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Developed plunger facility for ps lifetimes and g-factor of short lived states at IMP

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A new plunger based facility has been recently developed at Institute of Modern Physics (IMP), Lanzhou. This facility will be used to measure the nuclear level lifetimes in *ns-ps* range and the g-factor, providing deep insight into the study of nuclear wave functions and structure of nucleus. It is based on the plunger technique of Alexander and Bell [1], well known at present for the measurement of lifetimes depending on the Doppler shifts of γ-rays emitted during the reaction [2-4] based on Recoil Distance Method (RDM). The detailed explanation of the above mentioned technique, its application in nuclear gamma spectroscopy and the related data analysis can be found in the refs. [1, 2, 5] . At IMP, the newly designed plunger follows the principle of capacitance measurement measuring the minimum distance in between the two parallel foils, making the capacitance. Minimum the distance measured between the foils allow to measure shorter lifetimes for the decaying state produced during the reaction.

This setup consists of a PI-Q521 motor, capable of moving in the range of 32 *mm* in total with a step accuracy of 2 *nm*. The two foils i.e. target and stopper are mounted on this motor with some special type of structure designed using Inventor 2019 tool. The designed setup is quite small in size and the foils used for making the parallel arrangement are also very thin having thickness ranging from *μg/cm2* to *mg/cm2*, depending on the requirement of study. So, this setup requires high level of expertise and care for handling the motion of motor and the foils stretched with specially designed cones for this purpose. For controlling the motion of motor, LABVIEW based program has been developed which not only controls the motion but also has been upgraded to keep an eye on the variation of capacitance observed due to some mechanical disturbance arising during the experiment. This designed setup has been recently used for an in-beam test experiment to test the proper working of motor, physical effect on the foils with incident beam, to observe the capacitance fluctuations and the LABVIEW based feedback program to minimize the effects due to mechanical disturbances. During test run, positive results have been observed with some small issues needed to be rectified before performing the other in-beam experiment focusing on lifetimes as well as g-factor measurement. In near future, this newly designed setup will allow us to measure the lifetimes based on RDM technique, and the g-factor of short-lived excited states employing the Time Differential Recoil in Vacuum technique (TDRIV) [6, 7] providing indispensable information for rigorous tests of the nuclear models. There is also plan of using this setup with radioactive ion beams available at IMP, China and Research Center for Nuclear Physics (RCNP), Japan.

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Field of your work

Experiental nuclear physics

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