RCNP EXPERIMENT E

PROPOSAL FOR EXPERIMENT AT RCNP

December 21, 2020

TITLE:
Identification of the α-condensed state in ^{20}Ne

SPOKESPERSON:

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RUNNING TIME:	Installation time without beam		5 days
	Setup and beam tuning time		2 days
	Data runs		10.0 days
BEAM LINE:			Ring : WS course
BEAM REQUIREMENTS:		Type of particle	$^{4}He^{++}$
		Beam energy	386 MeV
		Beam intensity	$\leq$ 30 pnA
		Energy resolution	$\leq$ 100 keV
		RF timing resolution	$\leq$ 1 ns
		Achromatic beam transport	
		halo-free, small emittance	
BUDGET:	Experimental expenses		1,350,000 yen

SAFETY CONTROLLED ITEMS:

The VDCs of Grand Raiden

^{20}Ne gas target

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SUMMARY OF THE PROPOSAL

The alpha-cluster correlation is a very important property of atomic nuclei. It is theoretically suggested that the α condensation where alpha clusters are condensed state into the same lowest $0s$ orbit in their common mean field manifests at low densities and temperatures. The equation of state of nuclear matter is hence influenced by the α condensation.

The α condensation is expected to manifest in finite nuclei as the α-condensed state, and such α-condensed states similar to the famous Hoyle state in ^{12}C are predicted to exist slightly above $k\alpha$-decay thresholds in heavier self-conjugate $A = 4k$ nuclei up to $k \sim 10$. Therefore, it should be examined whether the α-condensed states universally exist in heavier nuclei.

The candidate states of the α-condensed states are already assigned for ^{8}Be, ^{12}C, and ^{16}O, but no known states have been assigned for heavier nuclei. Recently, we reported the candidate states of the α-condensed state in ^{20}Ne based on the results of the experiment E402. However, statistical significance of the candidate states is not fully high and we could not determine the spins and parities of these states.

We propose to identify the α-condensed state in ^{20}Ne by a series of measurements of the inelastic α scattering at forward angles including 0° in coincidence with the detection of the decay charged particles from the excited states. This coincidence measurement is very promising because we have already presented the candidates states in ^{20}Ne by the same measurement. A gas target with very thin gas-sealing windows enables low-energy decay charged particle to penetrate the target cell, and a new Si telescope array with a large solid angle, SAKRA, is employed to detect the decay charged particle in order to overcome the low luminosity due to the low mass thickness of the target. The proposed experiment should provide the convincing result for the α-condensed state in ^{20}Ne.