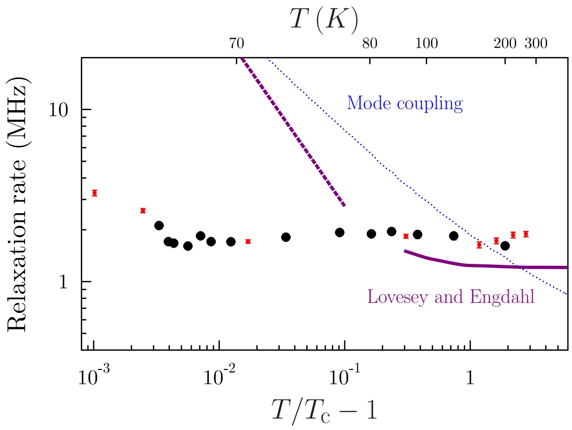

FIG. 4: (Color online.) Relaxation rate as a function of temperature in the paramagnetic regime for pure EuO (solid circles) and (b) $Eu_{0.994}Gd_{0.006}O$ (dots). The predicted relaxation rates for $T > T_C$ according to Ref. 15 (numerical calculation: thick solid line, purple; critical regime using experimental values of correlation length: thick dashed line, purple) and Ref. 16 (dotted line, blue) are also shown.

cooling to T_C from about 0.3 K above it; this is also not observed in our data. Magnetic polaron formation has been detected using Raman scattering [28] in a narrow range (≈ 20 K) above T_C. It may be that the formation of magnetic polarons modifies the relaxation in this regime from that which would be expected from theory, perhaps by providing an additional relaxation channel for the muon which masks the critical slowing down predicted by the theory and hence the absence of the divergence in λ. We note that a similar absence of a divergence in λ is observed in EuB_6 [29] in which magnetic polarons have been found [28].

In conclusion, we have identified the muon site in EuO and estimated the hyperfine field. Our results confirm long-range order which is relatively insensitive to low doping of Gd. The measured λ in the paramagnetic state agrees quite well with the theory of Lovesey and Engdahl, but the available theories fail in the critical regime, possibly due to magnetic polaron formation.

We thank EPSRC (UK) for financial support and Alex Amato for experimental assistance. Part of this work was performed at the Swiss Muon Source, Paul Scherrer Institute, Villigen, Switzerland.

* Electronic address: s.blundell@physics.ox.ac.uk

[1] B. T. Matthias, R. M. Bozorth and J. H. van Vleck, Phys. Rev. Lett. **7**, 160 (1961).
[2] Y. Shapira, S. Foner and T. B. Reed, Phys. Rev. B **8**, 2299 (1973).
[3] P. Sinjukow and W. Nolting, Phys. Rev. B **68**, 125107 (2003).
[4] J. B. Torrance, M. W. Shafer and T. R. McGuire, Phys. Rev. Lett. **29**, 1168 (1972).
[5] K. J. Hubbard and D. G. Schlom, J. Mater. Res. **11**, 2757 (1996).
[6] K. Sattler and H. C. Siegmann, Phys. Rev. Lett. **29**, 1565 (1972).
[7] P. G. Steeneken, L. H. Tjeng, I. Elfimov, G. A. Sawatzky, G. Ghiringhelli, N. B. Brookes and D.-J. Huang, Phys. Rev. Lett. **88**, 047201 (2002).
[8] A. Schmehl *et al.* Nat. Mat. **6**, 882 (2007).
[9] O. W. Dietrich, J. Als-Nielsen and L. Passell, Phys. Rev. B **14**, 4923 (1976); J. Als-Nielsen, O. W. Dietrich and L. Passell, Phys. Rev. B **14**, 4908 (1976); L. Passell, O. W. Dietrich and J. Als-Nielsen, Phys. Rev. B **14**, 4897 (1976).
[10] H. Miyazaki, T. Ito, H. J. Im, S. Yagi, M. Kato, K. Soda and S. Kimura, Phys. Rev. Lett. **102**, 227203 (2009).
[11] Ven-Chung Lee and L. Liu, Phys. Rev. B **30**, 2026 (1984).
[12] A. Mauger and C. Godart, Phys. Rep. **141**, 51 (1986).
[13] H. G. Bohn, W. Zinn, B. Dorner and A. Kollmar, Phys. Rev. B **22**, 5447 (1980).
[14] S. W. Lovesey and E. B. Karlsson and K. N. Trohidou, J. Phys.: Condens. Matter **4**, 2043 (1992); S. W. Lovesey, K. N. Trohidou and E. B. Karlsson J. Phys.: Condens. Matter **4**, 2061 (1992).
[15] S. W. Lovesey and E. Engdahl, J. Phys.: Condens. Matter **7**, 769 (1995).
[16] A. Yaouanc, P. Dalmas de Réotier and E. Frey, Phys. Rev. B **47**, 796 (1993).
[17] S. F. J. Cox, J. Phys. C **20**, 3187, (1987); S. J. Blundell, Contemp. Phys. **40**, 175, (1999).
[18] P. Dalmas de Réotier and A. Yaouanc, J. Phys. C **9**, 9113, (1997).
[19] A. Comment, J.-P. Ansermet, C. P. Slichter, H. Rho, C. S. Snow and S. L. Cooper, Phys. Rev. B **72**, 014428 (2005).
[20] S. J. Blundell, Physica B **404**, 581, (2009).
[21] A. Kasuya and M. Tachiki, Phys. Rev. B **8**, 5298 (1973).
[22] D.G. Eshchenko, V.G. Storchak, E. Morenzoni and D. Andreica, Physica B **404**, 903 (2009).
[23] V. G. Storchak, J. H. Brewer, D. J. Arseneau, S. L. Stubbs, O. E. Parfenov, D. G. Eshchenko, E. Morenzoni and T. G. Aminov, Phys. Rev. B **79**, 193205 (2009).
[24] V.G. Storchak, O.E. Parfenov, J.H. Brewer, P.L. Russo, S.L. Stubbs, R.L. Lichti, D.G. Eshchenko, E. Morenzoni, T.G. Aminov, V.P. Zlomanov, A.A. Vinokurov, R.L. Kallaher and S. von Molnár, Phys. Rev. B **80**, 235203 (2009).
[25] V.G. Storchak, O.E. Parfenov, J.H. Brewer, P.L. Russo, S.L. Stubbs, R.L. Lichti, D.G. Eshchenko, E. Morenzoni, V.P. Zlomanov, A.A. Vinokurov and V.G. Bamburov, Physica B **404**, 899 (2009).
[26] J. Als-Nielsen, O. W. Dietrich, W. Kunnmann and L. Passell, Phys. Rev. Lett. **27**, 741 (1971).
[27] A. D. Bruce and A. Aharony, Phys. Rev. B **10**, 2078 (1974).
[28] C. S. Snow, S. L. Cooper, D. P. Young, Z. Fisk, A. Comment and J.-P. Ansermet, Phys. Rev. B **64**, 174412 (2001).
[29] M. L. Brooks, T. Lancaster, S. J. Blundell, W. Hayes, F. L. Pratt and Z. Fisk, Phys. Rev. B **70**, 020401(R) (2004).