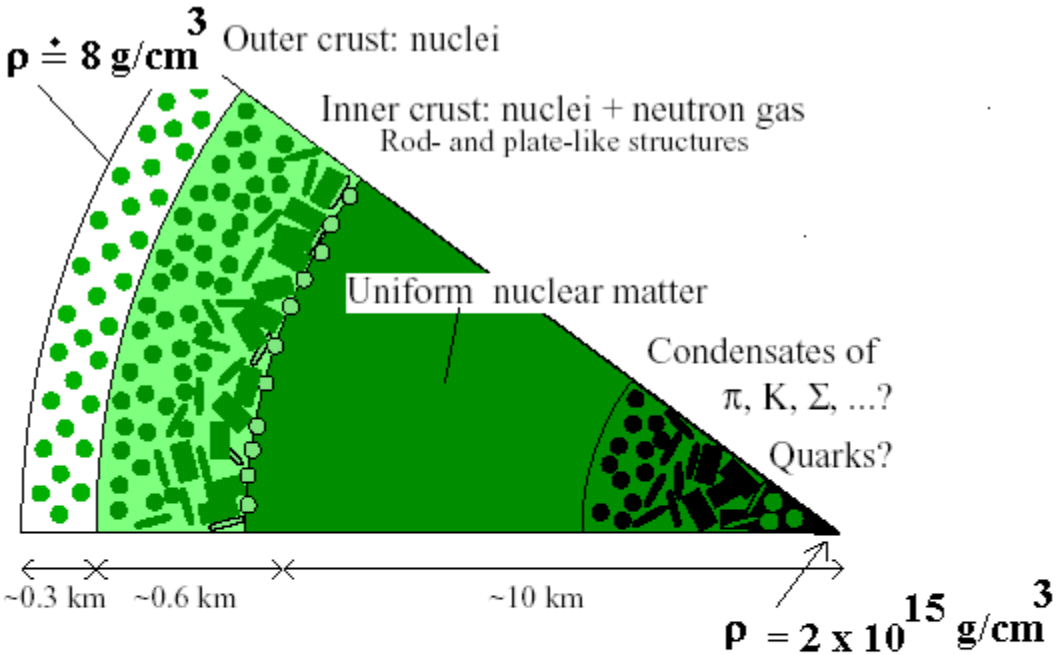
Physical properties of systems containing nuclear matter

Object	Mass(g)	R(km)	r_S (km)	Density(g/cm$^{3)}$
neutron star	4×10^{33}	10	6	5×10^{14}
white dwarf	2×10^{33}	5400	3	3×10^{6}
Sun	2×10^{33}	7×10^{5}	3	1.4 avg, 160 in core
Jupiter	2×10^{30}	7×10^{4}	3×10^{-3}	1.3
Earth	6×10^{27}	6×10^{3}	9×10^{-6}	5.5
Lead nucleus	3.5×10^{-22}	6×10^{-18}	2.6×10^{-55}	3×10^{14}

