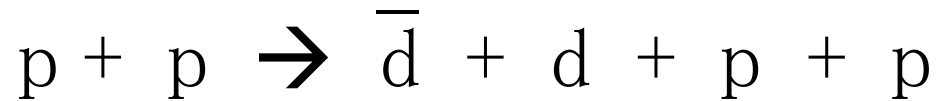


# A possibility of antideuteron accumulation and antiatomic physics

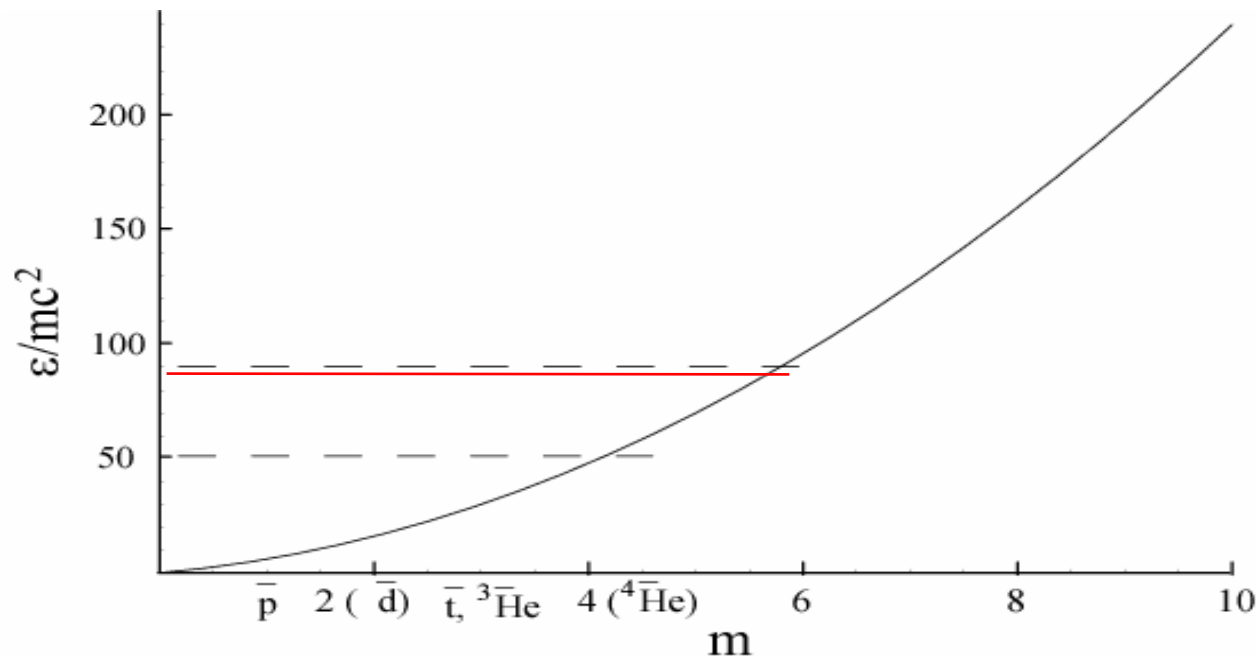
RIKEN & Univ.Tokyo

Y.Yamazaki, M.Wada, H.Torii,  
N.Kuroda, and K.Komaki

# Production of $\bar{d}$



$$\gamma_{\text{thr}} = 2(1 + m_d/m_p)^2 - 1 = 17$$



# Discovery of $\bar{d}$

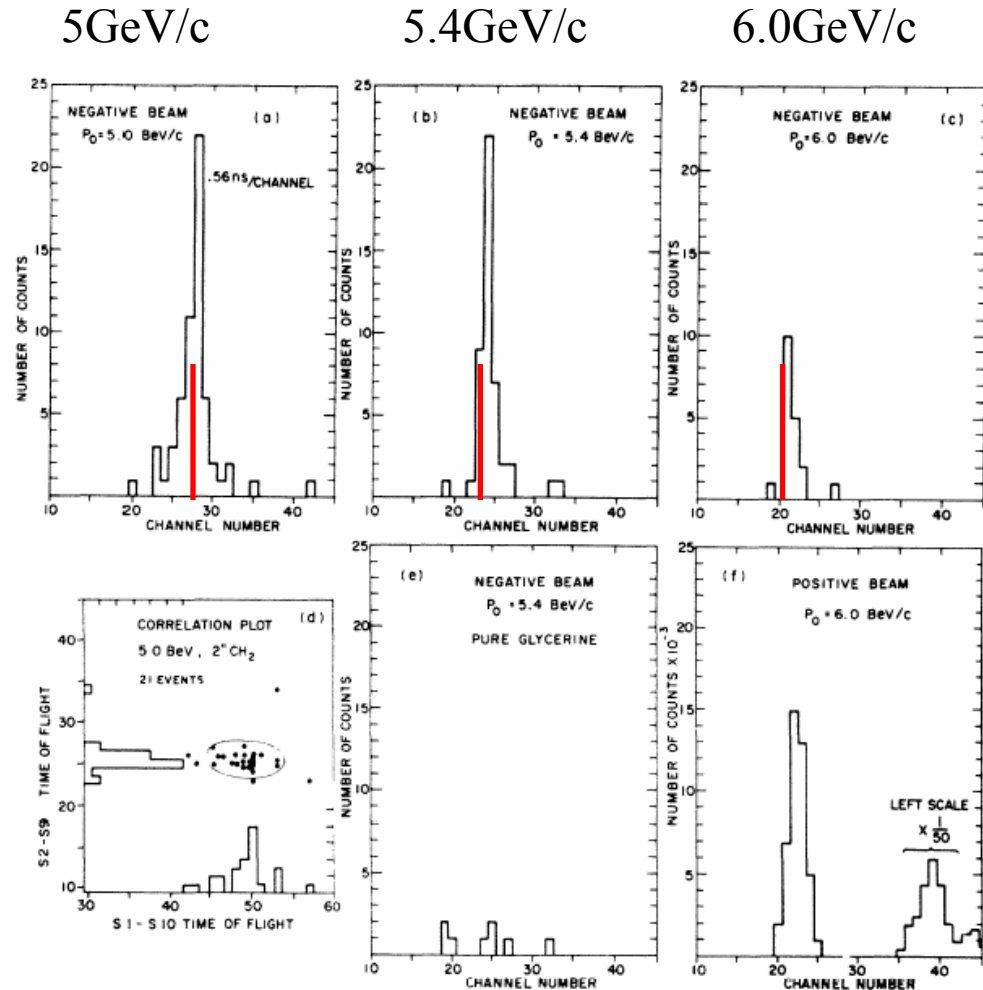
