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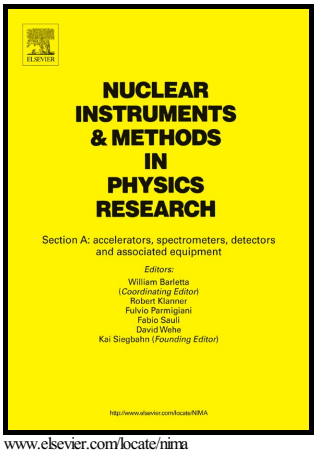

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Cryogenic system for X-ray Compton scattering measurements of superfluid helium below 2 K

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Abstract

A cryostat was constructed for high-resolution X-ray Compton scattering measurements at temperature down to 1.7 K, in order to investigate superfluid helium-4. Compton profiles of helium were measured using synchrotron X-rays for gas and liquid phases, respectively. In the measurement of the liquid phase, we succeeded in measuring the Compton profile of the superfluid helium at 1.7 K. Comparison of the results with theoretical calculation reveals importance of many-body effects beyond the mean-field treatment of electron systems.

Keywords: Synchrotron radiation, Compton scattering, Liquid helium, Superfluidity

1. Introduction

Liquid helium provides various interesting topics to the condensed matter physics.[1, 2] The quantum mechanical motion plays an important role for the nature of liquid helium. For example, it remains liquid even in zero kelvin at 1 atm due to its large zero-point motion. The most fascinating feature of liquid helium is superfluidity. The superfluid transition takes place at $T_\lambda = 2.17$ K at ambient pressure, which is regarded as the Bose-Einstein condensation

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