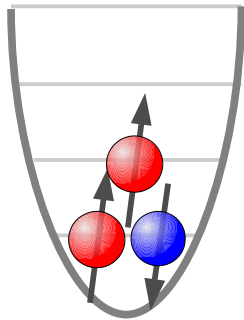


Ferromagnetism in a few-fermion atom gas

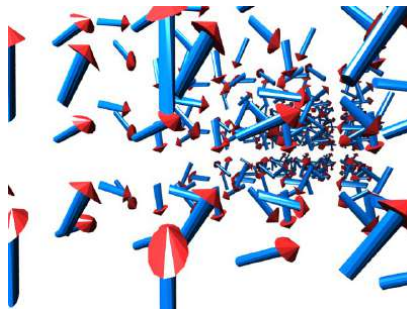
Gareth Conduit

Condensed matter across the length scales

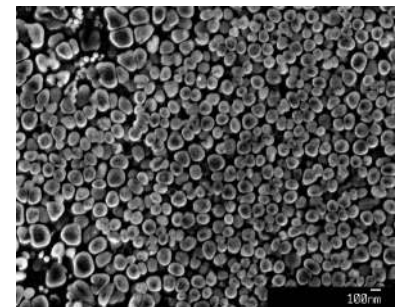
Few-fermionic atoms



Electron gas

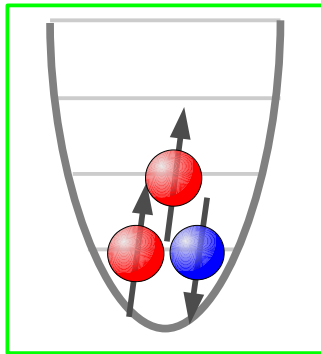


Alloy design

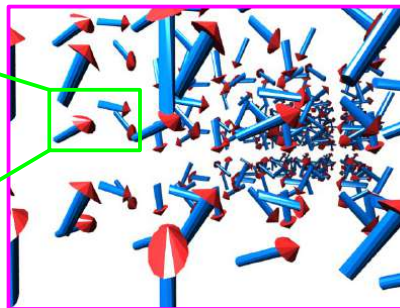


Condensed matter across the length scales

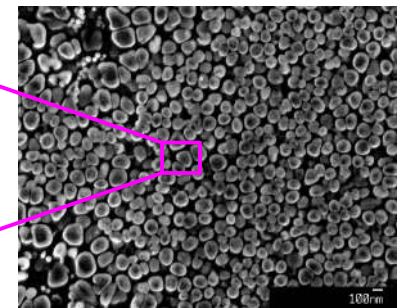
Few-fermionic atoms



Electron gas



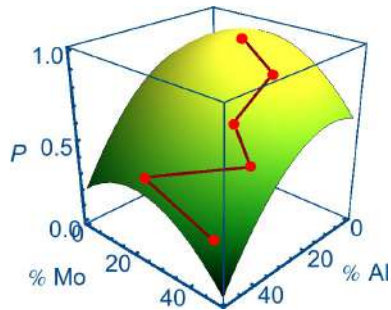
Alloy design



Concurrent materials design

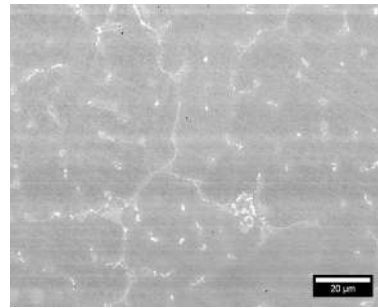
Discovery algorithm

Patent GB1302743.8 (2013)



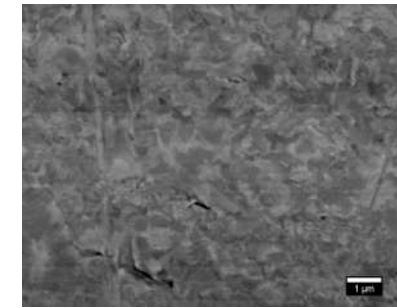
Mo-Hf forging alloy

Patent GB1307533.8 (2013)



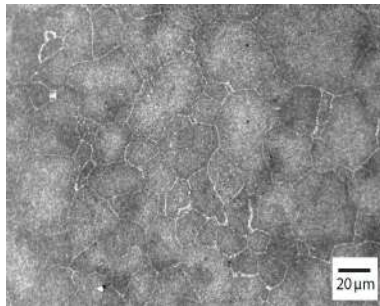
Mo-Nb forging alloy

Patent GB1307535.3 (2013)



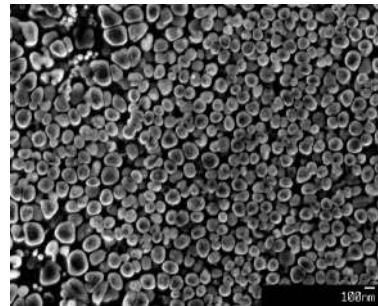
RR1000 grain growth

Acta Materialia, **61**,
3378 (2013)



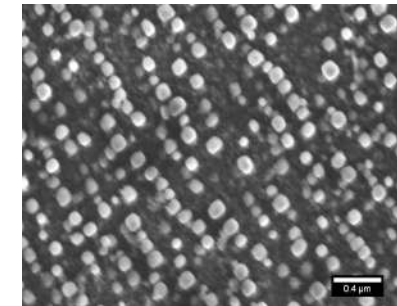
Ni disc alloy

Rolls-Royce invention
NC12261 (2012)

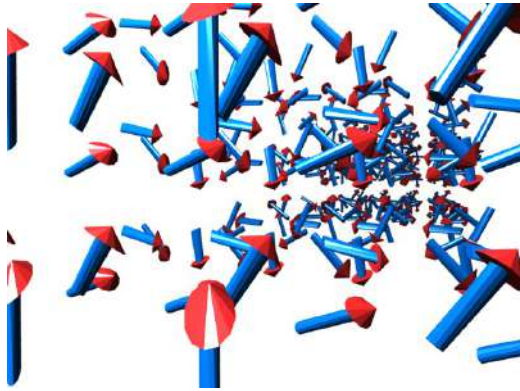


Ni combustor liner

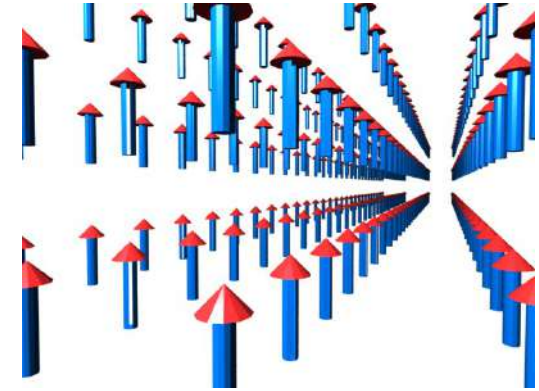
Rolls-Royce invention
NC13006 (2013)



Homogeneous electron gas



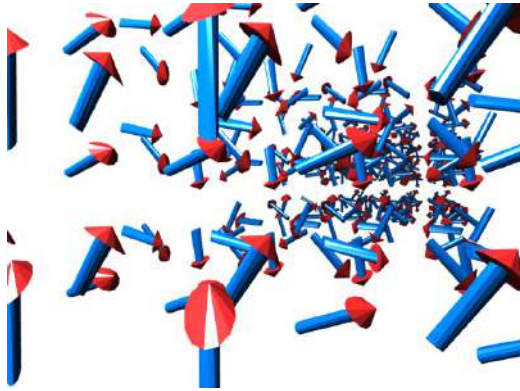
Paramagnet



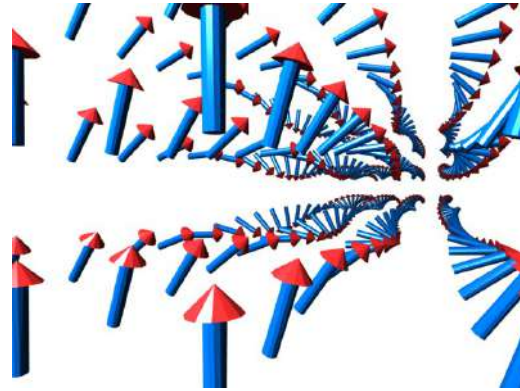
Ferromagnet



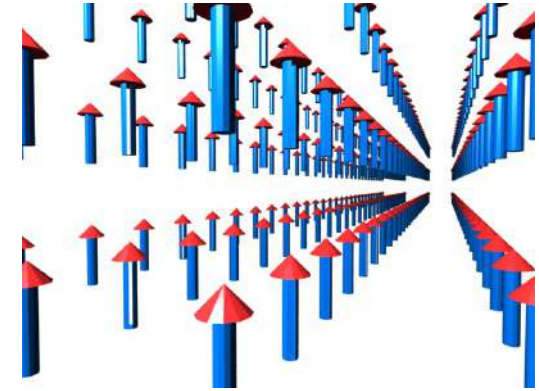
Homogeneous electron gas



Paramagnet



Spiral

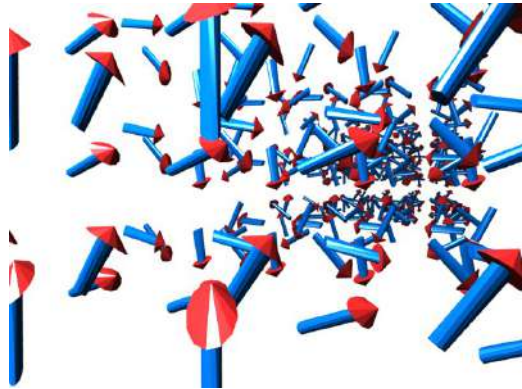


Ferromagnet

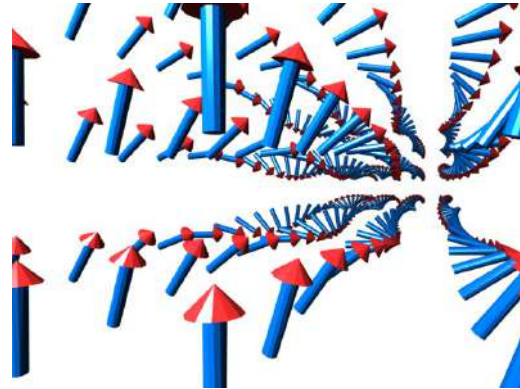


GJ Conduit, AG Green, BD Simons, Phys. Rev. Lett. **103**, 200403 (2009)

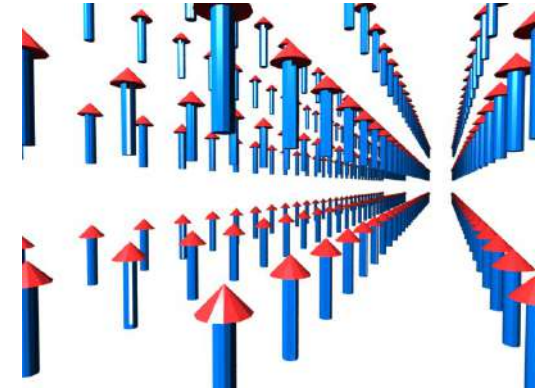
Homogeneous electron gas



Paramagnet



Spiral



Ferromagnet

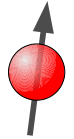


GJ Conduit, AG Green, BD Simons, *Phys. Rev. Lett.* **103**, 200403 (2009)



S Lausberg *et al.* *Phys. Rev. Lett.* **109**, 216402 (2012)

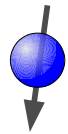
Few-fermion ferromagnet



Up spin



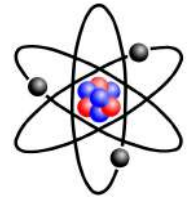
$$|F = 1/2, m_F = 1/2\rangle$$



Down spin



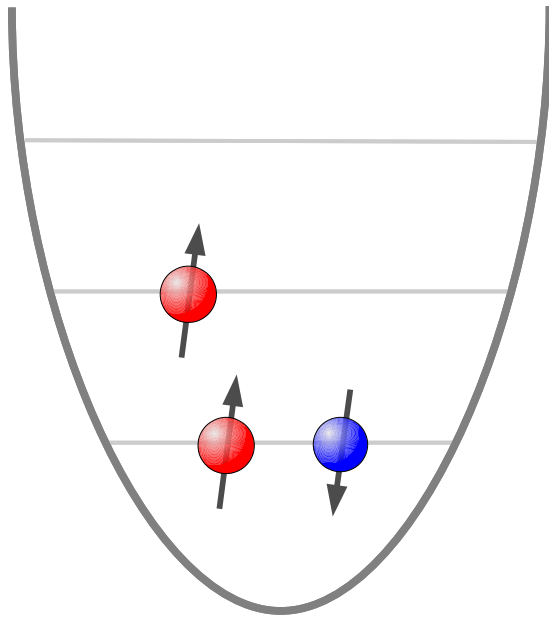
$$|F = 1/2, m_F = -1/2\rangle$$



${}^6\text{Li}$ atom

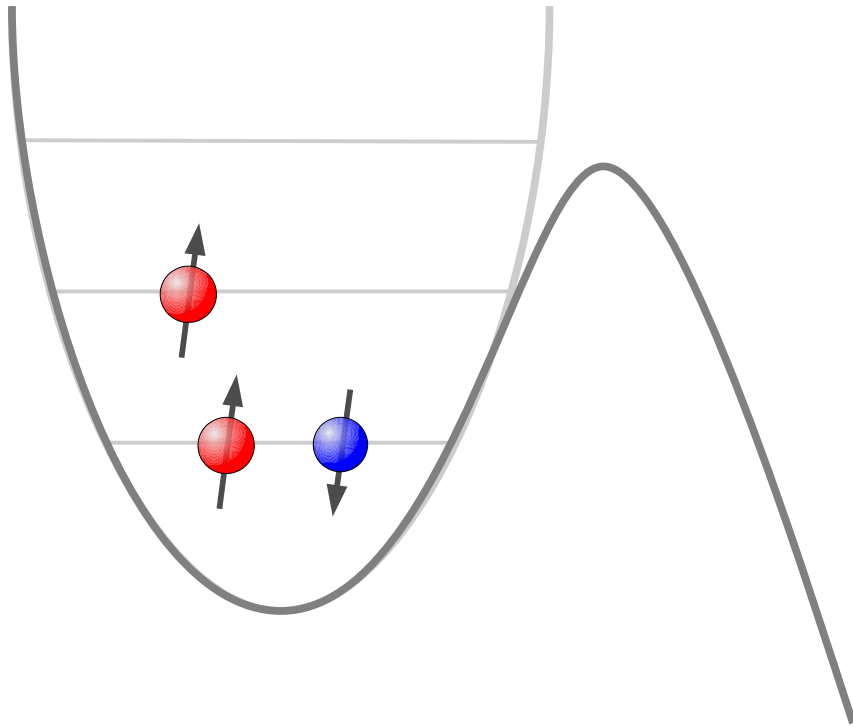
GJ Conduit & PO Bugnion, arXiv:1304.3299