Neutron Star Structure

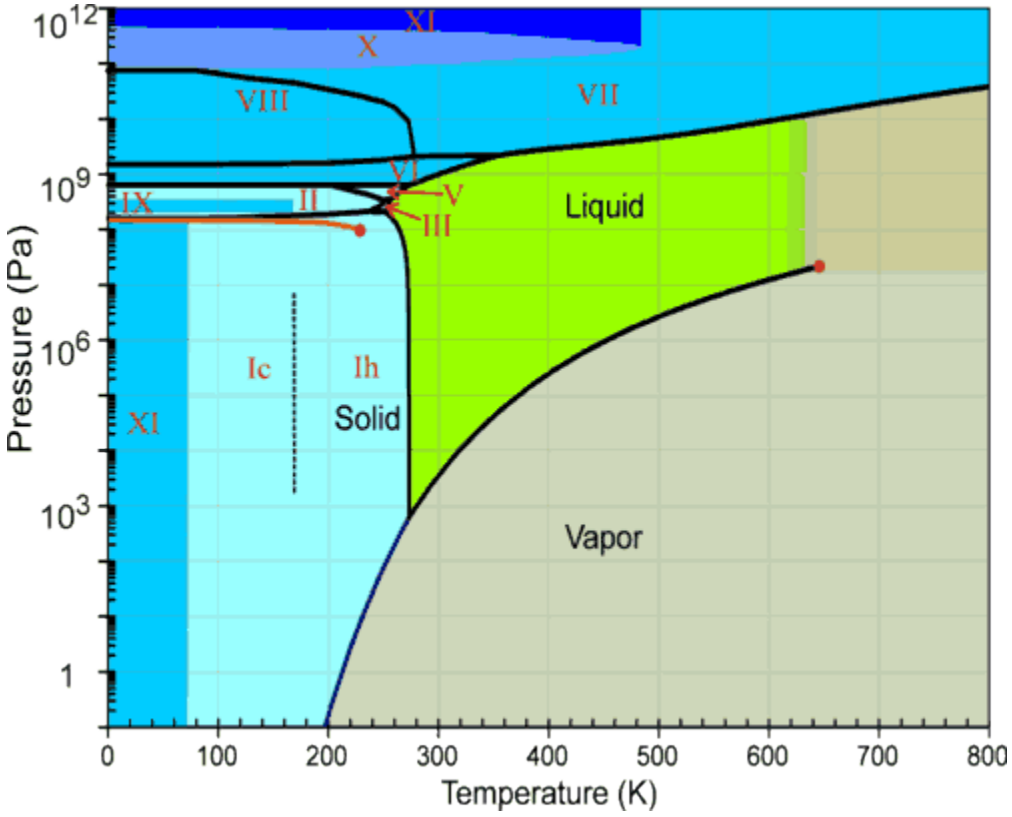


Cross section of a $\sim 1.4 M_\odot$ neutron star. The ~ 1 km thick crust consist of neutron rich nuclei in a lattice and a uniform background of electrons and, in the inner crust, also a neutron gas. The interior of the neutron star contains a nuclear liquid of mainly neutrons and $\sim 10\%$ protons at densities above nuclear matter density n_0 increasing towards the center. Here pressures and densities may be sufficiently high that the dense cold strongly interacting matter undergoes phase transitions to, e.g., quark or hyperon matter or pion or kaon condensates appear. Typical sizes of the nuclear and quark matter structures are $\sim 10^{-14}$ m but have been scaled up to be seen.

