NEUTRON BACKGROUND IN THE TPC

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MOTIVATION

NEUTRONS BACKSCATTERED FROM THE COLLIMATOR:

$7.5\ 10^6$ n / bunch x ?

85 % HAVE $E_n < 20$ MeV

(PRELIMINARY FROM S. YE, QUOTED BY M. BATTAGLIA CERN MEETING FEB '99)

(WORK IN PROGRESS BY N. TESCH AND D. SCHULTE)

26.10^8 n / bunch x ? (N. TESCH, PREVIOUS TALK)

IF THE TPC GAS CONTAINS HYDROGENE

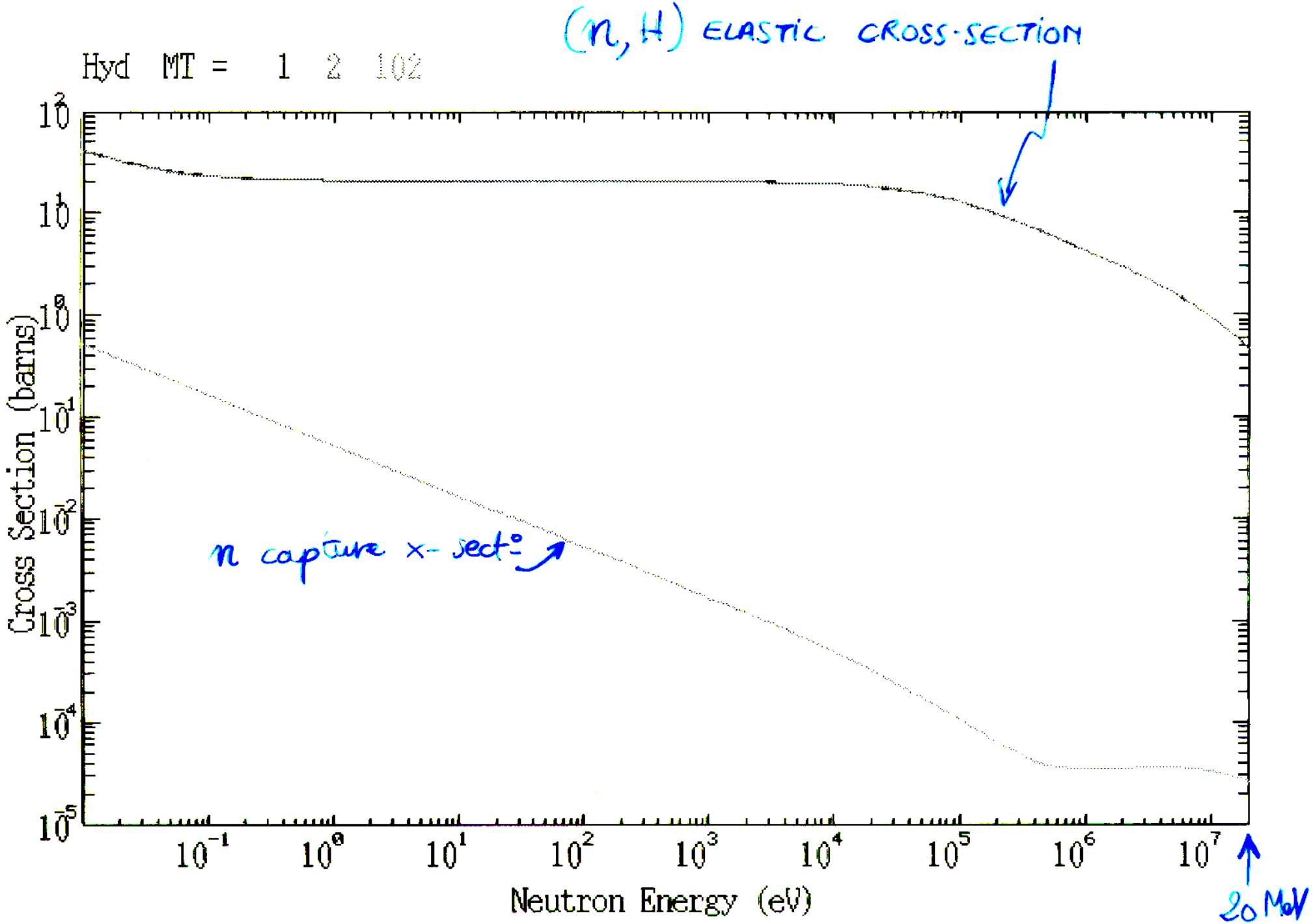
n CAN KNOCK OUT A p WHICH THEN IONISES.