Trapped atoms

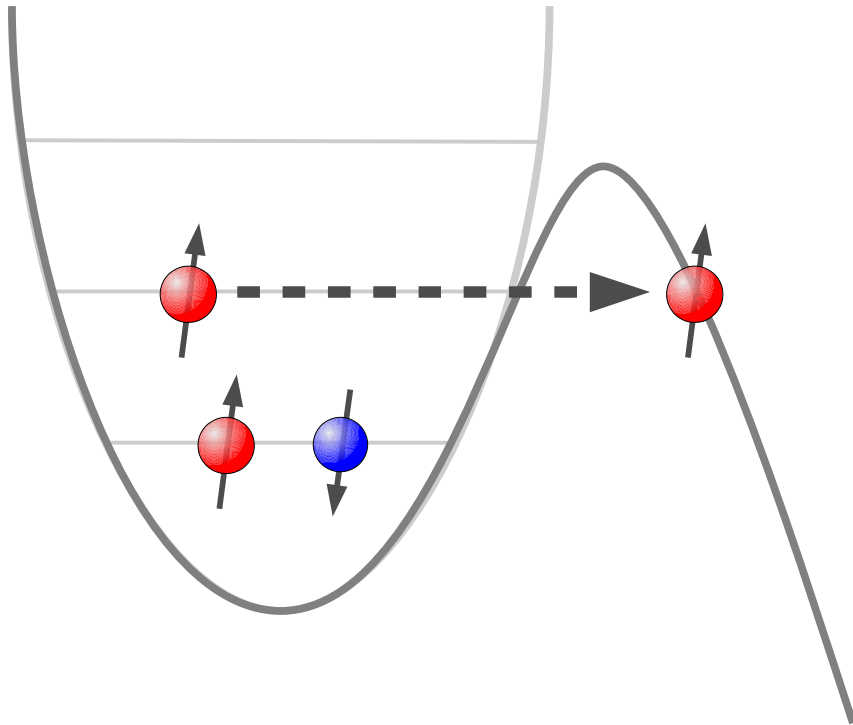


F Serwane *et al.*, *Science* **332**, 336 (2011)
G Zürn *et al.*, *Phys. Rev. Lett.* 108, 075303 (2012)

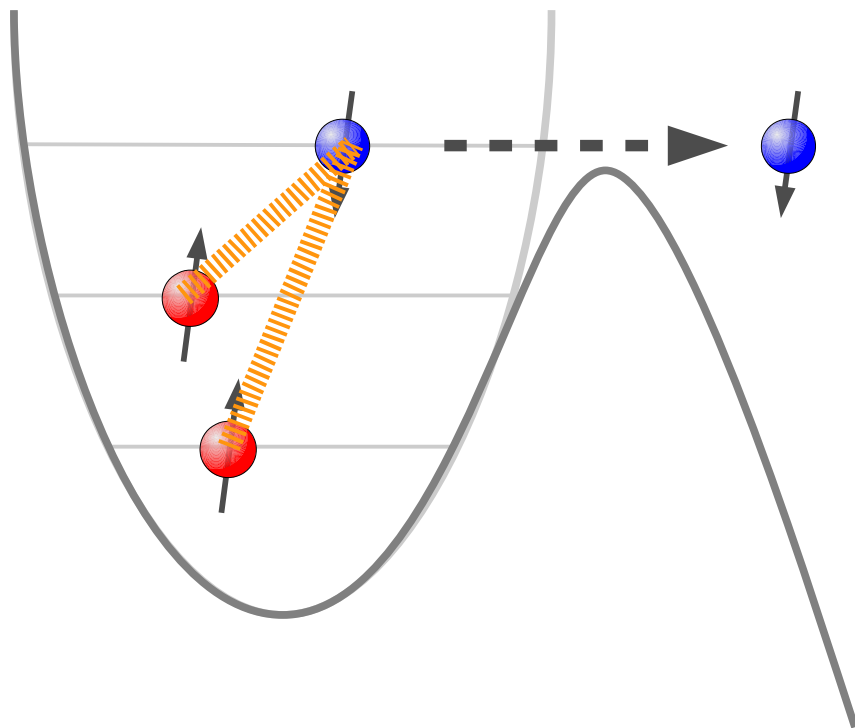
Tunneling probe



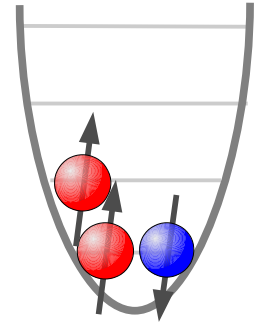
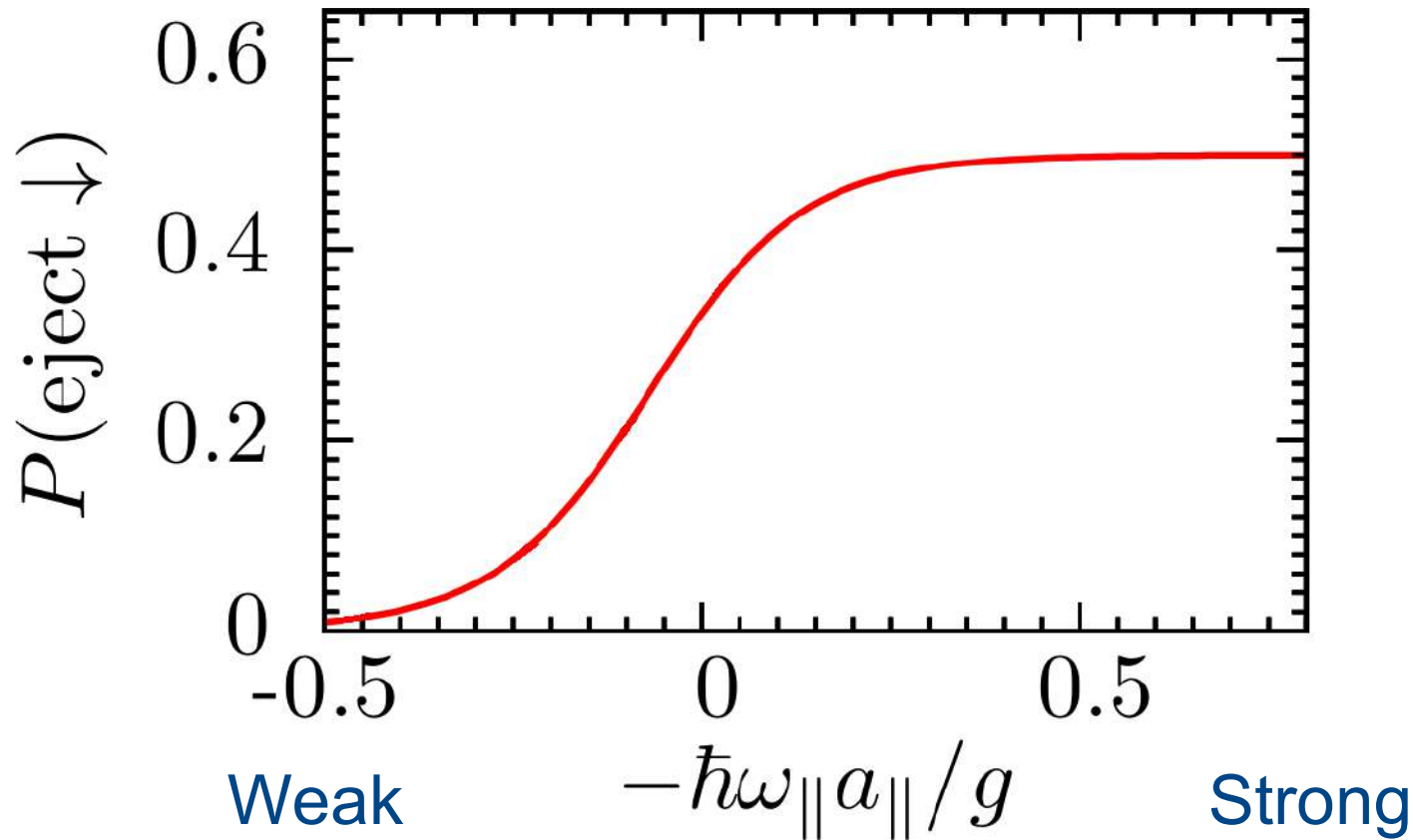
Tunneling probe



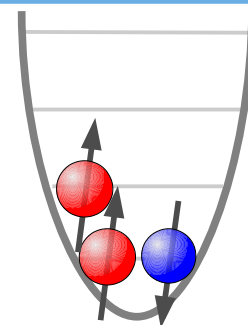
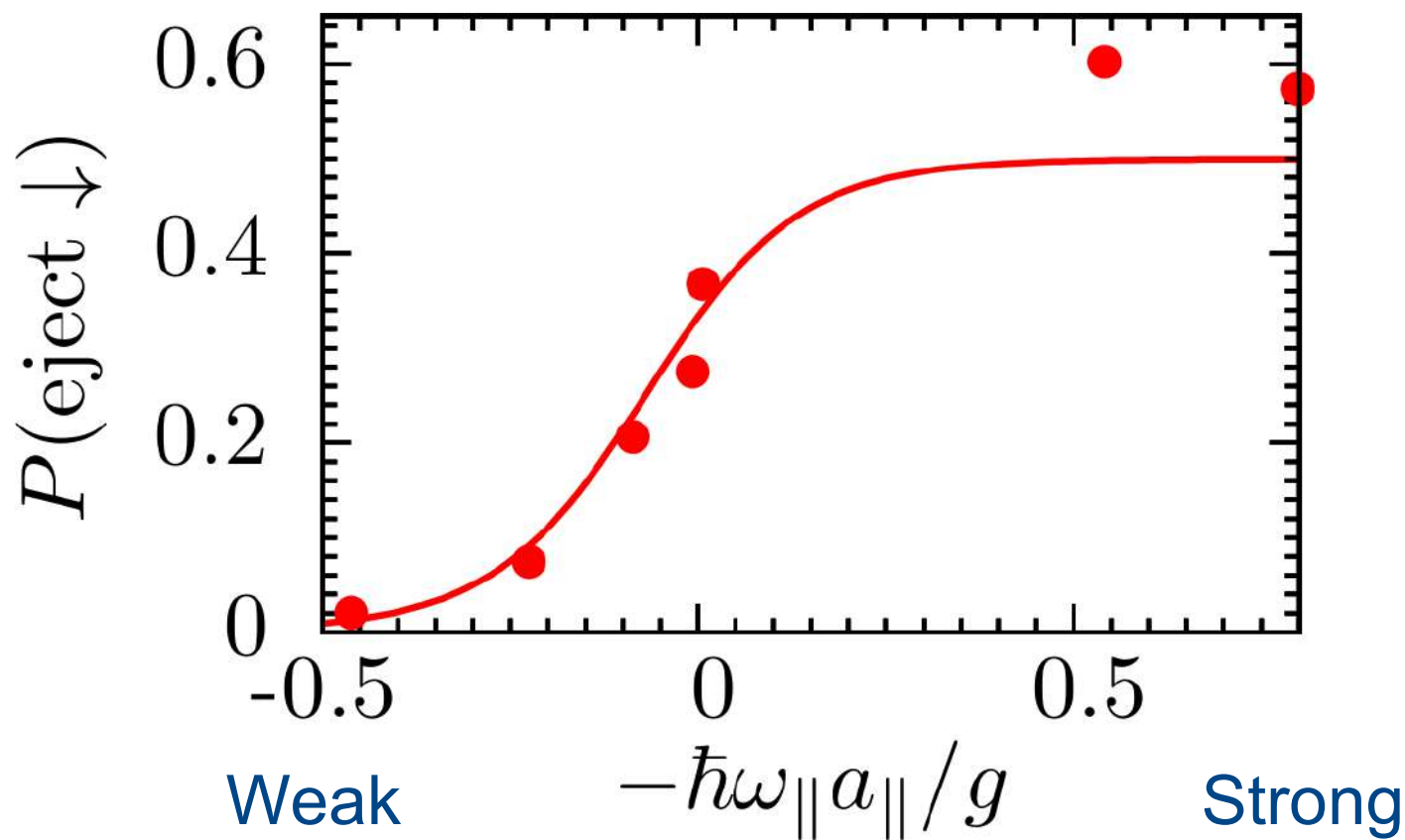
Tunneling probe



