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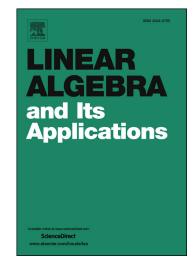
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## Lower bounds of graph energy in terms of matching number \*

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Abstract: The energy  $\mathcal{E}(G)$  of a graph G is the sum of the absolute values of all eigenvalues of G. We are interested in the relation between the energy of a graph G and the matching number  $\mu(G)$  of G. It is proved that  $\mathcal{E}(G) \geq 2\mu(G)$  for every graph G, and  $\mathcal{E}(G) \geq 2\mu(G) + \frac{\sqrt{5}}{5}c_1(G)$  if the cycles of G (if any) are pairwise vertex-disjoint, where  $c_1(G)$  denotes the number of odd cycles in G. Besides, we prove that  $\mathcal{E}(G) \geq r(G) + \frac{1}{2}$  if G has at least one odd cycle and it is not of full rank, where r(G) is the rank of G.

AMS classification: 05C20, 05C50, 05C75.

Keywords: graph energy; matching number; rank.

## **1** Introduction

Throughout, G denotes a simple graph, i.e., a graph with no loop and no multiple edge. Let V(G) and E(G) denote the vertex set and edge set of G, respectively, and let A(G) denote the adjacency matrix of G. The rank of A(G) is also called the rank of G and is denoted by r(G). If  $x, y \in V(G)$  are adjacent we denote by xy the edge joining x and y. A graph H is called a subgraph of G if  $V(H) \subseteq V(G)$  and  $E(H) \subseteq E(G)$ . Further, H is called an induced subgraph of G if two vertices of V(H) are adjacent in H if and only if they are adjacent in G. The neighbors of a vertex  $x \in V(G)$  in an induced subgraph H of G is written as  $N_H(x)$  and  $N_G(x)$  is simplified as N(x). The number of vertices in N(x) is called the degree of x in G, which is written as d(x). If d(x) = 1, we call x a pendant vertex of G, and the unique neighbor of a pendant vertex is called a quasi-pendant vertex. For a subset U of V(G), denote by G - U the graph obtained from G by deleting the vertices of U together with all edges incident to them. If H is an induced subgraph of G, we will use G - H to denote the induced subgraph G - V(H). The subgraph G - H of G is also called the complement of H in G. Moreover, when no edge of G joins H and its complement G - H, we write  $G = H \oplus (G - H)$ . For an induced subgraph H of G and a vertex x outside H, the induced subgraph of G with vertex set  $V(H) \cup \{x\}$  is simply written as H + x. A matching M in G is a set of pairwise non-adjacent edges, that is, no

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