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Finite Temperature

Langevin dynamics:

Stochastic contribution to the effective field

Gaussian distribution
One thermal reservoir

$$\frac{\partial \mathbf{m}_i}{\partial t} = -\gamma[\mathbf{m}_i \times [\mathbf{B}_i + \mathbf{b}_i(t)]] - \gamma\frac{\alpha}{m}[\mathbf{m}_i \times [\mathbf{m}_i \times [\mathbf{B}_i + \mathbf{b}_i(t)]]]$$

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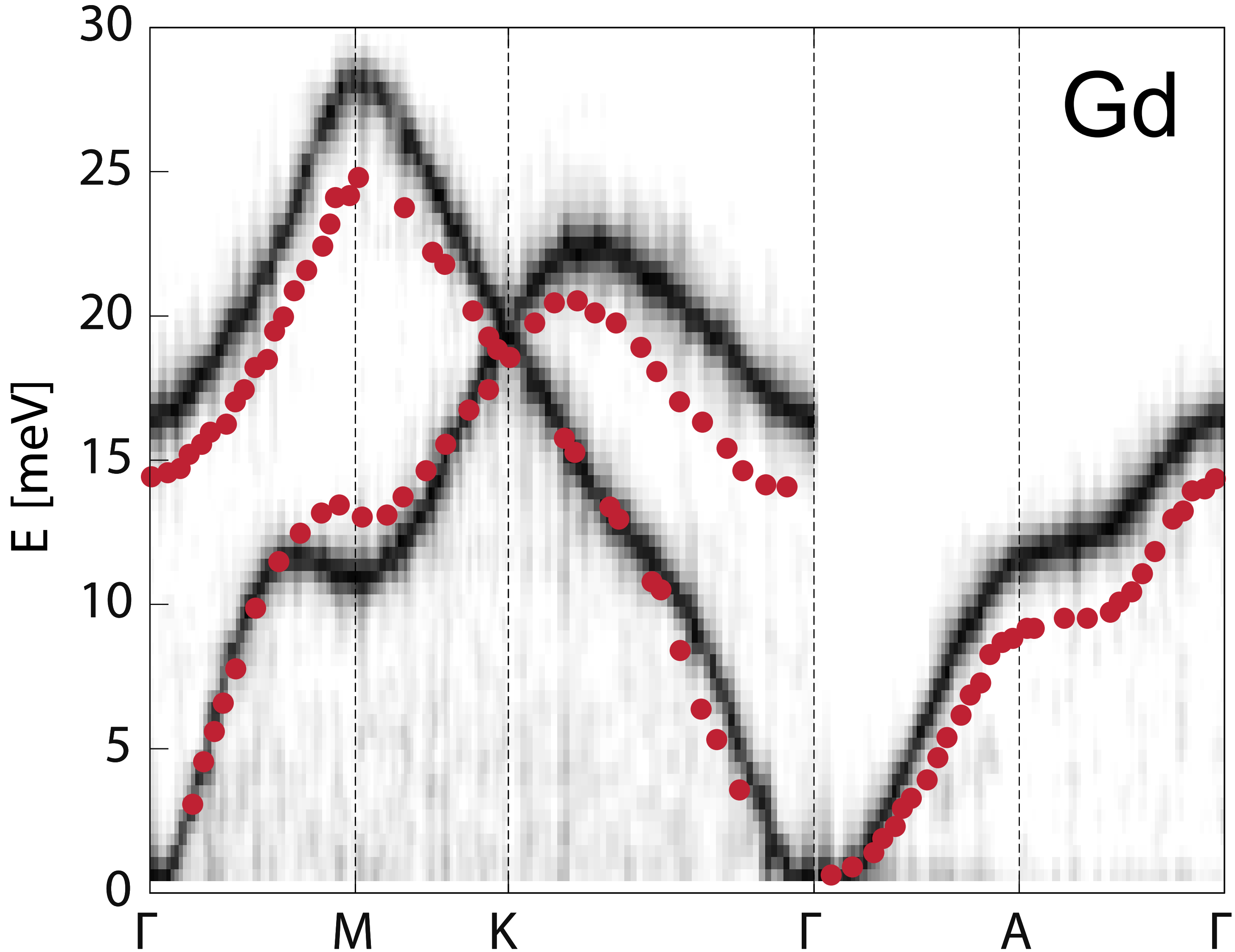
Spin wave dispersion spectrum



