Mehrkanal Kondo-Effekt in endlichen Gittern

Bachelorarbeits Kolloquium

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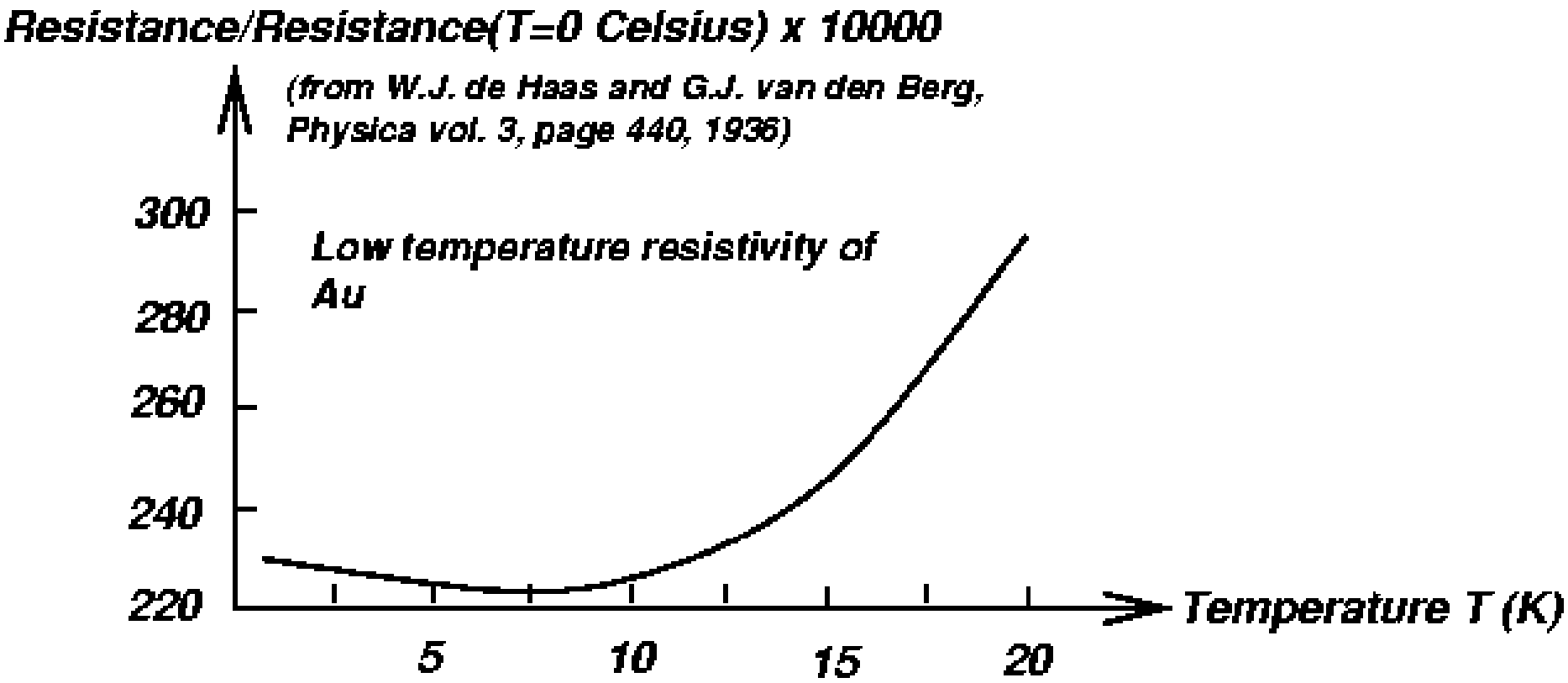
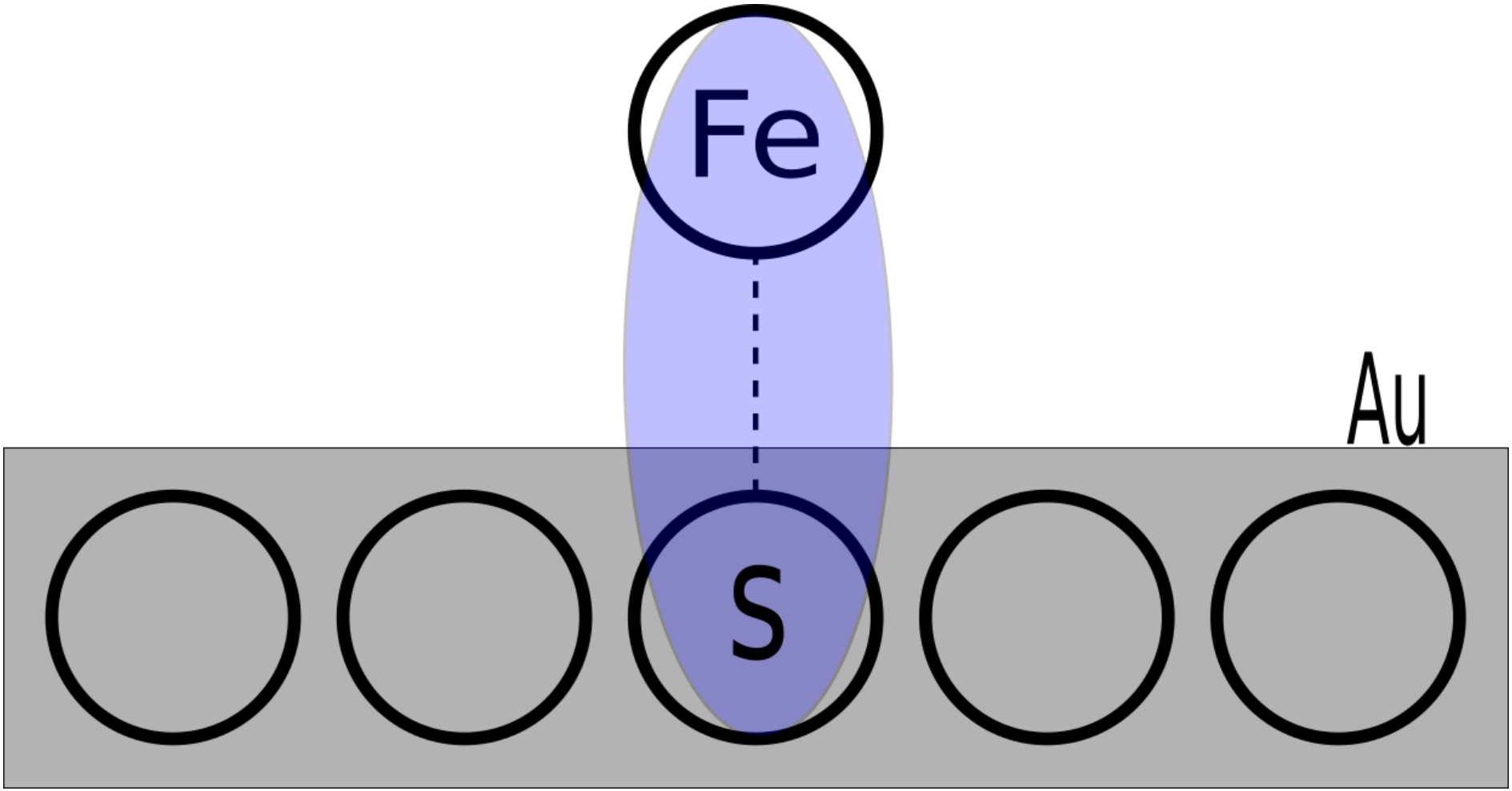
Einleitung

