RCNP EXPERIMENT E264

PROPOSAL FOR EXPERIMENT AT RCNP

21/02/2005

TITLE:

Feasibility test for the permanent electric dipole moment search of francium atom
– Measurement of Francium yield produced from heavy-ion fusion reaction –

SPOKESPERSON:

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Y. Takahashi	Department of Physics, Kyoto University	AP
T. Murakami	Department of Physics, Kyoto University	A
B.P. Das	Indian institute of Astrophysics	P

RUNNING TIME:

5 days

BEAM LINE: New Beam Line: AVF extracted beam line
(construction will be completed in this spring)

BEAM REQUIREMENTS:

Type of particle	18O
Beam energy	$>$ 100 MeV
Beam intensity	> 1 muA
Energy resolution	—
Time resolution	—

BUDGET:

Total budget request	4,900,000
Experimental expenses	4,700,000
Travel plan	200,000

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SPOKESPERSON: Yasuhiro SAKEMI

SUMMARY OF THE PROPOSAL

Existence of an Electric Dipole Moment (EDM) of the elementary particle would imply that time-reversal (T) invariance and parity (P) are violated. Searches for the EDM of the electron are motivated by the existence of charge-parity (CP) violation in neutral kaon decay, which is known to be equivalent to T violation. According to the standard model, the electron EDM is far too small to be detected, but a number of models beyond the standard model predict values for the electron EDM large enough to be observed in practical experiments. In paramagnetic atoms an electron EDM results in an atomic EDM enhanced by the factor Z^{32}. The element which has largest enhancement factor is a heaviest alkali element francium (Fr). The Fr has no stable isotopes, and we can not make a concentrated sample due to a short life time. We propose to take the Fr atoms from heavy-ion fusion reaction products and inject them into a laser trap apparatus, where we obtain a cold dense cloud of neutral Fr atoms. The key point to achieve the high precision search of the EDM is a production yield of Fr atoms. The goal of this proposed experiment is to establish the experimental technique to produce and collect the Fr atoms, transport to the trapping chamber with high transmission efficiency, and to get more than10^7 Fr atoms/s which is the highest production rate in the world.