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Hangyang Meng, Xiuyun Guo

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Weak second maximal subgroups in solvable groups*

Hangyang Meng and Xiuyun Guo[†]
 Department of Mathematics, Shanghai University
 Shanghai 200444, P. R. China

Abstract

In this paper, we investigate the differences between weak second maximal subgroups and second maximal subgroups. A sufficient and necessary condition is also given to describe a class of groups whose weak second maximal subgroups coincide with its second maximal subgroups (called WSM-groups) under the solvable case. As an application, we will prove that every non-vanishing element of a solvable WSM-group lies in its Fitting subgroup.

Mathematics Subject Classification (2010): 20C15, 20D10, 20D30.

Keywords: non-vanishing elements, second maximal subgroups, quasi-primitive modules

1 Introduction

All groups considered in paper are finite.

Recall that an element x of a group G is said to be the *non-vanishing* element of G if $\chi(x) \neq 0$ for all $\chi \in \text{Irr}(G)$, where $\text{Irr}(G)$ is the set of all irreducible complex character of G . It is clear that every central element of a group is non-vanishing. However, as the authors point out in [4], not only may a non-vanishing element of a group be noncentral, it can even fail to lie in an abelian normal subgroup of the group. For all that, I. Issacs, G. Navarro and T. Wolf prove that every non-vanishing element of odd order in a solvable group must always lie in a nilpotent normal subgroup of the

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[†]Corresponding author. E-mail: xyguo@staff.shu.edu.cn

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