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Weak localization in multiterminal networks of diffusive wires

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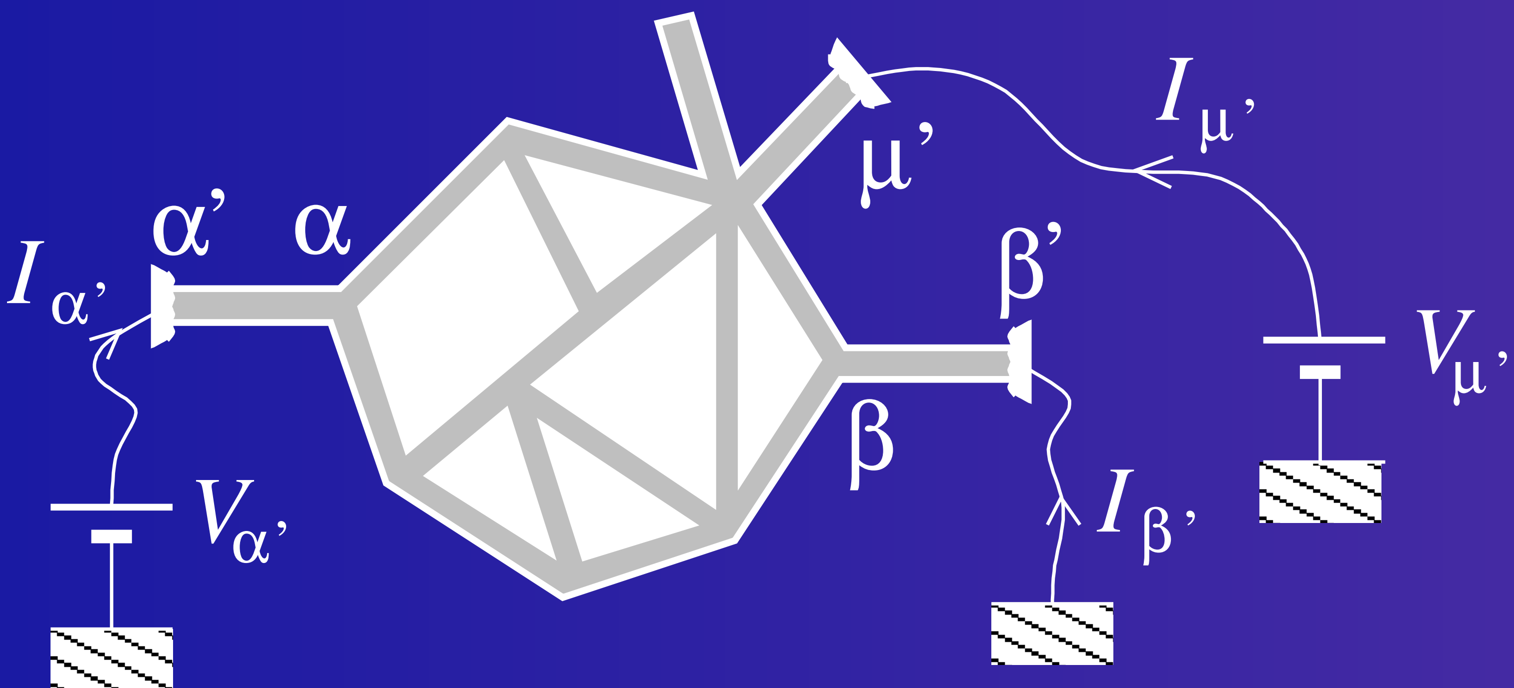
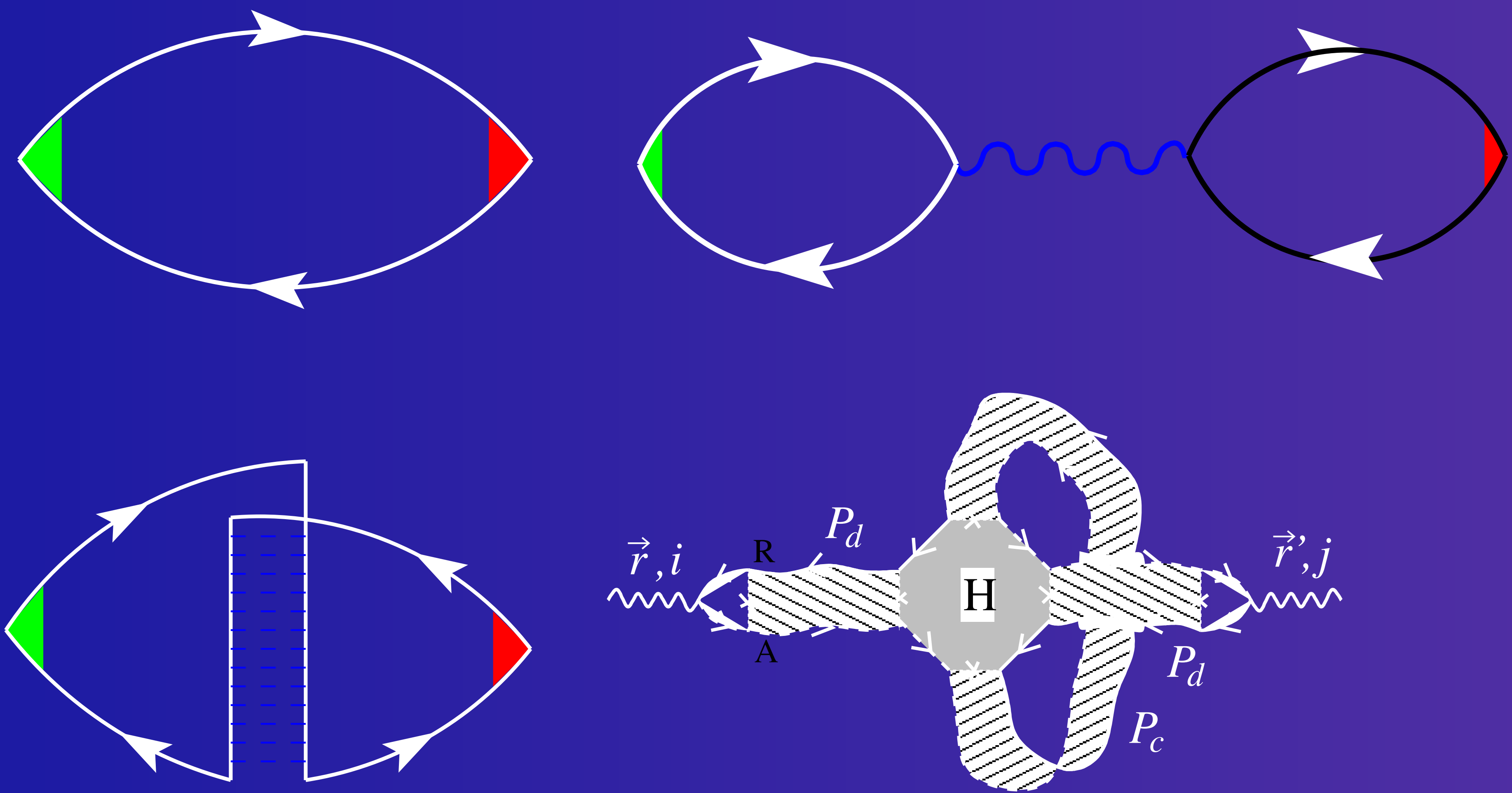


