Hi people of this world

$$\mathcal{H}_{\text{iso}} = -\frac{1}{2}\sum_{i\neq j} J_{ij}\vec{S}_i\cdot\vec{S}_j \tag{1}$$

$$\omega = \frac{J}{\hbar}\left(1-\cos(ka)\right) \tag{2}$$

$$\frac{\mathrm{d}\vec{S}_i}{\mathrm{d}t} = -\frac{\gamma}{(1+\alpha^2)\mu_s}\vec{S}_i\times\left(\vec{H}_i(t)+\alpha\vec{S}_i\times\vec{H}_i(t)\right) \tag{3}$$

$$\vec{H}_i(t) = \vec{\xi}_i(t) - \frac{\partial\mathcal{H}}{\partial\vec{S}_i} \tag{4}$$

$$\begin{aligned}\mathcal{H} = -\frac{1}{2}\sum_{i\neq j}\Bigg[&\underbrace{J_{ij}\vec{S}_i\cdot\vec{S}_j}_{\textbf{ISO}}\underbrace{-\vec{D}_{ij}\cdot\left(\vec{S}_i\times\vec{S}_j\right)}_{\textbf{DMI}}\underbrace{+\vec{S}_i^T\mathcal{J}_{ij}^{\text{tia}}\vec{S}_j}_{\textbf{TIA}}\\ &\underbrace{+\frac{\mu_s^2\mu_0}{4\pi}\left(\frac{3(\vec{S}_i\cdot\vec{r}_{ij})(\vec{r}_{ij}\cdot\vec{S}_j)}{\left|\vec{r}_{ij}\right|^5}-\frac{\vec{S}_i\cdot\vec{S}_j}{\left|\vec{r}_{ij}\right|^3}\right)}_{\textbf{DDI}}\Bigg]\\ -\sum_i\Bigg[&\underbrace{\mu_s\vec{B}\cdot\vec{S}_i}_{\textbf{Zeeman}}\underbrace{+d_2S_{i,z}^2}_{\textbf{MCA2}}\underbrace{+d_4S_{i,z}^4}_{\textbf{MCA4}}\Bigg]\end{aligned} \tag{5}$$

But implemented is the following equivalent HAMILTONian

$$\begin{aligned}\mathcal{H} = &-\frac{1}{2}\sum_{i\neq j}\vec{S}_i^T\tilde{\mathfrak{J}}_{ij}\vec{S}_j\\ &-d_2\sum_i S_{i,z}^2 - d_4\sum_i S_{i,z}^4\\ &-\mu_S\sum_i\vec{S}_i\cdot\vec{B}\end{aligned} \tag{6}$$

$$\vec{n}(T) = \frac{1}{4}\left(\langle\vec{m}_A\rangle(T)-\langle\vec{m}_B\rangle(T)\langle\vec{m}_C\rangle(T)+\langle\vec{m}_D\rangle(T)\right) \tag{7}$$

old

$$\begin{aligned}d_2 &= 112.8\,\mu\text{eV},\\ d_4 &= 1.1\,\mu\text{eV}\end{aligned} \tag{8}$$

new

$$\begin{aligned} d_2 &= 133.5\,\mu\mathrm{eV}, \\ d_4 &= 1.3\,\mu\mathrm{eV} \end{aligned} \tag{9}$$

$$\alpha(l) = \alpha_{\mathrm{offset}} + \alpha_{\max} \cdot \frac{1 - \alpha_{\mathrm{offset}}}{2} \cdot \left[\tanh \left(\frac{\frac{d}{2} - \Delta(l)}{w} \right) \right] \tag{10}$$

$$\vec{B}_{\mathrm{ext}}(t) = \vec{B}_{\mathrm{amp}} \cdot \begin{pmatrix} 0 \\ \sin(\omega \cdot t + \phi) \\ \cos(\omega \cdot t + \phi) \end{pmatrix} \tag{11}$$

$$\Delta \langle S_z(l) \rangle = \langle S_z(l) \rangle_T - \langle S_z(l) \rangle_0 \tag{12}$$

$$f_{\mathrm{SL}}(\omega) = \left| \int \left[\langle S_{x,\mathrm{SL}}(t) \rangle + \langle S_{y,\mathrm{SL}}(t) \rangle \right] \exp(-\mathrm{i} 2\pi \omega t) \,\mathrm{d}t \right| \tag{13}$$

$$f_{\mathrm{SL}}(k, \omega) = \left| \int \int \left[\langle S_{x,\mathrm{SL}}(x,t) \rangle + \mathrm{i} \langle S_{y,\mathrm{SL}}(x,t) \rangle \right] \exp(-2\pi \mathrm{i}(\omega t + kx)) \,\mathrm{d}t \,\mathrm{d}x \right| \tag{14}$$

$$f_{\mathrm{SL}}(k, \omega) = \left| \int \int \left[\langle S_{x,\mathrm{SL}}(x,t) \rangle \right] \exp(-2\pi \mathrm{i}(\omega t + kx)) \,\mathrm{d}t \,\mathrm{d}x \right| \tag{15}$$

