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On the Cohomology of Four-Dimensional Almost Complex Lie Algebras

It is shown that the unimodularity condition for a four-dimensional Lie algebra $\mathfrak{g}$ with $H^2(\mathfrak{g}) \neq \{0\}$ is equivalent with a certain decomposition of the group $H^2(\mathfrak{g})$ taking place with respect to any almost complex structure J on $\mathfrak{g}$. One direction of this result was proved by T.-J. Li and A. Tomassini ["Almost Kähler structures on four dimensional unimodular Lie algebras", J. Geom. Phys. 62 (2012) 1714–1731]. This note proves the other direction.

Keywords: 4-dimensional Lie algebras, almost complex structure, cohomology decomposition.

MSC: 17B56, 53C15