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ABSTRACT ONLY

ON THE LOW MAGNETIC FIELDS OF MILLISECOND PULSARS: MAGNETIC FIELD DECAY BEFORE ACCRETION

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This abstract summarizes our oral contribution to the XV LARIM. Millisecond pulsars (MSPs) are old neutron stars (NSs) though to be formed from classical pulsars in binary systems, where they have obtained their fast rotation from accretion of matter and angular momentum from a companion star. Besides from rapid spin, MSPs have significantly smaller surface B-field flux densities compared to the normal population of young radio pulsars (Typically 10^8 G vs 10^{12} G, respectively). A long standing question is whether these low B-fields are due to the gigayear old age of the NS or a result of the accretion process. We examine the first hypothesis, in which ambipolar diffusion expels the magnetic flux from the neutron star core, in this way driving its decay. This process is particularly effective during the long period in which the NS has cooled substantially and has not yet started accreting, making the final magnetic field dependent on the evolutionary time of the companion star (and thus its initial mass). This lead us to three main cases according to the current pulsar companion, NS systems with a: He-white dwarf, CO-white dwarf or a NS companion. We study the thermal and magnetic field evolution driven by the NS core and conclude that a magnetic field decay before accretion is implausible and would not reproduced the observed magnetic field distribution in binary systems, particularly the ones in wide binaries ($P_{orb} > 200$ days). The magnetic field in the core would remain frozen and will not evolve until the currents in the crust are dissipated on a timescale in the order of giga-years for pure pre-accreted crusts.

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