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A SEARCH FOR EXCITED STATES OF  $3\text{He}$

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### Publication Date

1967-03-02

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Submitted to Physics Letters

UCRL-17422  
Preprint

UNIVERSITY OF CALIFORNIA

Lawrence Radiation Laboratory  
Berkeley, California

AEC Contract No. W-7405-eng-48

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March 2, 1967

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March 2, 1967

Abstract

The  ${}^3\text{He} + {}^3\text{He}$  interaction does not excite sharp states of  ${}^3\text{He}$  with a cross section larger than  $120 \mu\text{bsr}^{-1}$  below 30 MeV excitation.

The possible existence of a bound trineutron<sup>1)</sup> has stimulated the search for states of the three nucleon systems, although conflicting evidence has been reported recently with respect to the original experiment<sup>2)</sup>. Kim et al.<sup>3)</sup> have investigated the reaction  $p + {}^3\text{He}$  at 30.2 MeV laboratory energy, and have observed peaks in the proton spectra at 8.2, 10.2 and 12.6 MeV excitation. Such peaks were observed at two laboratory angles and were interpreted as a possible indication of states of the  ${}^3\text{He}$  nucleus. The cross section for excitation of the 10.2 MeV state was estimated to be about  $2 \times 10^3 \mu\text{bsr}^{-1}$  at  $\theta_{\text{LAB}} = 15^\circ$ , and somewhat lower values were obtained for the other two states. In contrast, at 25 MeV laboratory energy Austin et al. observed no peaks in the  $p + \text{He}^3$  interaction<sup>4)</sup> and established a limit of  $250 \mu\text{bsr}^{-1}$  for the cross section for such states of  $\text{He}^3$ , from this reaction.

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<sup>‡</sup> Summer visitor from California Institute of Technology.

On the other hand Baldin<sup>5)</sup> has predicted the existence of a state within the investigated energy region.

Warner et al.<sup>6)</sup> have investigated the  $^4\text{He} + ^3\text{He}$  reaction and their conclusion was that no peaks (attributable to unbound  $T = 1/2$  levels of  $^3\text{He}$ ) were observed down to a cross section of about  $300 \mu\text{bsr}^{-1}$ .

We have investigated the  $^3\text{He} + ^3\text{He}$  interaction at 44 and 53 MeV laboratory energy, using the  $^3\text{He}$  beam of the Berkeley 88-inch isochronous cyclotron. The  $^3\text{He}$  spectra were detected using Si detector telescopes together with an electronic particle identifier circuit<sup>7)</sup>, over a wide angular range from  $5^\circ$  to  $42^\circ$  laboratory angles. Calibration spectra were obtained from the reaction  $^{14}\text{N}(^3\text{He}, ^3\text{He}')^{14}\text{N}^*$ . The identified  $^3\text{He}$  energy spectra were recorded using a 4096 channel analyzer. Figures 1 and 3 exhibit the general features of the measured spectra, and fig. 2 shows a spectrum obtained under identical experimental conditions from  $^{14}\text{N} + \text{He}^3$ , for comparison. The analysis of our spectra is consistent with the absence of sharp peaks to a limit of about  $120 \mu\text{bsr}^{-1}$ , and up to about 30 MeV excitation for the smallest angle measured.

In conclusion, the  $\text{He}^3 + \text{He}^3$  interaction can reach both  $T = 1/2$  and  $T = 3/2$  states, and our results indicate that no such states are excited down to cross section values much lower than those mentioned by Kim et al.<sup>3)</sup> for the  $p + \text{He}^3$  interaction.

We wish to acknowledge the assistance of D. Landis with the electronic equipment, J. Meneghetti with the mechanical part of the experiment and R. Lothrop who made the Si detectors.

