

①

$$\Delta U = \int_0^\infty d\epsilon \epsilon g(\epsilon) f(\epsilon) - \int_0^{\epsilon_F} d\epsilon \epsilon g(\epsilon) + \int_0^{\epsilon_F} d\epsilon \epsilon g(\epsilon) - \int_0^{\epsilon_F} d\epsilon \epsilon g(\epsilon)$$

$$= \int_0^\infty d\epsilon \epsilon g(\epsilon) f(\epsilon) - \int_0^{\epsilon_F} d\epsilon \epsilon g(\epsilon) + \int_0^{\epsilon_F} d\epsilon \epsilon g(\epsilon) - \int_0^{\epsilon_F} d\epsilon \epsilon g(\epsilon)$$

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$$- \left\{ \int_0^{\epsilon_F} d\epsilon \epsilon g(\epsilon) f(\epsilon) + \int_{\epsilon_F}^\infty d\epsilon \epsilon g(\epsilon) f(\epsilon) \right\}$$

$$\int_0^{\epsilon_F} d\epsilon \epsilon g(\epsilon) f(\epsilon) + \int_{\epsilon_F}^\infty d\epsilon \epsilon g(\epsilon) f(\epsilon)$$

$$\int_0^{\epsilon_F} d\epsilon (\epsilon - \epsilon_F) g(\epsilon) f(\epsilon) + \int_{\epsilon_F}^\infty d\epsilon (\epsilon - \epsilon_F) g(\epsilon) f(\epsilon) + \int_0^{\epsilon_F} d\epsilon (\epsilon - \epsilon_F) g(\epsilon) - \int_0^{\epsilon_F} d\epsilon (\epsilon - \epsilon_F) g(\epsilon) (1 - f(\epsilon))$$