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# The Magnetocaloric Effect in Ferromagnetic PrSi: Evidence of a Novel Magnetic Gound State and Higher Order Exchange Interactions

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<p>The discovery of the giant magnetocaloric effect (MCE) in Gd<sub>5</sub>Si<sub>2</sub>Ge<sub>2</sub>, a member of the substitution series Gd<sub>5</sub>Si<sub>4-x</sub>Ge<sub>x</sub> has generated significant interest into MCE phenomena in rare earth intermetalic compounds. Much recent effort has gone into determining how the MCE in such systems is influenced by the many salient features associated with rare earth magnetism. Here the MCE in polycrystalline ferromagnetic PrSi is determined from specific heat measurements. While the magnitude of the MCE in PrSi is found to be modest when compared to other binary systems, the power of MCE analyses in probing electronic and ground-state properties in magnetic systems is emphasized in this work. We forward a description in terms of a novel magnetic ground state for the 4f -electrons associated with the Pr<sup>

3+</sup> -ions in this particular compound. It is found that the MCE in this system can be accurately reproduced by modeling the system as a modified Ising-type ferromagnet with the addition of a significant higher order exchange term and assuming that the ground state of the 4f-electrons is the unperturbed 9-fold degenerate free-ion spin-orbit coupled ground state multiplet. Such a ground state would imply that the usual splitting of the degenerate energy levels of the free ion multiplet by the crystalline electric field is absent in this system, which in turn implies that significant multipolar interactions may be responsible for the higher order exchange terms present in the magnetic Hamiltonian.

## Level (Hons, MSc, <br>   PhD, other)?

PhD

## Consider for a student <br>   award (Yes / No)?

Yes

## Would you like to <br> submit a short paper <br> for the Conference <br> Proceedings (Yes / No)?

Yes

**Primary author:** Mr SNYMAN, Jasper Snyman (University of Johannesburg)

**Co-author:** Prof. STRYDOM, Andre (University of Johannesburg)

**Presenter:** Mr SNYMAN, Jasper Snyman (University of Johannesburg)

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