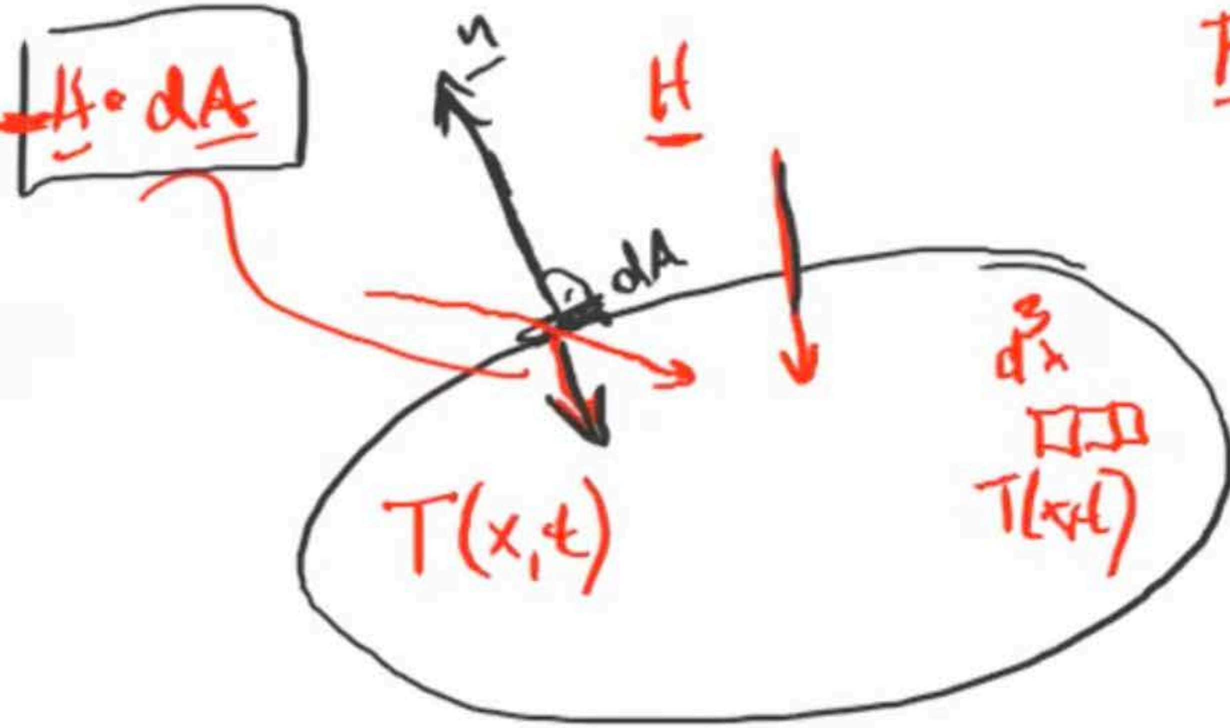


Fourier's law: $\underline{H} = -K\,\underline{\nabla} T(\underline{x},t)$

1st law: $\Delta E = \cancel{\Delta W} + \Delta Q$

work heat

$$\boxed{\Delta E = \Delta Q}$$

$\Delta E = C\rho\,\Delta T$

heat cap. density

$E(t) = \int d^3x\, C\rho\, T(x,t)$

$$\frac{\partial E}{\partial t} = \frac{\partial}{\partial t}\int d^3x\, C\rho\, T(x,t) = -\oint \underline{H}\cdot d\underline{A}$$

CHANGE IN ENERGY INSIDE = HEAT FLOW across BOUNDARY

$$\boxed{\frac{\partial E}{\partial t} = -\oint \underline{H}\cdot d\underline{A}}$$

$$\int d^3x\, \frac{\partial}{\partial t} C\rho\, T(x,t) = -\oint(-K\,\underline{\nabla} T)\cdot d\underline{A} = +\int d^3x\, K\, \underline{\nabla}\cdot\underline{\nabla} T$$

Gauss divergence: $\int d^3x\, \underline{\nabla}\cdot\underline{E} = \oint \underline{E}\cdot d\underline{A}$, $\underline{E} = \nabla\phi$ $\Big\}$ $\oint \underline{\nabla}\phi\cdot d\underline{A} = \int d^3x\, \underline{\nabla}\cdot\underline{\nabla}\phi$

$$\int d^3x \frac{\partial}{\partial t} c\varrho\, T(x,t) = + \int d^3x\, \kappa\, \underline{\nabla}^2 T(x,t)$$

$$\boxed{\frac{\partial}{\partial t} c\varrho\, T(x,t) = \kappa\, \underline{\nabla}^2 T(x,t)}$$

$$\boxed{\frac{\partial T}{\partial t} = \frac{\kappa}{c\varrho}\, \underline{\nabla}^2 T(x,t)}$$

heat equation

General heat/diffusion equation

$u(\underline{x},t)$

diffusion coefficient

$$\frac{\partial u}{\partial t} = \underline{\nabla}\, D(\underline{x})\, \underline{\nabla} u$$