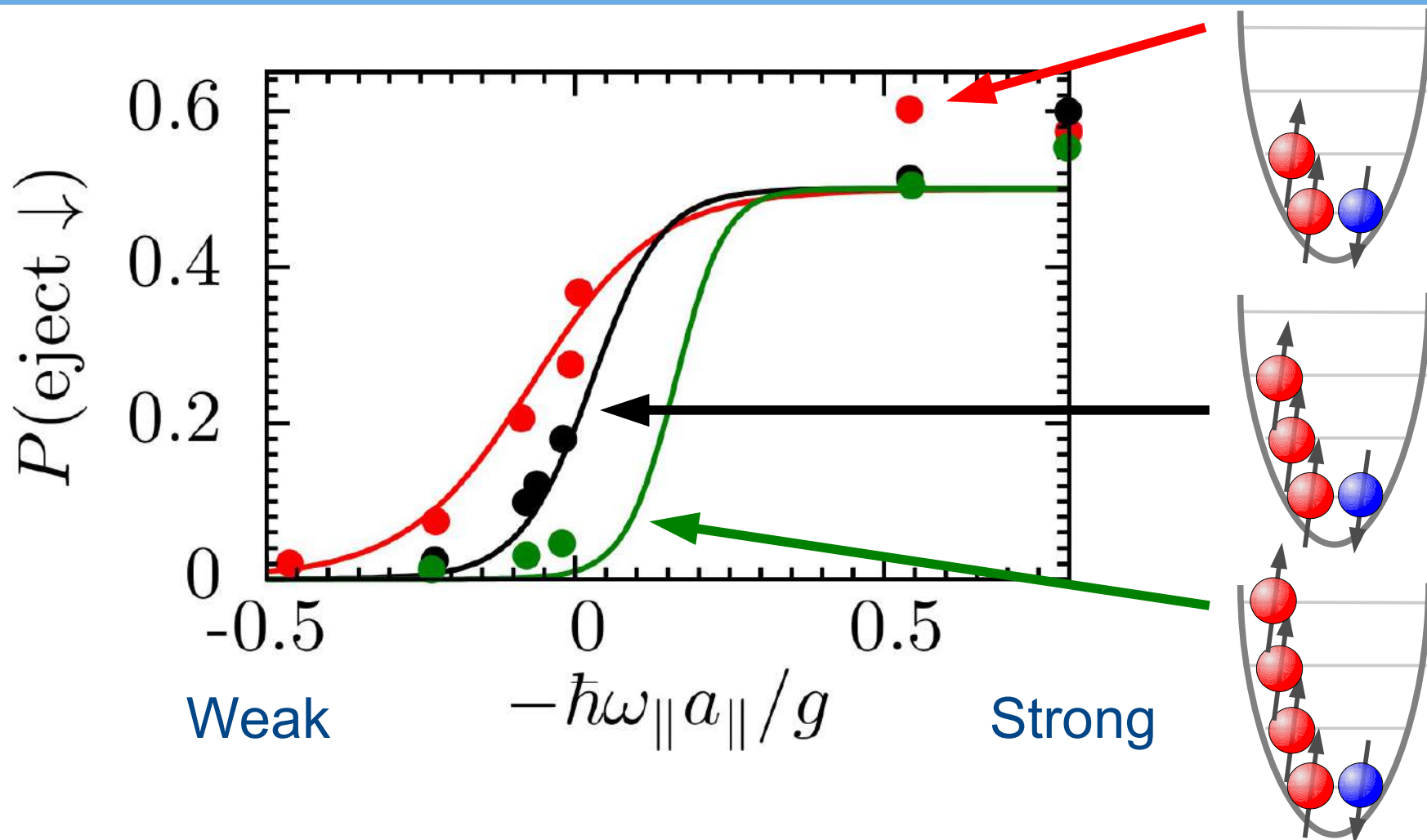
Tunneling probability



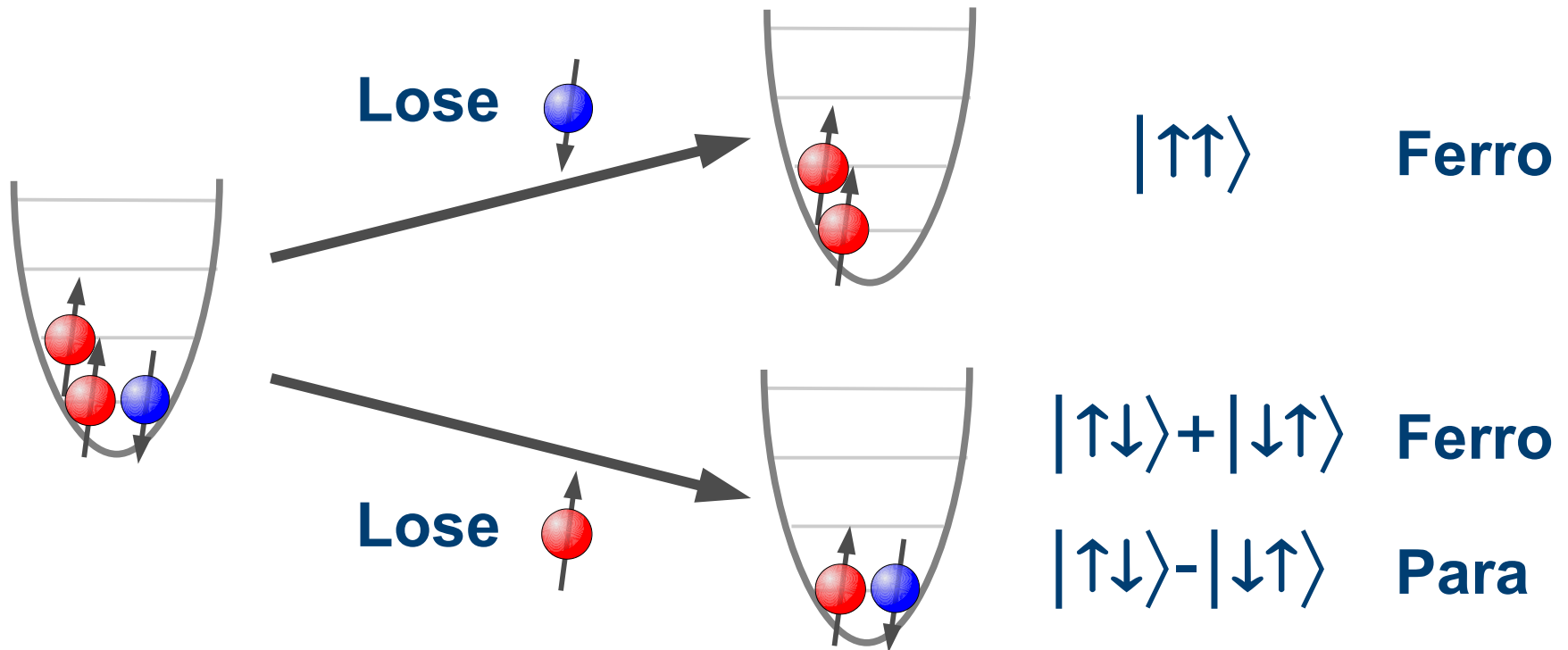
Tunneling probability



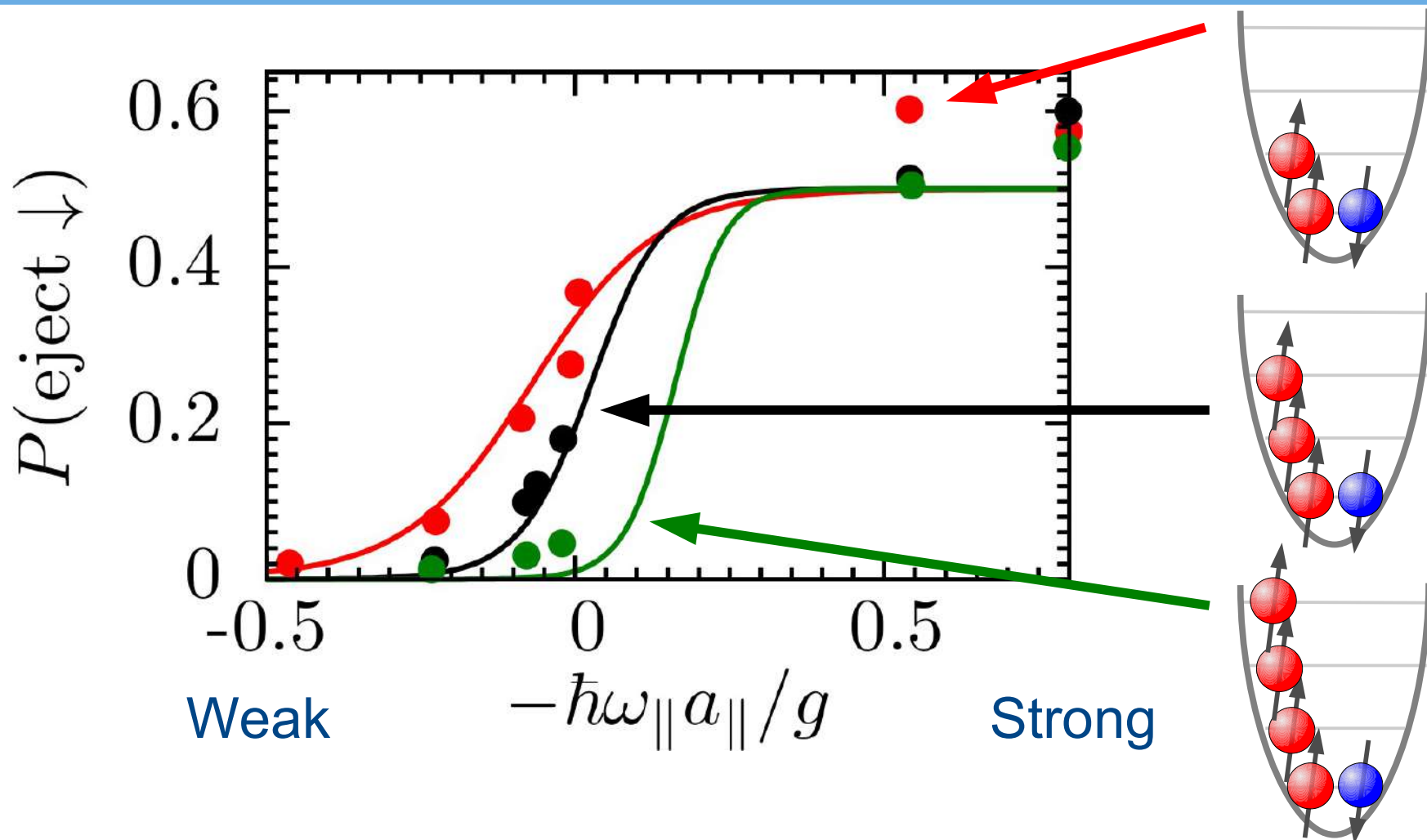
Tunneling probability



Why probability of $\frac{1}{2}$?

