

Surface state electrons on He-3, and etc.

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Collaborators

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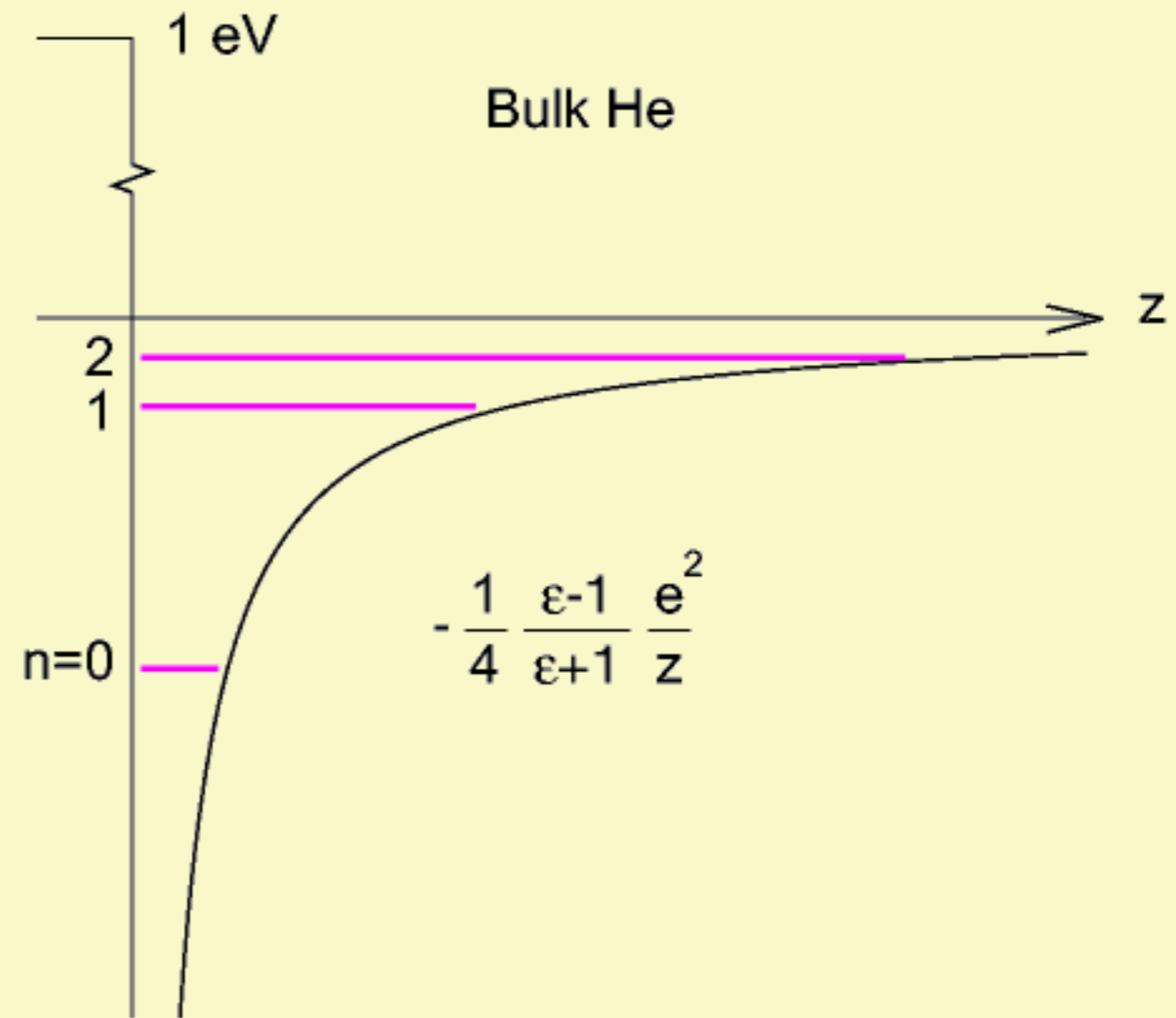
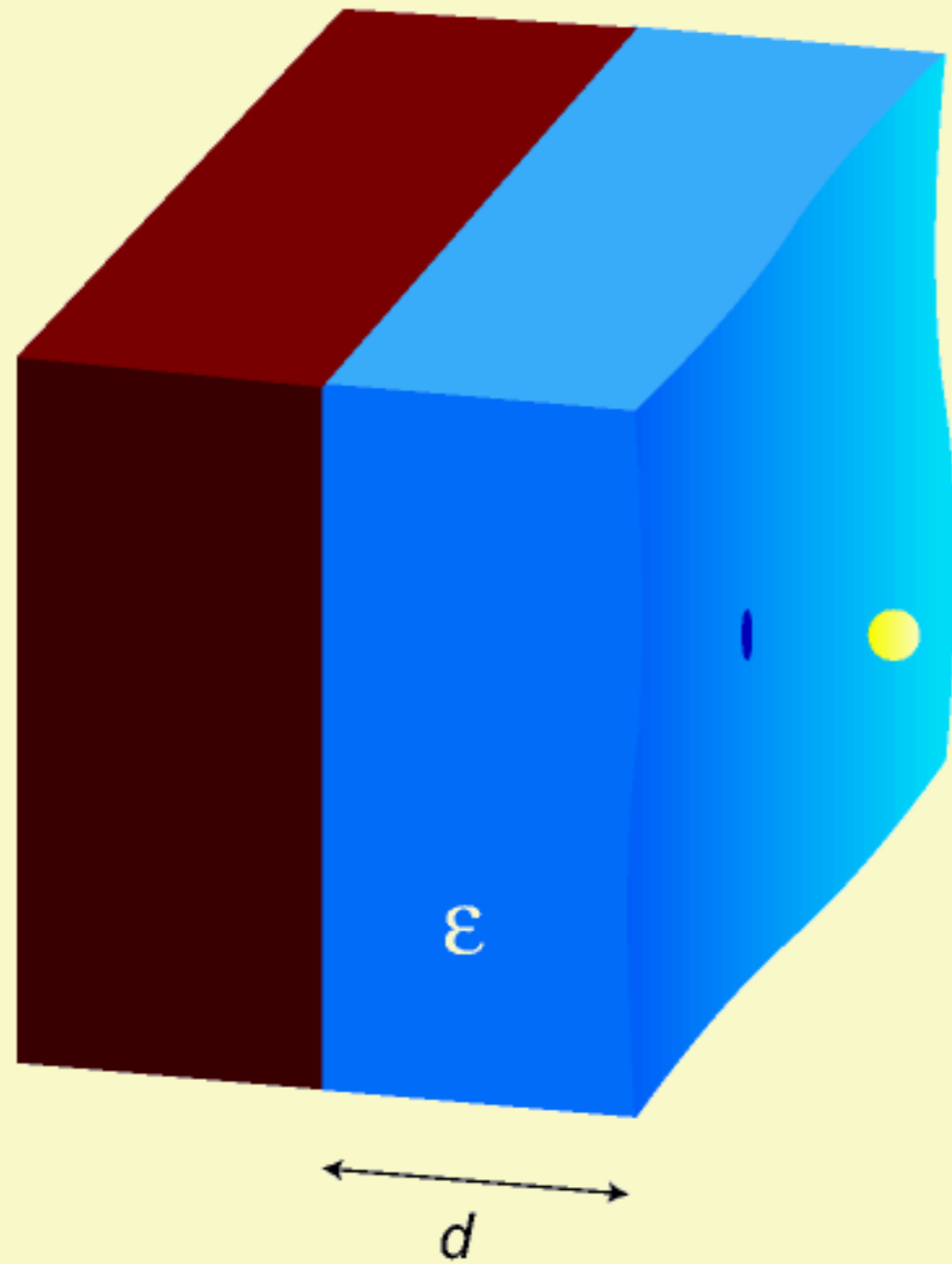
Supports