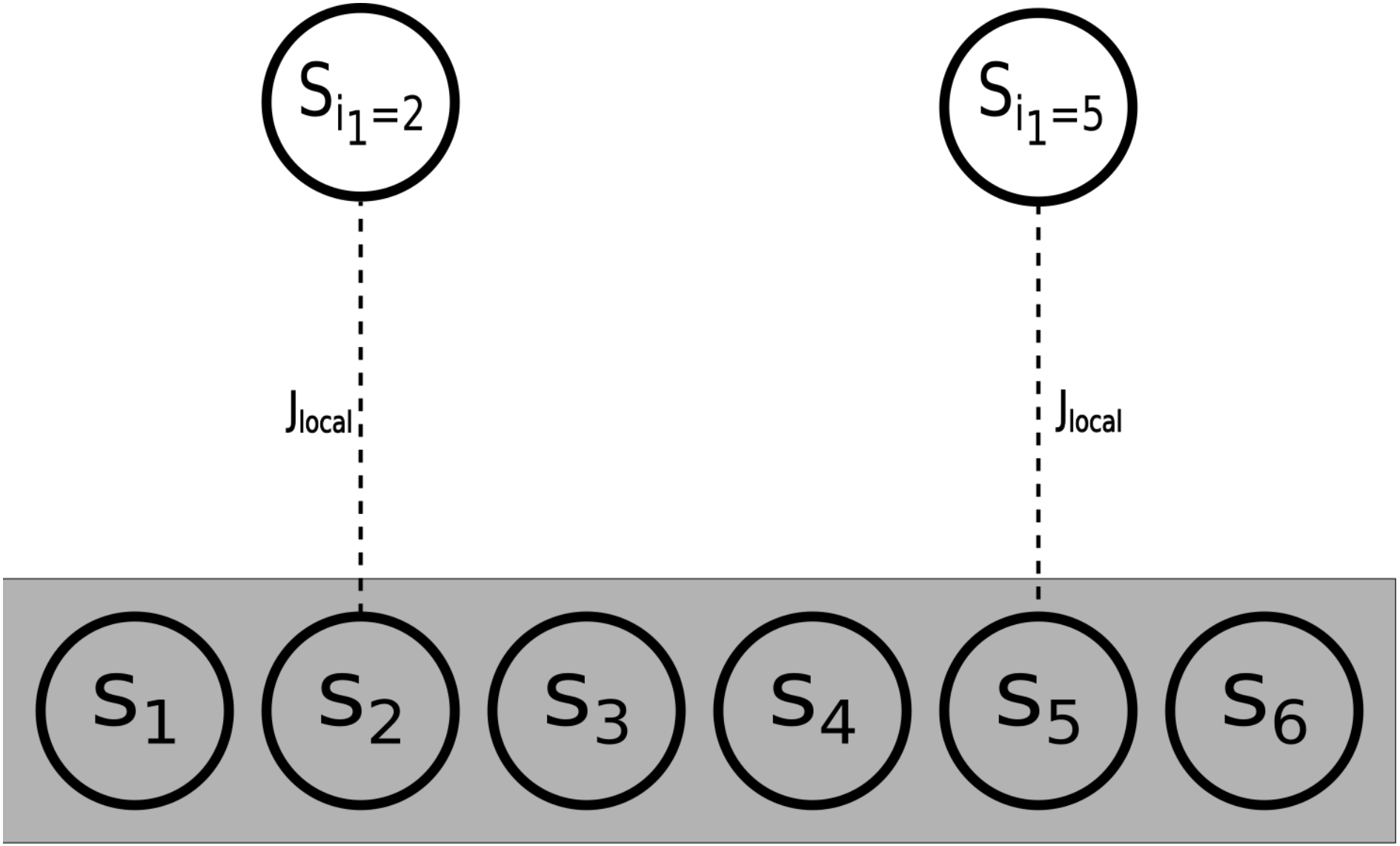
Widerstandsminimum



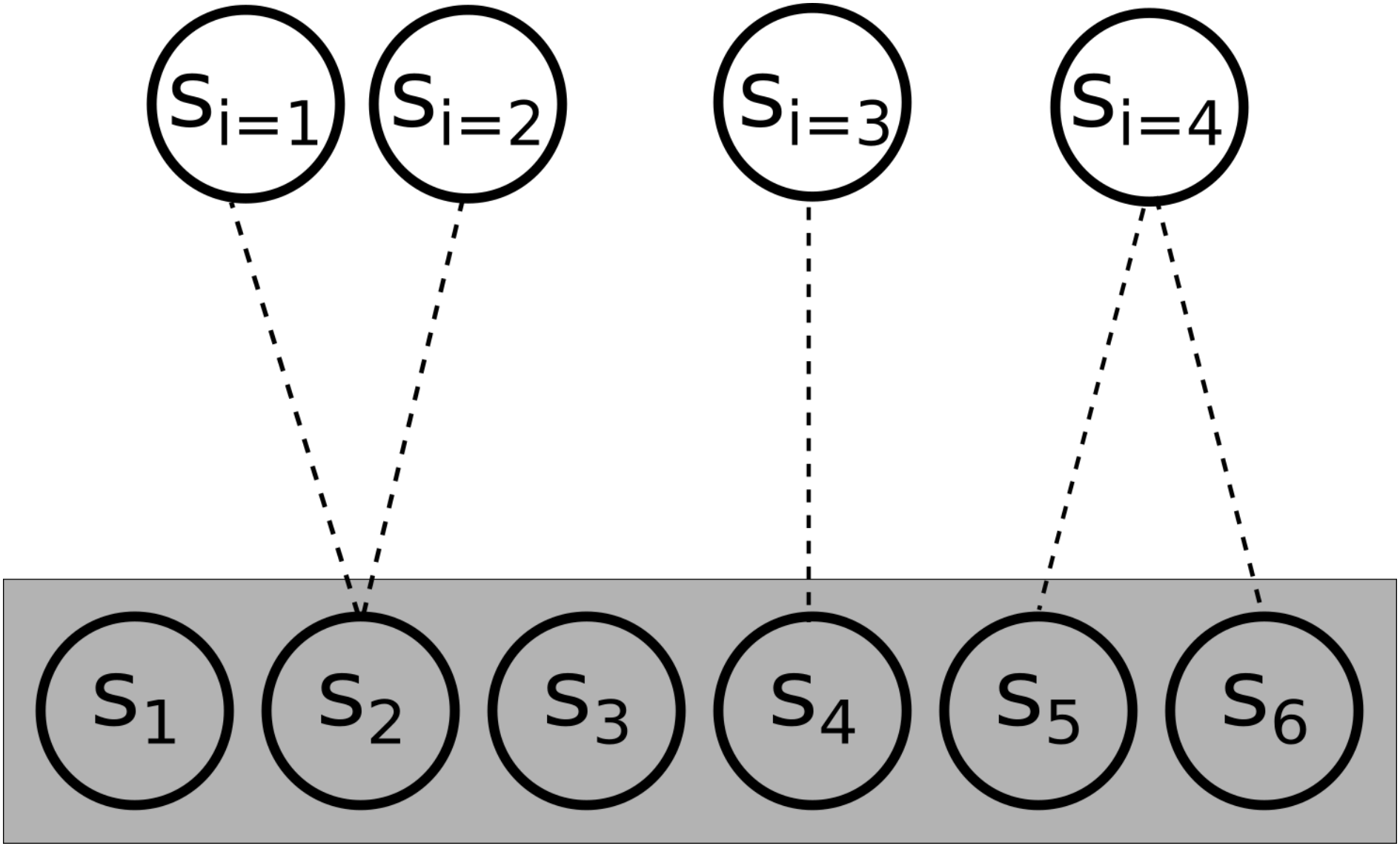
Kondos Erklärung



Lokale Kondo-Box



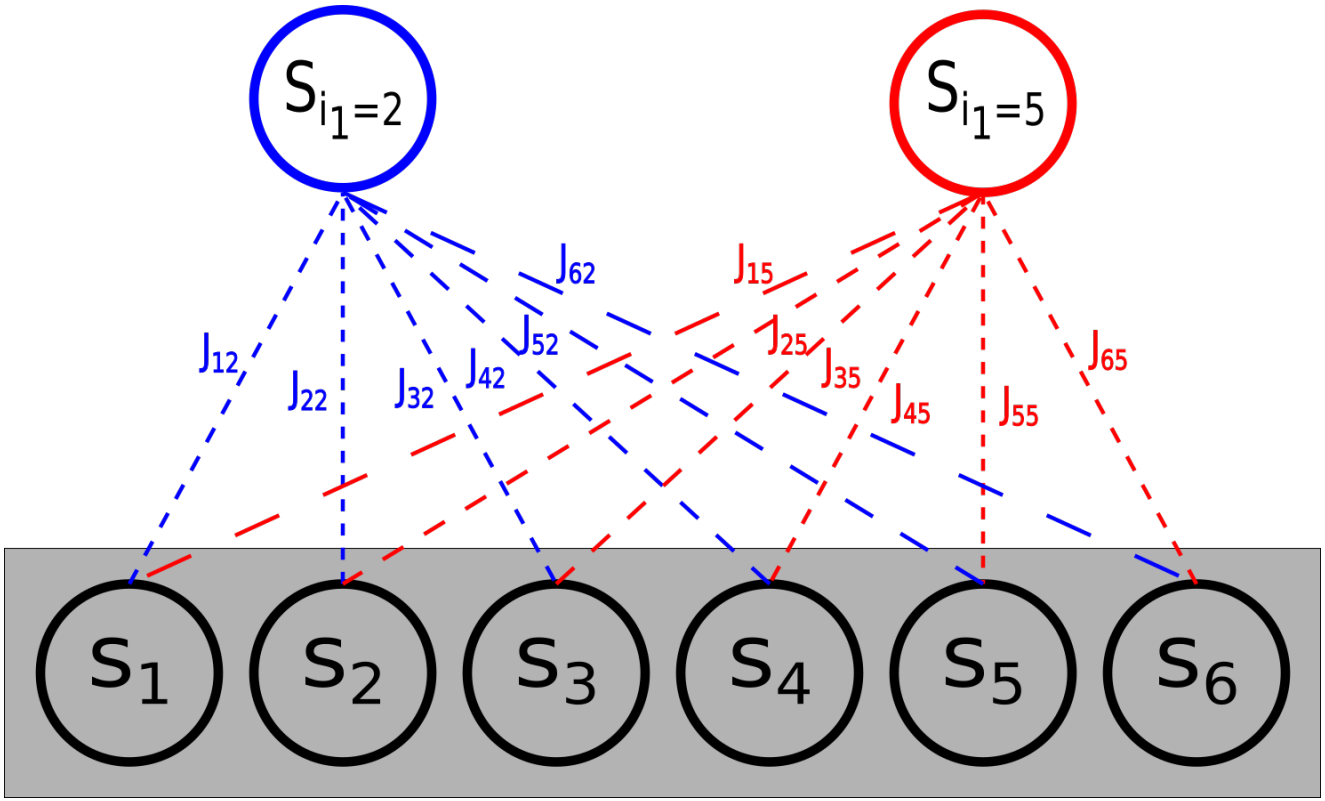
Lokale Kondo-Box



Modell

Ausgangsmodell

$$H = H_0 + H_1 = \sum_{jj'\sigma} t_{jj'} c^{\dagger}_{j\sigma} c_{j'\sigma} + \sum_{r=1}^{R} \sum_{n=1