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J.Wojtkowska, V.Evseyev, T.Kozlowski,
V.Roganov

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It has been proposed in some theoretical works[1-4] that in nuclear muon and pion capture the excitation of collective states in the intermediate nucleus is of importance. These states are the isotope analogues of the giant dipole resonance states excited in photo-nuclear and (e, e′) reactions. An indirect confirmation of this machanism was the agreement of the experimental total muon capture rates with the theoretical ones obtained under this assumption. According to /1,4,5/ the peaks in the experimental neutron spectrum should be a direct confirmation of the important role of the resonant excitation of the intermediate nucleus in muon capture.

Up to now the muon capture neutron spectra were measured with poor resolution neutron spectrometers[6,7]. In the present work preliminary results on the measurements of neutron spectra from muon capture on $^{32}S$ and $^{40}Ca$ in the (2 - 13) MeV energy region and a relatively good resolution are presented. This work was performed using the pure muon beam from the muon channel[8] of the Dubna 680 MeV synchrocyclotron.

The experimental set-up is shown in Fig.1. The incident muon beam, which had the 150 MeV/c momentum, passed through monitor counters 1 and 2. then was moderated bv a carbon absorber and stopped in the target (stop events were detected by $123\bar{4}$ coincidences).

Sulphur and metallic calcium targets were 4g/cm$^2$ thick. The stilbene crystal (30 mm in diameter, and 20 mm high) with the 56 AVP photomultiplier was used as a neutron detector. The anticoincidence circuit between the neutron detector and counters 1 and 4 was employed. The zero-crossing pulse shape discriminator was used to distinguish between neutrons and $\gamma$-rays. The operation of the electronic logic was such as to detect neutrons for 1 $\mu$sec time interval, passed 0.05 $\mu$sec after muon stopping. In muon stopping and neutron spectrometer channels the antipile-up circuits with a 6 $\mu$sec dead time were used. The coincidences between muon stopping and neutron spectrometer pulses triggered the multichannel analyser in which the proton and electron spectra were measured simultaneously. The background measured with LiH target was equal to $\cong$ 3% for proton energy $E_p = 2$ MeV and $\cong$ 0.4% for $E_p = 12$ MeV. The energy calibration of the neutron spectrometer was performed using the standard $\gamma$-ray and (Po-Be) sources. The energy resolution (FWHM) has been found to be 0.35 MeV for $E_p = 2$ MeV and 0.8 MeV for $E_p = 12$ MeV. The long time gain stability of the arrangement was better than2%.

Pulse-height analyser proton spectra were devided into 0.25 MeV bins. The neutron spectra obtained by the differentiation of the proton spectra and corrected for the efficiency of the neutron detector are shown in Fig.2. These spectra have a complicated line structure. These results are the first direct experimental confirmation of the resonance mechanism of muon capture.