30BeV p + Be (D.E.Dorfan et al., pr114(1965)1003)

$\bar{d}$  confirmed by comparing

- 1) momentum and tof
- 2) Cerenkov count for diff.  $n$



$\sim 100 \bar{d}s @ 5\text{GeV}/c (4 \times 10^{-8} \bar{d}/\pi^-)$



# Production of $\bar{d}$ at higher p energies

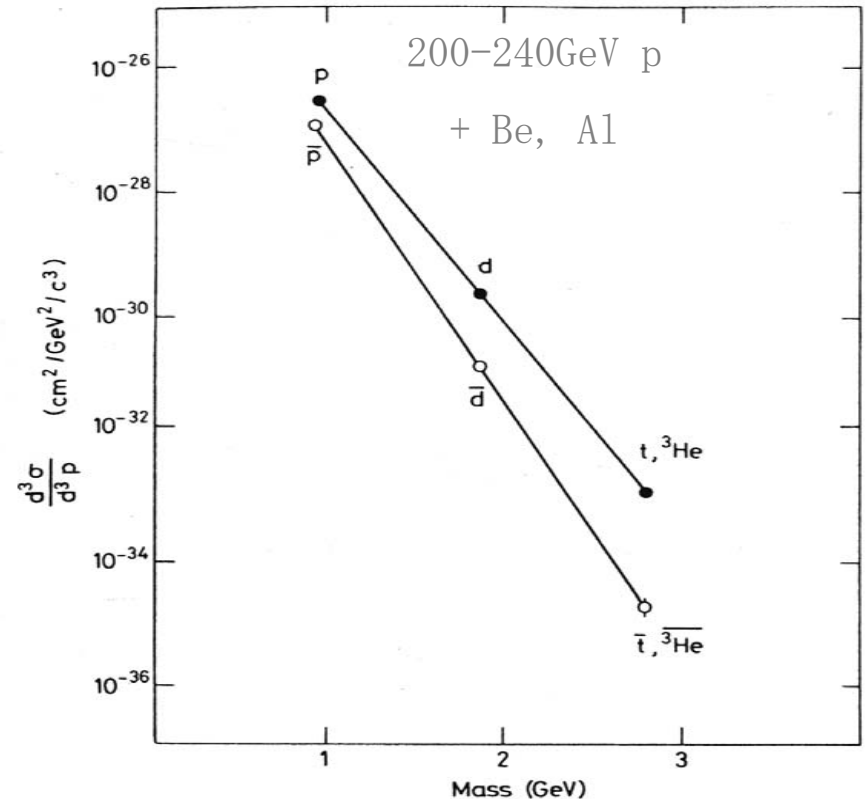
@200GeV p + Be, Al:

$\bar{p}$ ;  $\bar{d}$ :  $\bar{t}$ :  ${}^3\bar{\text{He}}$ :  ${}^4\bar{\text{He}}$

