Planes, nets and webs

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June 28, 2005

The main open questions in the study of finite projective planes concern the possible orders of finite planes, and the question of whether planes of prime order are necessarily the classical ones. A promising approach to both questions relies on conjectured bounds for ranks of finite nets (i.e. rank of the incidence matrix over a field of positive characteristic). The conjectured rank bounds for (finite) nets agree with the known rank bounds for (infinite) webs, but different mathematical tools are required in the finite case. In 1991 I verified the conjectured rank bounds for 3-nets (those having 3 parallel classes of lines) using loop theory. I will describe recent progress in the case of 4-nets, using the method of exponential sums.