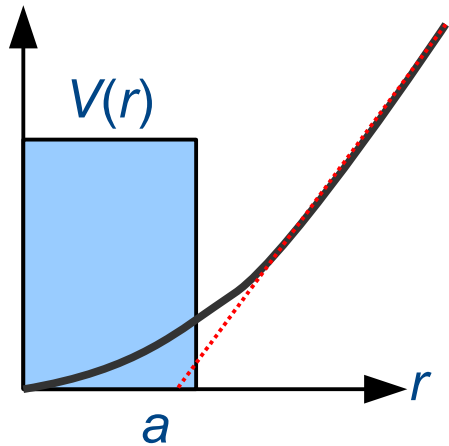


Tunneling probability



Two-atom scattering

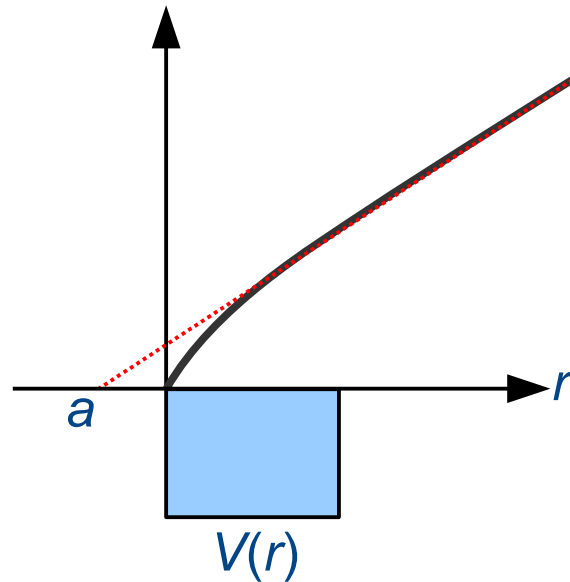
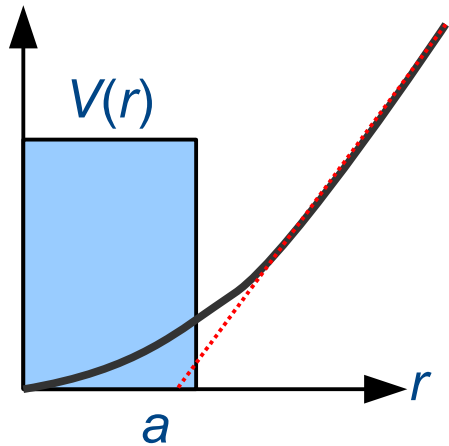
Repulsive