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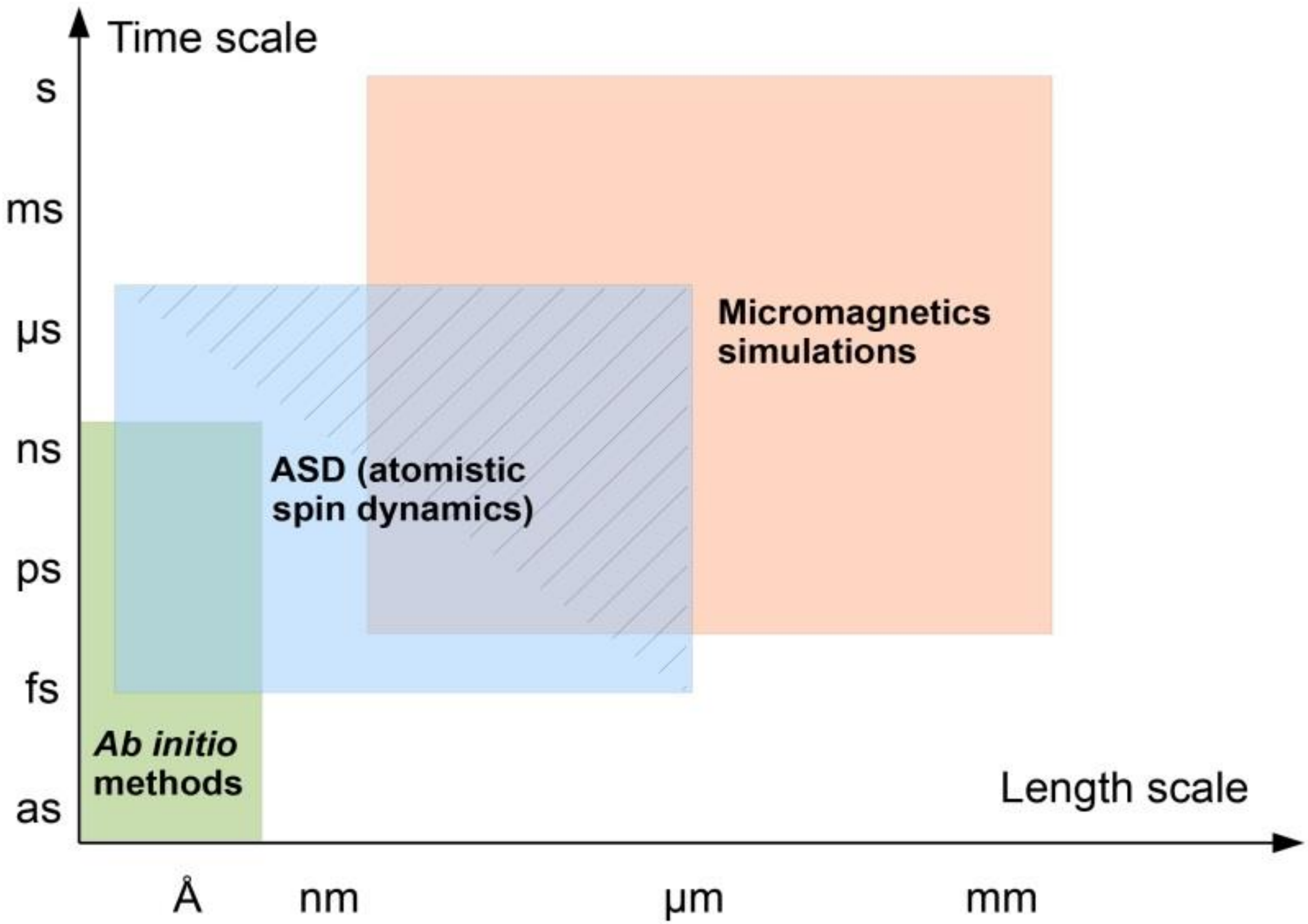
Multiscale simulations



Method:

Micromagnetics

$$\frac{\partial \vec{m}}{\partial t} = -\gamma \vec{m} \times \vec{H} - \alpha \vec{m} \times \left(\vec{m} \times \vec{H} \right)$$

$$\vec{H}^{\text{exc}} = Ae \cdot \nabla\nabla \vec{m}$$
$$\vec{H}^{D} = \nabla \cdot (De \times \vec{m})$$
$$\vec{H}^{\text{ani}} = Ka \cdot \vec{m}$$
$$\vec{H}^{e} = \mu \vec{H}^{\text{app}}$$
$$\vec{H} = \vec{H}^{\text{exc}} + \vec{H}^{D} + \vec{H}^{\text{ani}} + \vec{H}^{e}.$$