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## Figure Captions

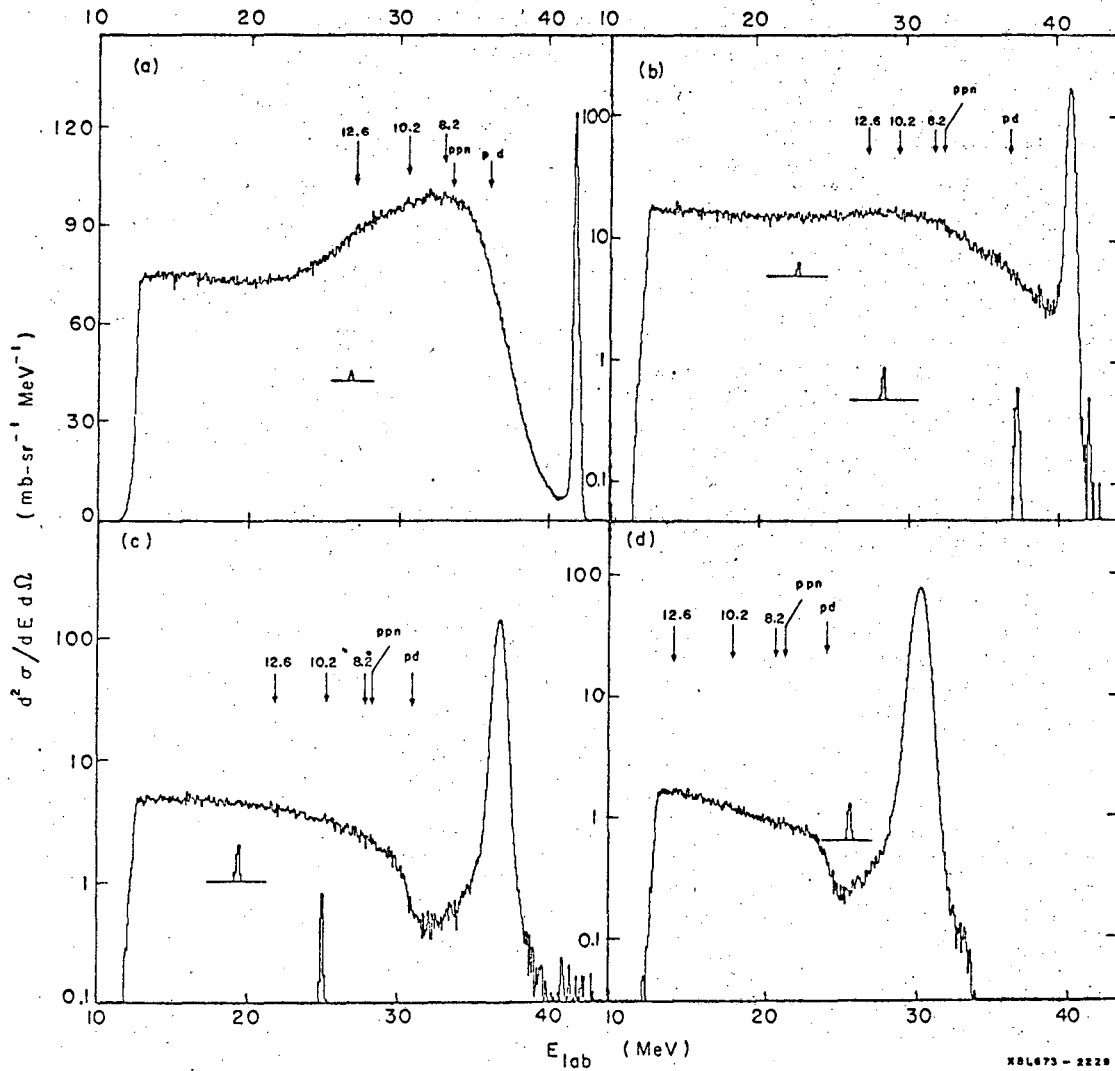
Fig. 1. Sample spectra at 44 MeV. Peaks corresponding to a cross section of  $120 \mu\text{b}\text{-sr}^{-1}$  are drawn for comparison. The low energy cut-off is due to the  $\Delta E$  detector thickness of the telescope. Thresholds and "states" are indicated by arrows.

a)  $5^\circ$  Lab b)  $10^\circ$  Lab c)  $20^\circ$  Lab d)  $31^\circ$  Lab. Spectra a) and b) show an electronically attenuated elastic group.

Fig. 2. Comparison spectrum from  $^{14}\text{N}(^3\text{He}, ^3\text{He})^{14}\text{N}^*$  at  $\theta_{\text{LAB}} = 15^\circ$ , taken under identical experimental conditions. The arrow points to a peak of cross section  $90 \mu\text{b}\text{-sr}^{-1}$ .