- Institute for Solid State Physics, Univ. of Tokyo
- Grant-in-Aid for Scientific Research, Monka-sho

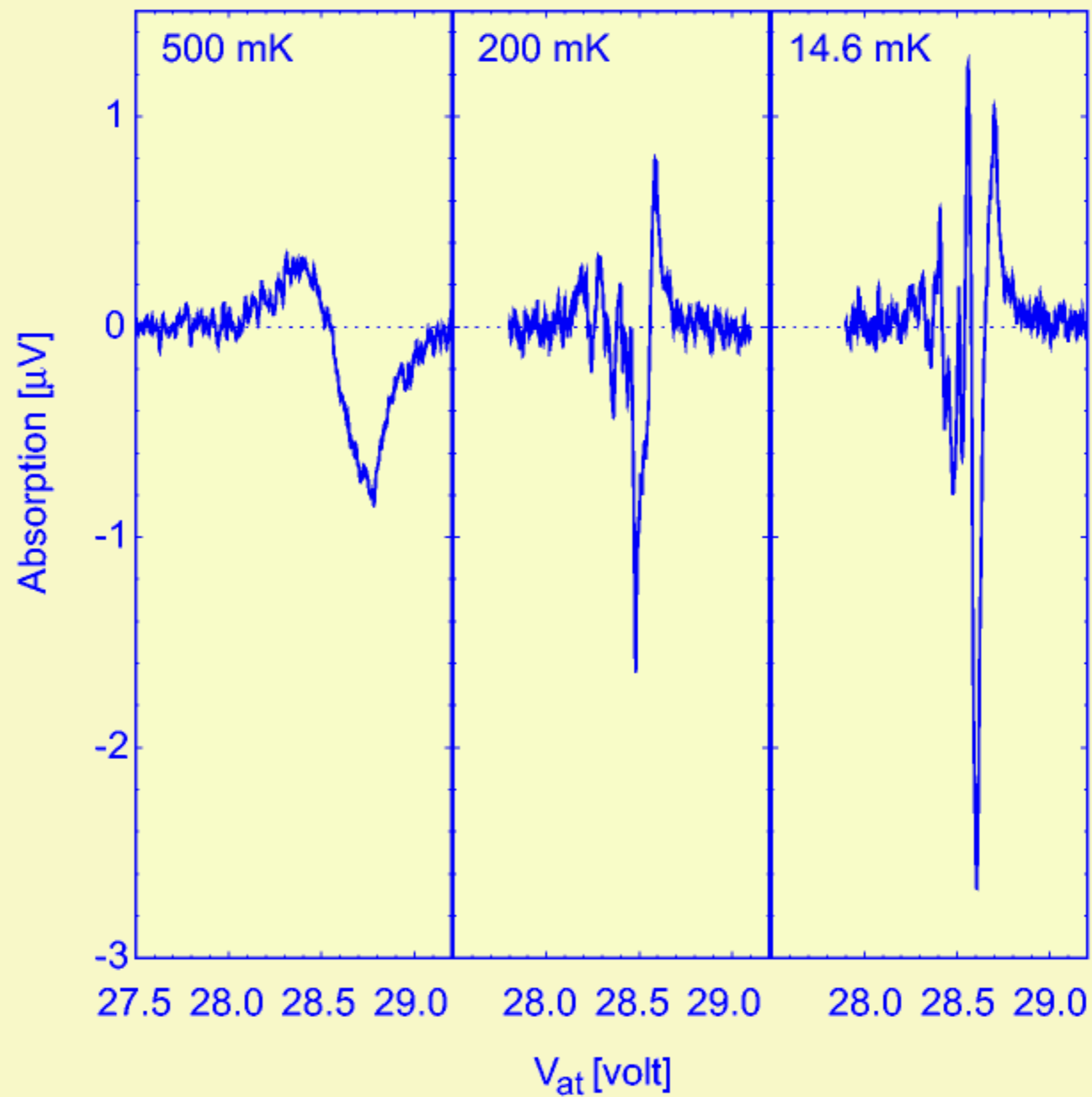
Outline

- Surface state electrons
- subband excitation
- DC mobility of the Wigner solid
- Quasiparticle scattering from free surface
- Superfluid He-3
- A phase: l texture
- B phase: Andreev scattering?
- B phase: Gap distortion and n texture
- He films, suspended channels, etc., as supports for electrons
- Conclusion

