



**HAL**  
open science

## Killing forms on Quaternion-Kähler manifolds

Andrei Moroianu, Uwe Semmelmann

► **To cite this version:**

Andrei Moroianu, Uwe Semmelmann. Killing forms on Quaternion-Kähler manifolds. *Annals of Global Analysis and Geometry*, 2005, 28, pp.319-335. 10.1007/s10455-005-1147-y . hal-00001296v3

**HAL Id: hal-00001296**

**<https://hal.science/hal-00001296v3>**

Submitted on 3 Oct 2008

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Killing forms on Quaternion-Kähler manifolds

– Corrigendum –

Andrei Moroianu and Uwe Semmelmann

The aim of this note is to fill a gap in the proof of Theorem 6.1 in [1] - stating that every Killing  $p$ -form ( $p \geq 2$ ) on a compact quaternion-Kähler manifold  $M^{4m}$  ( $m \geq 2$ ) is parallel. This gap, pointed out by Liana David, is due to two wrong coefficients in the formulas at the middle of page 329. The correct equations read

$$\begin{aligned} pd^+u &= d(L^-u), & (p-1)d^cu &= d(Ju + 3u), & pd^-u &= d(\Lambda^+u) - \delta^cu, \\ (p-1)\delta^+u &= -2d(Cu), & (p-1)\delta^cu &= -2d(\Lambda^+u) - 2d^-u, & (p-3)\delta^-u &= -2d(\Lambda u). \end{aligned}$$

The remaining part of the proof works verbatim for  $p > 3$ , but an extra argument is needed for  $p = 2$  and  $p = 3$ .

**The case  $p = 2$ .** From the 6 equations above one obtains the vanishing of  $d^+u$ ,  $\delta^-u$ , and  $\delta^+u + d^cu + 3du$ , but no longer that of  $\delta^cu$  and  $d^-u$ . Correspondingly, the proof of Lemma 6.3 fails. Fortunately, an ad hoc argument shows that  $du = 0$  in this case. Indeed, the third equation of the system (7) shows that  $du$  is an eigenform of  $2C - J$  for the eigenvalue 9. On the other hand, Lemma 5.1, Lemma 5.2 and the decomposition

$$\Lambda^3(H \otimes E) = H \otimes [\Lambda_0^{2,1}E \oplus E] \oplus \text{Sym}^3H \otimes [\Lambda_0^3E \oplus E]$$

show that the eigenvalues of  $2C - J$  on the four summands of  $\Lambda^3M$  are respectively 3,  $4m + 5$ , 15, and  $4m + 11$ . For  $m \geq 2$ , none of them equals 9.

**The case  $p = 3$ .** The proof works well in this case, except that one does not obtain  $\delta^-u = 0$  in Lemma 6.2. However, this relation is not needed until the point (b) at the bottom of page 331. In order to rule out that case, one has to replace the argument given there with the fact that for  $p = 3$  and  $m \geq 2$ , the inequality  $p \geq 2m + 1$  is impossible.

**Remark.** The assumption that  $m \geq 2$  is essential. For  $m = 1$ , the quaternionic projective space  $\mathbb{H}P^1 \simeq S^4$  carries non-parallel Killing 2-forms and 3-forms (cf. [2]).

## REFERENCES

- [1] A. MOROIANU, U. SEMMELMANN, *Twistor forms on quaternion-Kähler manifolds*, Ann. Global Anal. Geom. **28**, 319–335 (2005).
- [2] U. SEMMELMANN, *Conformal Killing forms on Riemannian manifolds*, Math. Z. **245**, 503–527 (2003).