}^{L} \sum_{\alpha}^{\{x,y,z\}} J^{(\alpha)}_{ni_r} s^{(\alpha)}_{n} S^{(\alpha)}_{i_r}$$



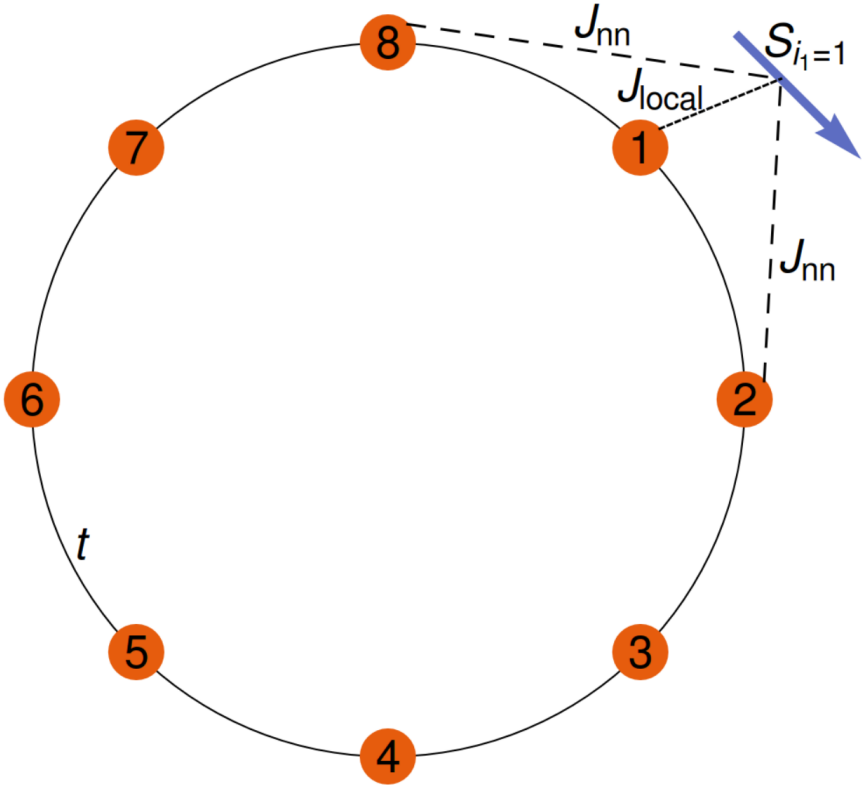
Effektives Modell

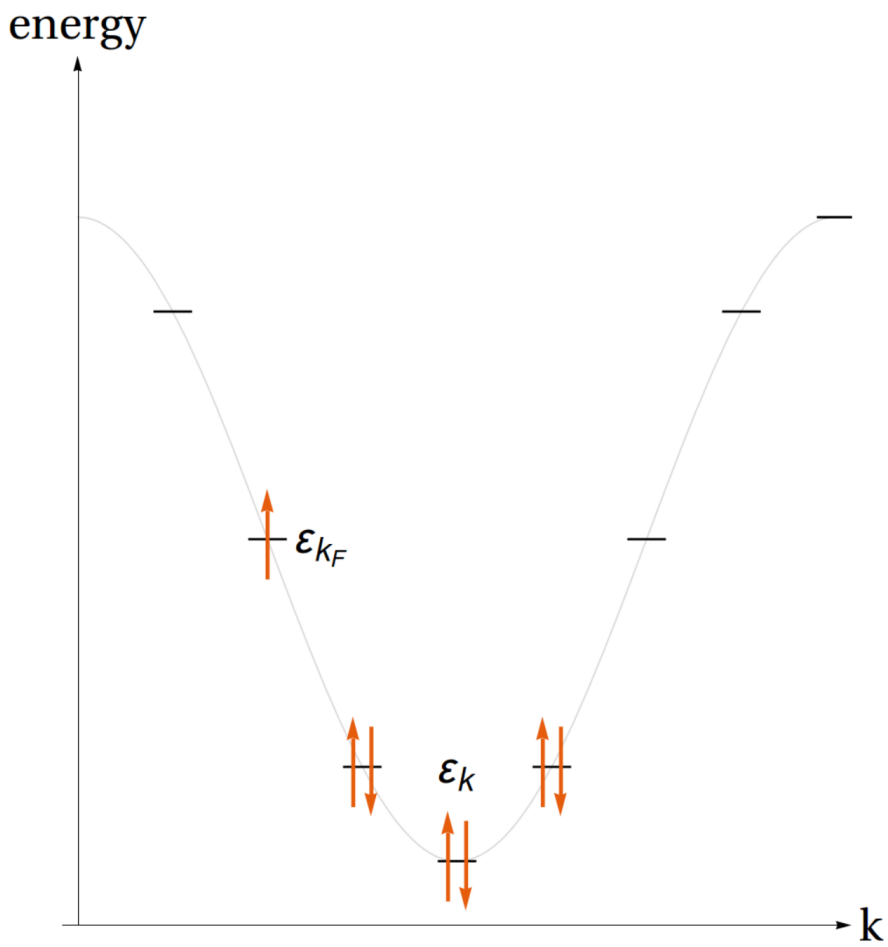
- $H^{\text{eff}} = P_0 H_1 P_0$
- Unitäre Transformation von Orts- in Impulsraum U.
- Unitäre Transformation innerhalb vom Impulsraum V.

