

Supporting Information

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A Spectroscopic Investigation of Magnetic Exchange Between Highly Anisotropic Spin Centers**

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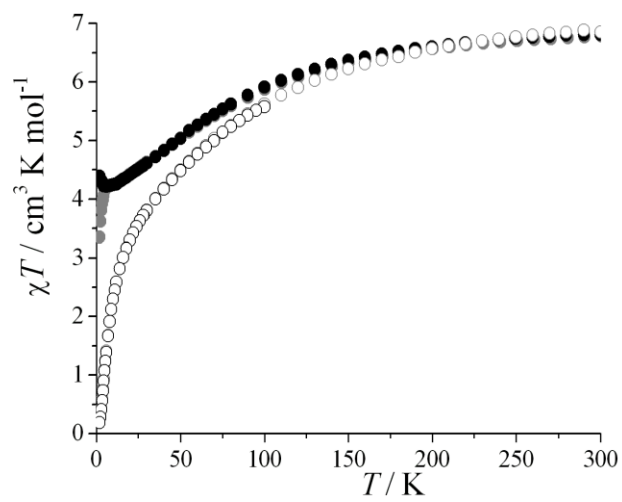


Figure S1. $\chi_m T$ vs. T for polycrystalline samples of **2** (filled circles) and **1** (open circles) in 0.1 (black) and 1 T (grey) applied magnetic field.

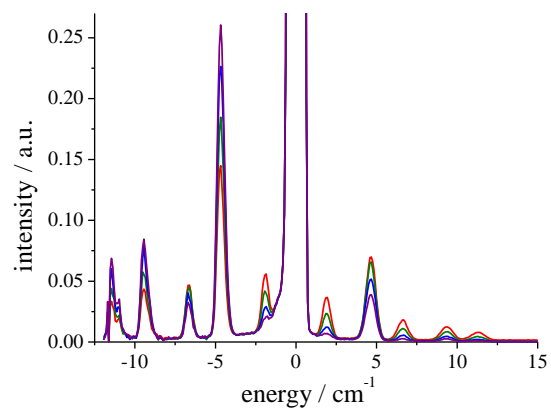


Figure S2. Variable temperature INS spectra of 1^D obtained with 6.0 Å neutrons: 16 (red), 8 (green), 5 (blue) and 4 K (purple).