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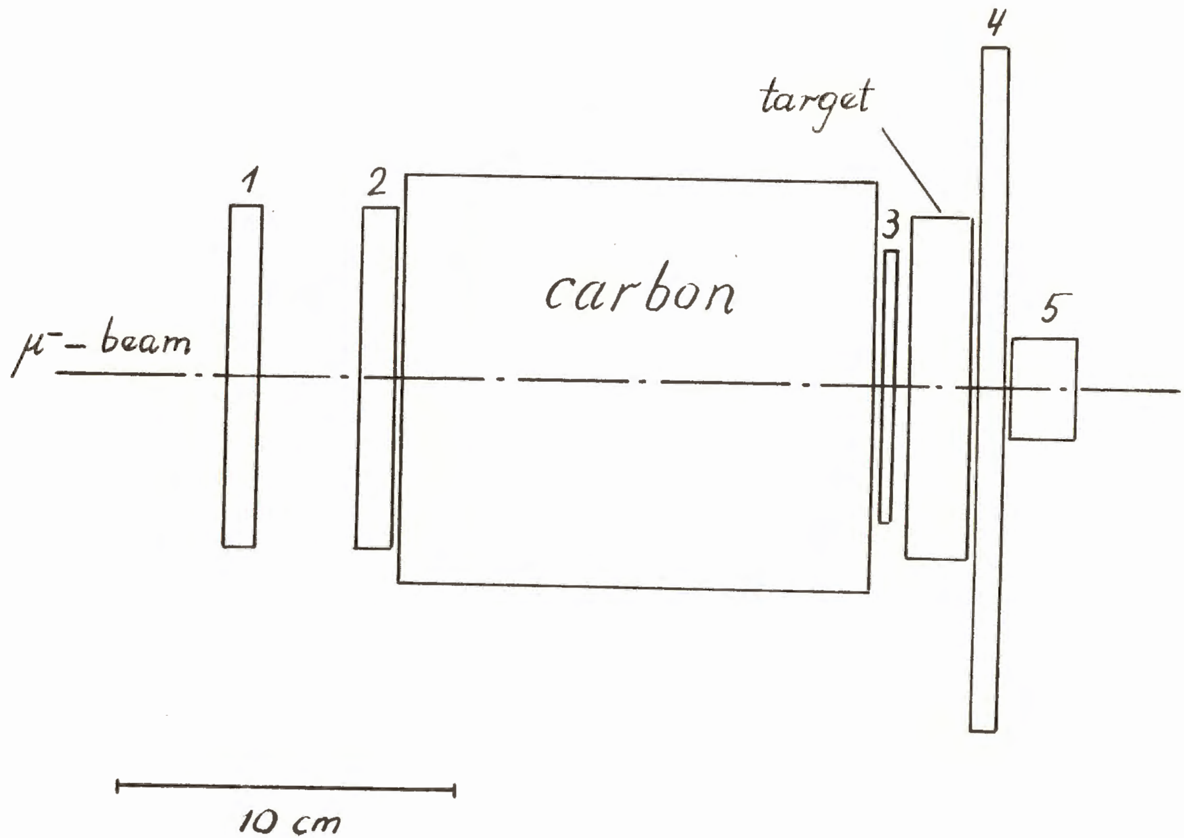


Fig. 1.Experimental arrangement.