Atomistic spin dynamics

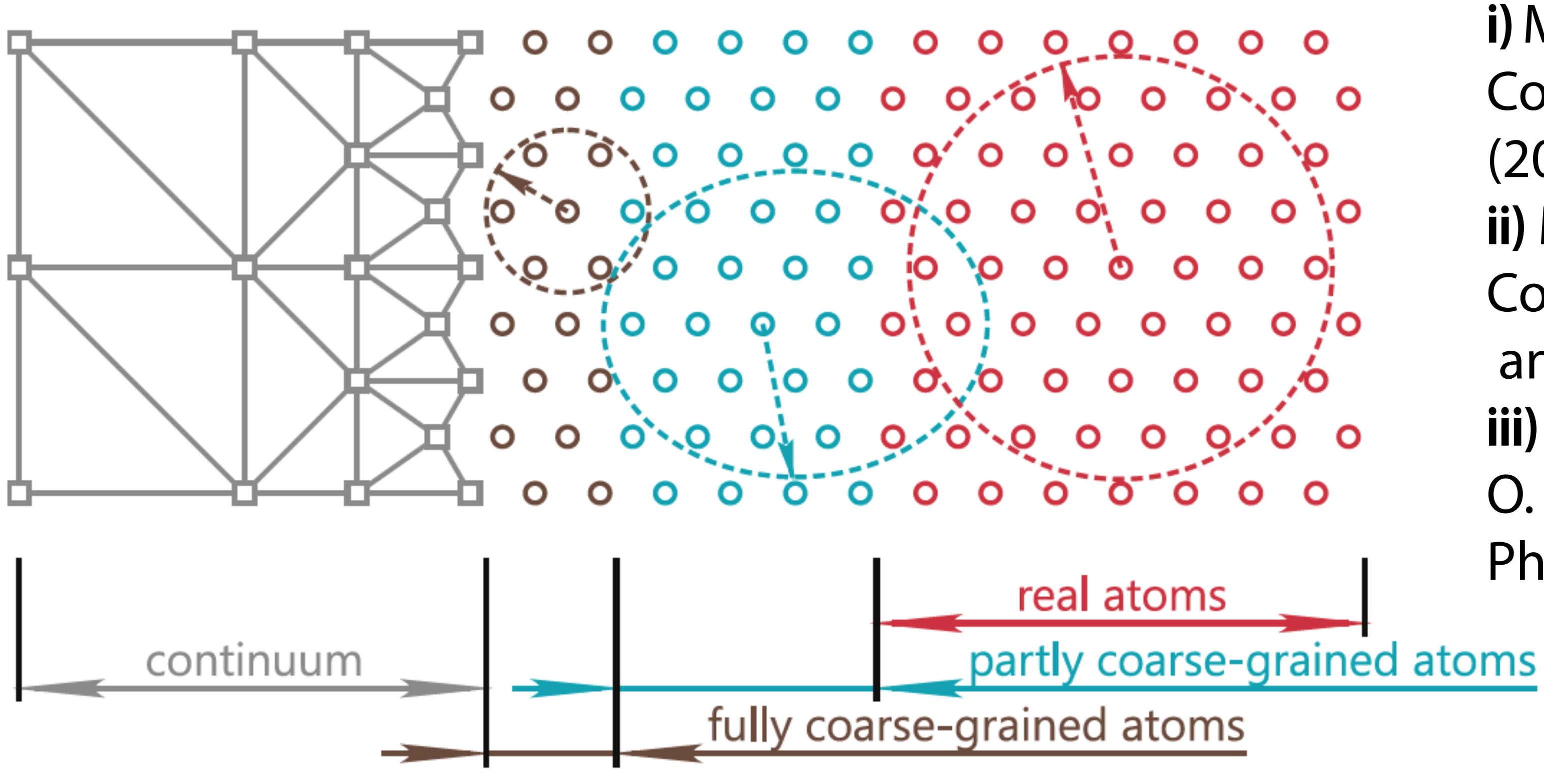
$$\frac{d\vec{s}_i}{dt} = -\gamma \vec{s}_i \times \vec{H}_i - \alpha \vec{s}_i \times \left(\vec{s}_i \times \vec{H}_i \right)$$

$$\vec{H}_i^{\text{exc}} = \sum_{j \neq i} J_{ij} \vec{s}_j$$
$$\vec{H}_i^{\text{D}} = \sum_{j \neq i} \vec{D}_{ij} \times \vec{s}_j$$
$$\vec{H}_i^{\text{ani}} = Ka \cdot \vec{s}_i$$
$$\vec{H}^{i} = \vec{H}_i^{\text{exc}} + \vec{H}_i^{D} + \vec{H}_i^{\text{ani}} + \vec{H}^{e}$$

$$Ae = \frac{1}{2} \sum_{j \neq i} J_{ij} \vec{r}_{ij} \, \vec{r}_{ij}$$

$$De = \sum_{j \neq i} \vec{r}_{ij} \, \vec{D}_{ij}$$

Method:



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ii) M.Poluektov, O. Eriksson, G.Kreiss, Computer Methods in Appl. Mech. and Eng. **329** 219 (2018)
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Results: Skyrmion with dislocation