# Magnetic fields in white dwarfs and neutron stars

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Magnetic fields are a ubiquitous feature of compact stars, from white dwarfs to neutron stars and magnetars. Magnetic field strengths are in the range $10^3 - 10^9$G in magnetic white dwarfs (MWDs), $10^8 - 10^{13}$G in ordinary neutron stars, and up to $10^{15}$G in the ultra-magnetic neutron stars known as magnetars. These fields are typically inferred through spectral modelling in MWDs and from spin-down rates in neutron stars, under the assumption of magnetic dipole radiation. Despite decades of observational and theoretical work, the origin of such fields remains a major unresolved problem in stellar astrophysics. The long-standing fossil field hypothesis suggests that magnetic fields are inherited from earlier evolutionary stages and survive stellar collapse. However, this explanation struggles to account for the observed absence of MWDs in detached binaries with non-degenerate companions. This inconsistency has led to increasing support for an alternative scenario: that many MWDs—and possibly some magnetars—form through stellar mergers. In this framework, differential rotation during a merger or common envelope phase drives dynamo action, amplifying weak seed fields to the observed strengths. Compelling observational support for the merger hypothesis comes from the population of hot and warm DQ white dwarfs, which are carbon-rich, dynamically old, and magnetic in over 70% of cases. Their surface composition and magnetic properties point strongly to a merger origin, offering a direct link between binary evolution and the formation of compact stars with extreme magnetic fields.