Addenda: Van Hove Singularity and Spontaneous Fermi Surface Symmetry Breaking in $Sr_3Ru_2O_7$

Hiroyuki YAMASE[1] and Andrey A. KATANIN[2]

[1] *National Institute for Materials Science, Tsukuba 305-0047, Japan*
[2] *Institute of Metal Physics, 620219 Ekaterinburg, Russia*

KEYWORDS: magnetic susceptibility, Pomeranchuk instability, Fermi surface, metamagnetism, ruthenates

In our original paper,[1)] we computed the uniform magnetic susceptibility χ by employing the standard formula eq. (4). However, the magnetic susceptibility picks up an additional component, and thus its full expression should read

$$\chi = -\frac{1}{N}\sum_{\mathbf{k},\sigma} f'(\xi_{\mathbf{k}}^{\sigma}) + g\frac{\left(\frac{1}{N}\sum_{\mathbf{k},\sigma}\sigma d_{\mathbf{k}} f'(\xi_{\mathbf{k}}^{\sigma})\right)^2}{1+\frac{g}{N}\sum_{\mathbf{k},\sigma} d_{\mathbf{k}}^2 f'(\xi_{\mathbf{k}}^{\sigma})}\,. \tag{A1}$$

This expression is obtained within random-phase approximation[2)] and becomes exact in the thermodynamic limit with Hamiltonian (1). The presence of the second term was overlooked in the original paper. This term yields a jump of the uniform magnetic susceptibility at a continuous phase transition and affects our results at low temperatures for $g \neq 0$ in Fig. 3(b). Statements associated with Fig. 3(b) in the original paper should read accordingly. We here give a brief comment about the additional term in eq. (A1). The details will be published elsewhere.[2)]

Because of the d-wave form factor in the numerator of the second term in eq. (A1), this term vanishes in the symmetric phase. However, it can be finite in the symmetry-broken phase, leading to a jump of χ at a continuous phase transition of the dFSD, as shown in Fig. A1. In addition, the numerator of the second term in eq. (A1) contains the spin variable $\sigma = \pm 1$, which imposes the necessity of breaking spin symmetry, i.e., $\xi_{\mathbf{k}}^{\uparrow} \neq \xi_{\mathbf{k}}^{\downarrow}$; otherwise, the numerator vanishes. Hence, the jump of χ in Fig. A1 is interpreted as a field-induced anomaly. The magnitude of the jump is more pronounced at $h = 0.48$ than at $h = 0.42$, and diverges at a tricritical field ($h \approx 0.49$). On the other hand, if the dFSD instability would occur for $h = 0$, for example, by tuning the chemical potential in our model (1), the second term of eq. (A1) would vanish, leading to a cusp of χ at the dFSD instability, as shown in Fig. 3(b) in our original paper. Since the uniform magnetic susceptibility has not been measured thus far in the static limit for $Sr_3Ru_2O_7$, the present addendum is possibly relevant to future experiments on $Sr_3Ru_2O_7$, which can be the first system to exhibit a jump of χ at a continuous phase transition.

References

1) H. Yamase and A. A. Katanin: J. Phys. Soc. Jpn. **76** (2007) 073706.
2) H. Yamase and P. Jakubczyk: Phys. Rev. B **82** (2010) 155119.

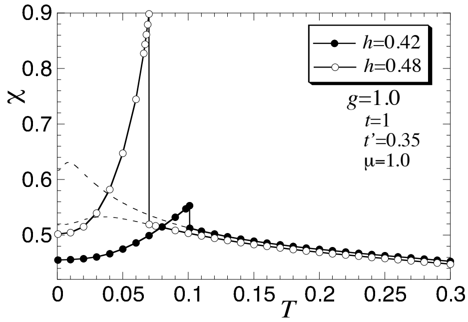

Fig. A1. T dependence of χ for two different values of h for $g = 1.0$; the dashed lines are results for $g = 0$; the choice of the parameters is the same as that in the original paper.