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Origin of pulsar radio emission

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For more than five decades, the origin of pulsar coherent radio emission has been one of the major unsolved problems in astrophysics. In this talk, I describe the results of our first-principles simulations of electron-positron pairs creation near magnetic poles of neutron stars - the process responsible for filling pulsar magnetosphere with dense pair plasma - which provide a clue to this long-standing mystery. We directly demonstrate that the intermittency of the pair creation process and its naturally-arising non-uniformity across magnetic field lines lead to the emission of strong coherent electromagnetic waves with properties commensurate with that of the observed pulsar radio emission. These waves are only moderately damped by dense plasma and should escape the magnetosphere and be observable as coherent radio emission. Our findings will lay the theoretical foundation for the interpretation of a plethora of observational phenomena seen in radio pulsars, magnetars, and possibly FRBs.

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