E423

RCNP EXPERIMENT E

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE:

α-clustering at the surface of $^{112-124}$Sn nuclei investigated in (p,pα) quasi-free knockout reactions

SPOKESPERSON:

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EXPERIMENTAL GROUP:

Full Name	Institution	Title or Position
Thomas Aumann	TU Darmstadt	P
Heiko Scheit	TU Darmstadt	R
Stefanos Paschalis	TU Darmstadt	PD
Joachim Tscheuschner	TU Darmstadt	PhD
Stefan Typel	GSI	R
Tomohiro Uesaka	RIKEN Nishina Center	CS
Masaki Sasano	RIKEN Nishina Center	R
Juzo Zenihiro	RIKEN Nishina Center	R
Hideaki Otsu	RIKEN Nishina Center	R
Masanori Dozono	RIKEN Nishina Center	PD
Shinsuke Ota	Center for Nuclear Study, University of Tokyo	A
Hiroshi Tokieda	Center for Nuclear Study, University of Tokyo	D3
Leung Tsz Tang	Center for Nuclear Study, University of Tokyo	D3
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Takashi Nakamura	Tokyo Institute of Technology	P
Takahiro Kawabata	Department of Physics, Kyoto University	AP
Miho Tsumura	Department of Physics, Kyoto University	M2
Tetsuo Noro	Department of Physics, Kyushu University	P
Satoshi Sakaguchi	Department of Physics, Kyushu University	A
Yukie Maeda	Department of Applied Physics, University of Miyazaki	A

RUNNING TIME:	Installation time without beam		5 days
	Detector Setup		1 day
	Data runs		5 days
BEAM LINE:			Ring : WS course
BEAM REQUIREMENTS:		Type of particle	p
		Beam energy	300 MeV
		Beam intensity	$\leq$ 500 nA
		Any other requirements	halo-free, small emittance
BUDGET:	Experimental expenses		800,000 yen for travel expenses

Proposal for an experiment at the RCNP Cyclotron Facility

Submitted to RCNP for the B-PAC evaluation in March 2014

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Principle investigators:

Experiment: T. Aumann (TU Darmstadt)
T. Uesaka (RIKEN)

Theory: S. Typel (GSI)

Summary of experiment

We propose an experiment to study the effect of α-clustering at the surface of heavy nuclei. We plan to measure the cross section for proton induced quasi-free α knockout on Sn isotopes, which is directly related to the probability of preformed α clusters at the nuclear surface. This effect has been predicted by generalized relativistic mean field calculations, which allow explicitly for clustering degrees of freedom, to occur in low-density nuclear matter and at the surface of heavy nuclei. This effect is important for the equation of state needed to describe properties of dilute matter in core-collapse supernovae, but also would have consequences on the effect of the neutron-skin thickness and its relation to the density dependence of the symmetry energy. In addition, the preforming of α clusters as a prerequisite for α decay would be naturally explained. Since the effect is predicted to depend also on the N/Z ratio of nuclei, we propose to investigate the Sn isotopic chain in order to test the theoretical prediction. We plan experiments with enriched targets of ^{112}Sn, ^{116}Sn, ^{120}Sn, and ^{124}Sn. The (p,pα) cross section will be measured in quasi-free kinematics by detecting the scattered protons with Grand Raiden, and the knocked out alpha particles with the large-acceptance spectrometer LAS. For two of the systems (^{112}Sn and ^{124}Sn), several spectrometer settings will be measured in order to reconstruct the intrinsic momentum distribution of the alpha particle. The proton beam energy will be 300 MeV and a current of 300 pnA is considered for the rate estimate. In total, we request 5 days of beam time.