$$H^{\text{eff}} = \sum_{r=1}^{R} \sum_{\alpha}^{\{x,y,z\}} \sum_{\ell=1}^{\eta} \lambda_{\ell}^{(\alpha)}(r) s_{\ell}^{\alpha}(r) S_{i_r}^{(\alpha)} P_0$$

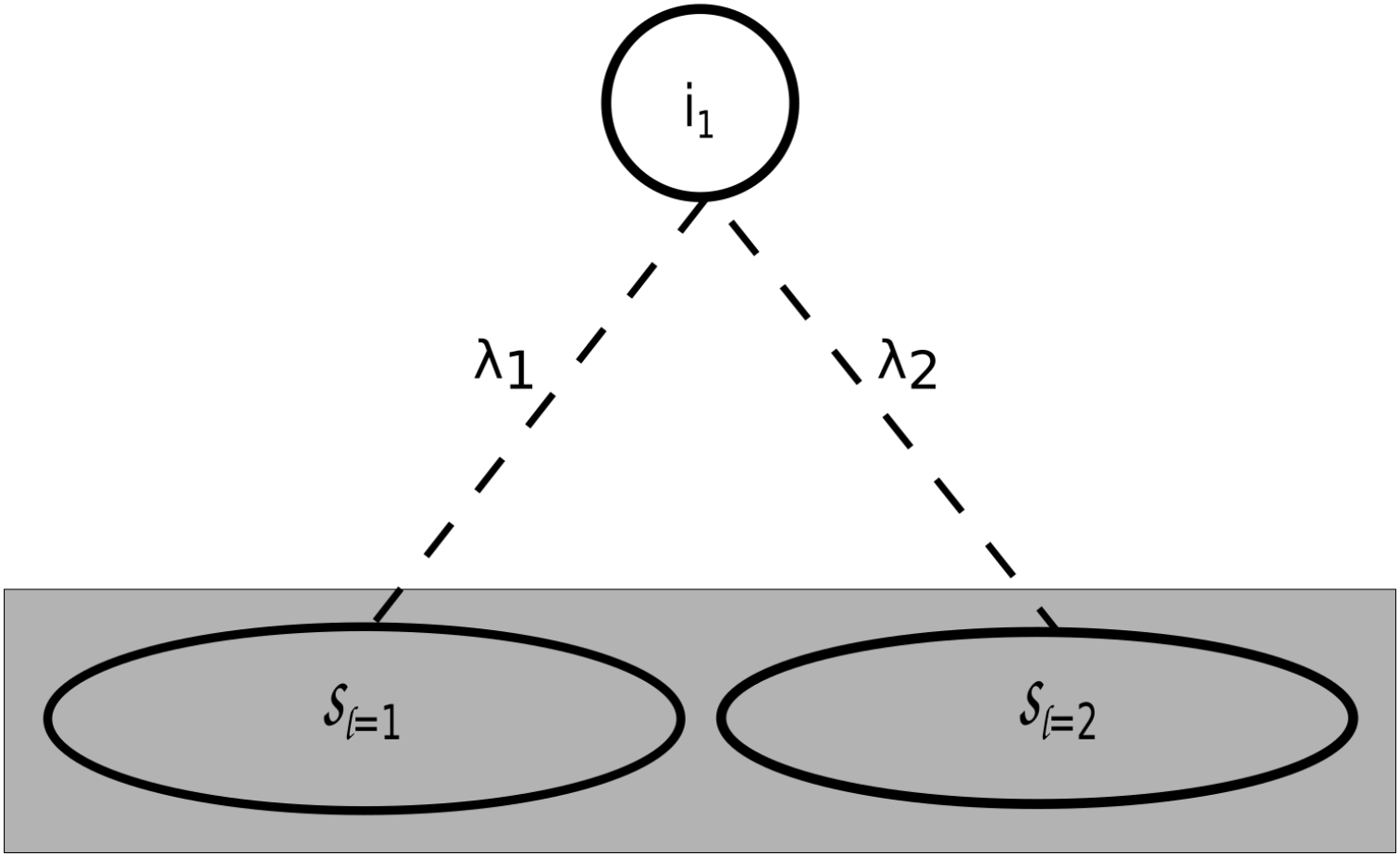
Eindimensionale Ringsysteme

Eindimensionale Ringsysteme



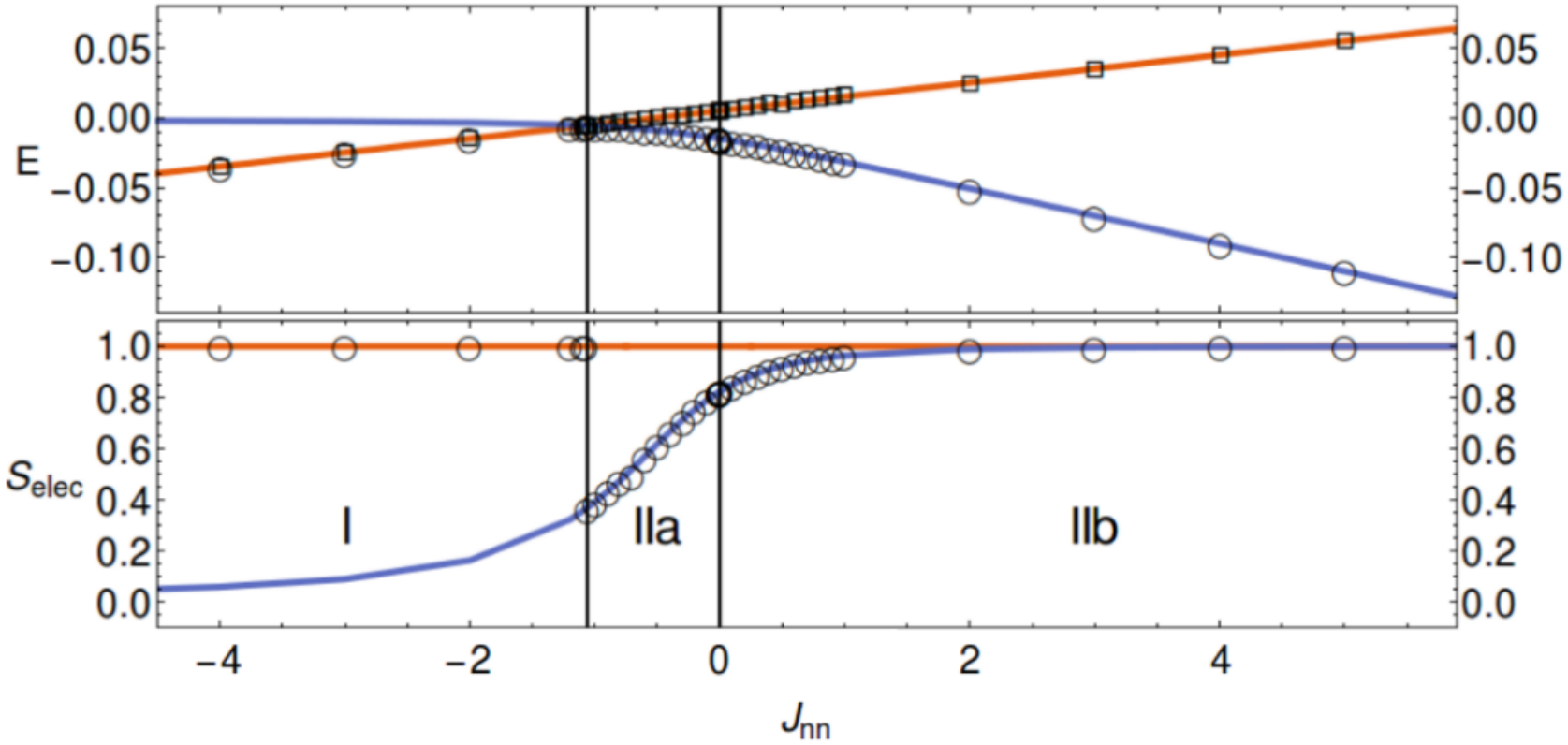


Effektives eindimensionales Ringsystem

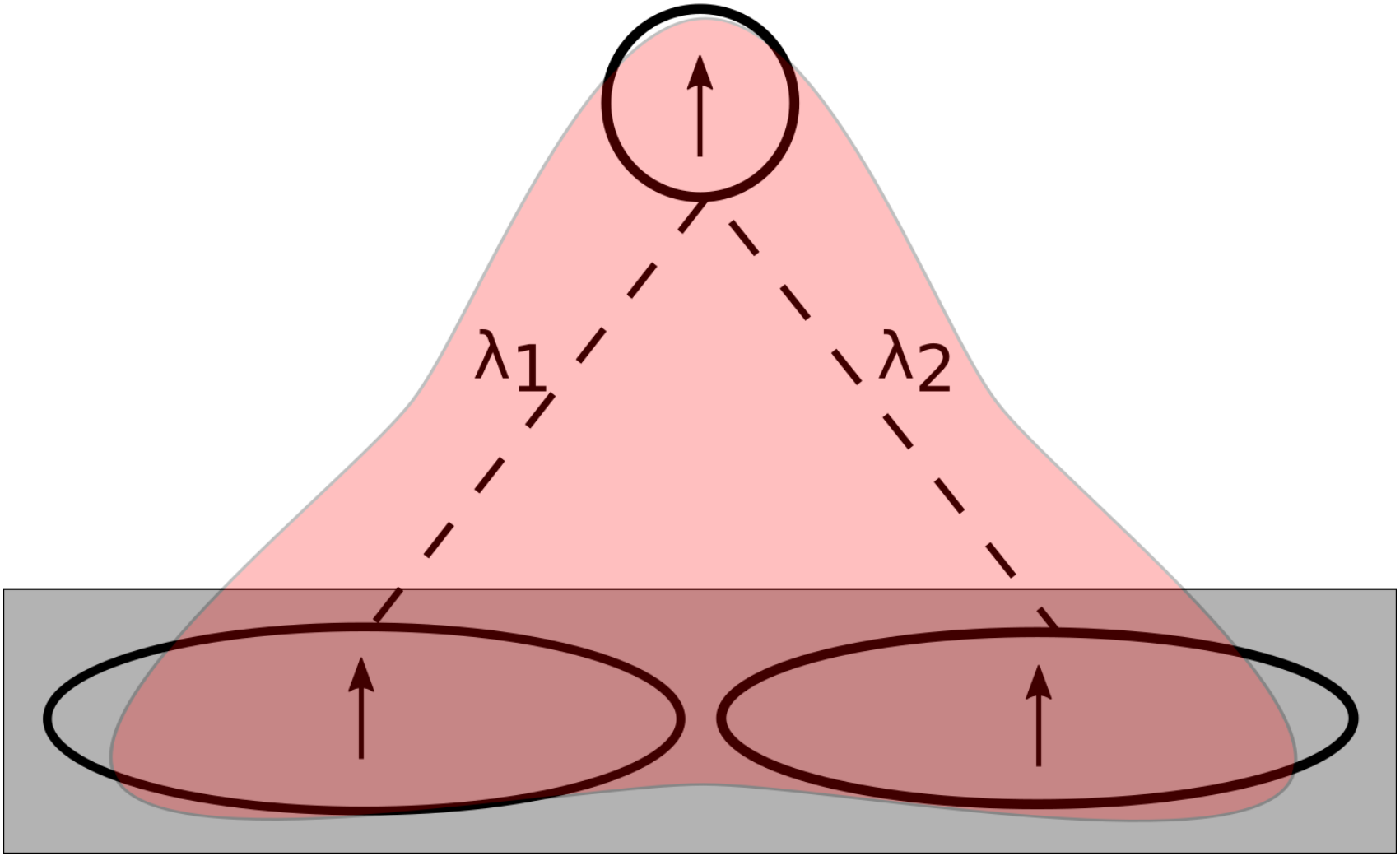


2 Fermi-Elektronen

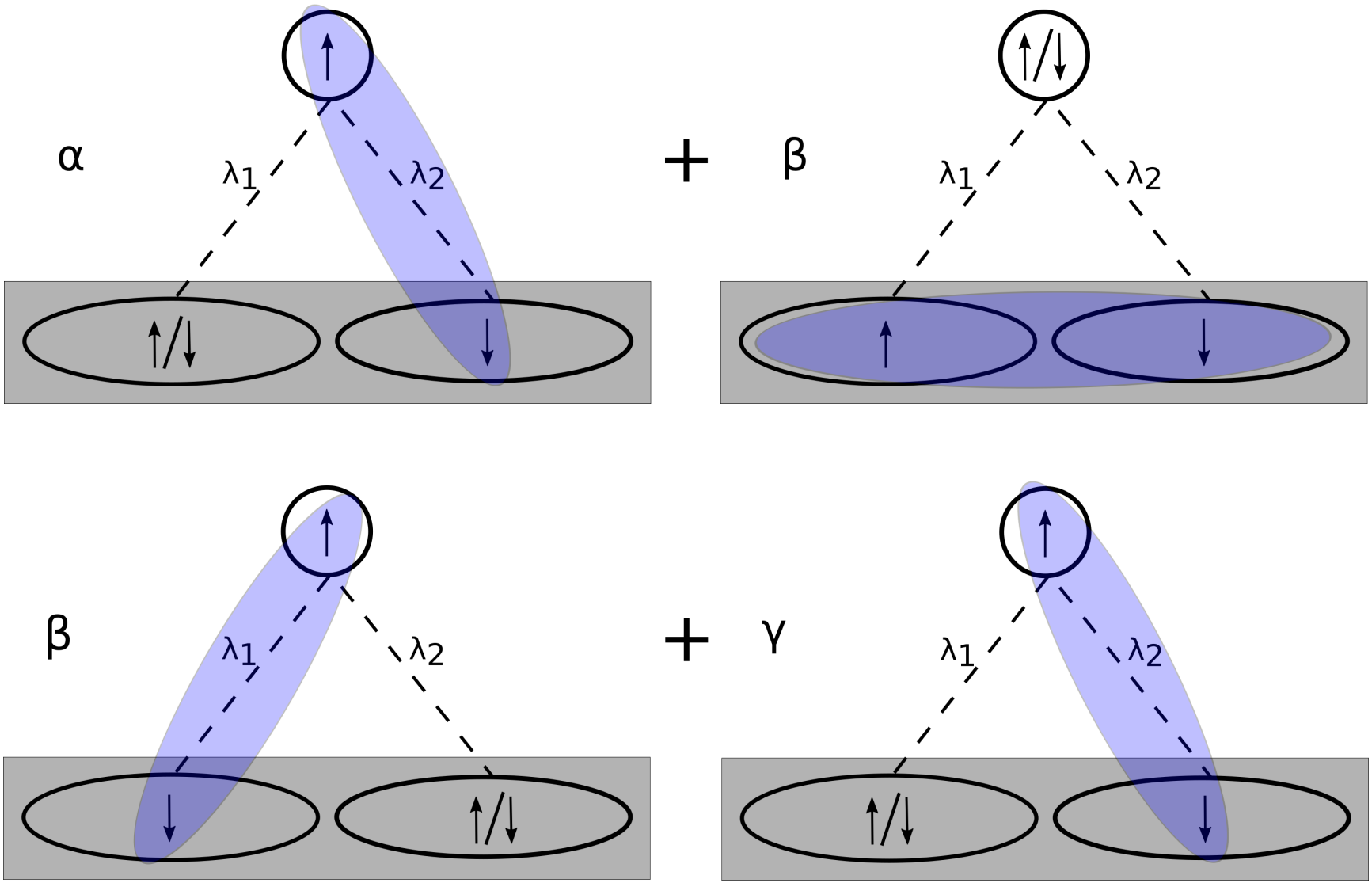
Numerische Daten



Zustandsdiagramme I

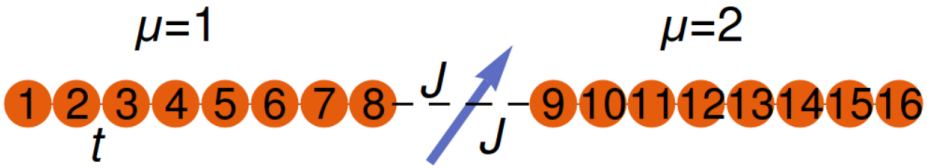