Two-atom scattering

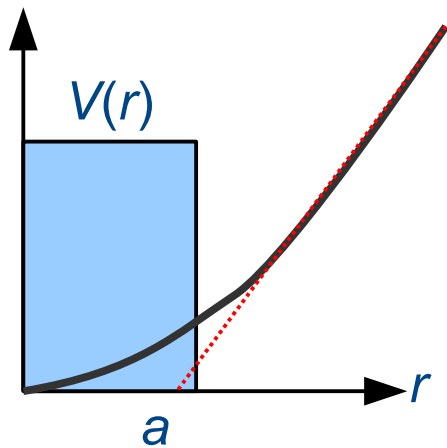
Repulsive

Attractive

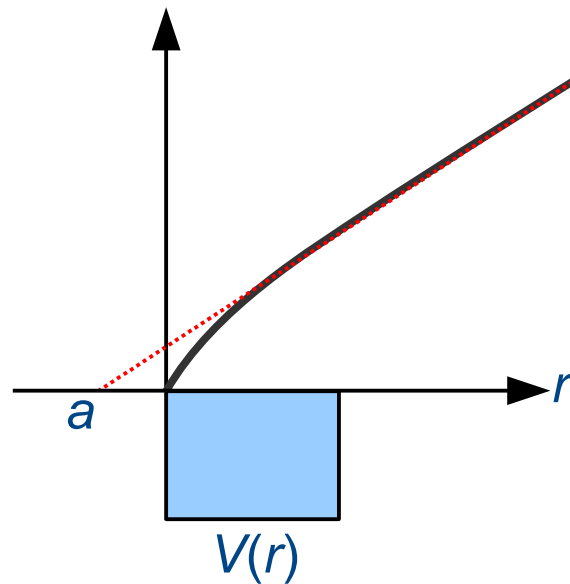


Two-atom scattering

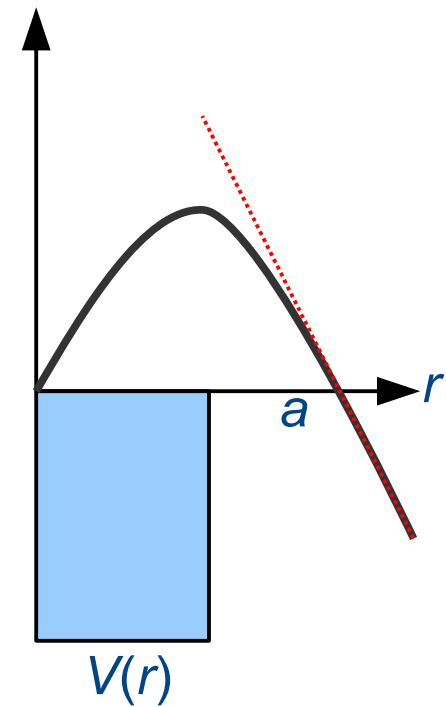
Repulsive



Attractive

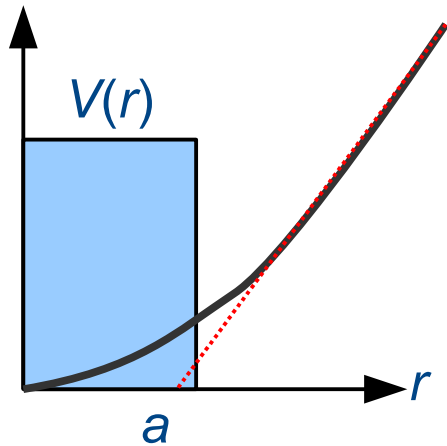


Repulsive

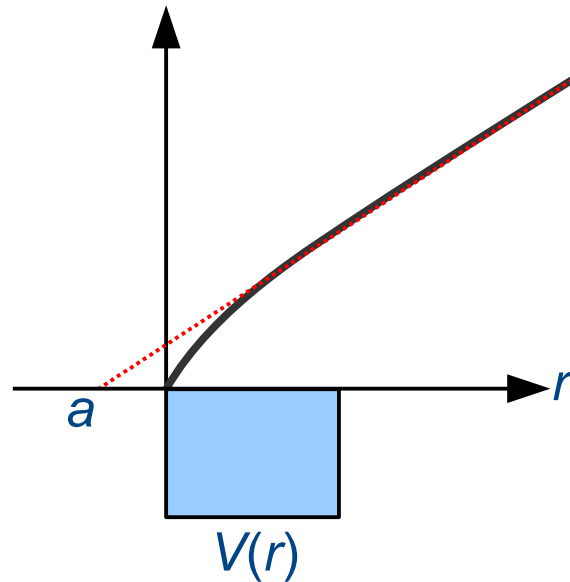


Two-atom scattering

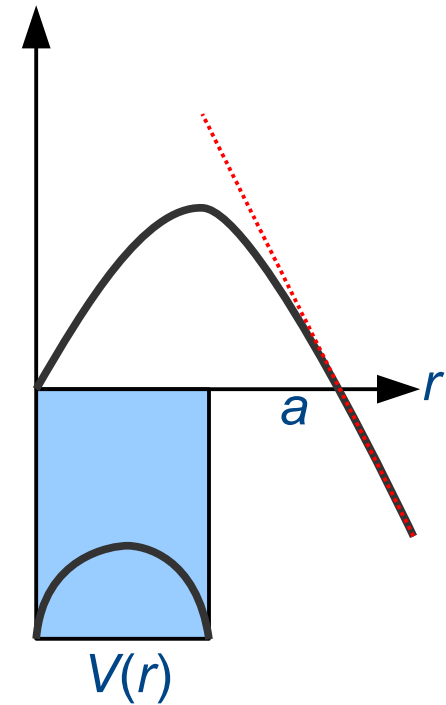
Repulsive



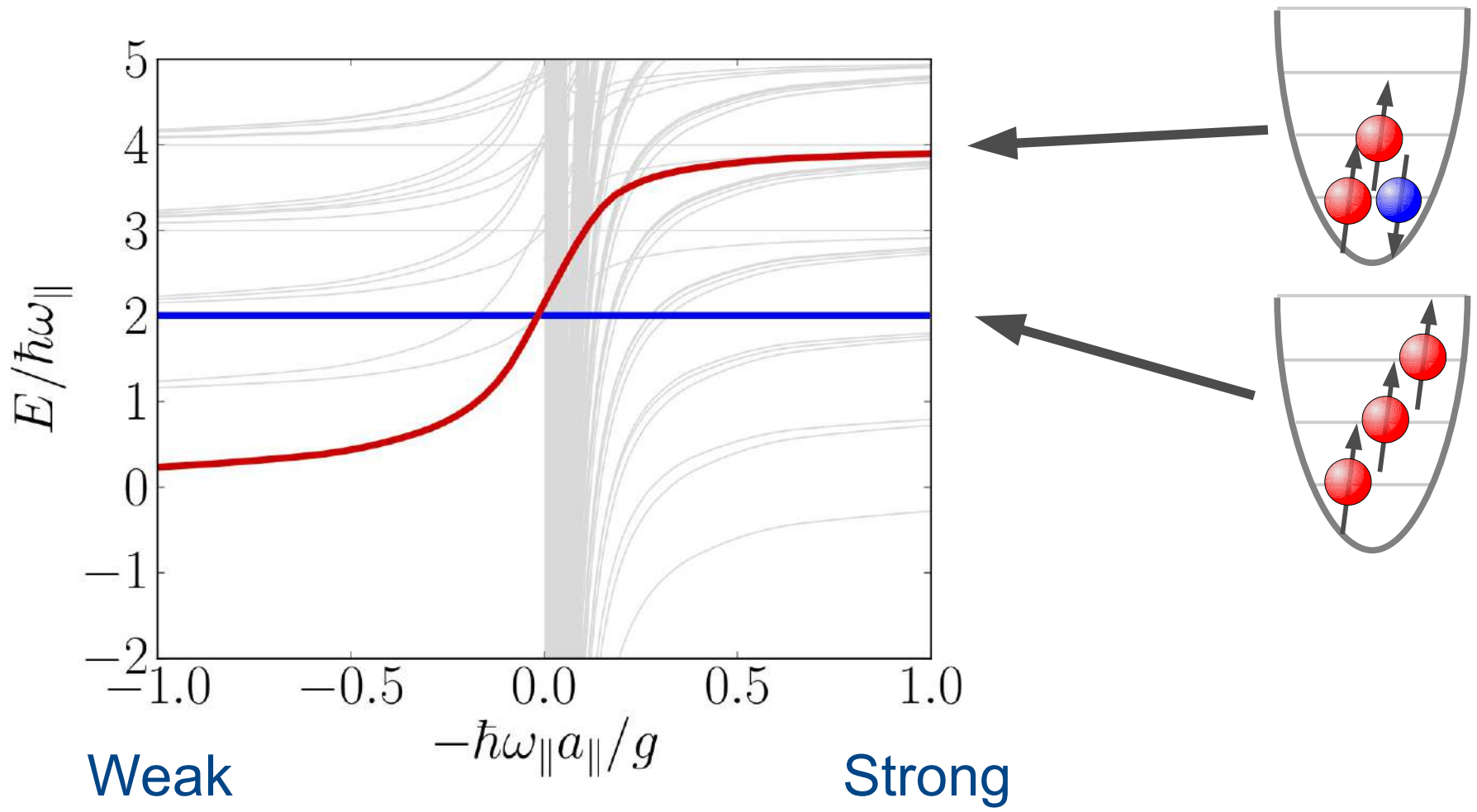
Attractive