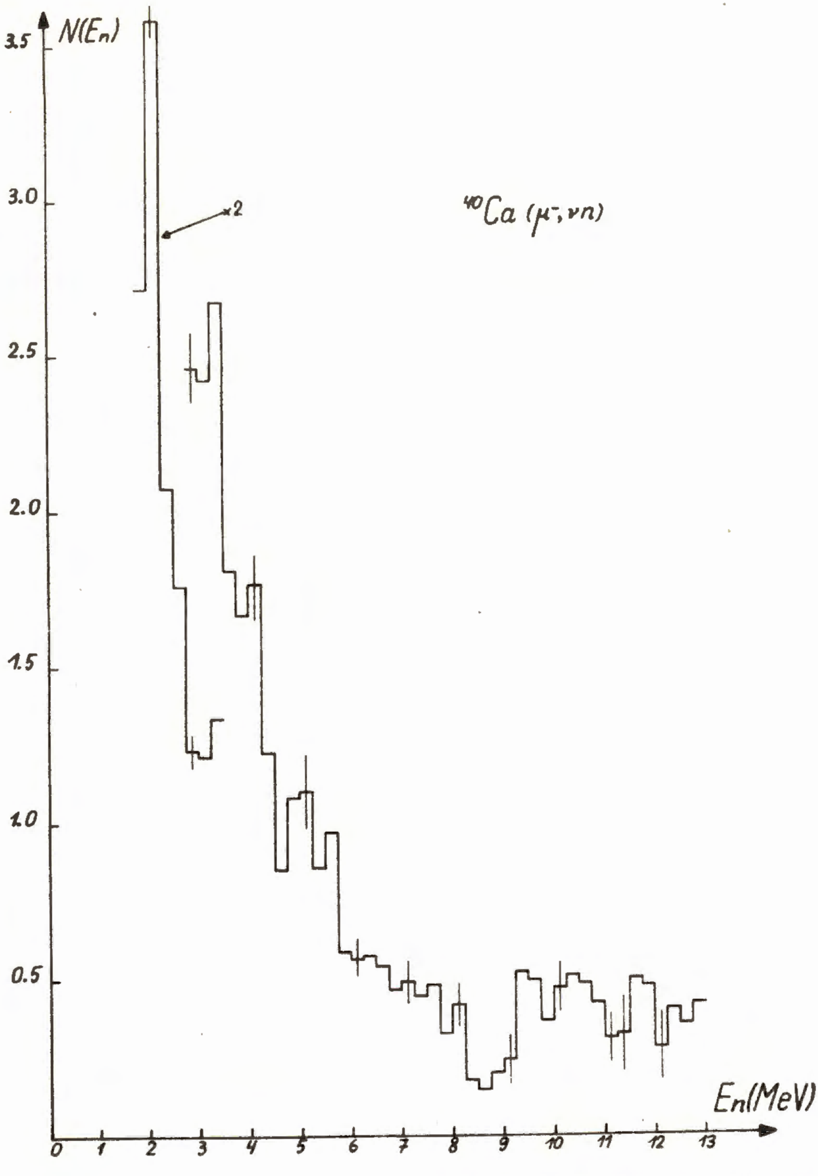


Fig.2. Energy neutron spectra (arbitrary units) from $\mu^-$ - capture on calcium .

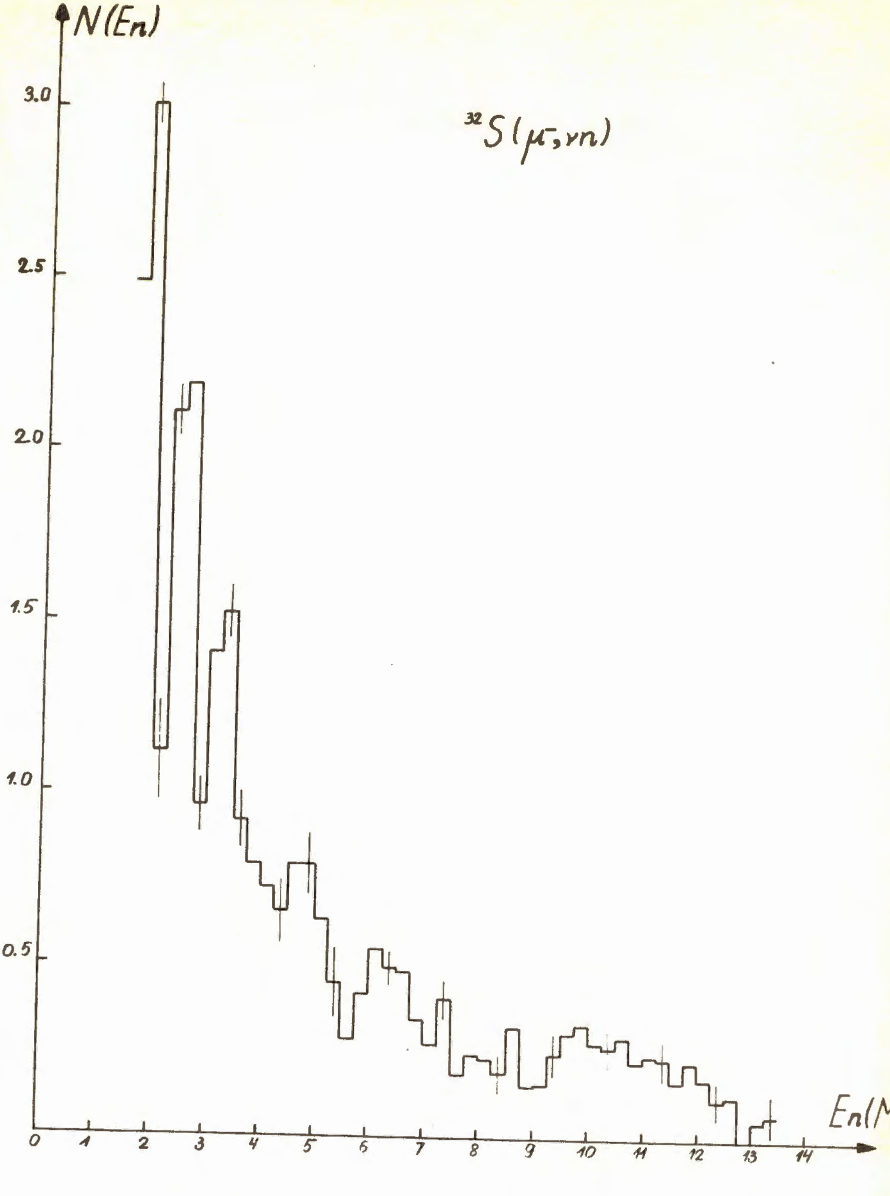


Fig. 3. Energy neutron spectra (arbitrary units) from $\mu^-$-capture on sulphur.