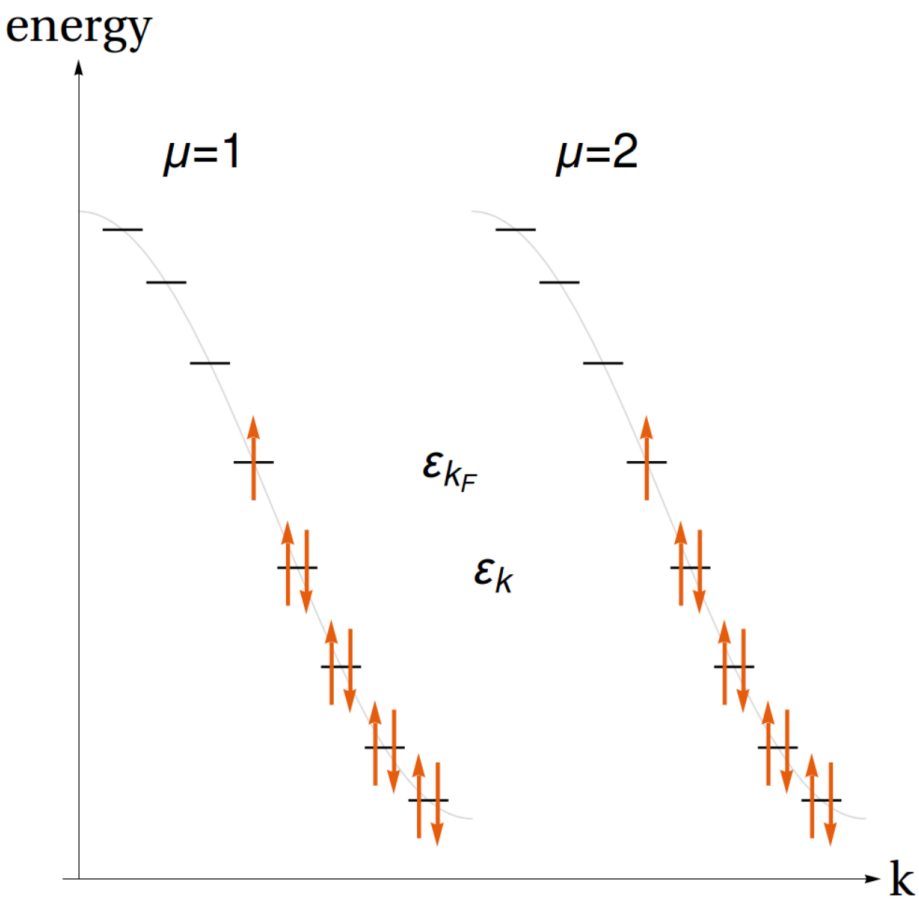
Zustandsdiagramme II



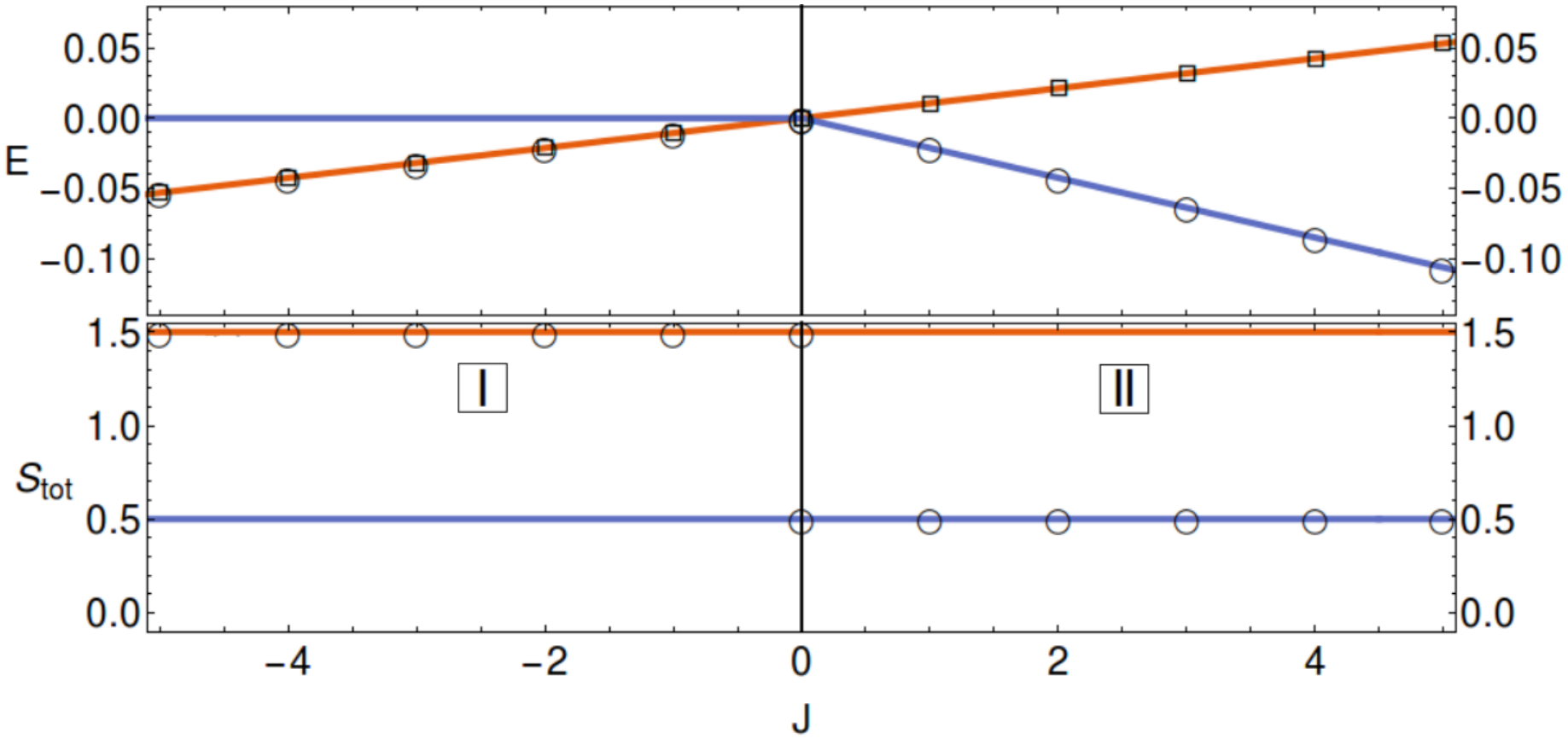
Forced Overscreening

Zwei eindimensionale Ketten

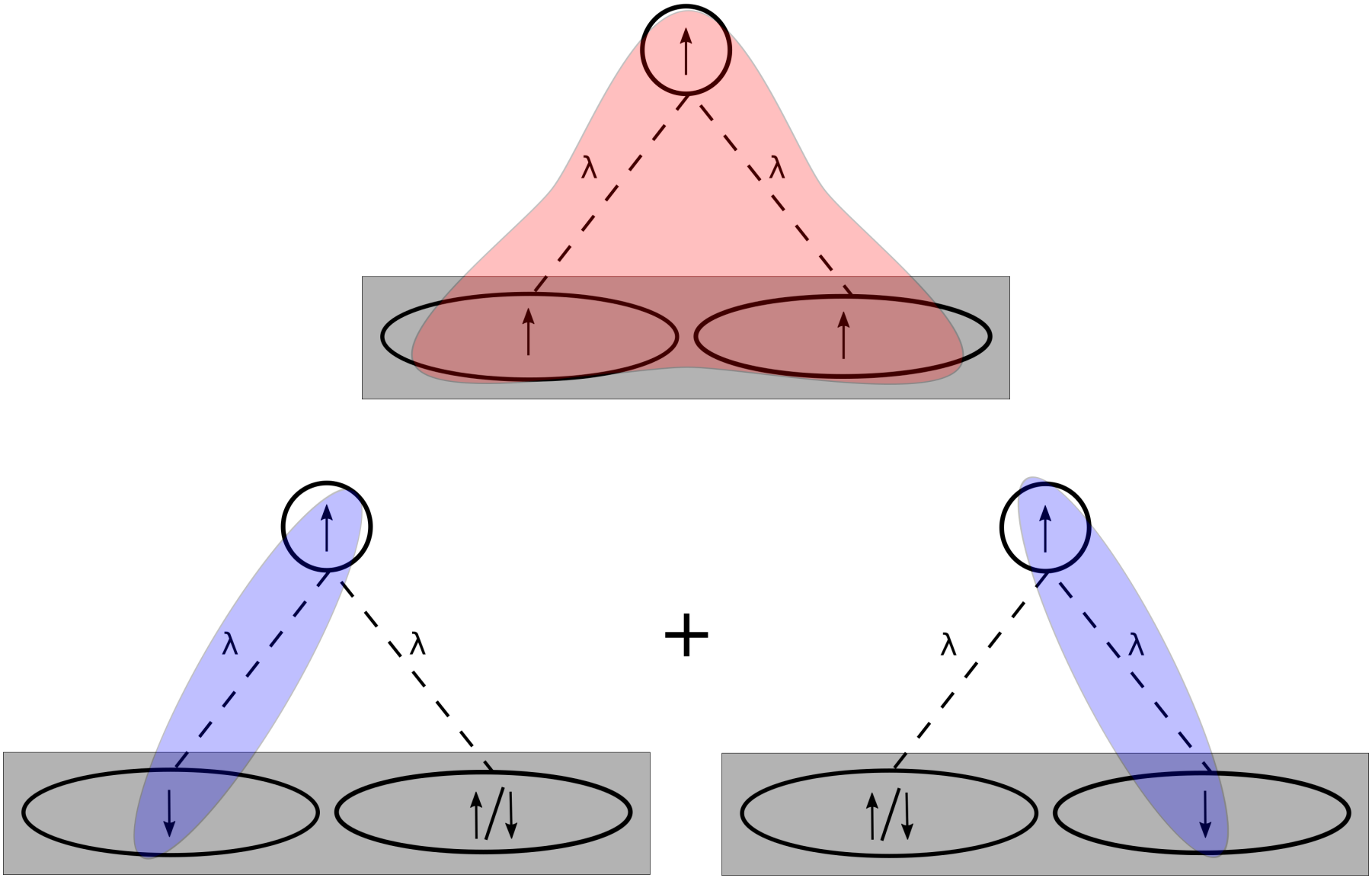




Numerische Daten



Zustandsdiagramme



Zusammenfassung

- Effektive Theorie für Kondo-Box mit nicht-lokaler, anisotroper Kopplung.
- Overscreening numerisch bestätigt.
- Nächste Schritte
  - Erweiterung auf zweite Ordnung Störungstheorie.
  - Mehrere Impurities in höheren Dimensionen.

