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The Gauss-Bonnet-Grotemeyer Theorem in Spaces of Constant Curvature

Let M be an oriented closed surface in $\mathbb{R}^3$ with Euler characteristic $\chi(M)$, Gauss curvature G and unit normal vector field $\vec{n}$ and let $\vec{a}$ be a fixed vector. K.P. Grotemeyer's 1963 Gauss-Bonnet identity states:

$$\int_M (\vec{a} \cdot \vec{n})^2 G dv = \frac{2\pi}{3} \chi(M).$$

This may be viewed as a moment variant of the classical Gauss-Bonnet formula. B.Y. Chen (1971) extended this result to higher dimensions. We give a corresponding formula in the context of spaces of constant curvature. Note that classical Gauss-Bonnet invariants have classical integral geometric interpretations (E. Teufel, G. Solanes) and there is hope that the same holds here as well. (joint work with Haizhong Li (Tsinghua University)).