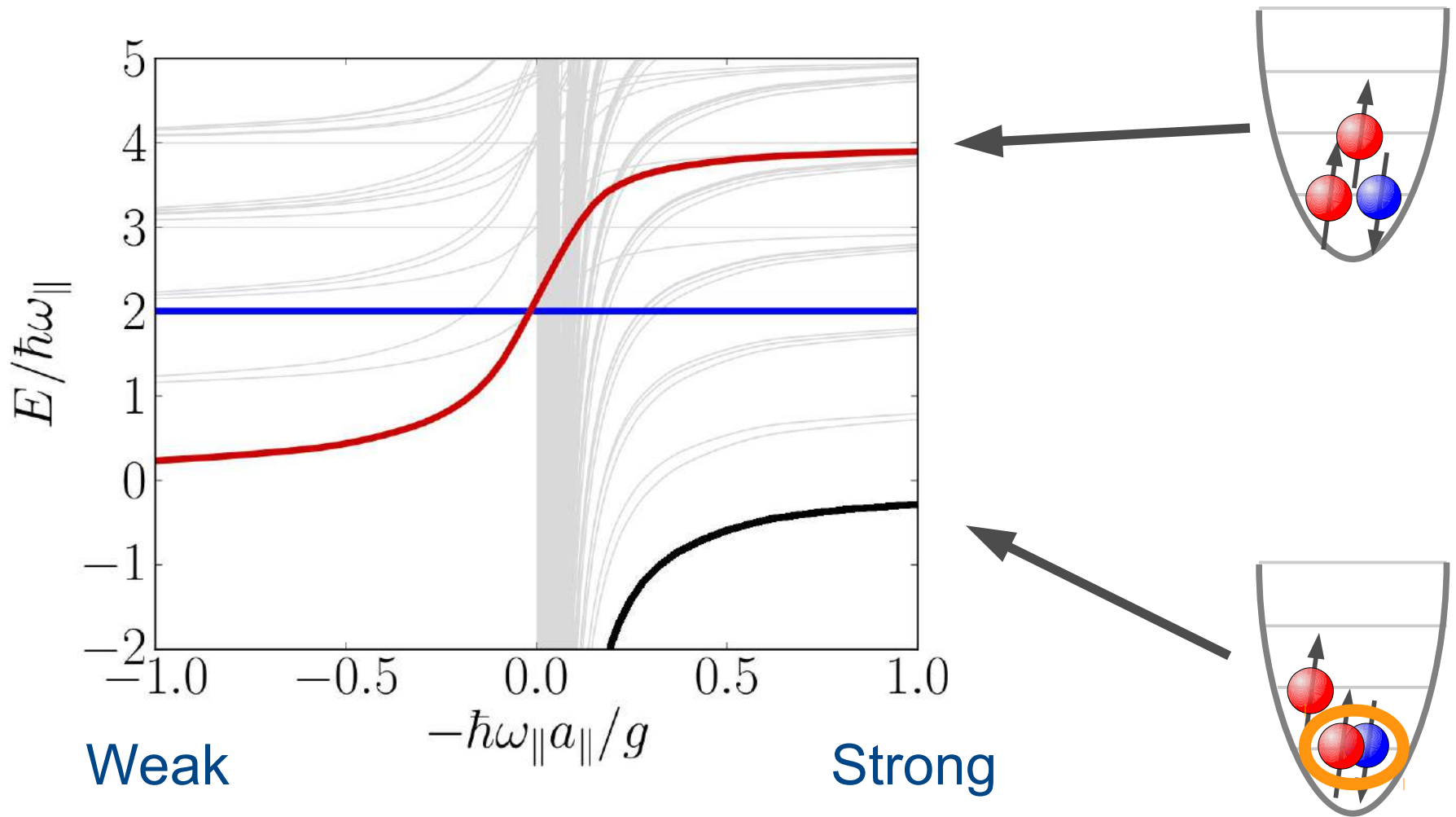
Repulsive



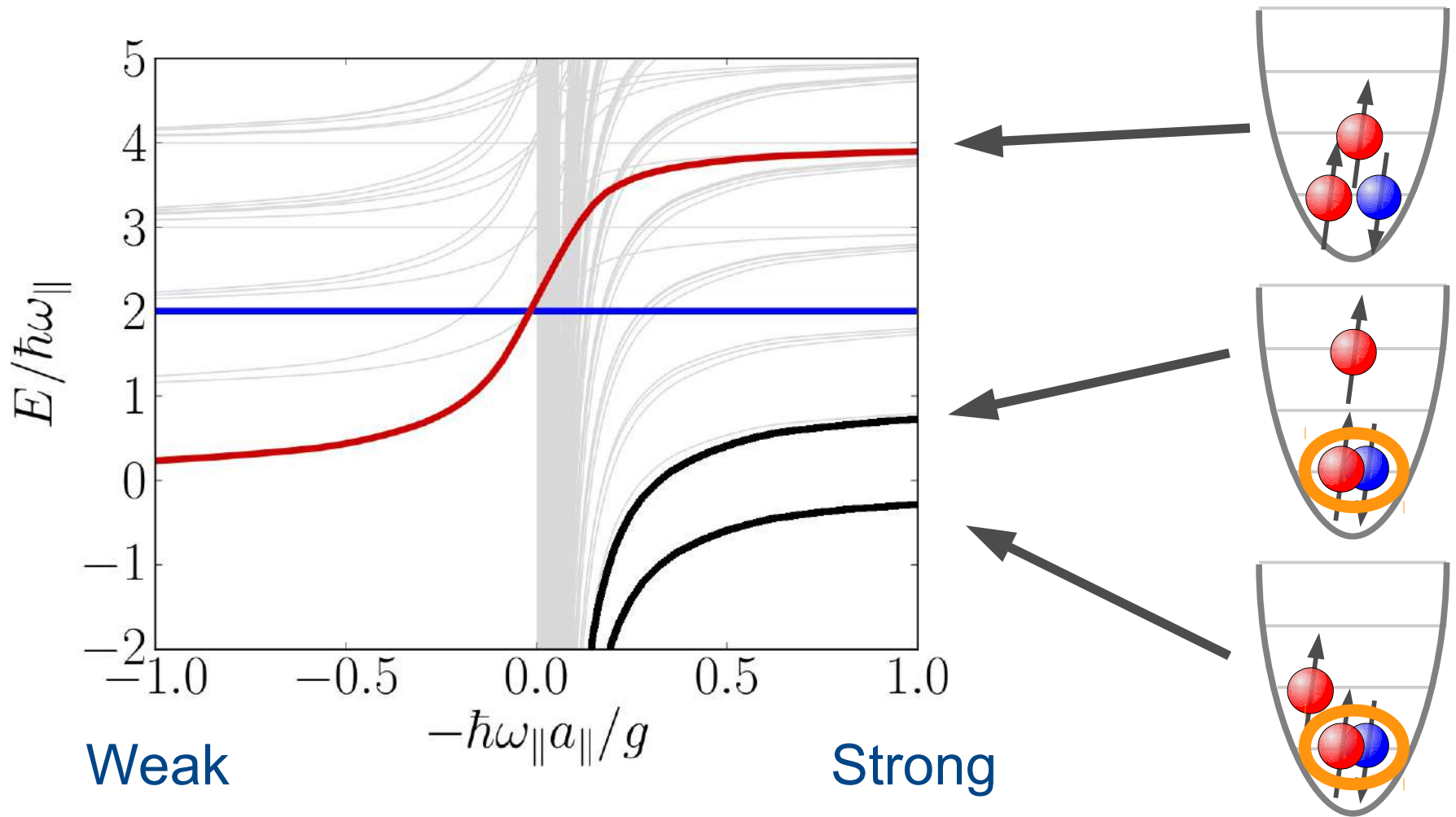
Three-atom bound state



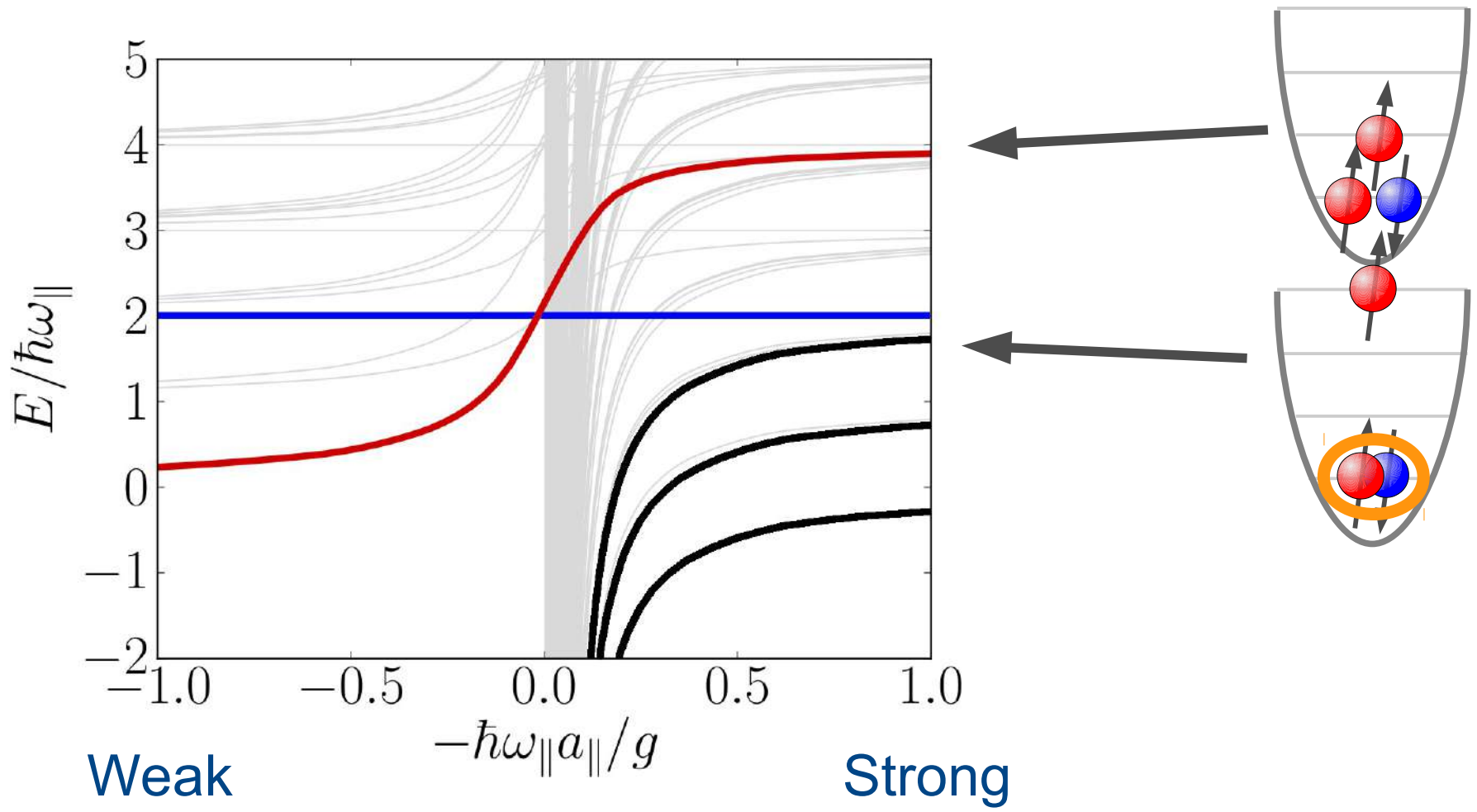
Three-atom bound state



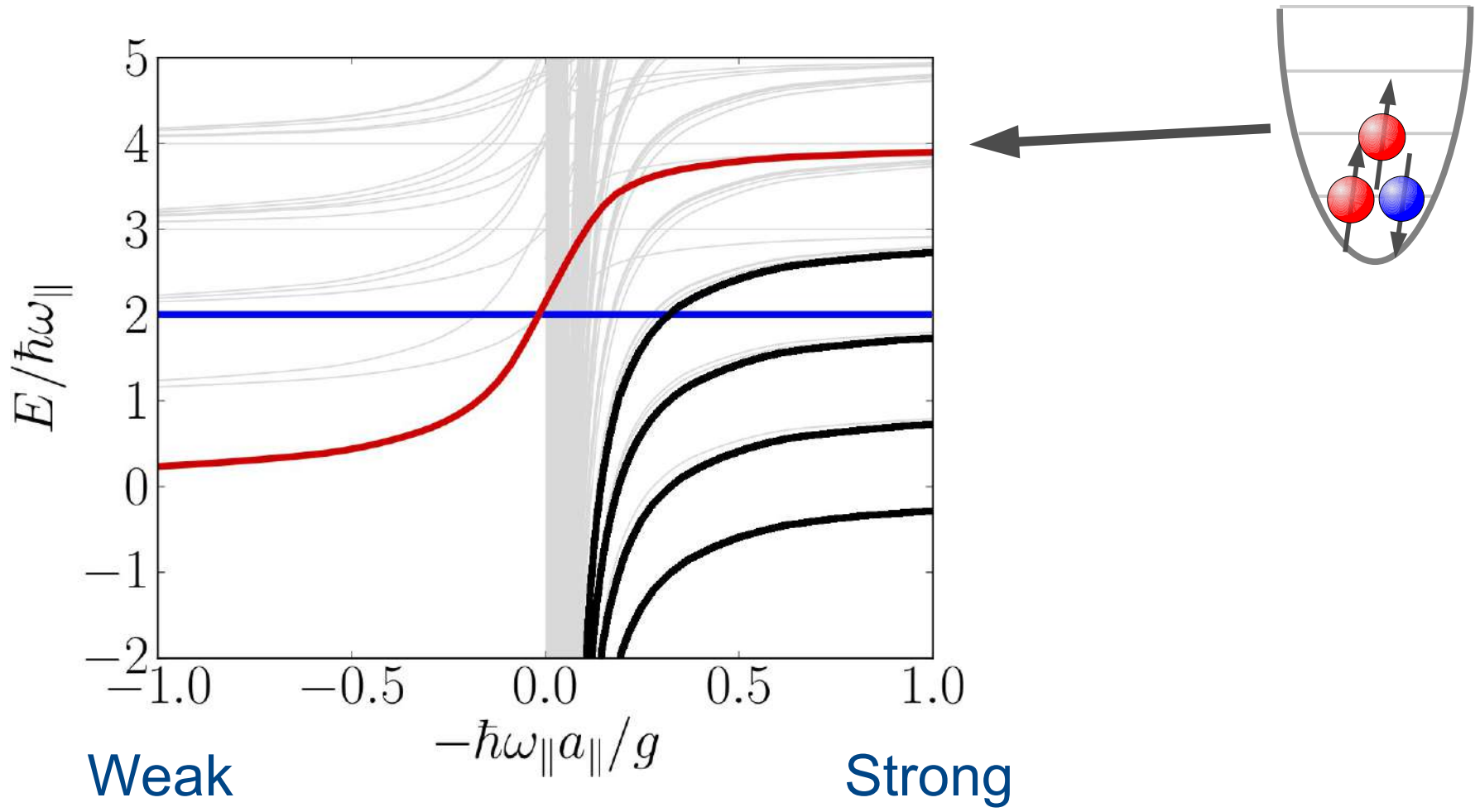
Three-atom bound state



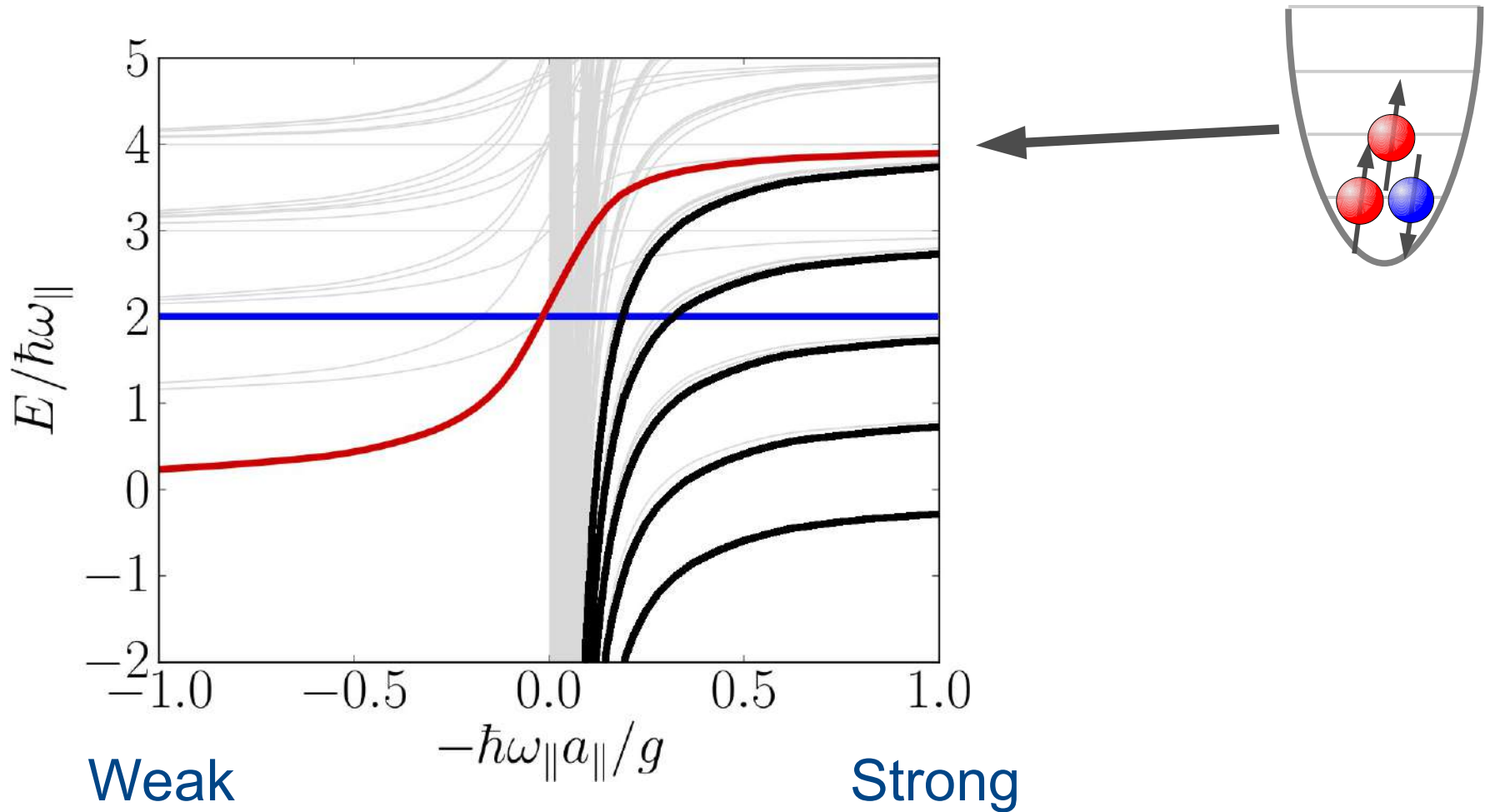
Three-atom bound state



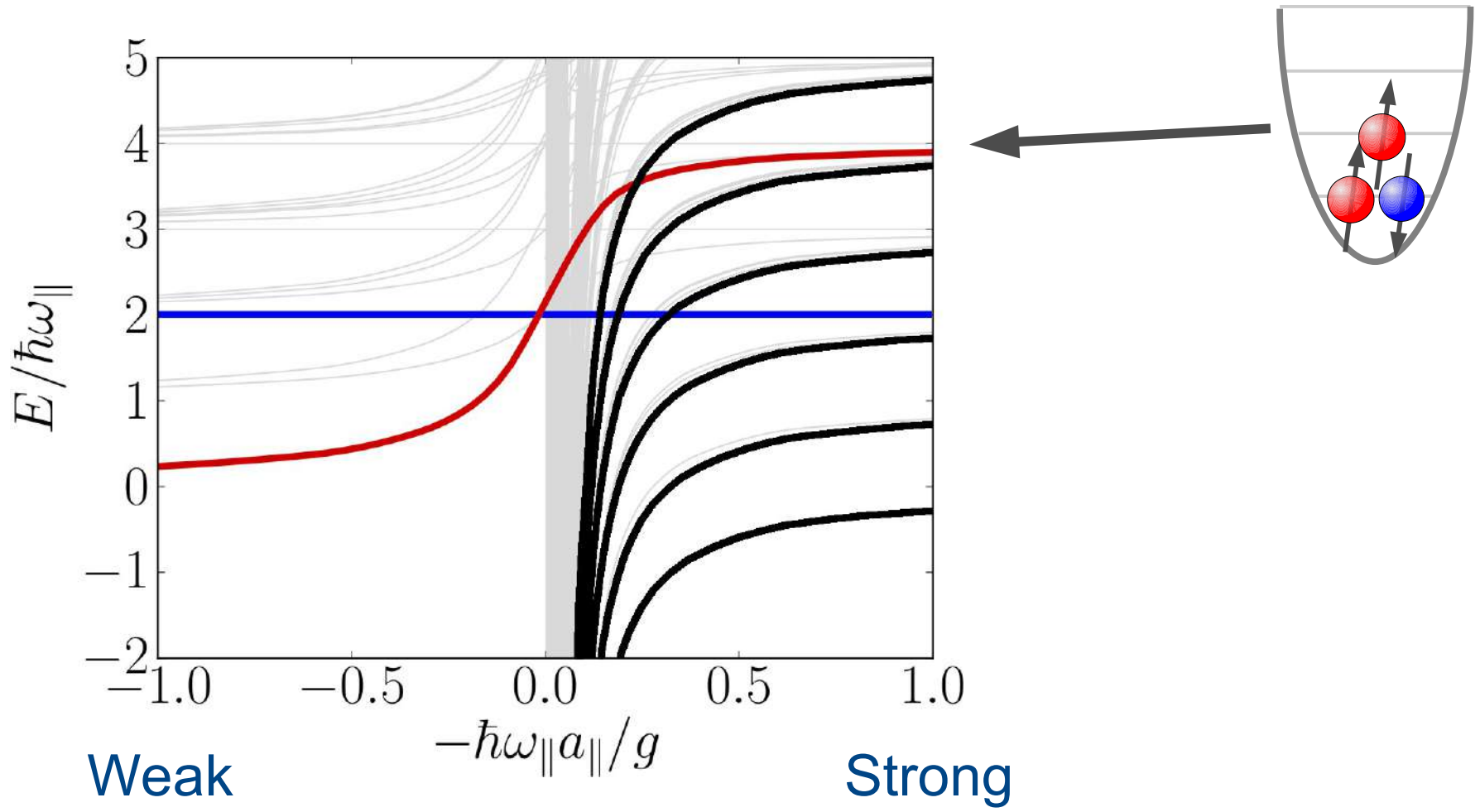
Three-atom bound state



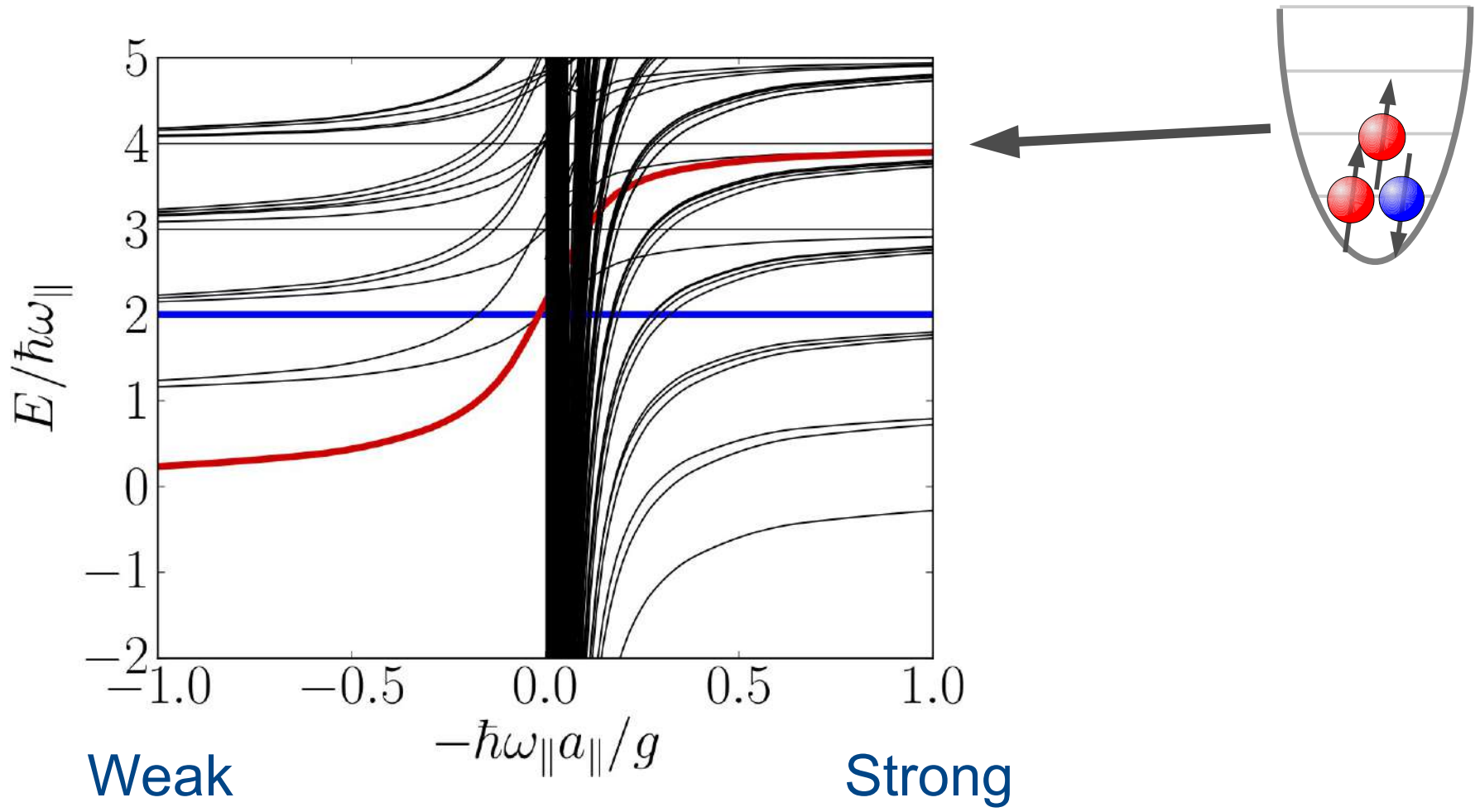