arXiv:astro-ph/0201465v2, Feb. 16, 2002, Henning Heiselberg

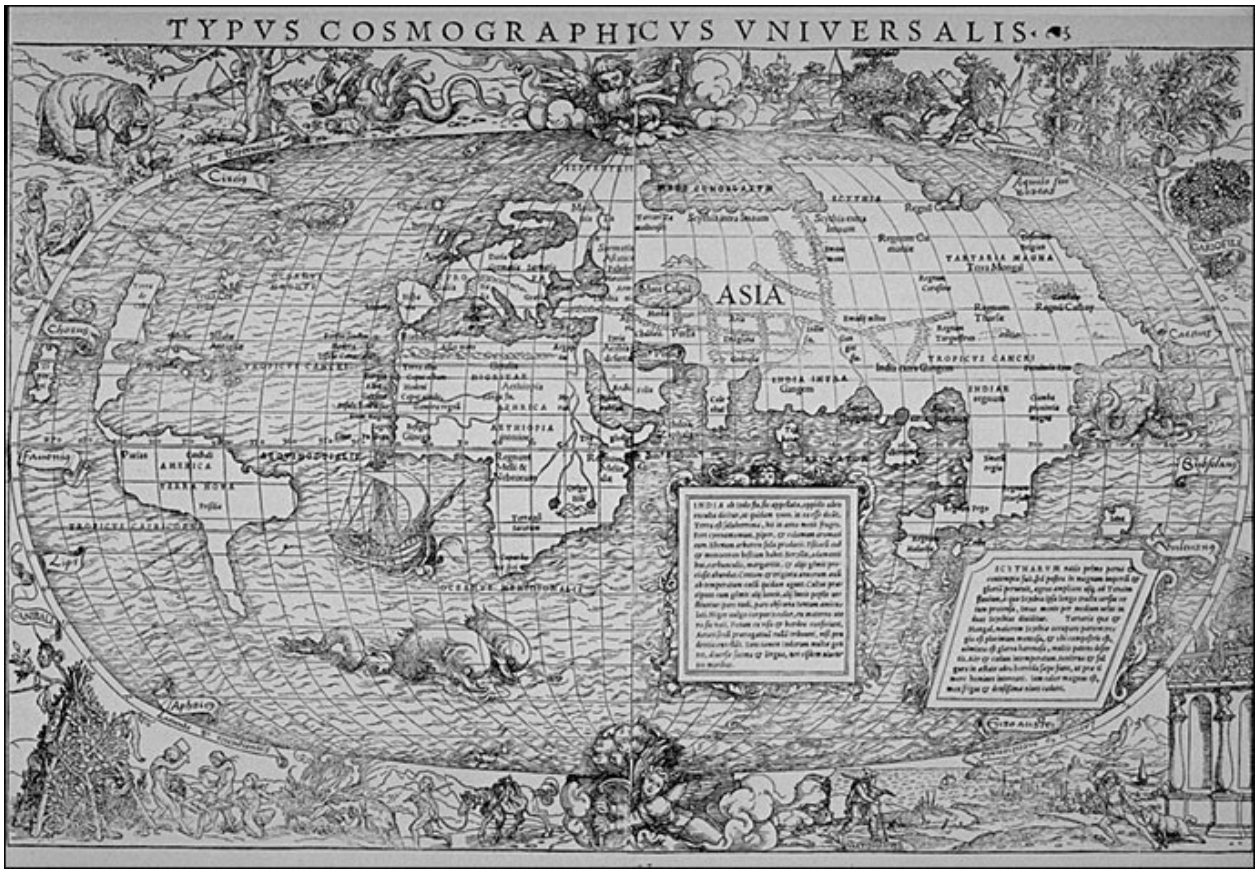
Phase diagram of water

The state of matter depends on pressure, temperature, and density.



