David Measdays presentation (March 30, 2000) D.M.1

Muon capture in nuclei.

The focus of these few remarks is the characteristics of muon capture in likely contaminants of the hydrogen T.P.C., and what might be useful and relevant. The table gives the overall situation, mainly from:—
T. Suzuki et al., Phys. Rev C35 2212 (1987)
This information above the line is known better than needed for the experiment. Very little experimental information has appeared since the Suzuki paper, except for the SIN/Bonn data on heavy elements.

Charged particle results are given in the illustrations. The results in Fig. 3 are from:—
S.E. Sobottka and E.L. Wills, Phys. Rev. Lett. 20 596 (1968)
They stopped muons in a silicon detector. No separation was possible between protons, deuterons and alphas, but total is (15±2)% of muon captures (Below 1.5 MeV is the heavy ion recoil). Protons/deuterons is roughly 2:1 above 18 MeV. In Fig 4.25 are the results for protons and alphas from μ^- stopping in AgBr. This figure is from:—
M. Lifshitz and P. Singer, Phys. Rev Letters, 41 18 (1978)
See also M. Lifshitz and P. Singer, Phys. Rev. C22 2135 (1980)

The data are from:—
[illegible]

(D.M.2)

The later data of:-

D. Kotelchuk and J.V. Tyler, Phys. Rev. 165 1190 (1968) have better statistics, but are not as useful, because they could not separate protons and deuterons. For light nuclei, Morinaga and Fry found 9.5(11)% of captures gave protons, 3.4(7)% gave alphas, whereas for AgBr 2.2(2)% gave protons and 0.5(1)% gave alphas.

For neon it was found that 20±4% gave charged particles. V.I. Komarov and O.V. Savchenko Sov. J. Nucl. Phys. 8 239 (1969) Unfortunately no information was given on particle identification or energy spectra.

Note that for heavy nuclei, most protons are accompanied by one or even 2 neutrons, see A. Wyttenbach et al, Nucl Phys. A294 278 (1978) Komarov and Savchenko saw 42 one prong events and 9 events with 2 or more prongs. Morinaga and Fry also report some complex stars. Thus:-

1) There is a minimum proton and alpha energy, diagnostic of the element on which the capture occurs.
2) Particles with a range of 10 cm in 10 bar hydrogen are 4 MeV protons; 10 MeV α has a range of 5 cm. Thus most protons will escape, but most alphas stop in the chamber.
3) Deuteron mix < 18 MeV is NOT known.

D.F. Measday
March 31, 2000.

Muon Capture in "Gases"

	C	N	O	Ne	Si	Ar
Huff factor	1.00	1.00	0.998	0.997	0.992	0.988
μ^- decay rate ($10^3 s^{-1}$)	455.16	455.16	454.2	453.8	451.5	449.7
Capture rate ($10^3 s^{-1}$)	37.9(5)	66(4)	102.5(10)	231(10)	871.2(18)	1270(80)
Total rate ($10^3 s^{-1}$)	493.1(5)	521(4)	556.7(10)	685(10)	1322.7(18)	1720(80)
$\tau(\mu^-)$ ns	2028 (2)	1919(15)	1796 (3)	1460(21)	756(1)	581(25)
Capture / Total (%)	7.69(9)	12.7(6)	18.4(2)	33.7(10)	65.87(4)	73.8(12)
Bound states (%)	18.6(7)	9(2)	11(1)	~15	26(3)	~15
1n	50	47(8)	66	**55**	46	57
2n	18	31(8)	10	**10**	13	20
p d α	13(2)	13 (2)	13(2)	**20(4)**	15(2)	8
Recoil Energy (85 MeV/c) (MeV)	0.35	0.30	0.26	0.20	0.14	0.10
Range in H_2 10 bar (mm)	0.65		0.41			

