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Thermonuclear fusion in dense stars: Electron screening and conductive cooling effects

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We study the plasma correlation effects on nonresonant thermonuclear reactions of carbon and oxygen in the interiors of white dwarfs and liquid envelopes of neutron stars.

We examine the effects of electron screening on thermodynamic enhancement of thermonuclear reactions in dense plasmas beyond the linear mixing rule. Using these improved enhancement factors, we calculate carbon and oxygen ignition curves in white dwarfs and neutron stars. The energy balance and ignition conditions in neutron star envelopes are evaluated, taking their detailed thermal structure into account. The result is compared to the simplified “one-zone model”, which is routinely used in the literature. We also consider the effect of strong magnetic fields on the ignition curves in the ocean of magnetars.