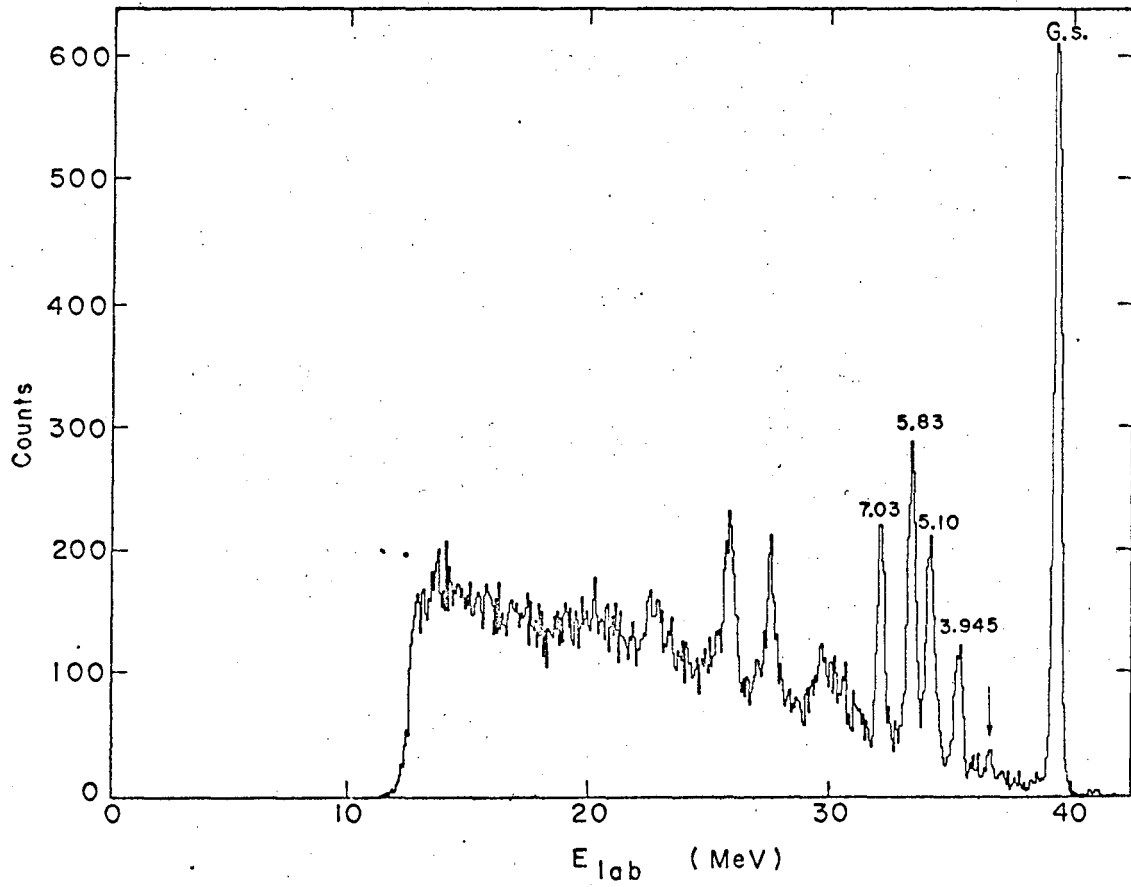
Fig. 3. Sample spectra at 53 MeV. Comparison peaks of  $120 \mu\text{b}\text{-sr}^{-1}$  are shown a)  $7^\circ$  Lab b)  $14^\circ$  Lab c)  $25^\circ$  Lab. Spectrum a) has an electronically attenuated elastic group.





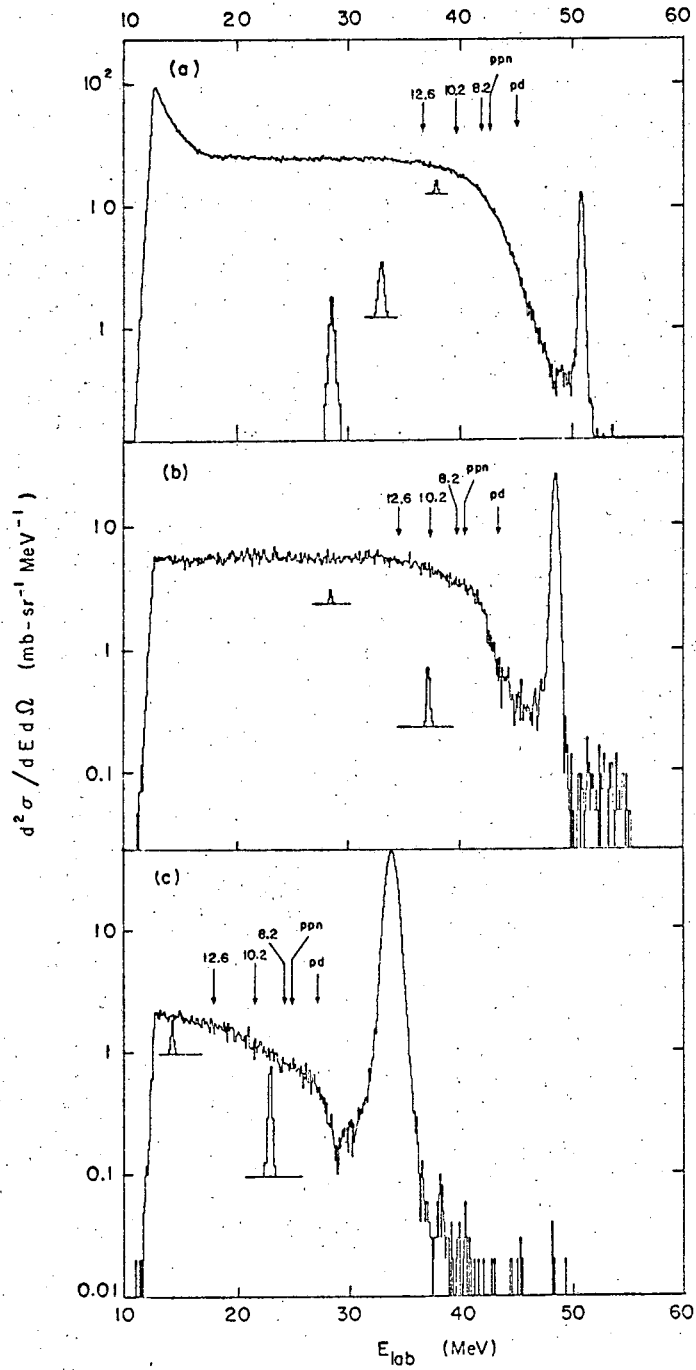
XBL673 - 2228

Fig. 1



XBL673-2228

Fig. 2



KRL 673-2230

Fig. 3

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