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On regular subgroups of $\mathrm{SL}_3(\mathbb{R})$

Motivated by a question of M. Kapovich, we show that the $\mathbb{Z}^2$ subgroups of $\mathrm{SL}_3(\mathbb{R})$ that are *regular* in the sense of Kapovich–Leeb–Porti are precisely the lattices in minimal horospherical subgroups. By work of Oh, it then follows that a Zariski-dense discrete subgroup Γ of $\mathrm{SL}_3(\mathbb{R})$ contains a regular $\mathbb{Z}^2$ if and only if Γ is commensurable to a conjugate of $\mathrm{SL}_3(\mathbb{Z})$. In particular, a Zariski-dense regular subgroup of $\mathrm{SL}_3(\mathbb{R})$ contains no $\mathbb{Z}^2$ subgroups. This is joint work with Konstantinos Tsouvalas.