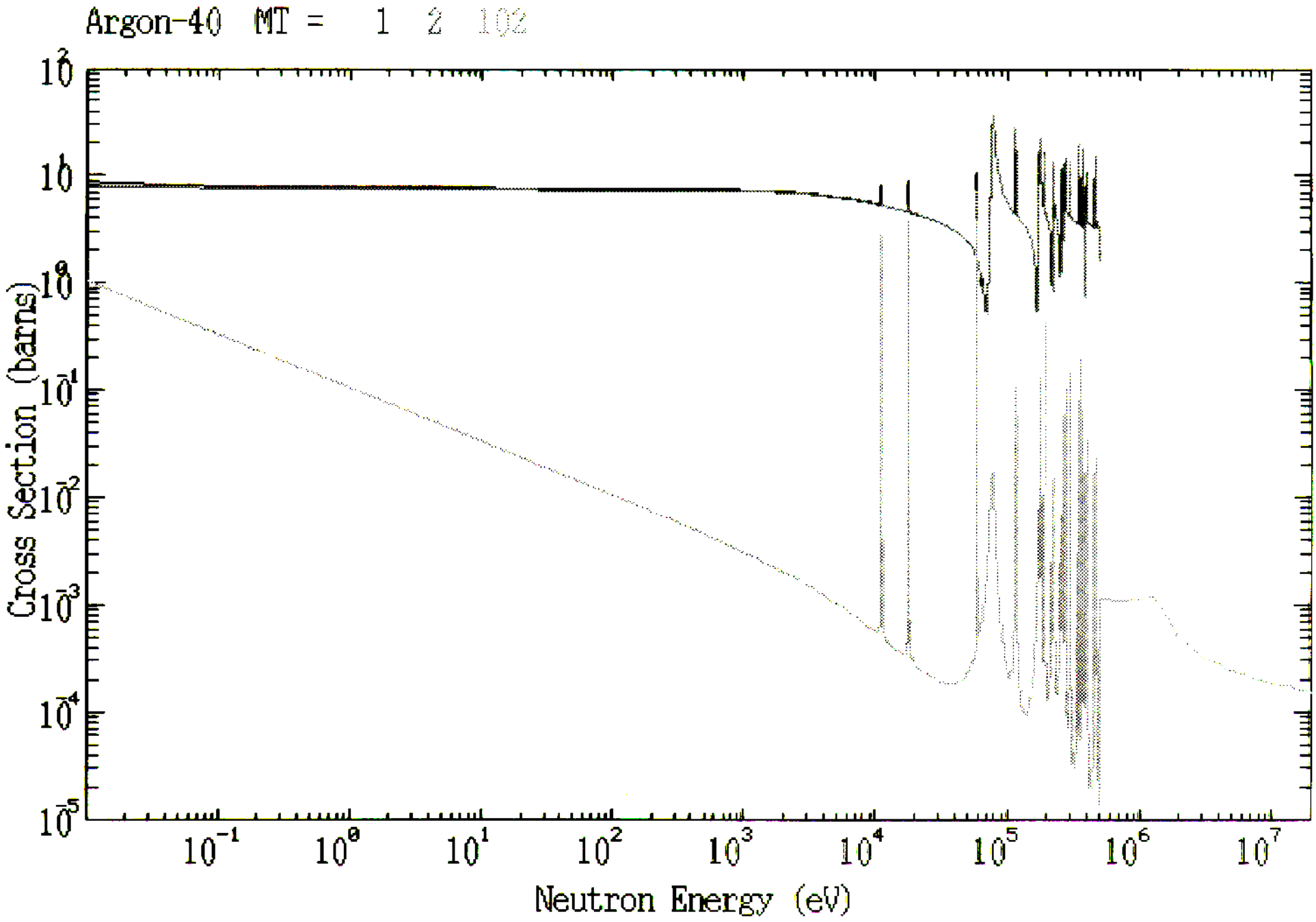
$E_n \rightarrow E_n/2$ ON AVERAGE AT EACH TIME

1 20 MeV n $\rightarrow$ 4 OR 5 "DOTS" IN THE TPC.

BEFORE BEING STOPPED AND THERMALIZED,

THEN CAPTURED.


(n, H) ELASTIC CROSS-SECTION
Hyd MT = 1 2 102
n capture x-sect°
Cross Section (barns)
Neutron Energy (eV)
20 MeV


Argon-40 MT = 1 2 102
Cross Section (barns)
Neutron Energy (eV)

NEGLECT RECOIL OF NUCLEI HEAVIER THAN ^1H.

