Cohen-Macaulayness for ordinary and symbolic powers of edge ideals

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This report is based on joint works with G. Rinaldo and K. Yoshida. We discuss generalization of the Cowsik-Nori theorem for squarefree monomial ideals generated in degree 2. More precisely, we show the following two theorems:

Theorem. *Let S be a polynomial ring over a field. Let $I = I(G)$ be the edge ideal of a graph G in S. Then the following conditions are equivalent:*
(1)G is a finite disjoint union of complete graphs.
(2)$S/I^{(i)}$ is Cohen-Macaulay for all $i \geq 1$.
(3)$S/I^{(i)}$ satisfies Serre's condition (S_2) for some $i \geq 3$.

Theorem. *Let S be a polynomial ring over a field. Let $I = I(G)$ be the edge ideal of a graph G in S. Then the following conditions are equivalent:*
(1)S/I is a complete intersection.
(2)S/I^i is Cohen-Macaulay for all $i \geq 1$.
(3)S/I^i is Cohen-Macaulay for some $i \geq 3$.