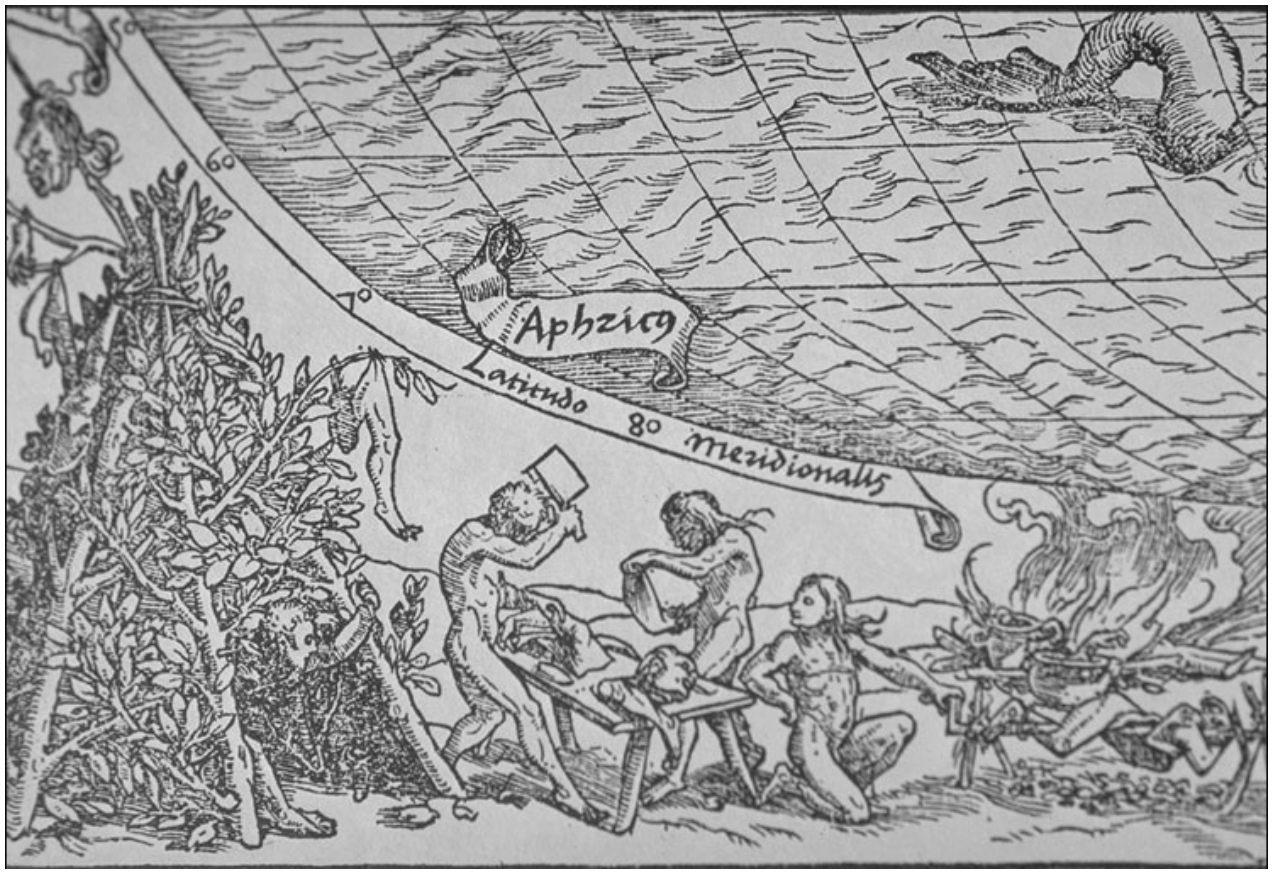
World map in 1532

Typus Cosmographicus Universalis, S. Grynaeus/H. Hoblein/S. Münster,



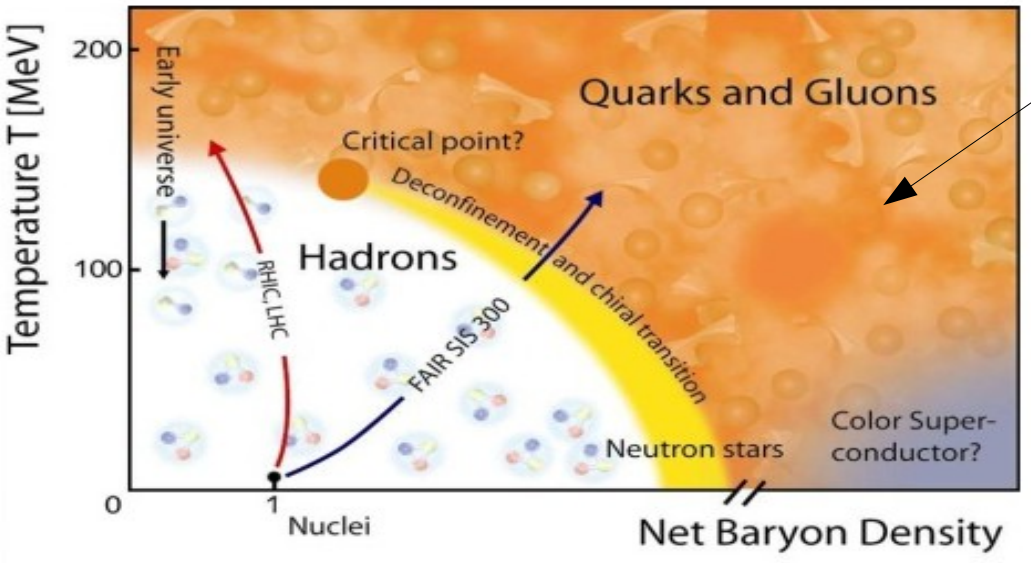
Danger in new territories!

What we don't know for a fact we can compensate for by imagination.



Are there areas of the phase diagram that have never been populated in the history of the Universe?

And indeed, there is a phase diagram of nuclear matter. Here it is, in a schematic representation, as it shows up in nearly every talk about quark matter and the quark-gluon plasma:



Are there monsters we can awaken?

Source: Compressed Baryonic Matter (CBM) Experiment at the Facility for Antiproton and Ion Research (FAIR) GSI, Darmstadt, Germany.