Rechnungen

$$H^{\text{eff}} = \sum_{r=1}^{R} \sum_{\alpha}^{\{x,y,z\}} \sum_{n=1}^{L} J_{n i_r}^{(\alpha)} (P_0 s_n^{(\alpha)} P_0) S_{i_r}^{(\alpha)}$$

$$\boldsymbol{s}_n = \frac{1}{2} \sum_{kk',gg',\sigma\sigma'} U_{kg;n}^{\dagger} c_{kg\sigma}^{\dagger} \boldsymbol{\sigma}_{\sigma\sigma'} c_{k'g'\sigma'} U_{n;k'g'}$$

$$P_0 \boldsymbol{s}_n P_0 = \frac{1}{2} \sum_{\sigma} \boldsymbol{\sigma}_{\sigma\sigma} + \frac{1}{2} \sum_{gg',\sigma\sigma'} U_{k_F g;n}^{\dagger} c_{k_F g\sigma}^{\dagger} \boldsymbol{\sigma}_{\sigma\sigma'} c_{k_F g'\sigma'} U_{n;k_F g'} P_0$$

$$H^{\text{eff}} = \sum_{r=1}^{R} \sum_{\alpha}^{\{x,y,z\}} \sum_{gg',\sigma\sigma'} \frac{1}{2} c_{k_F g\sigma}^{\dagger} \sigma_{\sigma\sigma'}^{(\alpha)} c_{k_F g'\sigma'} \sum_{n=1}^{L} \left[J_{n i_r}^{(\alpha)} U_{k_F g;n}^{\dagger} U_{n;k_F g'} \right] S_{i_r}^{(\alpha)} P_0$$

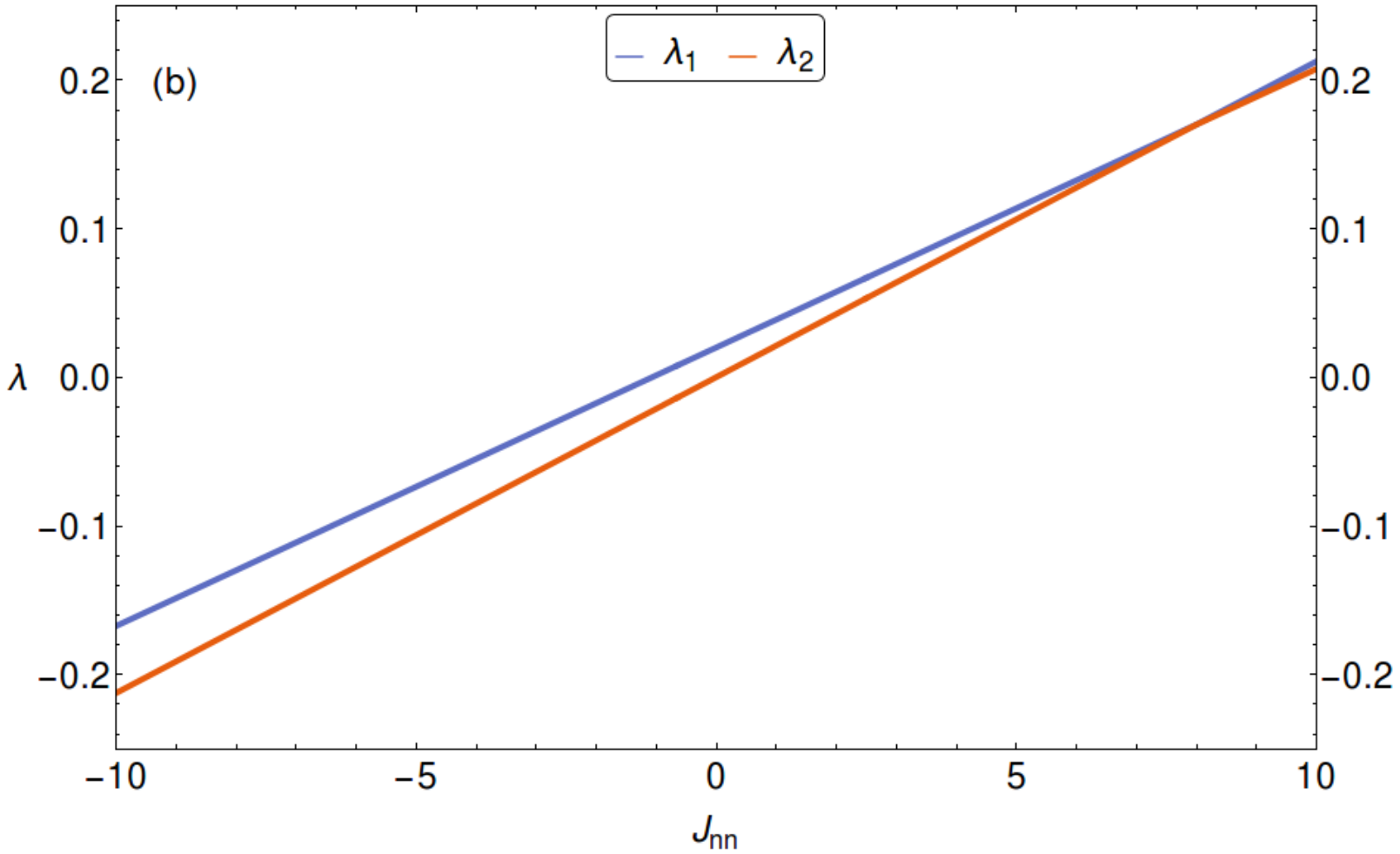
$$\underline{M}(\alpha, r)_{gg'} := \sum_{n=1}^{L} J^{(\alpha)}_{ni_r} U^{\dagger}_{k_F g;n} U_{n;k_F g'}$$

