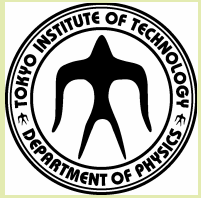

Crystal growth of clean and dirty solid Helium

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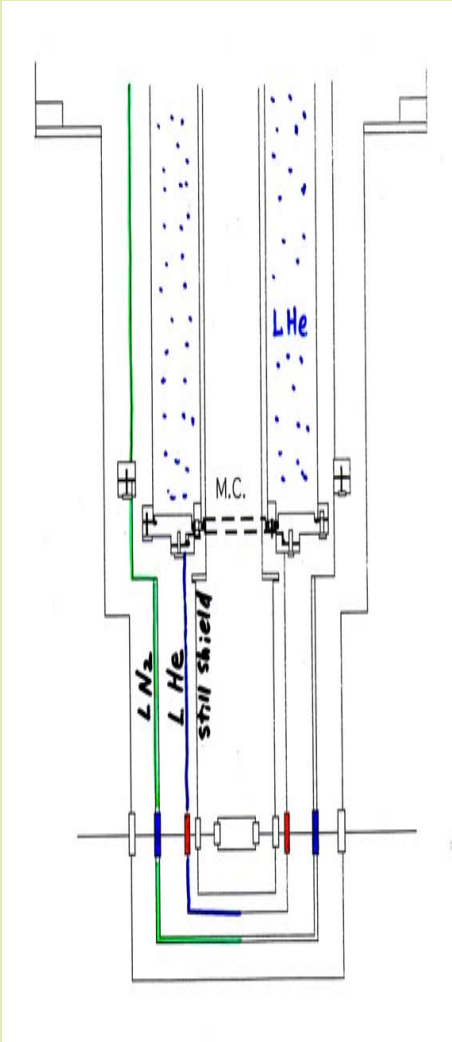
Basic properties of solid ^{4}He

- It is grown in the superfluid.
- No latent heat in the solid-superfluid transition
- The growth coefficient diverges as T goes to zero
- Very short time constant to the equilibrium
- True equilibrium crystal shape research is possible
- Large quantum fluctuation
- Suitable for the basic research on the crystal growth

Experimental technique

- Dilution refrigerator with optical access
- High speed camera to monitor the very fast motion of the crystal
- Manipulation of the crystal by ultransonic method

Sketch of the dilution refrigerator with the optical windows



The following improvement of the optical measurement is planned

1. Increase the time resolution
   (1ms → 10μs)
   together with cooling power of the fridge

2. Higher spatial resolution
   (50μ → 1μ)

3. Shrieren, and Holography technique are installed

Lots of novel phenomena have been observed

- Crystal growth and melting by acoustic wave pulse
- Nucleation of solid ^{4}He by acoustic wave pulse
- Nucleation and motion of negative crystal
- Roughening transition of negative crystal
- Instability of the crystal surface
- Deformation of crystal by gravity

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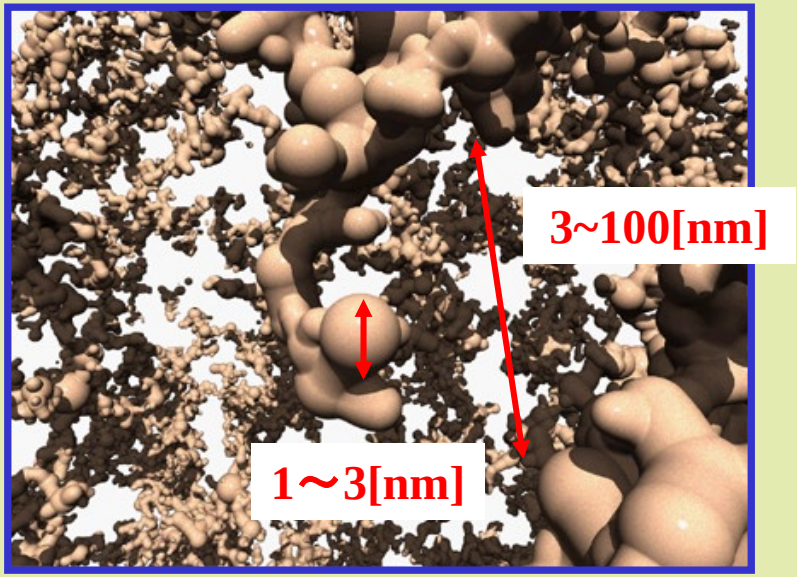
We presented one topic from the recent results on the super-clean crystal.

We found ^{4}He crystal is grown or melted by the acoustic radiation pressure, which is the stress on the interface coming from the difference of the acoustic energy density between two phases. With this technique we could measure the growth coefficient of the specific surface. We performed the experiment on c-facet at low temperature to find the anomalously fast growth rate of the facet. The experimental observation is beautifully explained by the new theory of the step motion in the quantum limit. The result is to be published in JPSJ 2006.

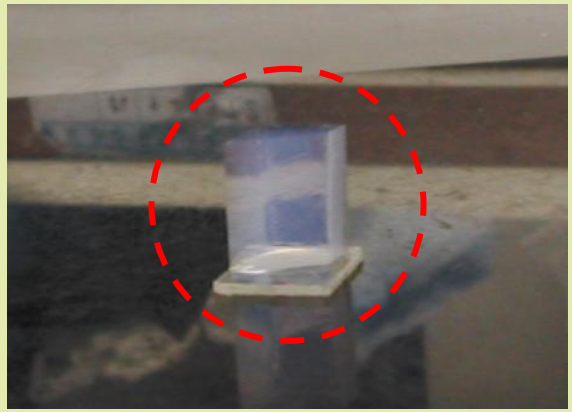
Solid ^{4}He as a dirty crystal.

We may be able to realize a dirty He crystal in the aerogel.

What is aerogel?



Porosity: 90～99%, Random and fractal structure



Sample aerogel is transparent.
We can observe what is happening on the He crystals in the aerogel by our optical apparatus.

The following experiments on solid ^{4}He in aerogel are planned with the focus on the randomness and the fractal structure

1. Roughening transition of c-facet in the aerogel.
2. Crystal growth and melting of solid ^{4}He in the aerogel

Experiment on solid ^{3}He

1. Solid ^{3}He at T～100 mK is the most fluctuating crystal. We are much interested in the solid ^{3}He at this temperature range. We plan to observe the crystal shape with the manipulation by acoustic wave.At the same time the roughening transition has to be investigated more intensively for both clean and dirty ^{3}He crystal.

2. The relation between the nuclear magnetic ordering and the crystal shape of bcc ^{3}He should be very important and interesting.Suitable method and feasibility of the experiment will be discussed soon and the experimental plan will be made.