Three-atom bound state



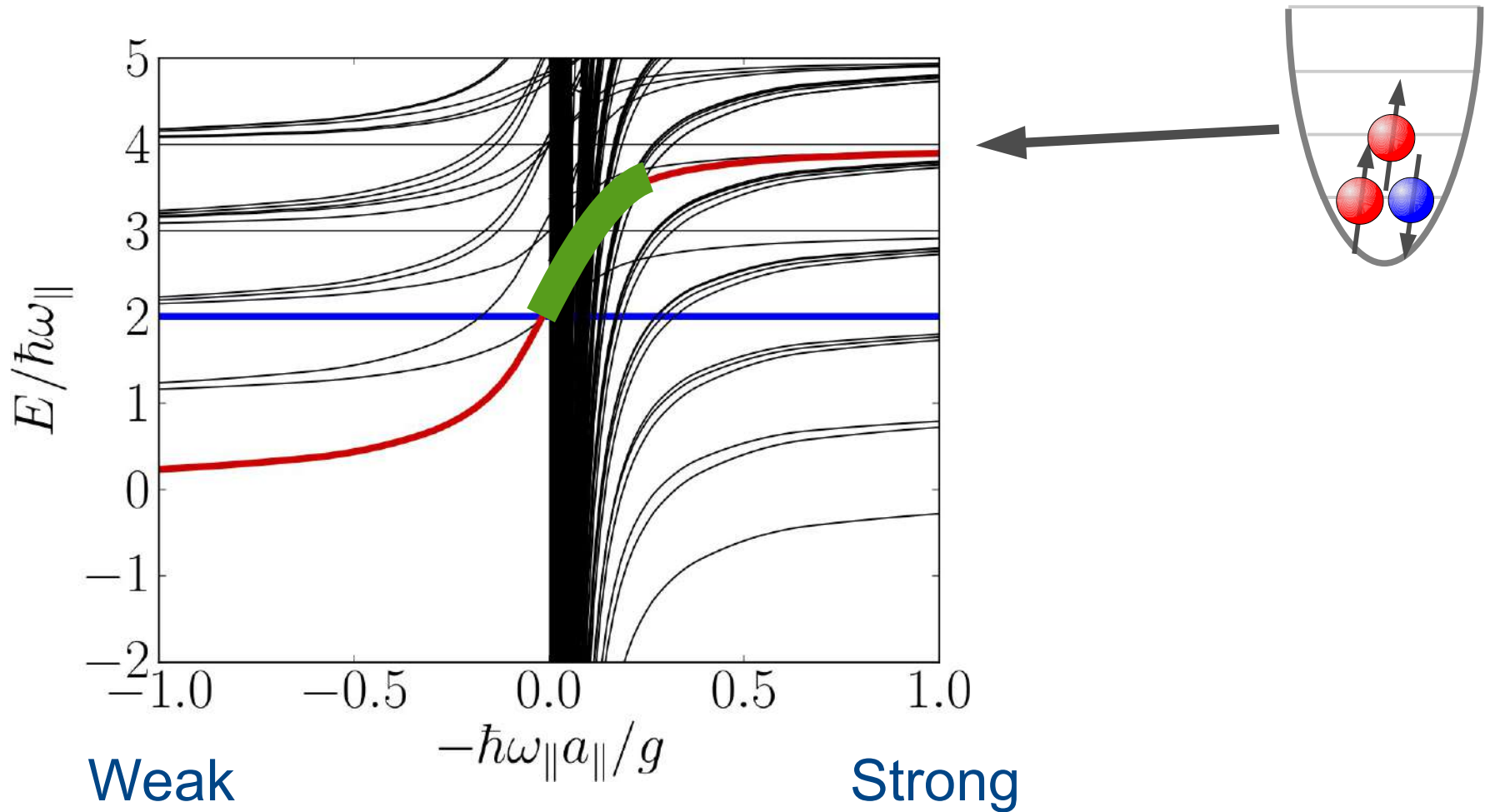
Three-atom bound state



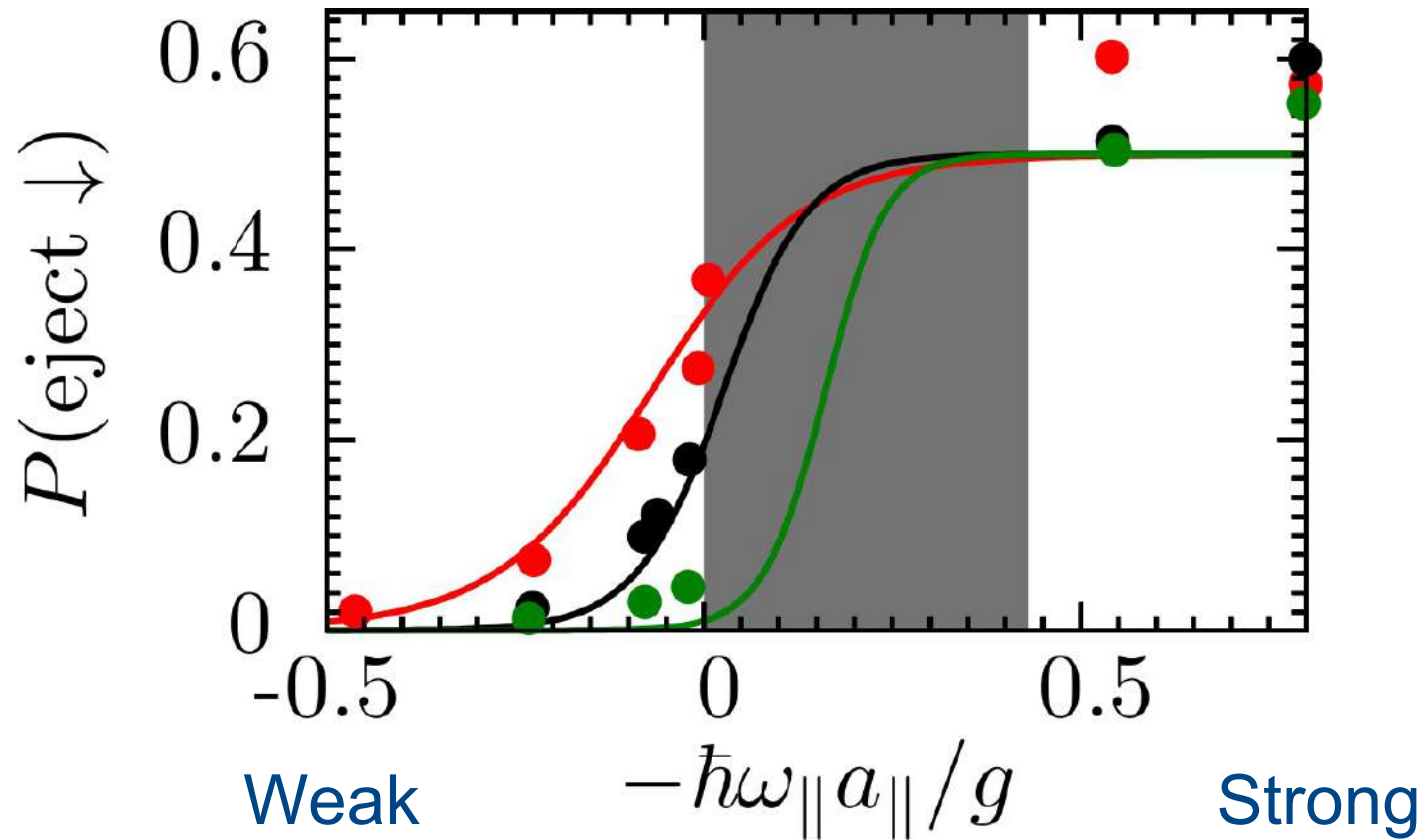
Three-atom bound state



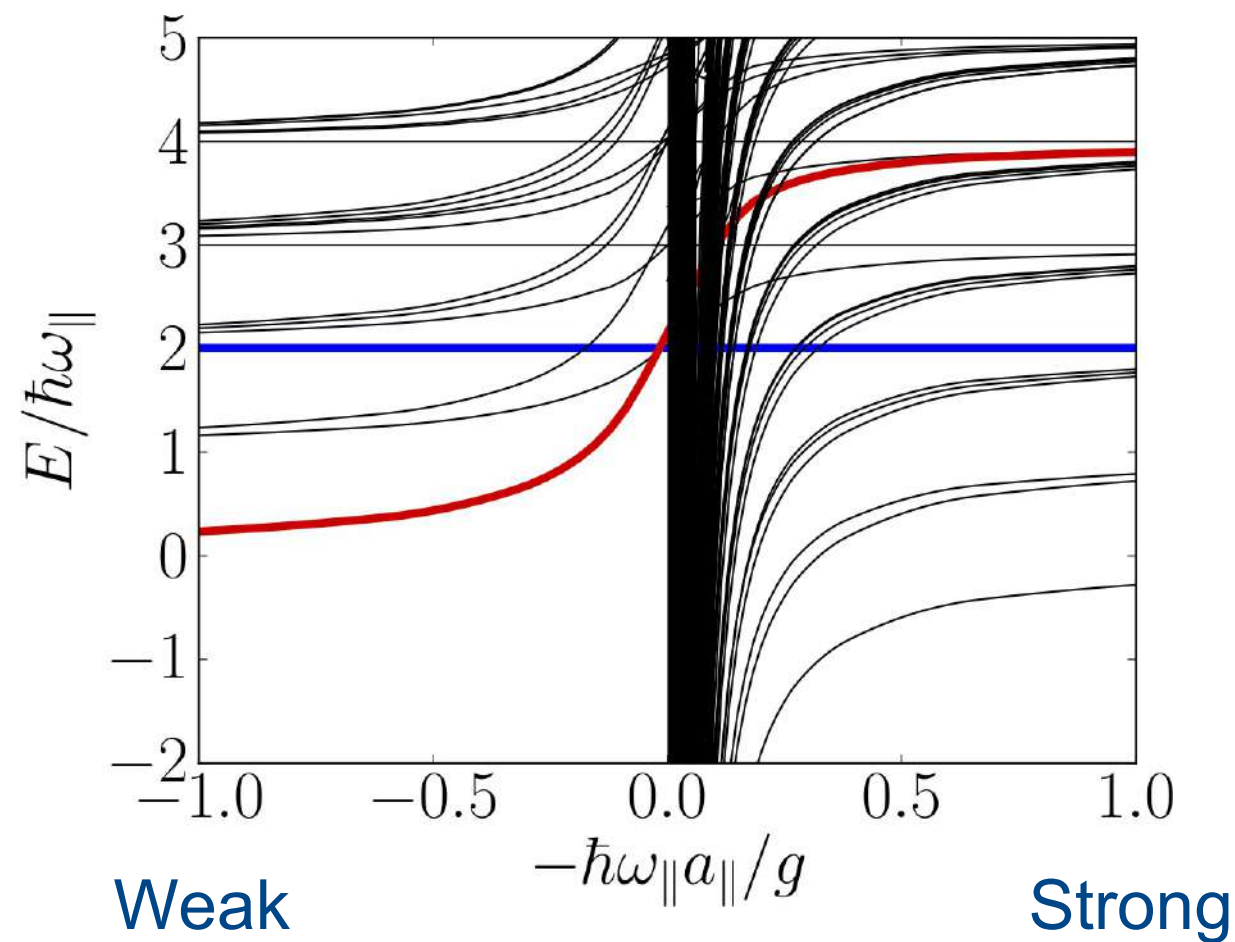
Three-atom bound state



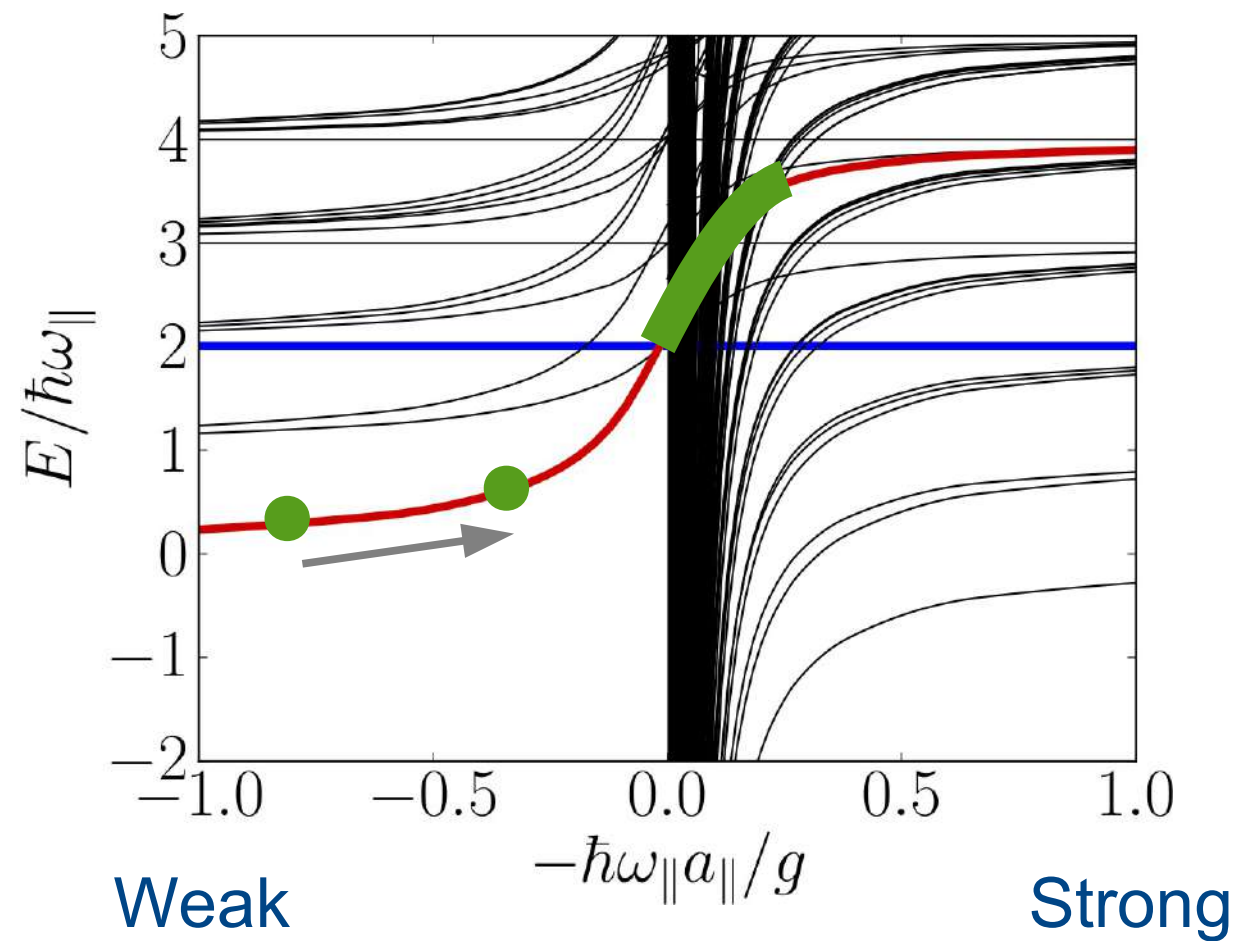
Loss affected region



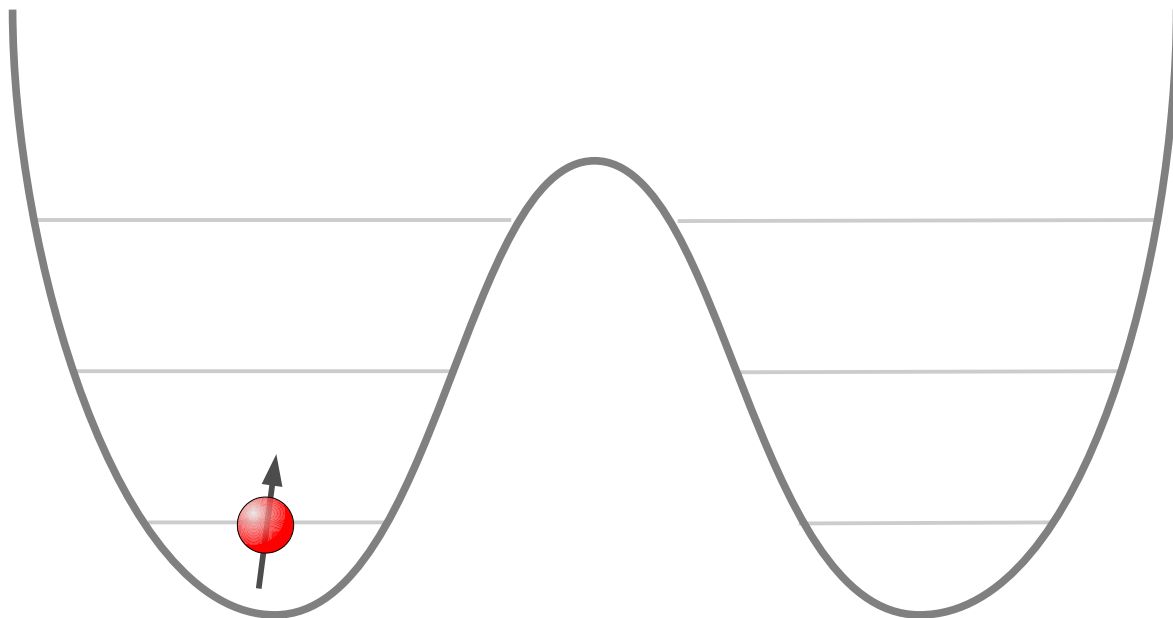
Time evolution



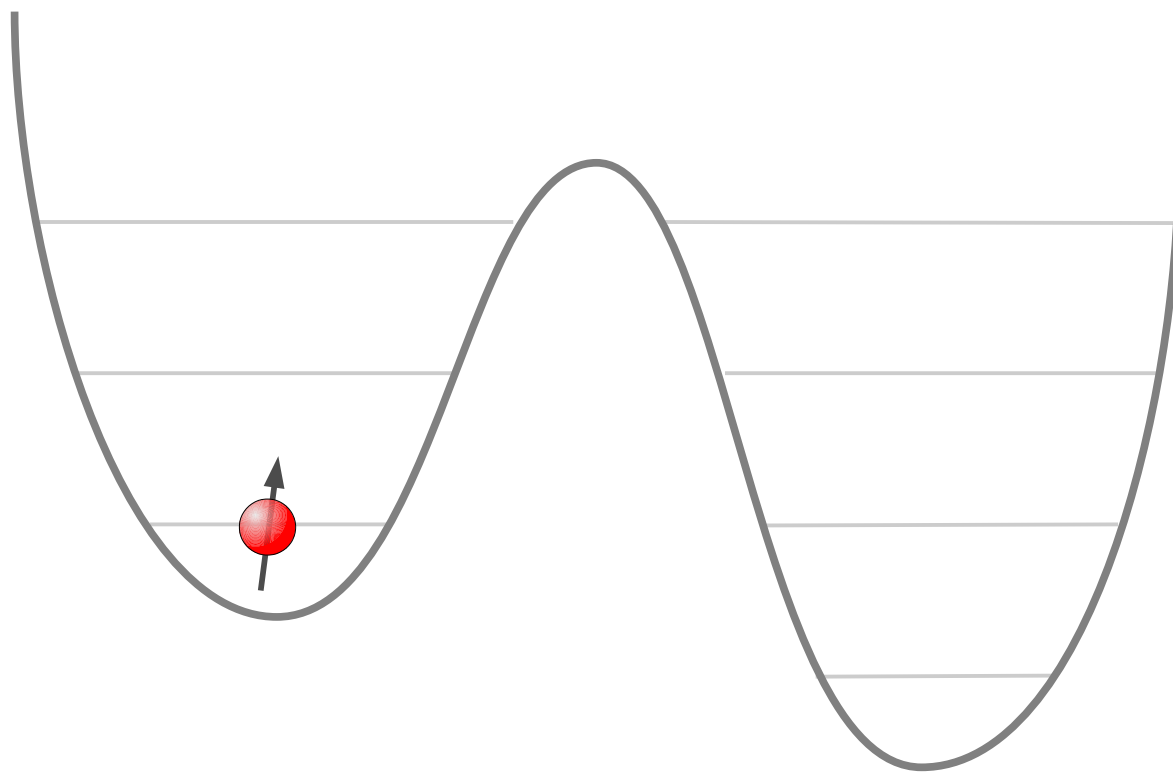
Time evolution



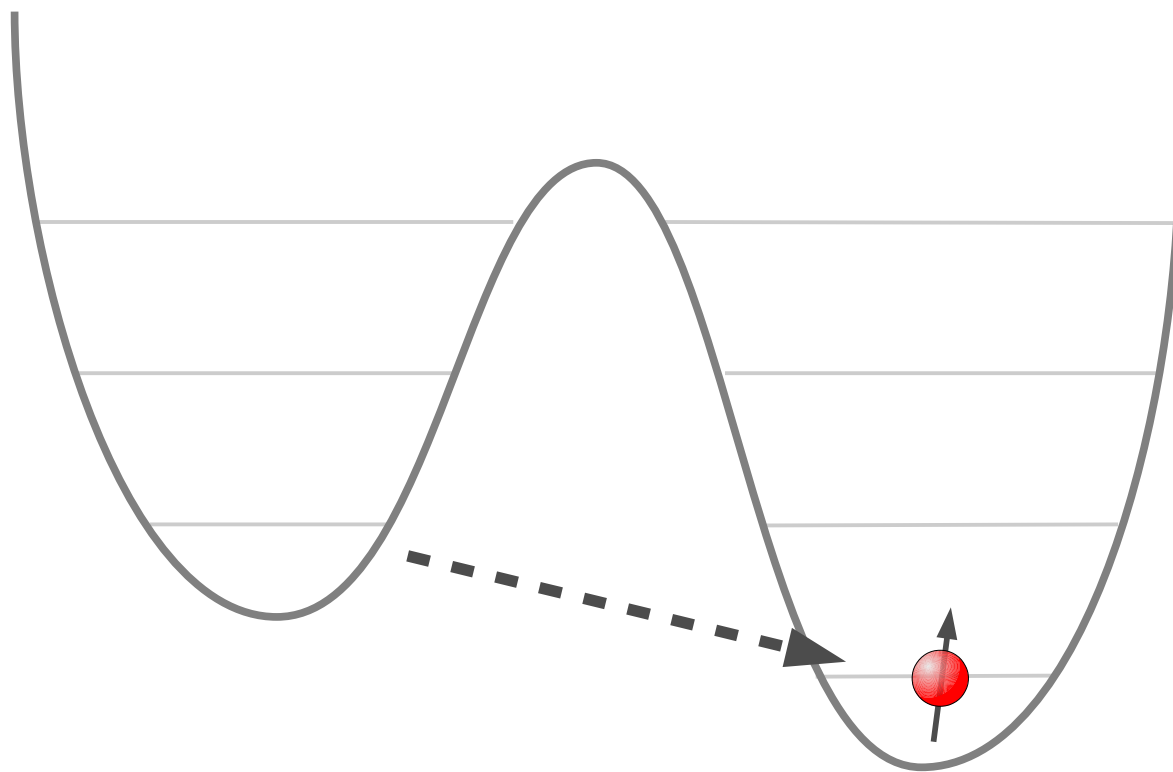