D.J.H.
March 27, 2000

DM3

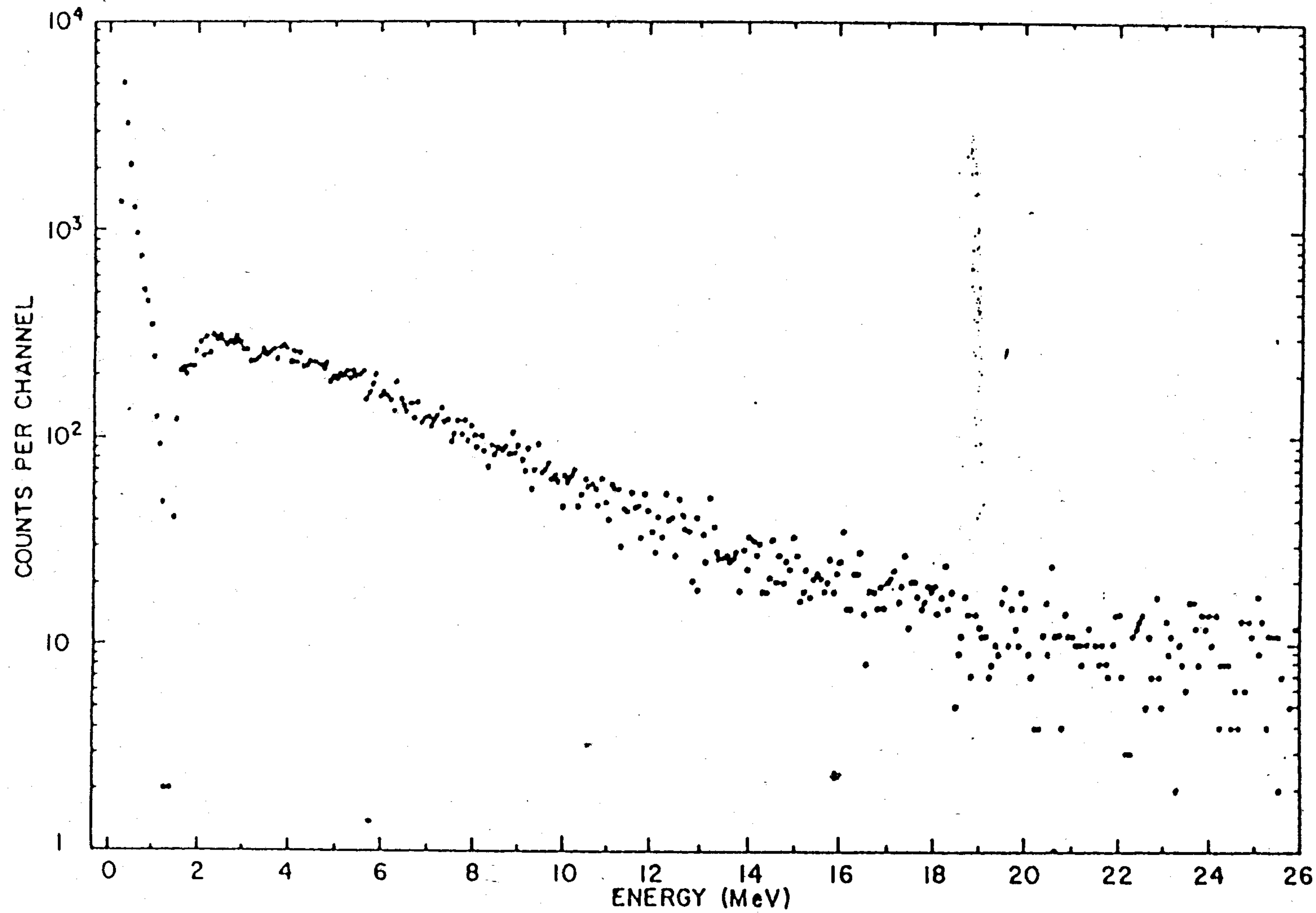
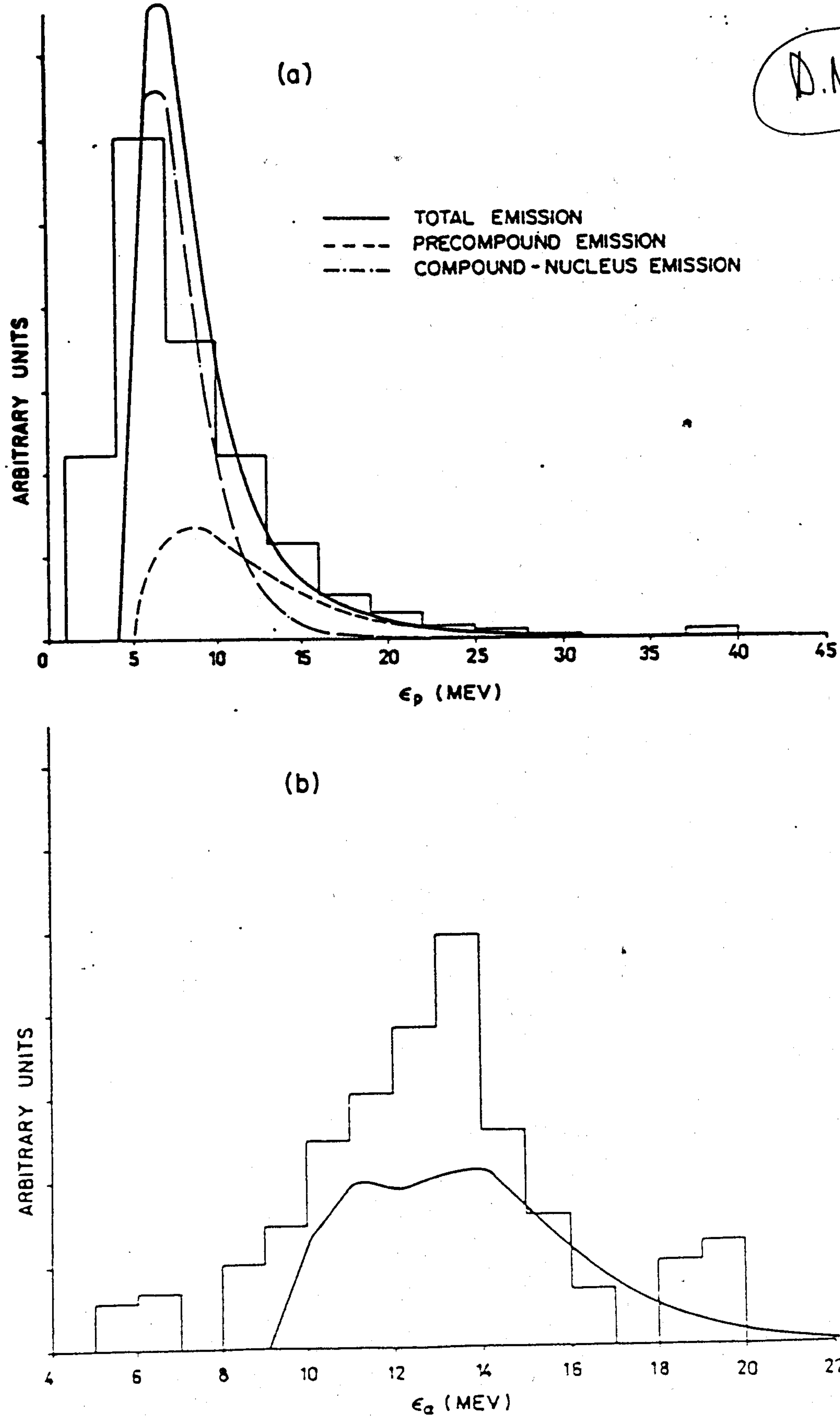


FIG. 3. Data after subtraction of muon-decay electron background and correction for escape of protons.

DM 4

D.M. 5



4.25 FIG. ~~2.~~ (a) Calculated energy spectrum curves of protons emitted after μ capture in AgBr, ~~versus the experimental histogram of Ref. ●.~~ [kotc] (b) Calculated energy spectrum of α's emitted after μ capture in AgBr, compared to the experimental histogram of Ref. ~~●.~~ [mori] All curves and histograms are normalized to the cal-