problem:

calculation of the resistance of a mesoscopic network of diffusive wires

Contributions to conductivity



Boundary conditions

adjacency matrix $a_{\alpha\beta}$:
$a_{\alpha\beta} = 1$ if the vertices α and β are connected
$a_{\alpha\beta} = 0$ otherwise.

- continuity of P
- $\sum_\beta a_{\alpha\beta} P'_{(\alpha\beta)}(\alpha) = \lambda_\alpha P(\alpha)$.

$\lambda_\alpha = 0$ for an internal vertex and $\lambda_\alpha = \infty$ at the vertices connected to external reservoirs, which imposes a Dirichlet boundary condition.

Results

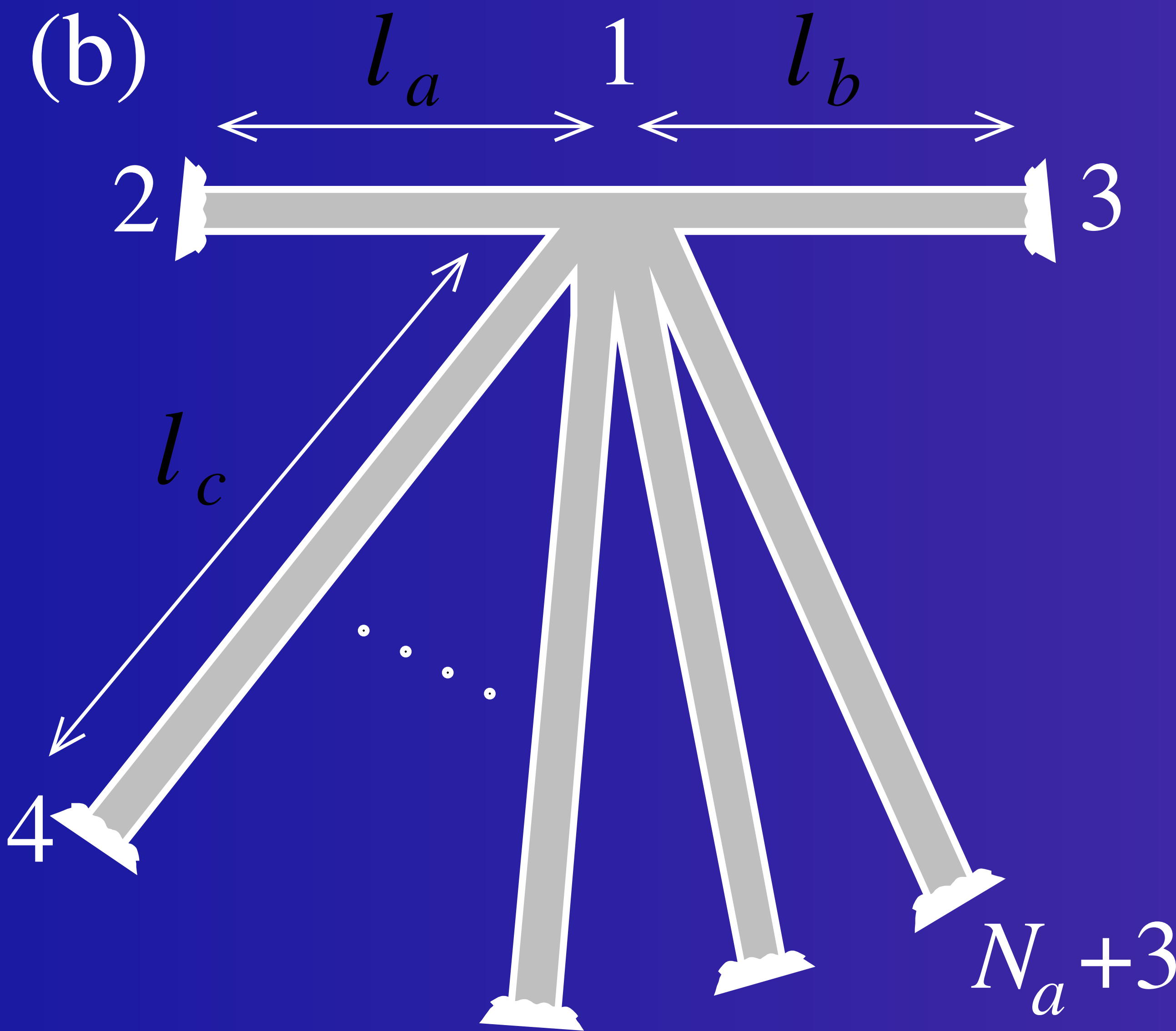
$$\Delta T_{\alpha'\beta'} = \frac{2}{\alpha_d N_c \ell_e} \sum_{(\mu\nu)} \frac{\partial T^{\mathrm{cl}}_{\alpha'\beta'}}{\partial\, l_{\mu\nu}} \int_{(\mu\nu)} \mathrm{d}x\, P_c(x,x),$$

$$\int_{(\mu\nu)} \mathrm{d}x\, P_c(x,x) = \frac{1}{2\sqrt{\gamma}} \Bigg\{ \left[\left(\mathcal{M}^{-1}\right)_{\mu\mu} + \left(\mathcal{M}^{-1}\right)_{\nu\nu} \right] \left(\coth\sqrt{\gamma} l_{\mu\nu} - \frac{\sqrt{\gamma} l_{\mu\nu}}{\mathrm{sh}^2\sqrt{\gamma} l_{\mu\nu}} \right)$$

$$+ \left[\left(\mathcal{M}^{-1}\right)_{\mu\nu} \mathrm{e}^{\mathrm{i}\theta_{\mu\nu}} + \left(\mathcal{M}^{-1}\right)_{\nu\mu} \mathrm{e}^{\mathrm{i}\theta_{\nu\mu}} + \frac{\mathrm{sh}\,\sqrt{\gamma} l_{\mu\nu}}{\sqrt{\gamma}} \right] \frac{-1 + \sqrt{\gamma} l_{\mu\nu} \coth\sqrt{\gamma} l_{\mu\nu}}{\mathrm{sh}\,\sqrt{\gamma} l_{\mu\nu}} \Bigg\}.$$

$$\mathcal{M}_{\alpha\beta} = \delta_{\alpha\beta} \left(\lambda_\alpha + \sqrt{\gamma} \sum_\mu a_{\alpha\mu} \coth(\sqrt{\gamma} l_{\alpha\mu}) \right) - a_{\alpha\beta} \frac{\sqrt{\gamma}\, \mathrm{e}^{-\mathrm{i}\theta_{\alpha\beta}}}{\mathrm{sh}(\sqrt{\gamma} l_{\alpha\beta})}.$$

Weak localization becomes antilocalization



Conclusions

note: on the mesoscopic conference in Italy Montambaux presented these ideas, and people did not protest

- general method calculating conductance between arbitary nodes of mesoscopic networks of quasi-1D diffusive wires
- methods used: disorder averaging technique, Landauer-Büttiker formalism, H. U. Baranger and A. D. Stone, Phys. Rev. B **40**, 8169 (1989).см. DVD№5
- geometrical effects can lead to change in the sign of weak localization correction

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this document is aviable on

http://theorie5.physik.unibas.ch/shalaev/public_html/index.html