Proximity Effect

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Solving the BdG Equation

- BdG Equation

$$\frac{\partial u}{\partial x} = i(\pi\xi_0\Delta_\infty)^{-1}[Eu - \Delta(x)v]$$

$$\frac{\partial v}{\partial x} = -i(\pi\xi_0\Delta_\infty)^{-1}[Ev - \Delta(x)u]$$

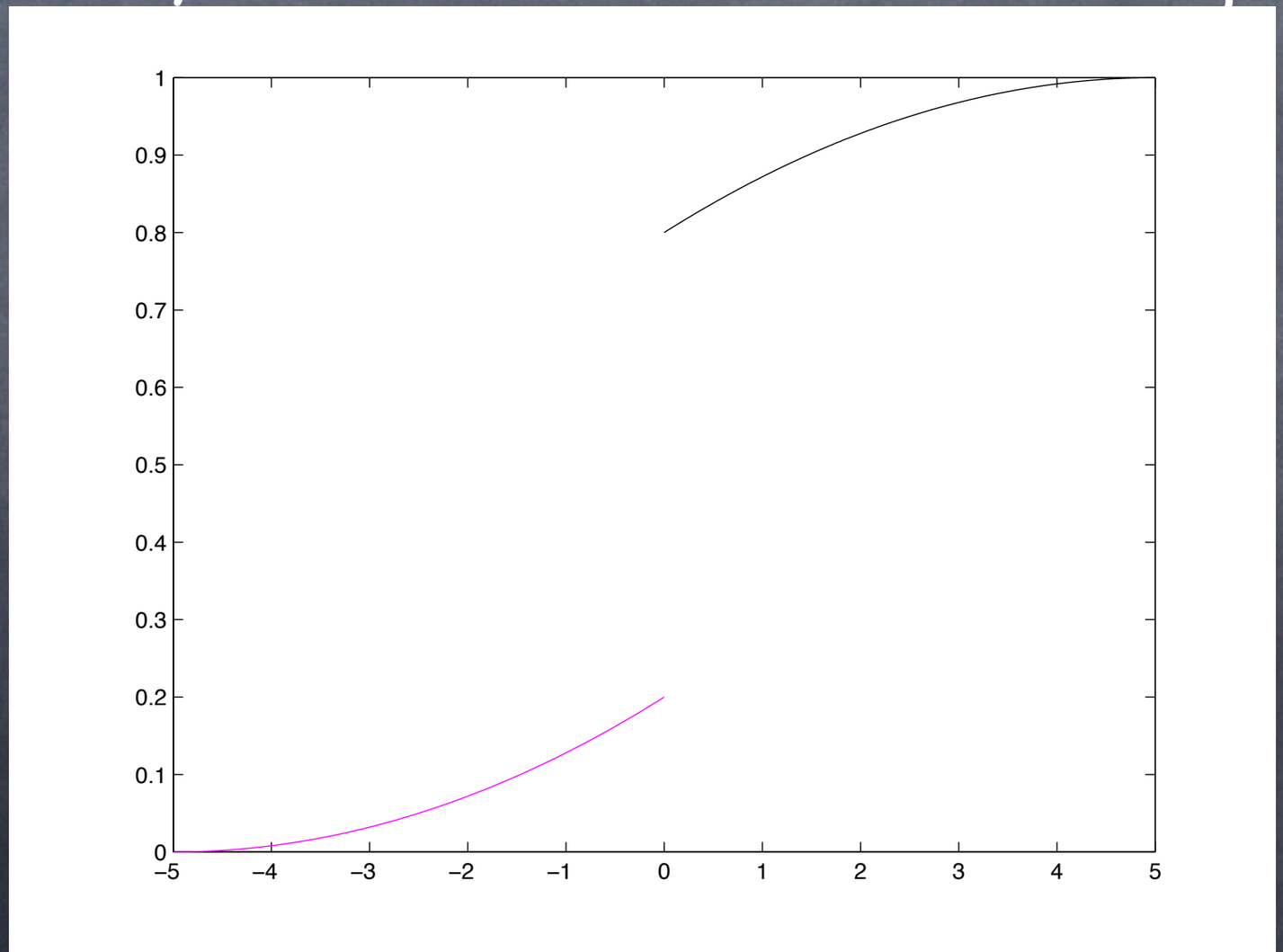
"Far-Superconducting Region"

- First We give the form of the "far-superconducting" solution

$$\varphi_1 = \begin{pmatrix} u_0 \\ v_0 \end{pmatrix} e^{i(k_F + k_S)x}$$

Region Divided

- We divide the tunnelling axis into four regions, which are, far superconducting, reduced, induced and far normal regions



