# Normal state spin dynamics in $Sr_2RuO_4$: anisotropy due to spin-orbit coupling

**I. Eremin, D. Manske, and K.H. Bennemann**
Institut für Theoretische Physik, Freie Universität Berlin, D-14195 Berlin, Germany

9.7 cm

The novel spin-triplet superconductivity with $T_c$=1.5K observed in layered $Sr_2RuO_4$ seems to be a new example of unconventional superconductivity. Most recently it was found that the superconducting order parameter contains line nodes half-way between the $RuO_2$-planes[1]. These results support a scenario of Cooper-pairing via spin-fluctuations as one of the most probable mechanism to explain the superconductivity in $Sr_2RuO_4$.
Using the three-band Hubbard Hamiltonian we calculate within the random-phase-approximation the spin susceptibility, $\chi(\mathbf{q}, \omega)$ and NMR spin-lattice relaxation rate, $1/T_1$, in the normal state of $Sr_2RuO_4$ and find quantitative agreement with experimental data[2]. Most importantly, at low temperatures we find that the out-of-plane component of the spin susceptibility, $\chi^{zz}$ [3], becomes two times larger than the in-plane one, $\chi^{+-}/2$, due to spin-orbit coupling. Furthermore, we obtain that the spin-orbit coupling induced anisotropy results in incommensurate antiferromagnetic fluctuations pointing into the $z$-direction originated from the quasi-one-dimensional $xz$- and $yz$-bands. Our results provide further evidence for the importance of spin fluctuations for triplet superconductivity in $Sr_2RuO_4$.
[1] M.A. Tanatar et al., Phys. Rev. Lett. 86, 2649 (2001).
[2] K. Ishida et al., Phys. Rev. B 64,100501(R) (2001).
[3] I. Eremin, D. Manske, and K.H. Bennemann, preprint cond-mat/0102051.

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**Corresponding author :**
I. Eremin

**Address for correspondence :**
Institut für Theoretische Physik
Freie Universität Berlin
Arnimallee 14, D-14195 Berlin
Germany

**Email address :**
ieremin@physik.fu-berlin.de