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On the Asymptotics of Connected Chord Diagrams

We pursue a combinatorial interpretation for expressions that appear in the asymptotic expansion of C_n, the number of connected chord diagrams on n chords. The main outcome presented here is a new combinatorial interpretation for entry A088221 of the OEIS. We will show that A088221 surprisingly counts pairs of connected chord diagrams (allowing empty diagrams). This question arose from a more applied context, namely, from quantum field theory where connected chord diagrams are used in describing solutions to the Dyson-Schwinger equations. The problem considered here come as a small outgrowth of a larger ongoing program aiming to replace the sometimes ill-defined analytic understanding of quantum field theory with a discrete combinatorial understanding that represents itself in a way that is more elementary, yet more robust.