博士論文公聴会の公示（物理学専攻）

学位申請者：田中　聖臣

論文題目： Determination of nuclear matter radii of Ca isotopes across the neutron magic number $N = 28$ via interaction cross section measurements

（相互作用断面積測定による中性子魔法数 $N = 28$ をまたぐ領域での Ca 同位体核物質半径の決定）

日時：2018 年 5 月 8 日（火） 13:00－14:30

場所：理学研究科 H 棟 7 階セミナー室（H701 号室）

主査：久野良孝

副査：青井考、緒方一介、王惠仁、川畑貴裕、福田光順

論文要旨:

Interaction cross sections σ_I for $^{42-51}$Ca on C target at around 270 MeV/nucleon have been measured at the Radioactive Isotope Beam Factory (RIBF) at RIKEN by using the BigRIPS fragment separator. The present σ_I data are the first systematic ones along the isotopic chain in Ca mass region. Based on the Glauber-type calculation with the modified optical limit approximation, the root-mean-square matter radii $\langle r^2 \rangle_m^{1/2}$ were successfully deduced.

For Ca isotopes, significant enhancements of $\langle r^2 \rangle_m^{1/2}$ compared to the systematics of spherical nuclear radii has been observed in the region beyond the neutron magic number $N = 28$. Those enhancements were examined with the several models. Within the simple single particle model, the significant core enlargement is required to explain the systematics of present experimental $\langle r^2 \rangle_m^{1/2}$ for $^{49-51}$Ca. On the other hand, the Hartree Fock calculations indicate that the enhancement is due to the rapid increase of surface diffuseness. However, any calculations cannot explain the significantly large enhancements of experimental results quantitatively.

We also obtained neutron skin thicknesses r_{np} from the deduced $\langle r^2 \rangle_m^{1/2}$ in combination with the previously measured charge radii. By using the obtained r_{np} for Ca isotopes, the sensitivity to the equation-of-state parameter L was examined with the help of mean field calculations. By utilizing the relative values of r_{np}, present data have a sensitivity of about 30 MeV precision to determine L without a fatal systematic error. Present r_{np} which were directly determined from the experimental proton and matter radii in the wide range of the relative neutron excess $\delta = (N - Z)/A$ of $0.05 < \delta < 0.22$ are more reliable compared to the previous experimental studies mainly with the indirect method. The future progress in the theoretical framework which explain quantitatively the evolution of nuclear radii for Ca isotopes including $^{49-51}$Ca probably enables us to extract a reliable L value from the present directly-determined r_{np}.