Reduced Region

- We generate the initial conditions for the solutions of this region,

$$u_{a1}(x_S) = u_0 e^{ik_S x_S}$$
$$u_{b1}(x_S) = 0$$

- The solution for this region could be written,
- $$\varphi = \begin{pmatrix} u_a \\ v_a \end{pmatrix} e^{ik_F x} + \begin{pmatrix} u_b \\ v_b \end{pmatrix} e^{-ik_F x}$$

Induced Region

- Analogously, another initial conditions are obtained from the reduced region solution
- The form of the induced region solution is identical to that of reduced region solution
- $$\varphi = \begin{pmatrix} u_a \\ v_a \end{pmatrix} e^{ik_F x} + \begin{pmatrix} u_b \\ v_b \end{pmatrix} e^{-ik_F x}$$

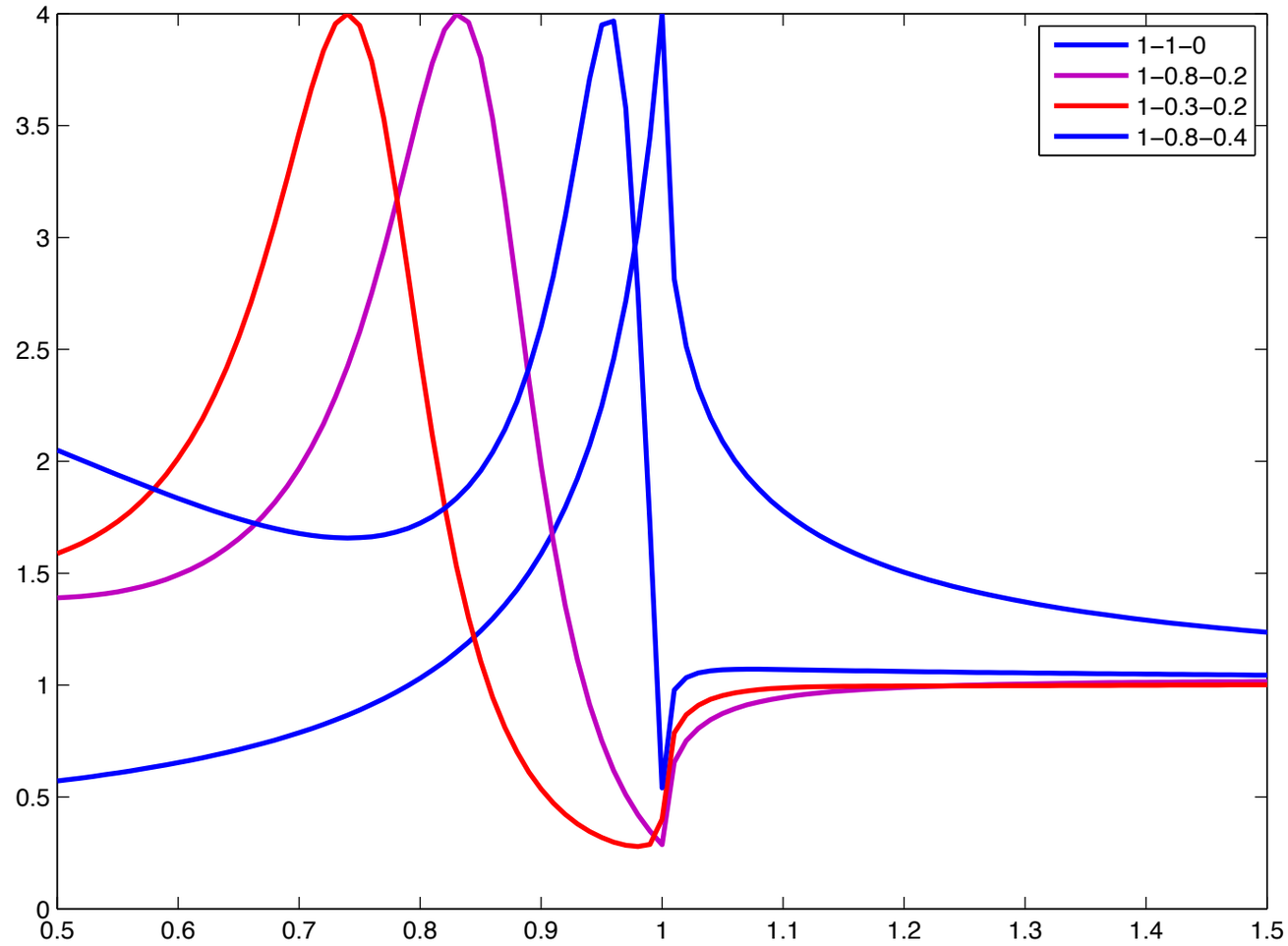
The Transmission Probability

- The transmission formula is
  $T = 1 + A - B = 1 + |a_e|^2 - |b_e|^2$
- where

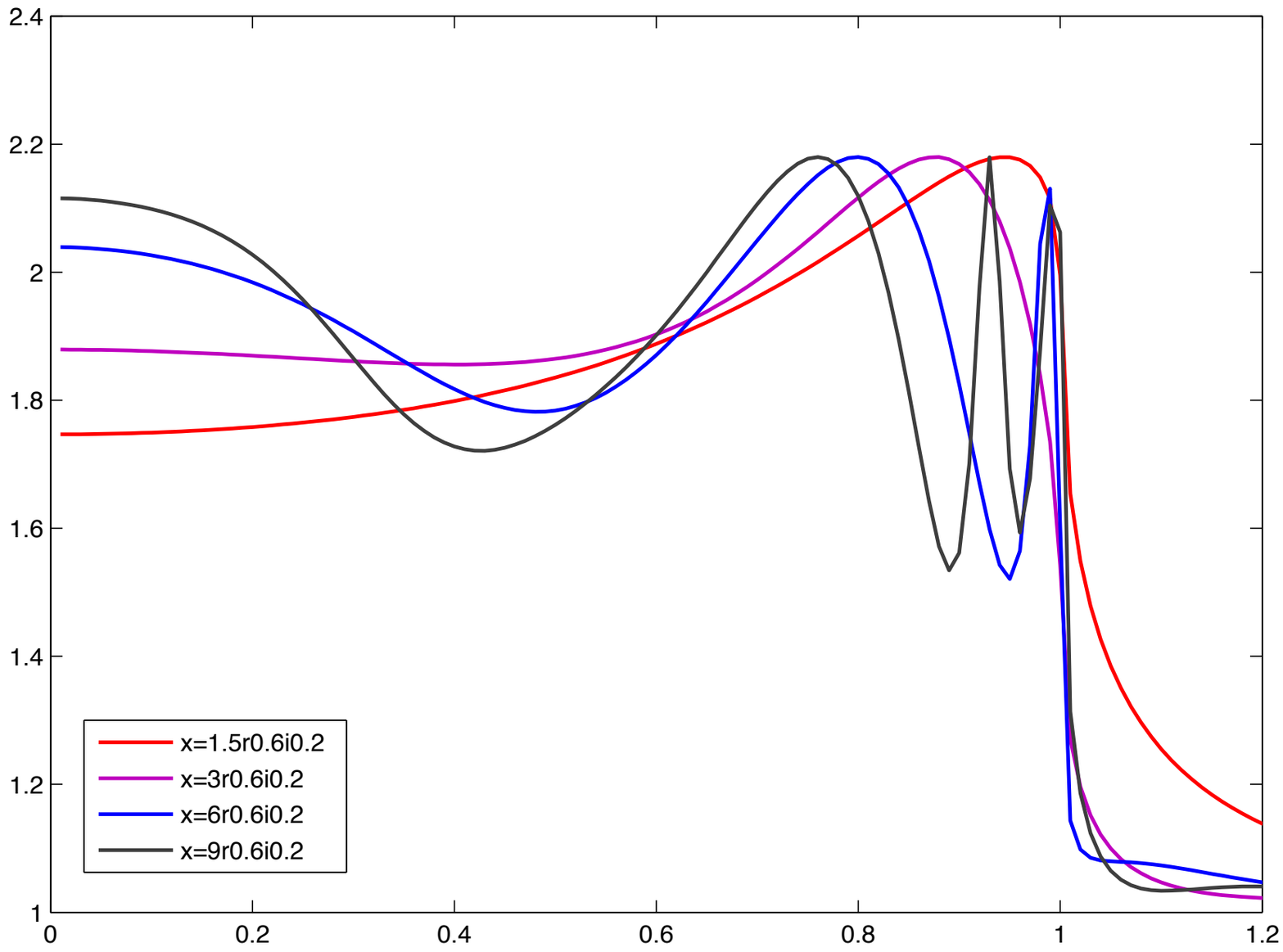
$$a_e = \frac{(1+Z^2)u_a v_a - Z^2 u_b v_b}{(1+Z^2)u_a^2 - Z^2 u_b^2} e^{-2ik_N x_N}$$