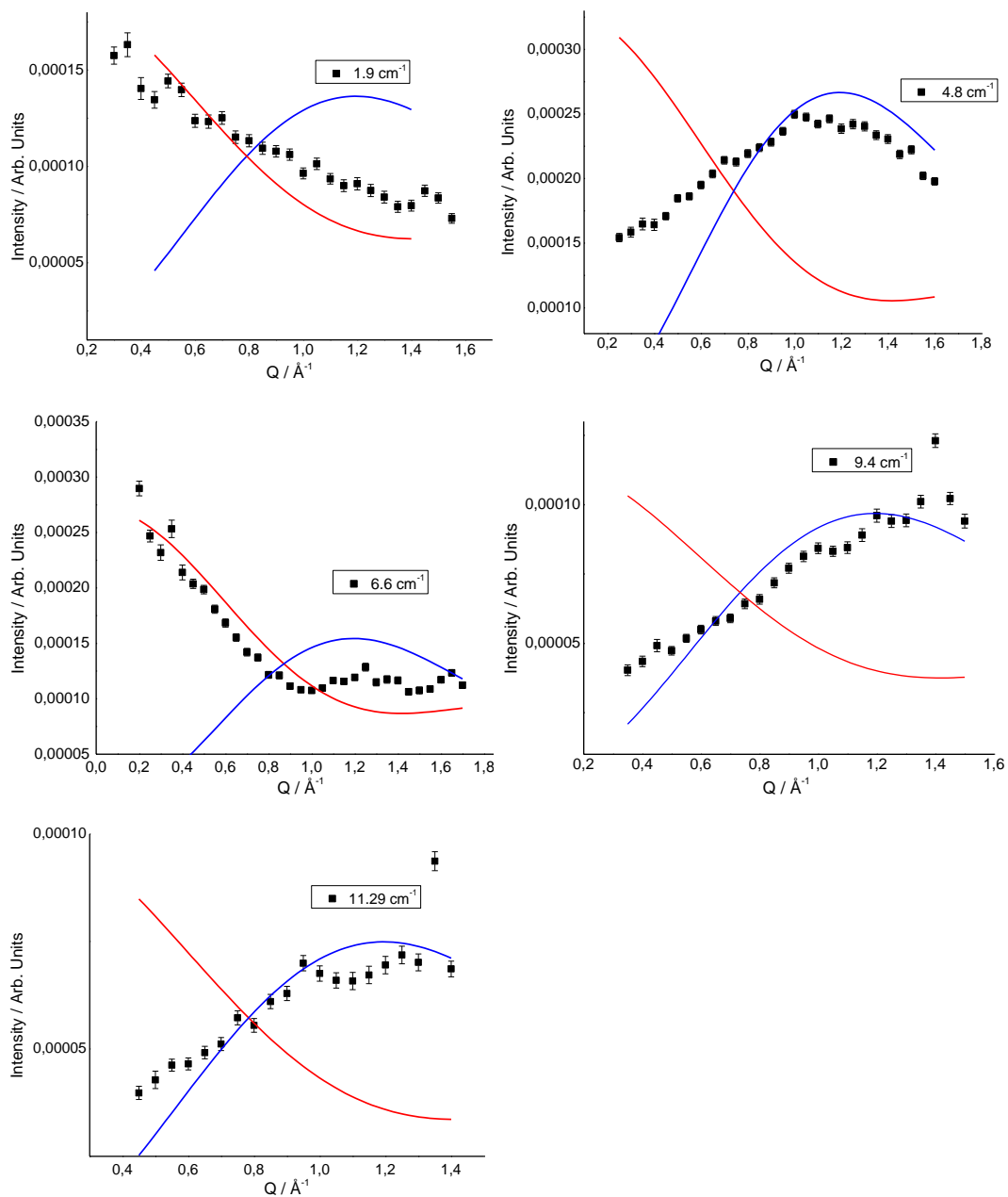


Figure S3. Intensities of INS transitions of 1^D as a function of scattering vector Q (black points) with calculated curves for $\Delta S_{\text{eff}} = 0$ (red) and $\Delta S_{\text{eff}} = 1$ (blue) transitions.

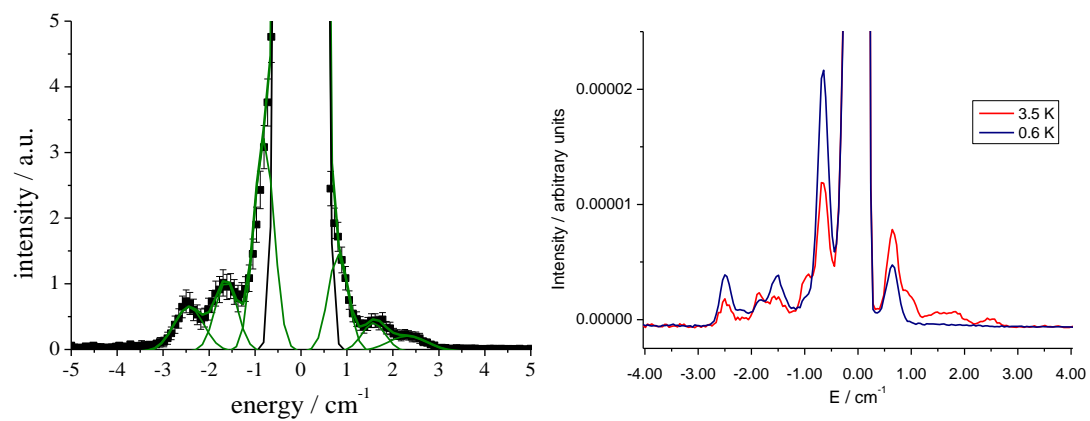


Figure S4. Left: INS spectrum of 2^D obtained with 6 Å neutrons at 4 K. Right: INS spectra of 2^D with 8.0 Å neutrons at 0.6 (blue) and 3.5 K (red).