Fick's law

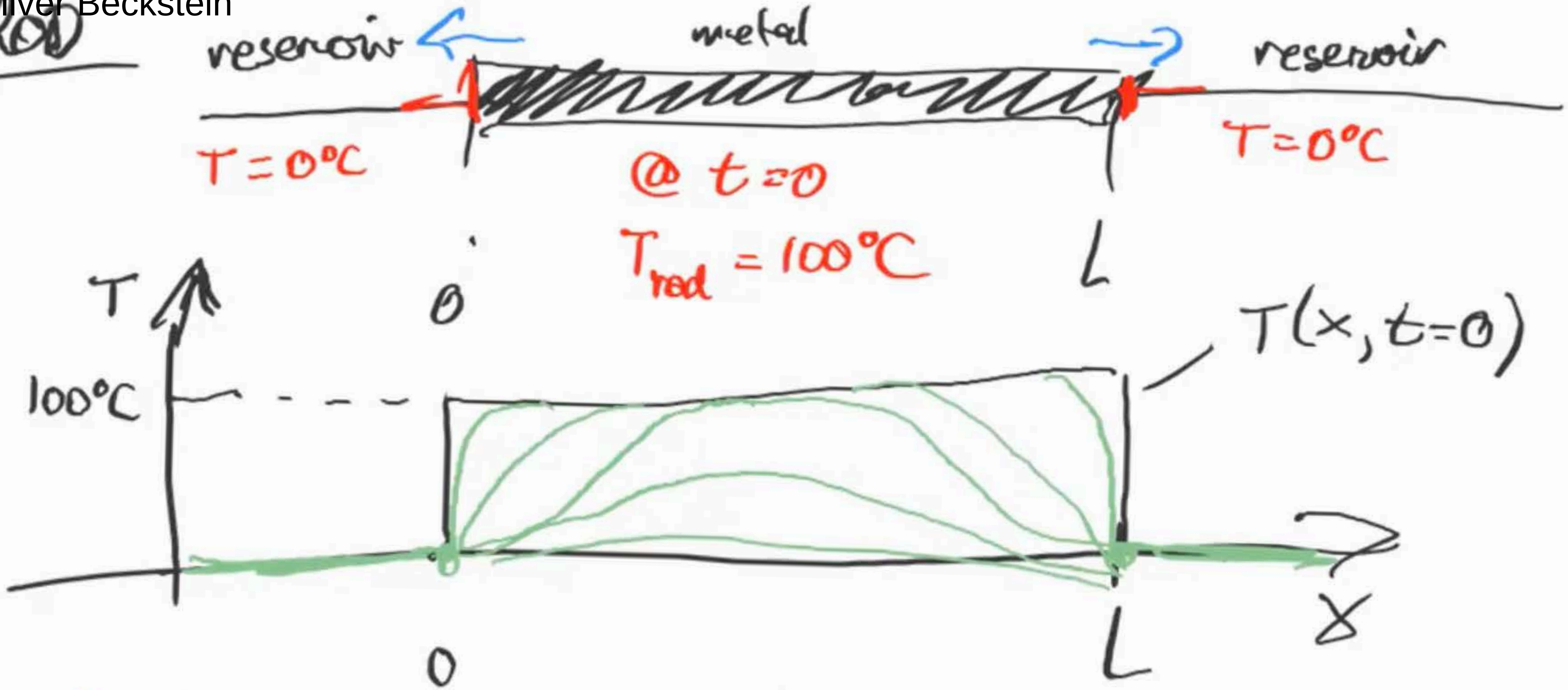
$j = D \nabla u$

$D = \text{const}$ + mass consv.

$$\frac{\partial u}{\partial t} = D\, \underline{\nabla}^2 u(x,t)$$

- Black-Scholes
- Schrödinger's eq. $i\hbar \frac{\partial \psi}{\partial t} = -\frac{\hbar^2}{2m} \nabla^2 \psi + V\psi$

1D ROD



$T(x, t>0) = ?$

$T(x, t)$

$T(x, t \to \infty)$

1) analytically PHY202

PHY201 (Math Methods)

2) numerically