Pramāṇa – J. Phys., Vol. 28, No. 5, May 1987, p. 591. © Printed in India.

Roughening (faceting) transitions on the helium crystal-superfluid interface

A V BABKIN, K O KESHISHEV, D B KOPELIOVICH and A YA PARSHIN

Institute for Physical Problems, USSR Academy of Sciences, 117334, Moscow, USSR

Abstract. The concept of roughening transitions (RT) was first introduced into theory by Burton and Cabrera (1949). RT, which manifests itself in disappearance of smooth facets in equilibrium shape of the crystal (faceting transition), has been under intensive theoretical study in the last few years (Andreev 1981; Rottman and Wortis 1984). Current interest in this field is connected mainly with the problems of "quantum roughening" and critical behaviour of the surface stiffness. Experimental studies of RT in usual classical crystals meet with serious difficulties due to very long crystal shape relaxation times. In this respect, helium crystals seem to be the best candidates because of their extremely fast growth kinetics which ensures sufficiently short shape relaxation times (Keshishev *et al* 1982).

We have recently investigated the equilibrium shape of large ^{4}He crystals in the vicinities of the two different RT ($T_R = 1{\cdot}2$ K and 0·9 K) by a simple optical technique which provides the temperature and angular dependences of the surface stiffness (Babkin *et al* 1958, 1984, 1985). The data obtained by this method show, in accord with theory, that both studied RT being continuous phase transitions. However, the measured critical behaviour of the surface stiffness cannot be explained satisfactorily by current theories, either by the phenomenological "mean field" theory (Andreev 1981) or by the lattice model calculation (Rottman and Wortis 1984).

Keywords. Roughening transitions; helium crystal.

PACS No. 67·80

References

Andreev A F 1981 *Sov. Phys. JETP* **53** 1063
Babkin A V, Keshishev K O, Kopeliovich D B and Parshin A Ya 1958 *Appl. Surf. Sci.* **22/23** 696
Babkin A V, Keshishev K O, Kopeliovich D B and Parshin A Ya 1984 *JETP Lett.* **39** 633
Babkin A V, Kopeliovich D B and Parshin A Ya 1985 *Zh. Eksp. Teor. Fiz.* **89** 2288
Burton W K and Cabrera N 1949 *Disc. Farad. Soc.* **5** 33
Keshishev K O, Parshin A Ya, Shal'nikov A J 1982 in *Soviet scientific reviews, Section A: Phys Rev.* (ed.) I M Khaltnikov (Harwood Academic Chur) V. 4 p. 155
Rottman C and Wortis M 1984 *Phys. Rev.* **B29** 328