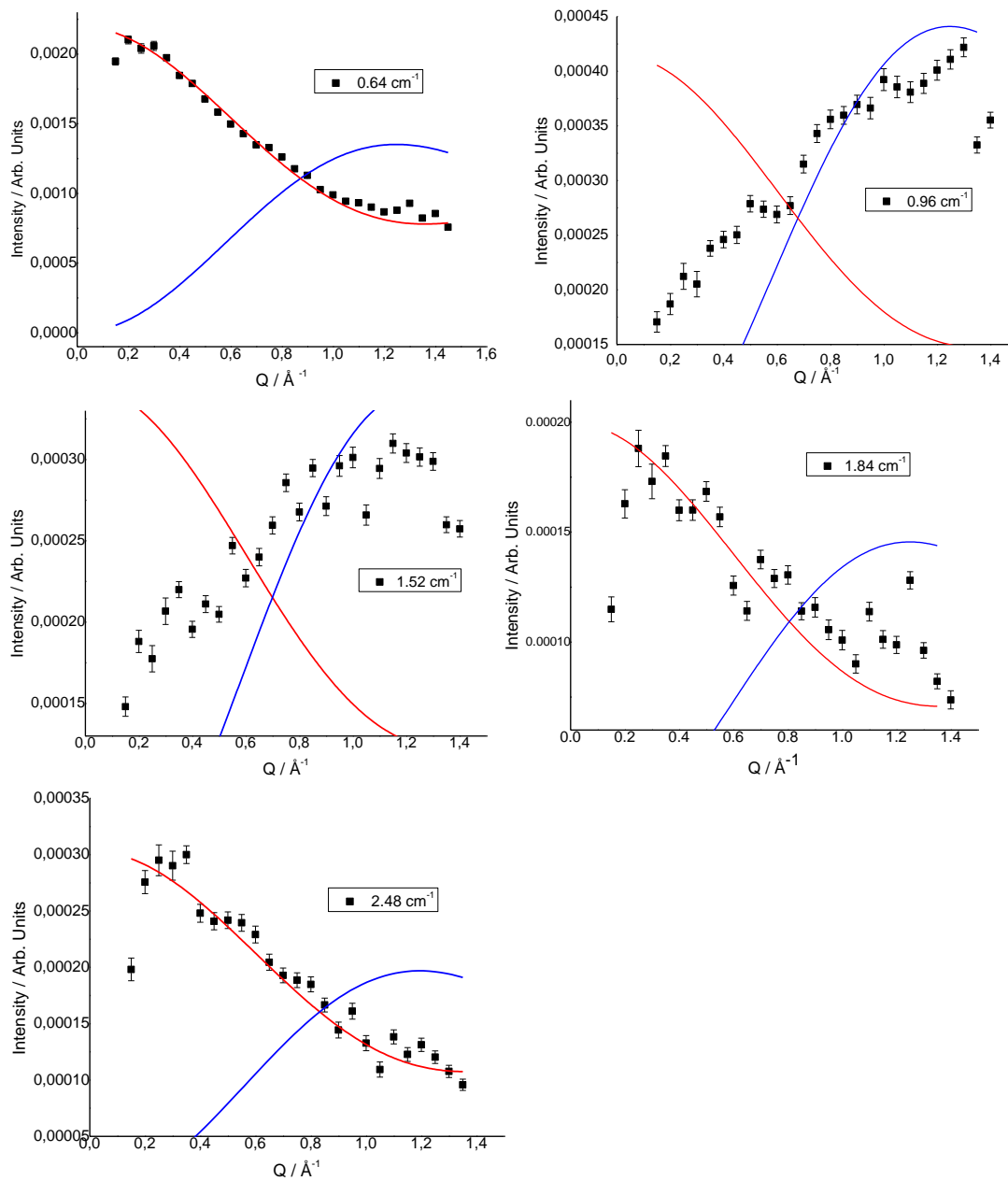


Figure S5. Intensities of INS transitions of 2^D as a function of scattering vector Q (black points) with calculated curves for $\Delta S_{\text{eff}} = 0$ (red) and $\Delta S_{\text{eff}} = 1$ (blue).

Table S1_ESI. *Ab initio* RASSI-SO energies (cm^{-1}) for the lowest six Kramers doublets, and calculated g_{eff} -values for the lowest Kramers doublet (KD), of **1** [two independent Co(II) ions] and **2** [one independent Co(II) ion].

KD	Energies for 1 / cm^{-1}		2 / cm^{-1}
	Co1	Co2	Co1,2
1	0	0	0
2	236	202	175
3	529	632	860
4	890	976	1135
5	1178	1178	1389
6	1268	1277	1485
Calculated g_{eff} -values (x,y,z) for lowest Kramers doublet			
	2.38, 3.03, 7.26	2.27, 3.56, 6.87	1.98, 4.32, 6.35

Table S2_ESI. Direction cosine matrix relating principal axes of \mathbf{g}_{Co1} and \mathbf{g}_{Co2} from *ab initio* calculations on complex **1**.

	g_{x2}	g_{y2}	g_{z2}
g_{x1}	0.3891	0.7074	0.5900
g_{y1}	-0.8044	0.5731	-0.1567
g_{z1}	-0.4490	-0.4136	0.7921

Table S3_ESI. Direction cosine matrix relating principal axes of \mathbf{g}_{Co1} and \mathbf{g}_{Co2} from *ab initio* calculations on complex **2**.

	g_{x2}	g_{y2}	g_{z2}
g_{x1}	0.2570	0.9550	-0.1482
g_{y1}	-0.9550	0.2274	-0.1907
g_{z1}	-0.1482	0.1907	0.9705