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## **Geometric and Spectral Aspects of the Aloff-Wallach Spaces**

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**Abstract:** The focus of our attention will be on the Aloff-Wallach manifolds  $SU(3)/S^1$ . The family of manifolds depending on the embedding parameters  $k, l$  is each equipped with a metric depending on four additional parameters. These six parameters in total lead to several interesting structures (Sasakian structures,  $3-\alpha-\delta$ -Sasakian structures, Einstein metrics, nearly parallel  $G_2$ , positive curvature, etc.) on this set of Riemannian manifolds. The interplay of these structures is discussed. (Joint work with Ilka Agricola, Henrik Naujoks)

Furthermore, we study the spectrum of the Laplace-Beltrami operator: The metrics on the Aloff-Wallach manifolds  $SU(3)/S^1$  are not normal homogeneous if they are not obtained by the rescaled Killing form. However, Wilking (1999) was able to prove that for  $k = l = 1$  a family of positively curved Aloff-Wallach manifolds has normal homogeneous realizations. For the latter, we computed the spectrum of the Laplace-Beltrami operator explicitly using methods of representation theory. These results extend those of Urakawa (1984) who computed the spectrum in the  $SU(3)$  normal homogeneous case. (Joint work with Ilka Agricola)