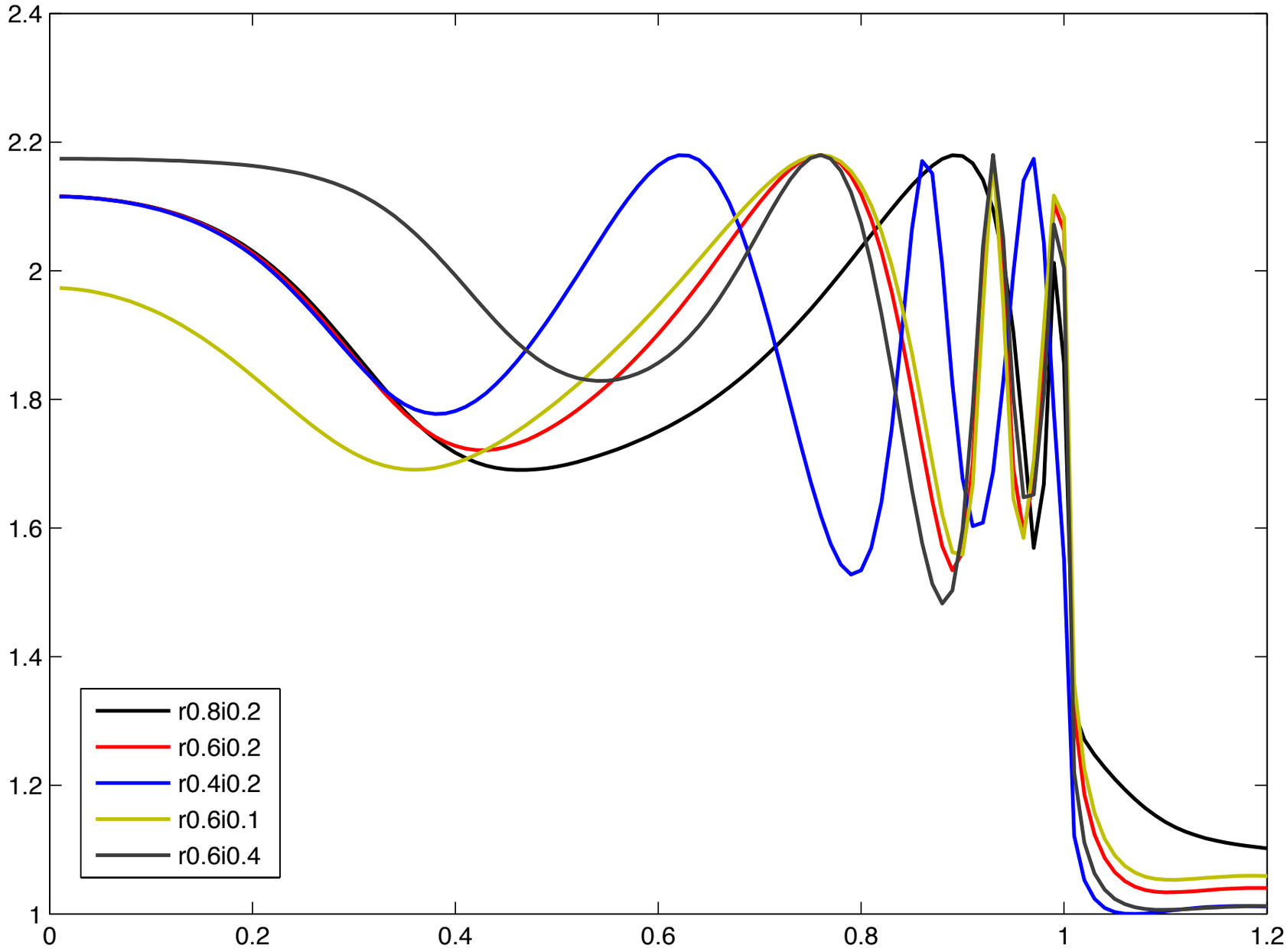
$$b_e = \frac{iZ(1-iZ)(u_b v_a - u_a v_b)}{(1+Z^2)u_a^2 - Z^2 u_b^2} e^{-2ik_N x_N}$$

BTK


4
3.5
3
2.5
2
1.5
1
0.5
0
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1–1–0
1–0.8–0.2
1–0.3–0.2
1–0.8–0.4

Thicker Proximity Region




2.4
2.2
2
1.8
1.6
1.4
1.2
1
0
0.2
0.4
0.6
0.8
1
1.2
r0.8i0.2
r0.6i0.2
r0.4i0.2
r0.6i0.1
r0.6i0.4

Raw Result for D-wave