Form 3

Abstract of Thesis

Name (Wei Min CHAN)	
Title	Study of ^{180m}Ta Decay and Development of Ultra-low Background Gamma-ray Spectrometry (^{180m}Taの崩壊の研究と超低バックグラウンドガンマ線スペクトロメトリーの開発)

Abstract of Thesis

Among all nuclear isomers that exist in nature, tantalum-180m (^{180m}Ta) has the longest half-life of more than 10^{16} years. Due to the highly forbidden transition with large spin parity difference from ground state, its half-life is yet to be finalized up until now. To achieve the most sensitive detection of ^{180m}Ta decay, ultra-low background condition is essential. In this research, a new ultra-low background HPGe detector system of CANDLES Collaboration was developed at Kamioka Underground Observatory and utilized to observe the rare decay of ^{180m}Ta. Two phases of tantalum physics run were completed, which Phase II has further background reduction on the detector system. The detector performance and background condition during the tantalum measurement were analyzed. Monte Carlo simulation was constructed for the new detector system to obtain the detection efficiency and study the interaction of gamma-rays with detector. To further reduce the background level, a new type of pulse shape discrimination (PSD) method for coaxial Ge detector was developed. Using the new PSD method, Compton background event at energy region less than 200 keV can be rejected effectively. By combined the experiment data in Tantalum Phase I and Phase II, physics runs with total livetime of 358.2 days was obtained. With various background reduction techniques and long-term tantalum measurement, the world most stringent half-life limit of ^{180m}Ta has been successfully achieved.

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論文審査の結果の要旨及び担当者

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論文審査の結果の要旨

Among all nuclear isomers that exist in nature, tantalum-180m (^{180m}Ta) has the longest half-life of more than 10^{16} years. Due to the highly forbidden transition with large spin parity difference from ground state, its half-life is yet to be finalized up until now. To achieve the most sensitive detection of ^{180m}Ta decay, ultra-low background condition is essential. In this research, a new ultra-low background HPGe detector system of CANDLES Collaboration was developed at Kamioka Underground Observatory and utilized to observe the rare decay of ^{180m}Ta. Two phases of tantalum physics run were completed, which Phase II has further background reduction on the detector system. The detector performance and background condition during the tantalum measurement were analyzed. Monte Carlo simulation was constructed for the new detector system to obtain the detection efficiency and study the interaction of gamma-rays with detector. To further reduce the background level, a new type of pulse shape discrimination (PSD) method for coaxial Ge detector was developed. Using the new PSD method, Compton background event at energy region less than 200 keV can be rejected effectively. By combined the experiment data in Tantalum Phase I and Phase II, physics runs with total livetime of 358.2 days was obtained. With various background reduction techniques and long-term tantalum measurement, the world most stringent half-life limit of ^{180m}Ta has been successfully achieved.

よって、本論文は博士（理学）の学位論文として十分価値あるものと認める。