$$\underline{M}(r,\alpha) = V(r,\alpha) D(r,\alpha) V^{-1}(r,\alpha) \,,$$

$$= V(r,\alpha) \underbrace{\begin{pmatrix} \lambda_1^{(\alpha)}(r) & & & & & \\ & \ddots & & & & \\ & & \lambda_\eta^{(\alpha)}(r) & & & \\ & & & 0 & & \\ & & & & \ddots & \\ & & & & & 0 \end{pmatrix}}_{G(k_F)} V^{-1}(r,\alpha)$$

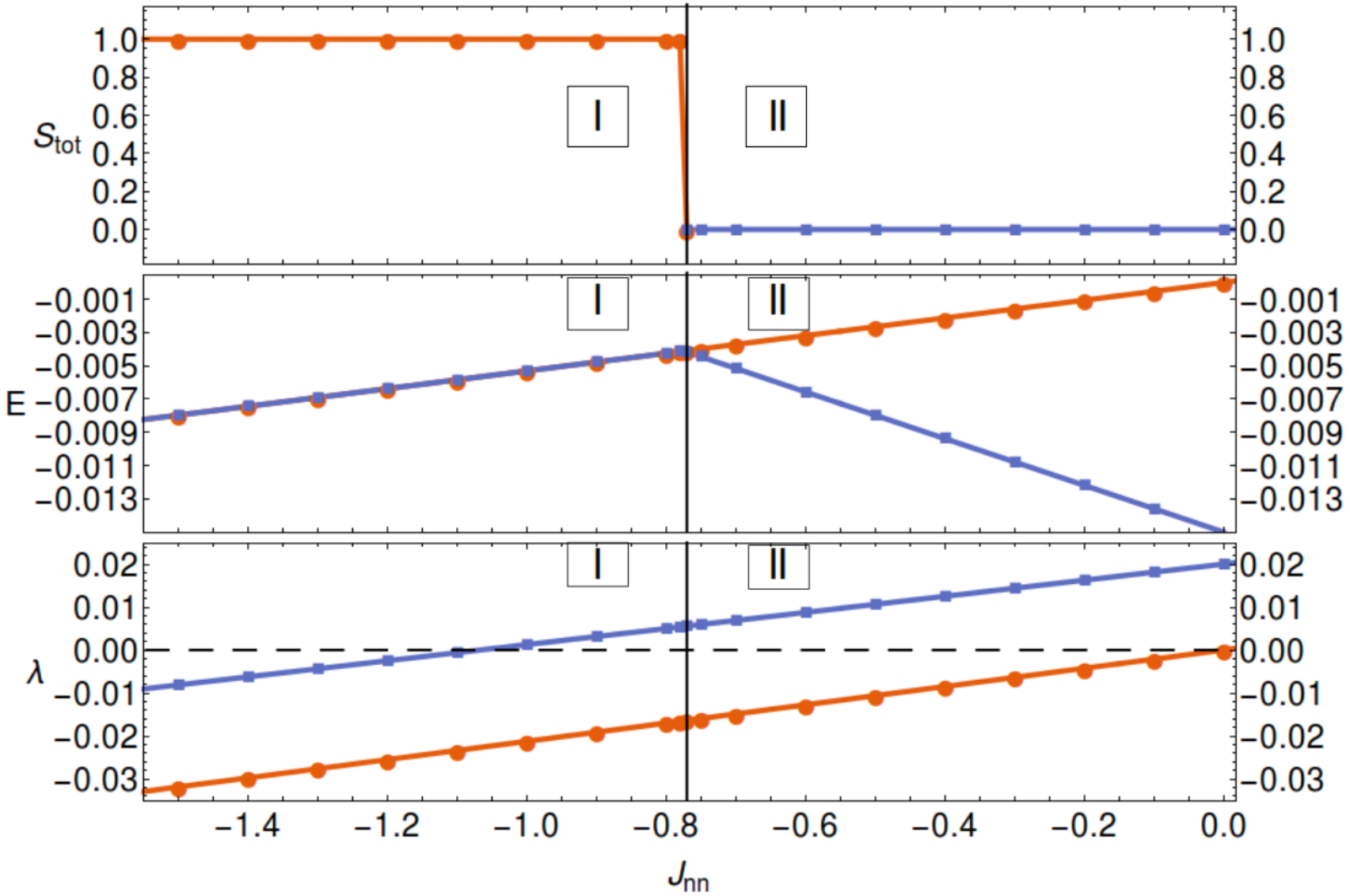
Ringsysteme

Effektive Kopplungen

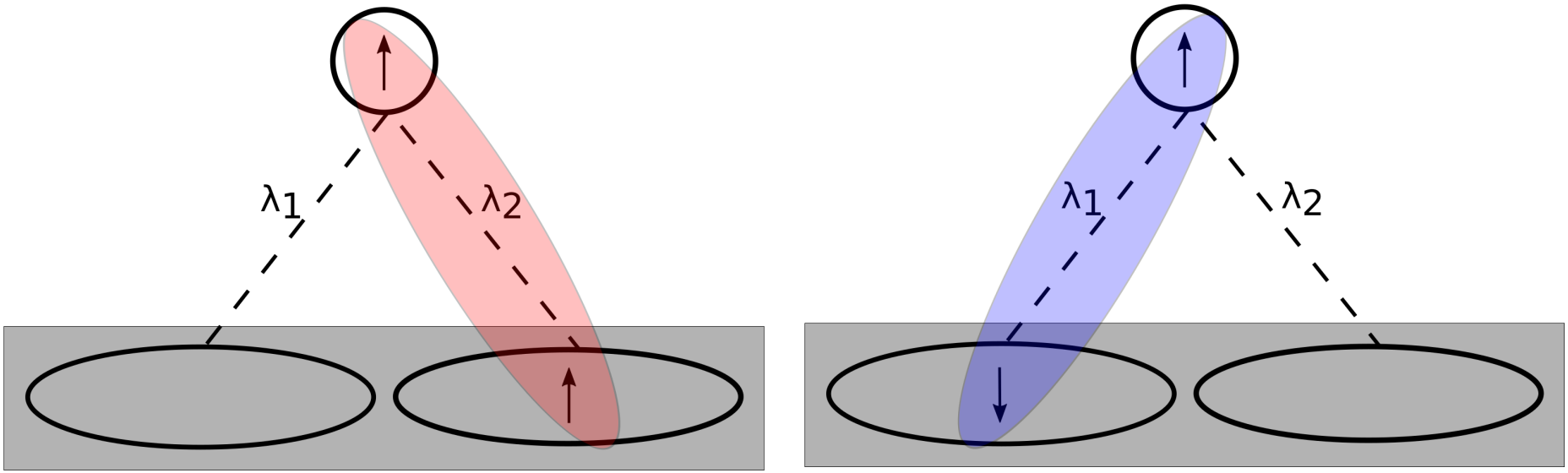


1 Fermi-Elektron

Numerische Daten



Zustandsdiagramme



2 Fermi-Elektronen

Numerische Daten