Theorem 1 (Shannons phrasing) *If a function $f(t)$ contains no frequencies higher than f_N Hz, it is completely determined by giving its ordinates at a series of points spaced $\frac{1}{2 f_N}$ seconds apart.*

$$f_N := \frac{1}{2} \cdot f_S = \frac{1}{2 \cdot t_S} \tag{16}$$

$$\begin{aligned} T_1 &\approx 24\,\mathrm{K}, \\ T_0 &= 0\,\mathrm{K} \end{aligned} \tag{17}$$

α-Fe_2O_3

$$B_{\mathrm{Mf}} = g \cdot \lambda \cdot M \tag{18}$$

$$\widehat{=}\ 8000\,\mathrm{T} \tag{19}$$

$$\psi_1 \qquad \psi_2 \tag{20}$$

$$\Psi \tag{21}$$

$$q_i = \vec{r}_i, s_i \quad i \in 1,2 \tag{22}$$

$$\Psi(q_1, q_2) = \psi_1(q_1) \cdot \psi_2(q_2) \tag{23}$$

$$\Psi(q_1, q_2) = \phi(\vec{r}_1, \vec{r}_2) \cdot \chi(s_1, s_2) \tag{24}$$

$$\phi(\vec{r}_1, \vec{r}_2) = \phi(\vec{r}_2, \vec{r}_1) \Leftrightarrow \chi(s_1, s_2) = -\chi(s_2, s_1) \tag{25}$$

$$\phi(\vec{r}_1, \vec{r}_2) = -\phi(\vec{r}_2, \vec{r}_1) \Leftrightarrow \chi(s_1, s_2) = \chi(s_2, s_1) \tag{26}$$

$$\tag{27}$$

$$|\uparrow\uparrow\rangle \tag{28}$$

$$\frac{1}{\sqrt{2}}\left(|\uparrow\downarrow\rangle + |\downarrow\uparrow\rangle\right) \tag{29}$$

$$|\downarrow\downarrow\rangle \tag{30}$$

$$\frac{1}{\sqrt{2}}\left(|\uparrow\downarrow\rangle - |\downarrow\uparrow\rangle\right) \tag{31}$$

$$\tag{32}$$

$$\mathcal{H} = \mathcal{H}_1 + \mathcal{H}_2 + \mathcal{H}_{12} + \mathcal{H}_{\mathrm{Mag}} \tag{33}$$

$$\mathcal{H}_{12} \propto \frac{e^2}{\vec{r}_{12}} \tag{34}$$

$$\mathit{\Psi}_{\mathrm{S}} = \frac{1}{\sqrt{2}}\left[\phi(\vec{r}_1, \vec{r}_2) + \phi(\vec{r}_2, \vec{r}_1)\right] \cdot \chi_S \tag{35}$$

$$\mathit{\Psi}_{\mathrm{T}} = \frac{1}{\sqrt{2}}\left[\phi(\vec{r}_1, \vec{r}_2) - \phi(\vec{r}_2, \vec{r}_1)\right] \cdot \chi_T \tag{36}$$

$$\tag{37}$$

$$U = \int \mathit{\Psi}^{\star} \mathcal{H} \mathit{\Psi} \, \mathrm{d}V \tag{38}$$

$$U_S = I_1 + I_2 + K_{12} + J_{12} \tag{39}$$

$$U_T = I_1 + I_2 + K_{12} - J_{12} \tag{40}$$

$$U_S - U_T = 2 \cdot J_{12} = 2 \cdot \int\int \phi_1^{\star}(\vec{r}_1)\phi_2^{\star}(\vec{r}_2)\mathcal{H}\phi_1(\vec{r}_2)\phi_2(\vec{r}_1)\,\mathrm{d}V_1\,\mathrm{d}V_2 \tag{41}$$

$$S^2 = (S_1 + S_2)^2 = \underbrace{S_1^2 + S_2^2}_{=\text{const.}} + 2S_1 \cdot S_2 \tag{42}$$

$$\mathcal{H}_{\text{eff.}}\left(S_1 \cdot S_2 = -\frac{3}{4}\right) = U_S \tag{43}$$

$$\mathcal{H}_{\text{eff.}}\left(S_1 \cdot S_2 = \frac{1}{4}\right) = U_T \tag{44}$$

$$\mathcal{H}_{\text{eff.}} = \frac{1}{4}\left(U_S + 3 \cdot U_T\right) - \left(U_S - U_T\right) \cdot S_1 \cdot S_2 \tag{45}$$

$$\mathcal{H}_{\text{eff.}} = \underbrace{\frac{1}{4}\left(U_S + 3 \cdot U_T\right)}_{=\text{const.}} - \underbrace{\left(U_S - U_T\right)}_{=2\cdot J_{12}} \cdot S_1 \cdot S_2 \tag{46}$$

$$\mathcal{H}_{\text{eff.}} = -2J_{12} \cdot S_1 \cdot S_2 \tag{47}$$

$$\mathcal{H}_{\text{Heisenberg}} = 2 \cdot \sum_{i<j} J_{ij} \cdot S_i \cdot S_j \tag{48}$$

$$J > 0 \Leftrightarrow \mathrm{U}_S > \mathrm{U}_T \Leftrightarrow \text{FM Grundzustand} \tag{49}$$
$$J < 0 \Leftrightarrow \mathrm{U}_S < \mathrm{U}_T \Leftrightarrow \text{AFM Grundzustand} \tag{50}$$