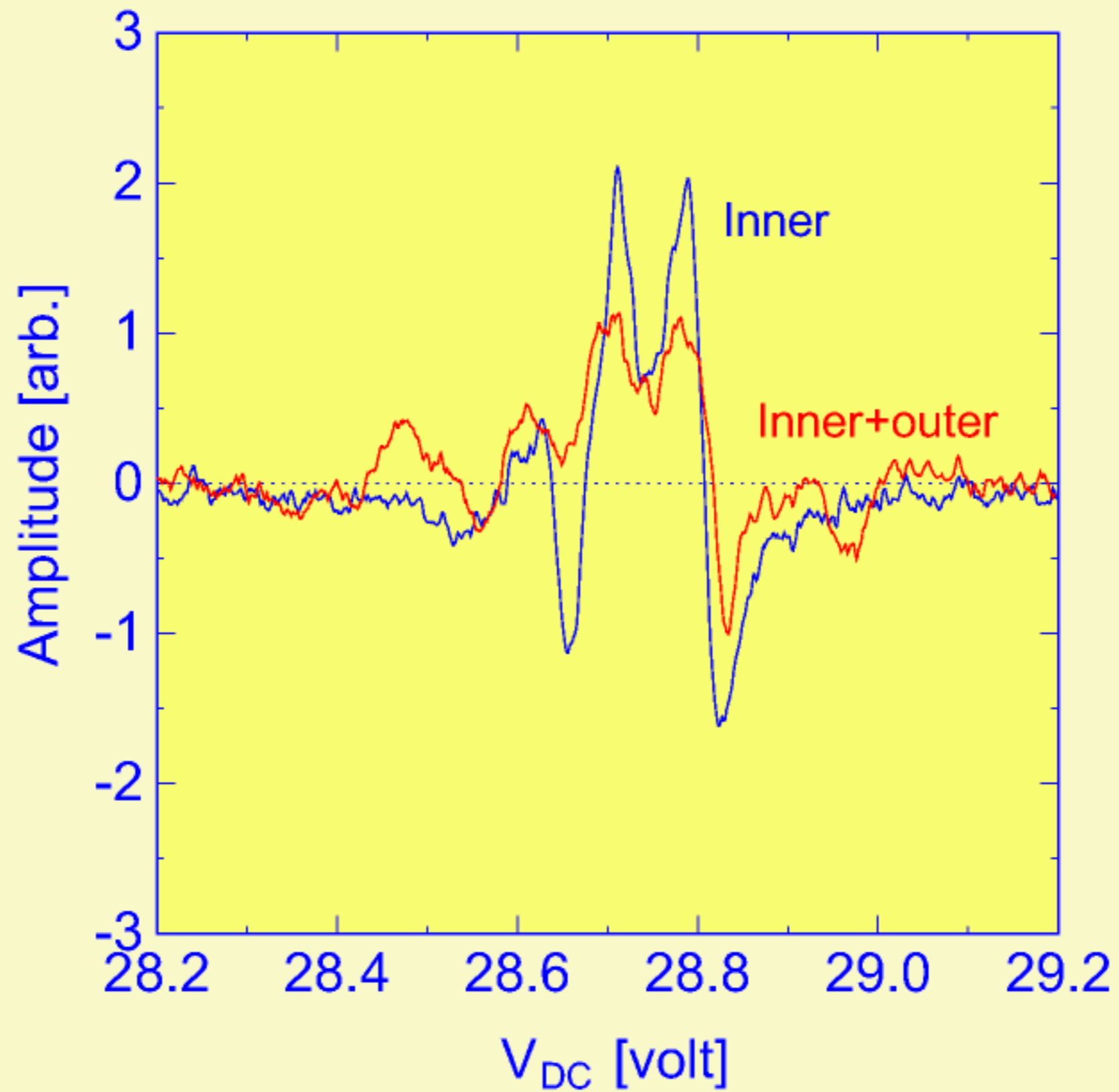
Image potential



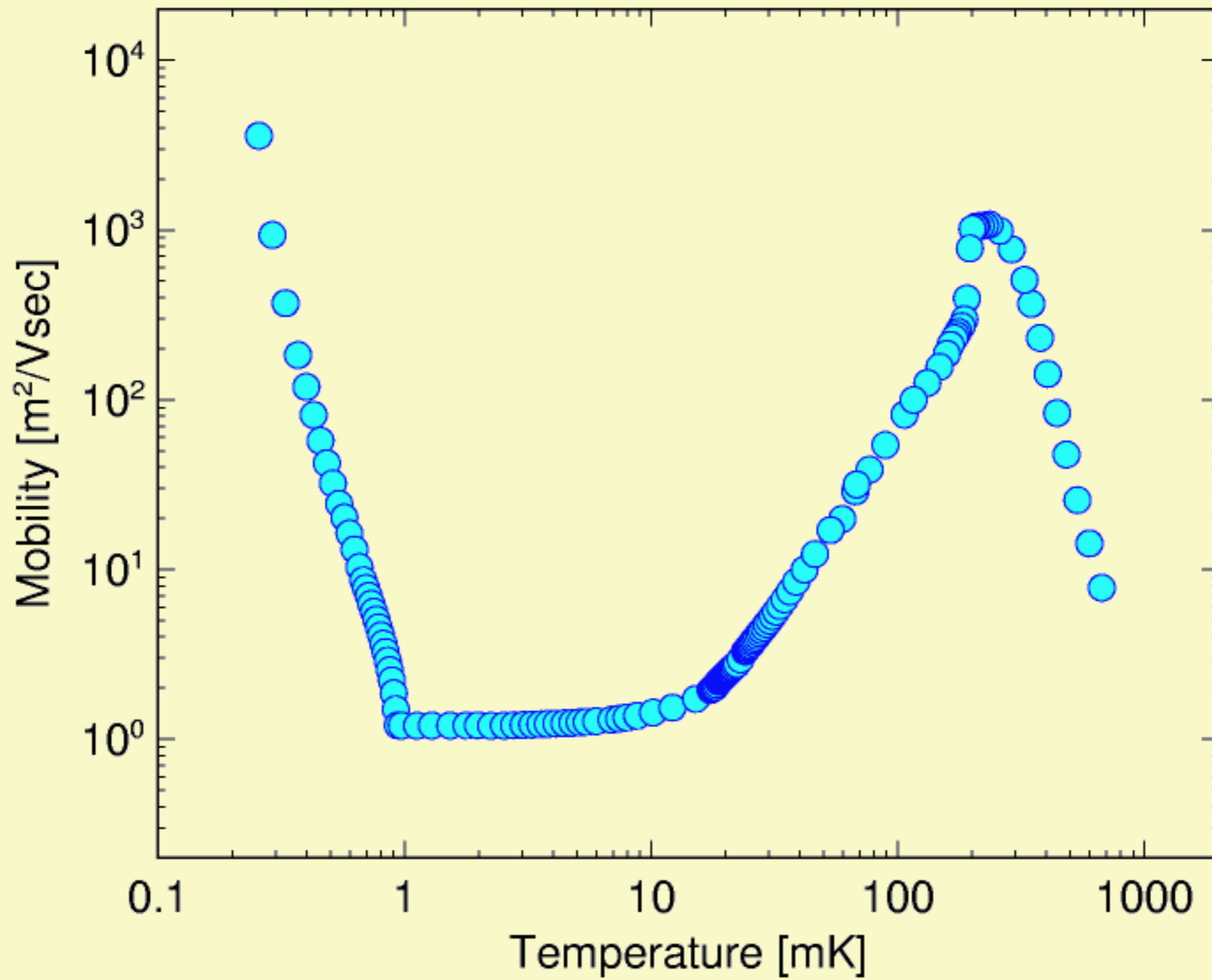
Microwave absorption



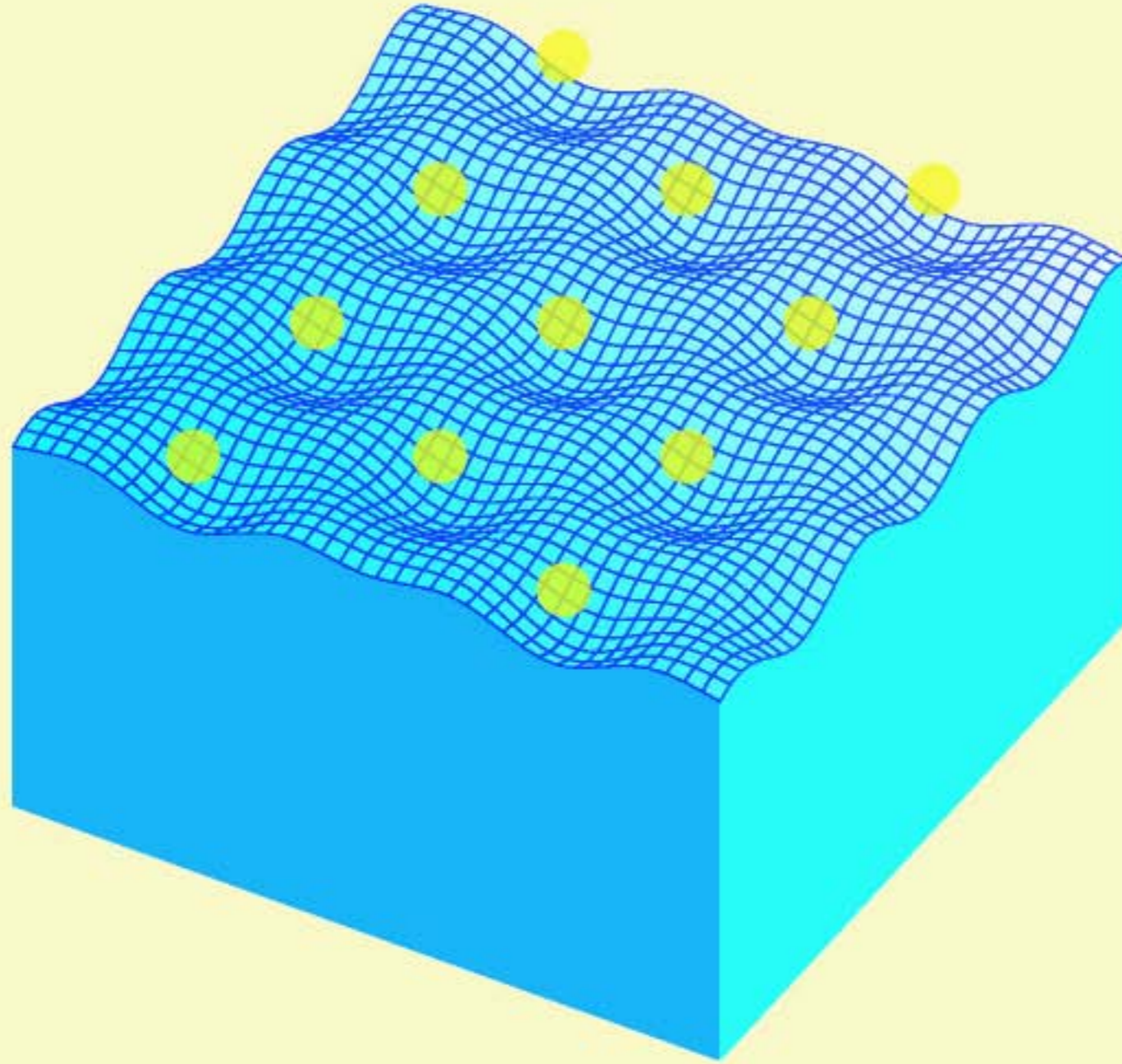
Inhomogeneity



