NEUTRON STAR COOLING: THEORETICAL ASPECTS AND OBSERVATIONAL CONSTRAINTS

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Cooling theory of isolated neutron stars is reviewed. The main cooling regulators are discussed: the presence of a stellar kernel where direct Urca process is open (or similar processes in exotic phases of dense matter); superfluidity of baryonic component of matter in stellar interiors; possible presence of surface layers of light elements; strong surface magnetic fields. It is shown that the combined effects of superfluidity and enhanced neutrino emission lead to the appearance of three types of middle-aged neutron stars (low-mass, medium-mass, and high-mass) with drastically different cooling rates (very slow, intermediate, very fast). The theory is compared with current observations of thermal radiation from isolated neutron stars. The prospects of studying neutron star parameters, internal structure (including the presence of exotic matter in stellar cores) are outlined.