Single atom tunneling



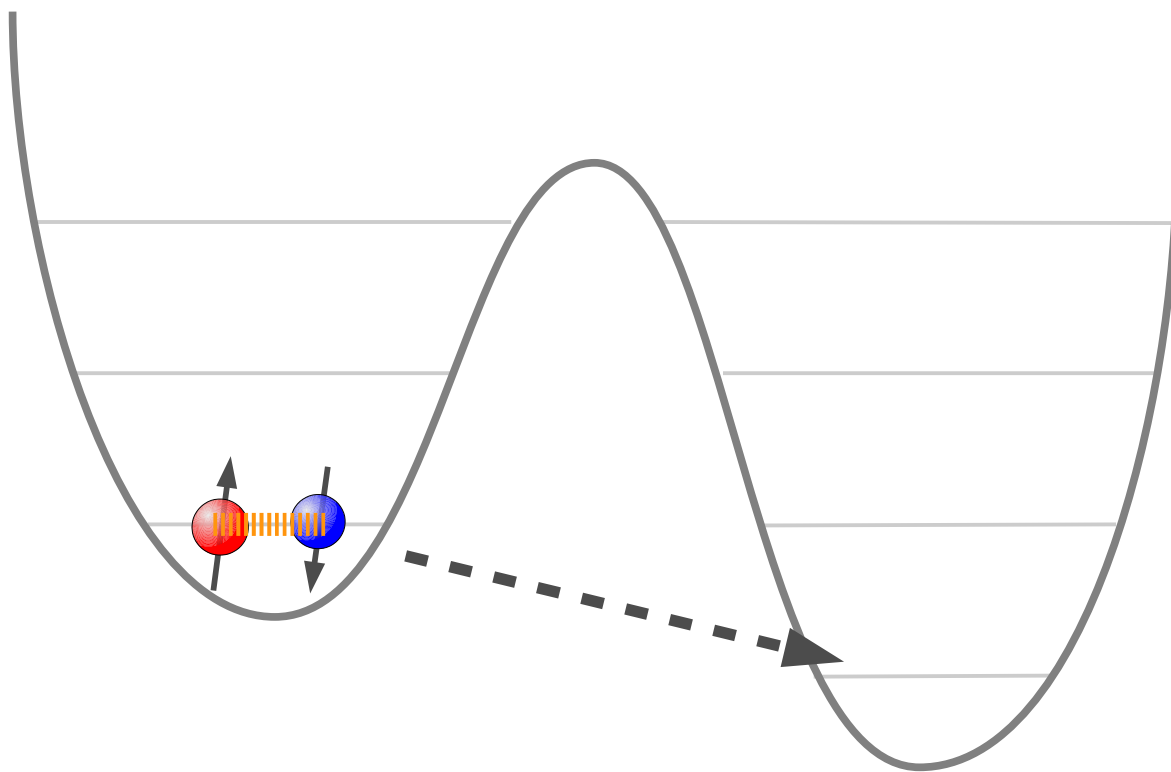
Single atom tunneling



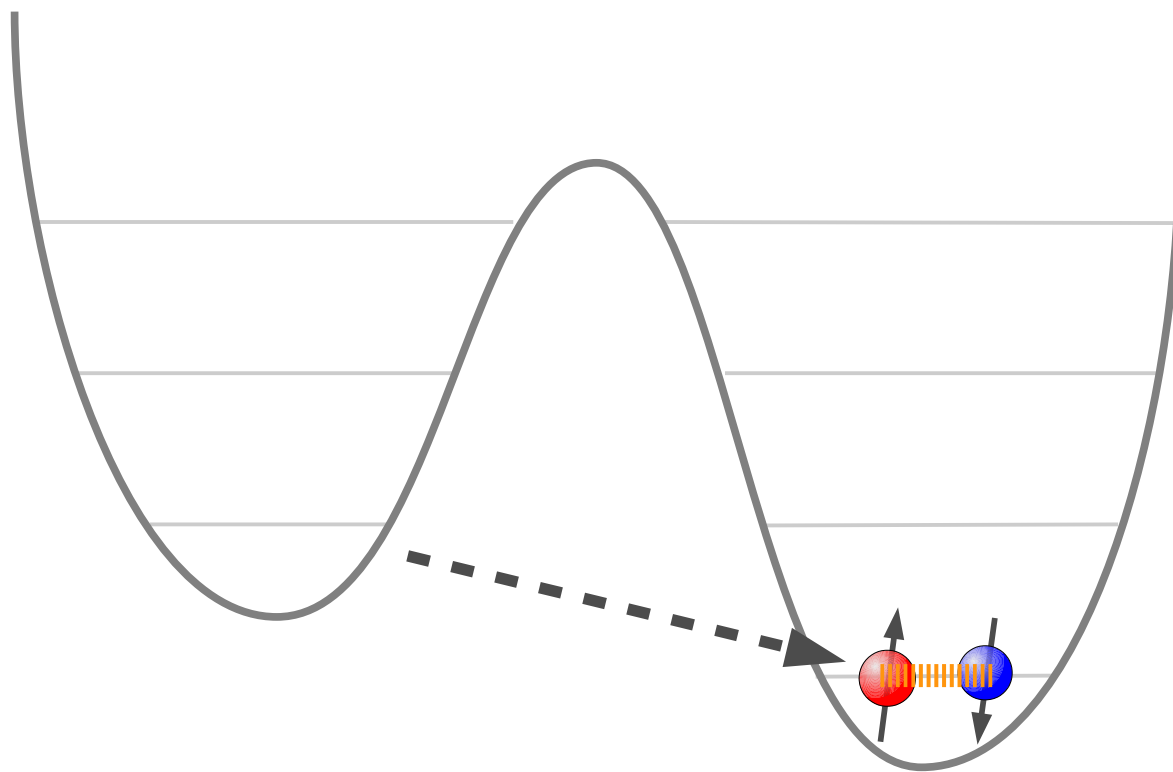
Single atom tunneling



Quantum coherent tunneling

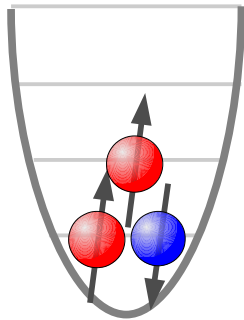


Quantum coherent tunneling

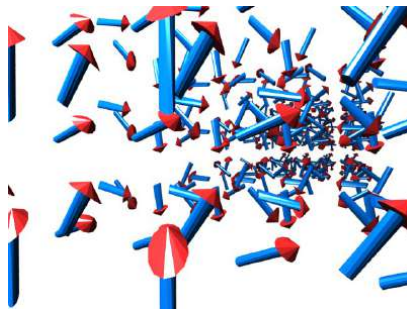


Condensed matter across the length scales

Few-fermionic atoms



Electron gas



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