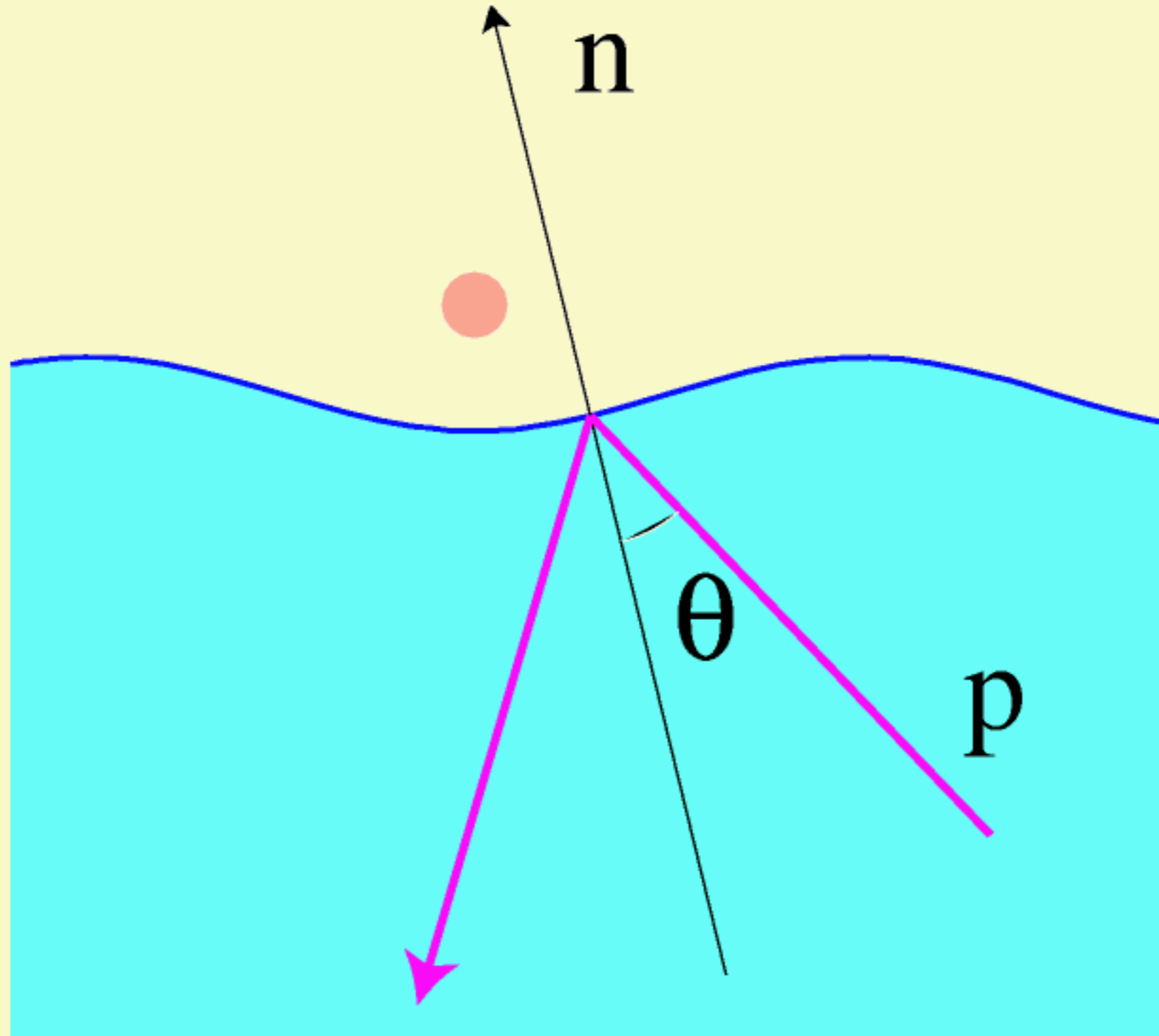
DC mobility



Wigner crystal



Scattering of quasiparticles



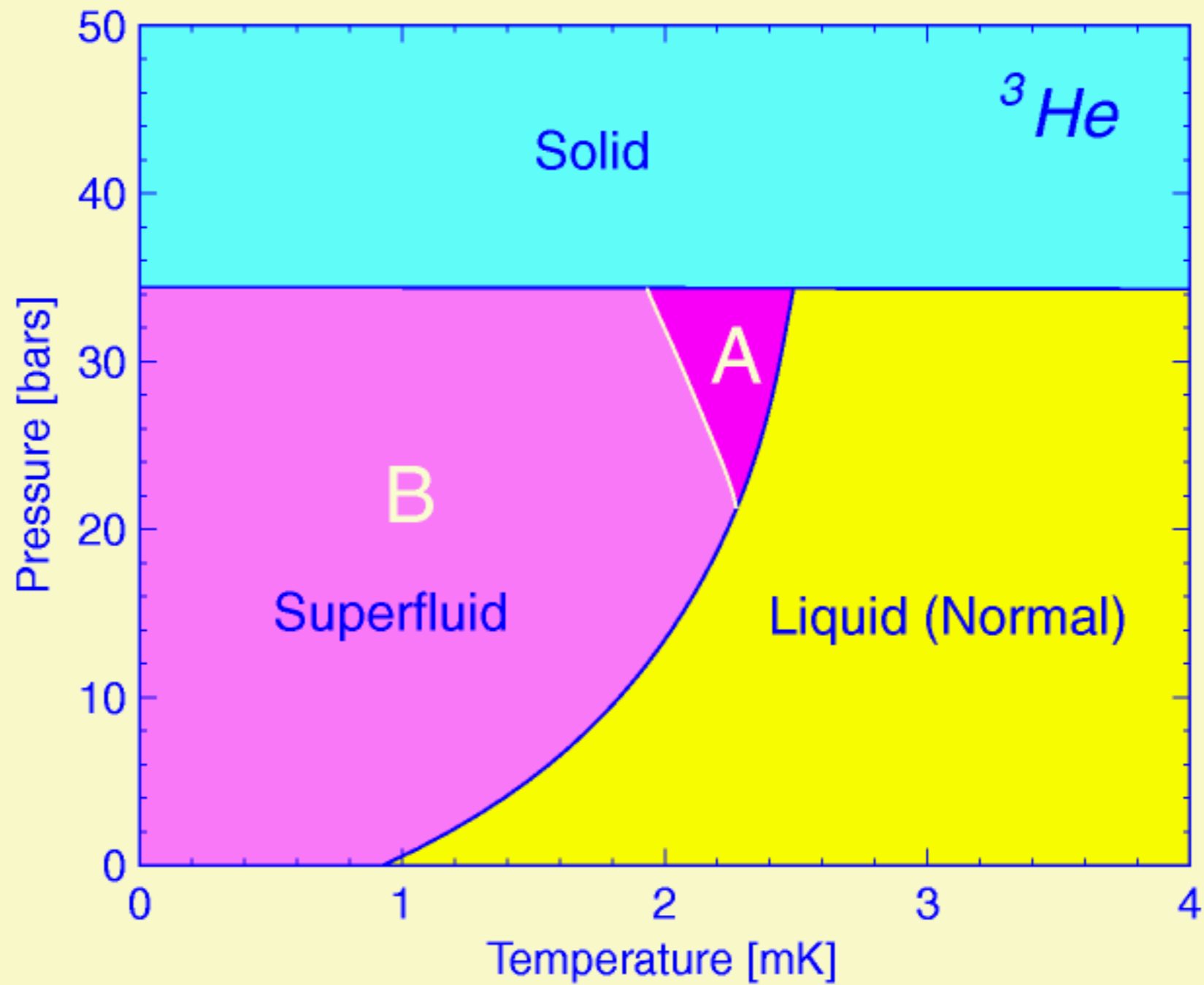
Ballistic regime

$$\frac{e}{\mu_n} = \frac{\hbar k_F^4}{4\pi^2 N} \int ds n_x^2$$

$$\frac{e}{\mu_s} = \frac{e}{\mu_n} \left\langle \frac{2}{\exp(\Delta(T)/k_B T) + 1} \right\rangle$$

$$\langle \dots \rangle = \frac{2}{\pi} \int_0^{2\pi} d\phi_p \int_0^{\pi/2} d\theta_p \sin \theta_p \cos^3 \theta_p \dots$$

A-B phases



Triplet Superfluid

Normal:

$$G = \text{SO}_3^{(L)} \times \text{SO}_3^{(S)} \times \text{P} \times (\text{T} \times \text{U}(1))$$