TIME BETWEEN n-H COLLISIONS $t_{coll.}$

$$\sigma(E_n)\, v\, t_{coll.} = \frac{V_0}{N_A} / x$$

$22.4\ 10^3\ cm^3$ ← V_0

$6.02\ 10^{23}$ ← N_A

0.692 barns at 14 MeV ← $\sigma(E_n)$

$\sqrt{\frac{2E_n}{m_n}}$ ← v

x is the fraction of H per molecule in the gas

ex: 90% Ar + 10% CH_4 → $x = 0.40$

95% Ar + 5% C_4H_{10} → $x = 0.50$

$$t_{coll} = \frac{V_0}{x N_A} \frac{1}{\sigma(E_n)\sqrt{2E/m}}$$

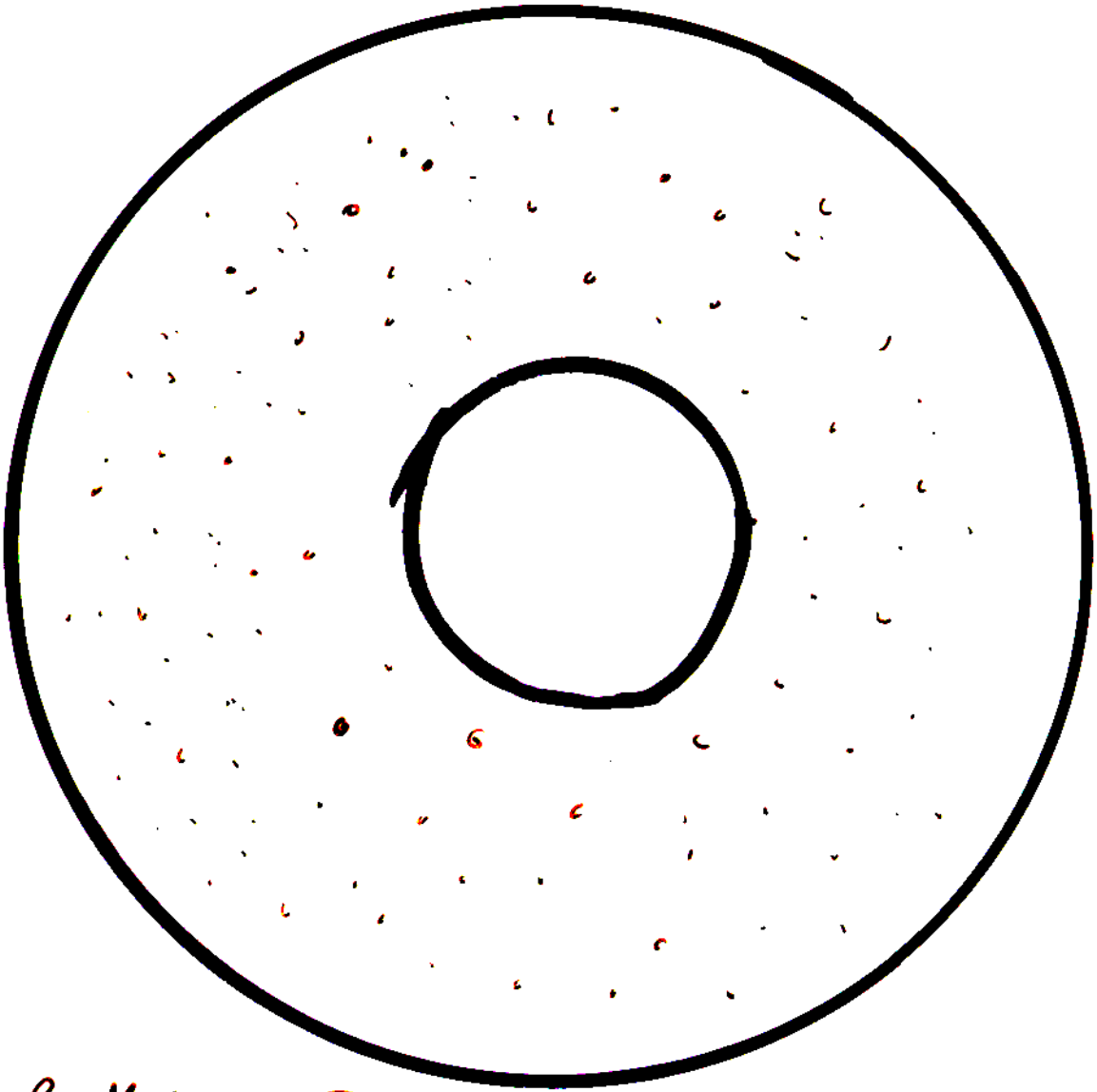
$$= \frac{12}{x}\ \mu s \quad \text{for } E_n = 20\ MeV\ (v = 2\ m/\mu s)\ (\rightarrow 50\ m)$$

$$= \frac{0.5}{x}\ \mu s \quad \text{for } E_n = 1\ MeV\ (v = 0.4\ m/\mu s)\ (0.4\ m)$$

EACH NEUTRON TRAPPED IN THE TPC
GIVES ~5 IONIZING PROTONS IN 40 μs

(120 bunch crossings)
(~ TYPICAL DRIFT TIME IN THE TPC)

WITH A FEW $n/cm^2/BX$:



20 MeV p $R = 1.6$ cm
1 MeV p $R = 0.8$ mm

CONCLUSION

- BETTER TO AVOID HAVING HYDROGENE IN THE GAS
  - → FIND A H-LESS QUENCHER
  - → OR NO QUENCHER?

- THINK ABOUT WHERE TO PUT n ABSORBERS.

- MORE WORK NEEDED TO SIMULATE Neutrons IN THE APPARATUS