A-phase:

$$\text{H(A)} = (\text{O}_z^{(S)} \times \text{O}_{x,\pi}^{(S)} \text{U}_{\pi/2}) \times (\text{O}_z^{(L-(1/2)N)} \times \text{O}_{x,\pi}^{(L)} \text{T}) \times \text{PU}_{\pi/2}$$

$$\psi_{\alpha\beta}(\mathbf{k}) \propto g\sigma_3(n_x + in_y), \quad (g = i\sigma_2)$$

$$|\Delta|^2 = |\psi_A|^2 \sin^2 \theta$$

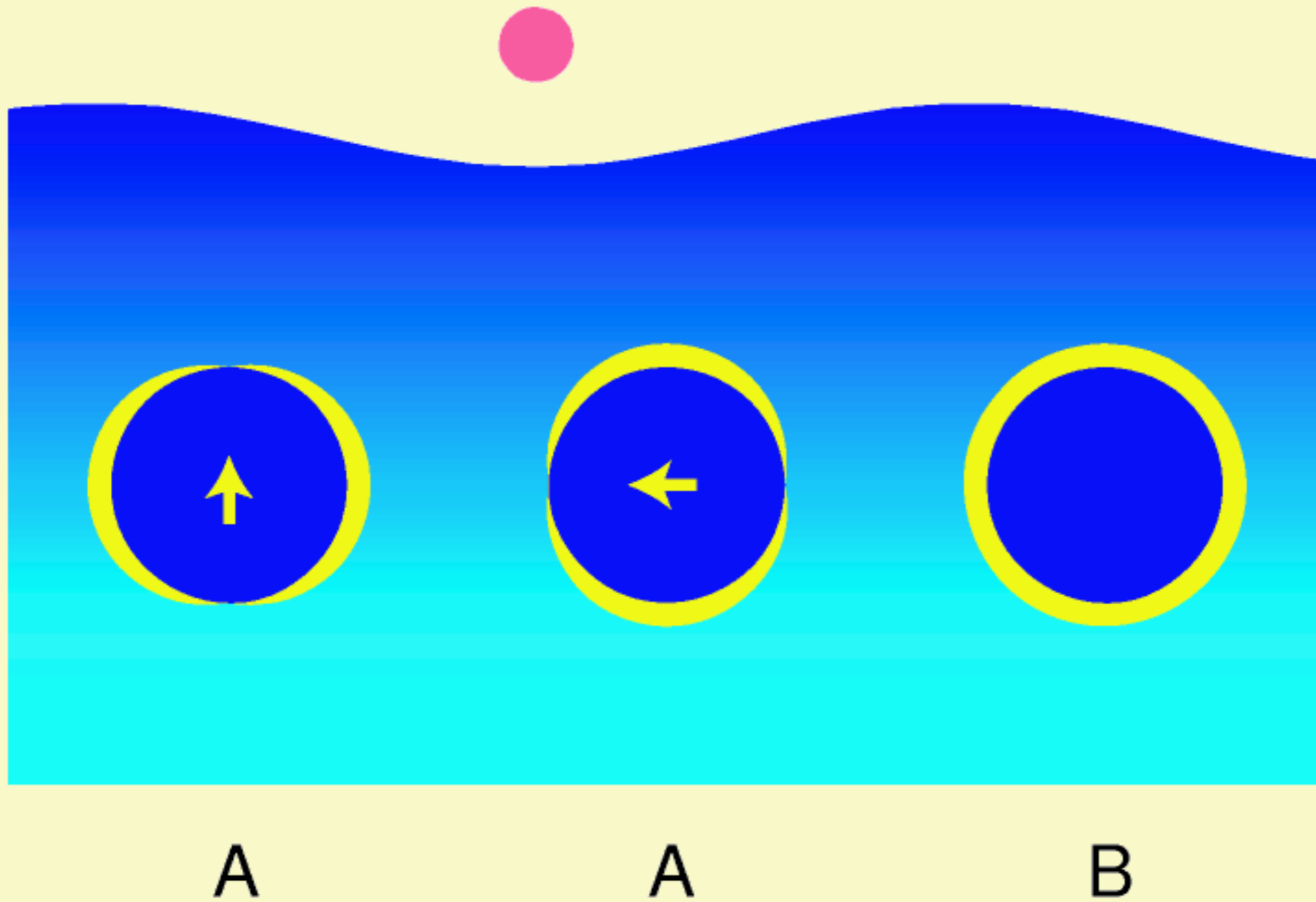
B-phase:

$$\text{H(B)} = (\text{SO}_3^{(L+S)} \times \text{T}) \times \text{PU}_{\pi/2}$$

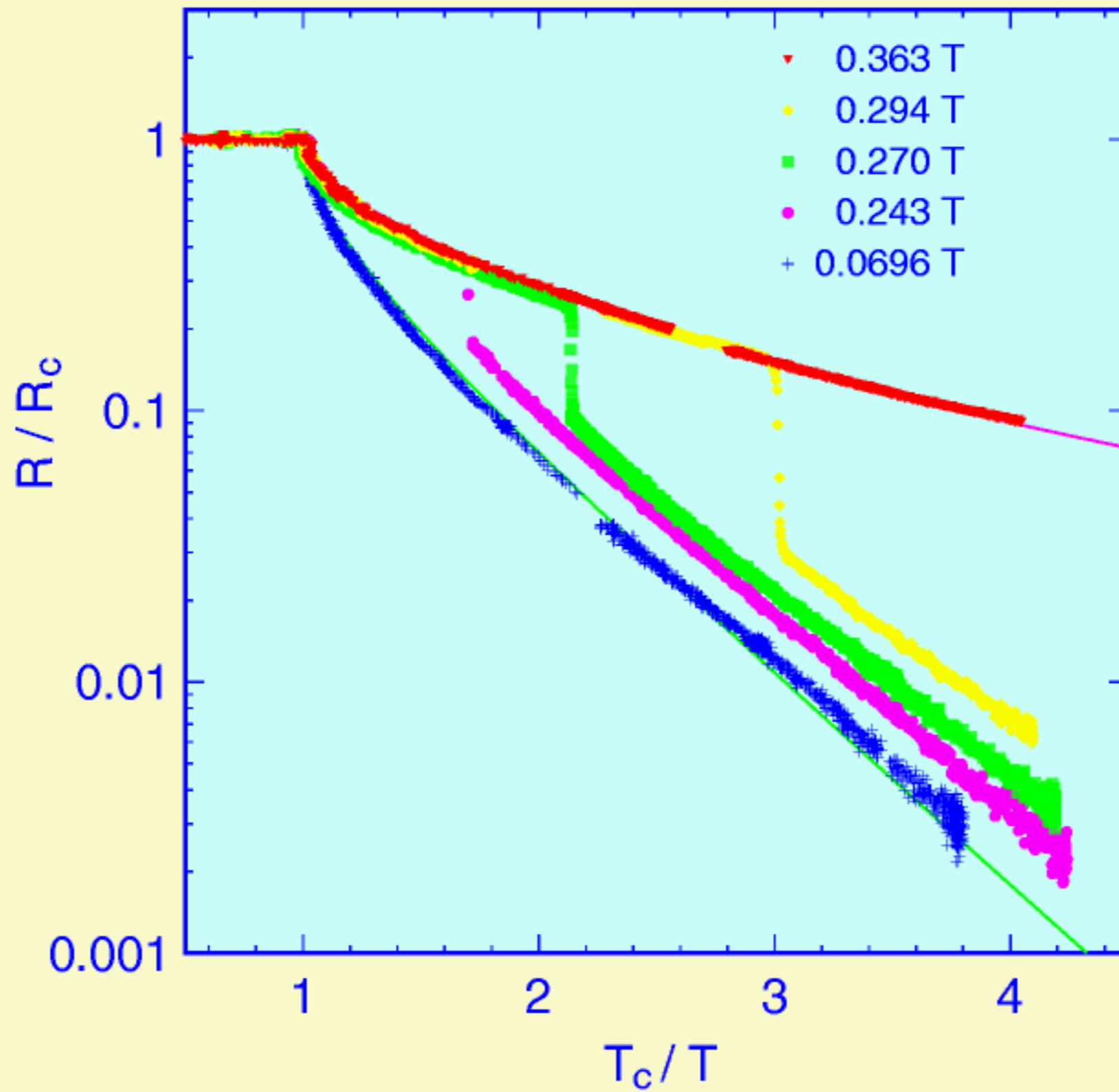
$$\psi_{\alpha\beta}(\mathbf{k}) \propto g\vec{\sigma} \cdot \mathbf{n}$$

$$|\Delta|^2 = |\psi_B|^2$$

Energy gap



Experimental Results



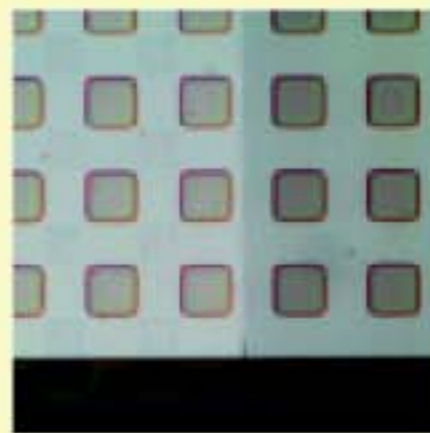
Electrons on He films



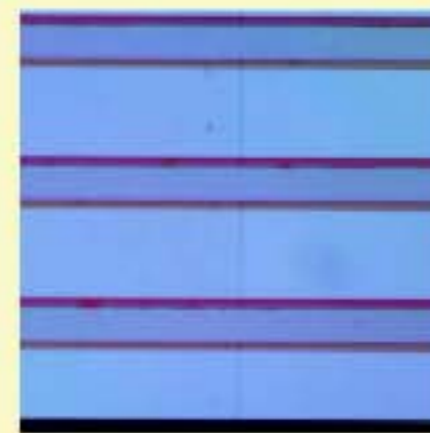
flat



resist



dot



1D channel
with guard



1D channel
without guard

Results

	C (pF)	C_{cal} (pF)	C/C_{cal} (%)
flat	0.068	130	0.05
resist	0.30	20	1.5
dot	0.48	5.4	8.9
1D channel without guard	0.094	7.2	1.3
1D channel with guard	1.7	7.2	24

Summary

- Quasiparticles are specularly scattered from the free surface.
- DC Mobility is sensitive to the distribution of quasiparticles.
- Energy gap profile of superfluid He-3 can be detected.
- A-phase I texture is perpendicular to the surface.
- Where is the Andreev scattering?
- B-phase n texture should be elucidated.
- Much to do toward the qubits.

Toward a single electron