$\sim 1:3 \times 10^{-4}:10^{-7}:3 \times 10^{-8}:<3 \times 10^{-10}$

30GeV  $\rightarrow$  5GeV/c  $6 \times 10^{-8} \bar{d}/\pi^-$

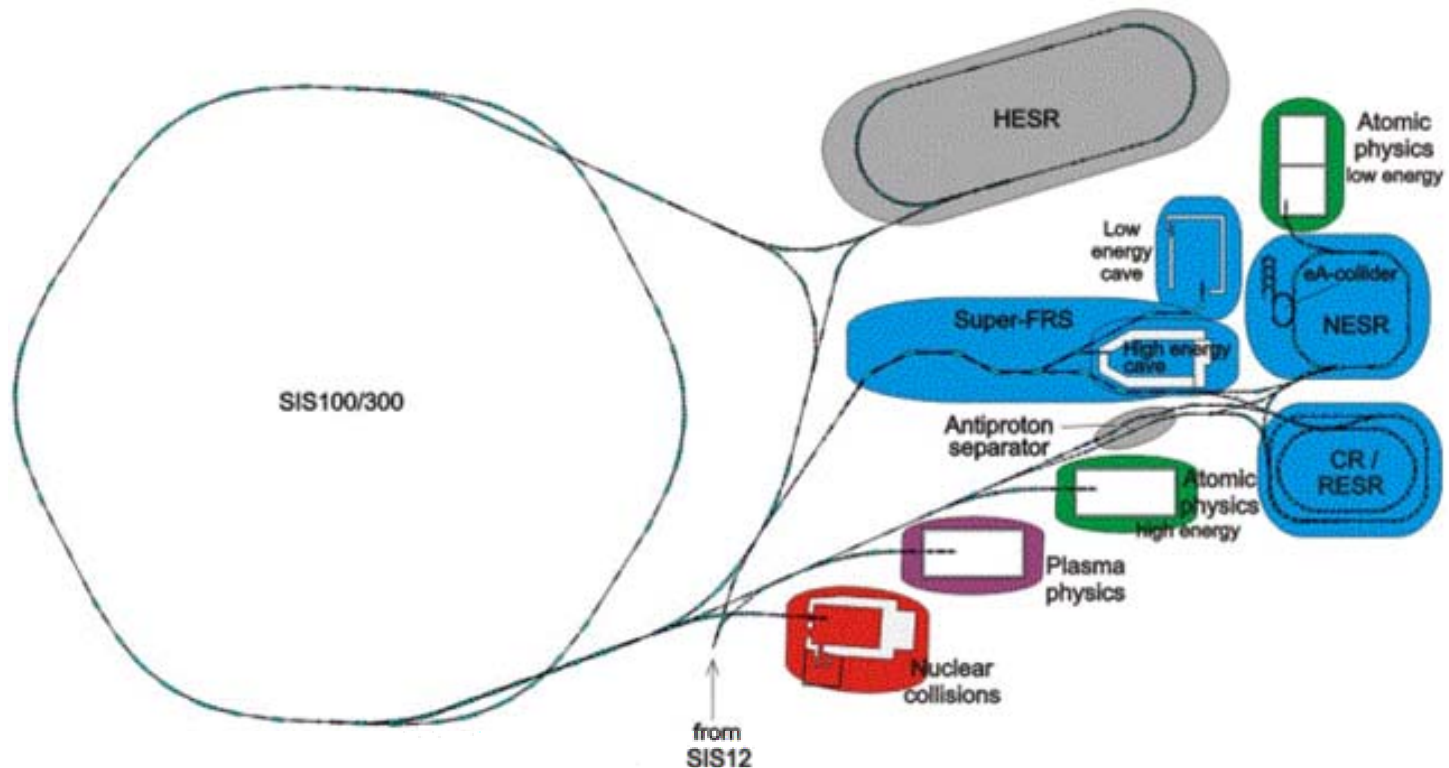
200Gev  $\rightarrow$  30GeV/c  $6 \times 10^{-6} \bar{d}/\pi^-$



A. Bussiere et al.,  
Nucl.Phys.B174(1980)1

# $\bar{d}$ "factory" at the GSI new facility?

$\sim 10^4$   $\bar{d}$ s/pulse from SIS300!



$\bar{D}$  spectroscopy as well as  $\bar{H}$ , gravity, antimatter chemistry ( $\bar{H}$   $\bar{D}$ ) etc.,  $\bar{d}$ RI, . . . . start of real antimatter science

# Key points

- Essential know-how's to trap  $\bar{d}$ s have been established with  $\bar{p}$ s
- Essential know-how's to prepare and study  $\bar{D}$ s will soon be established with  $\bar{H}$ s
- Extend the world of antimatter
- GSI will be the unique facility in the coming several tens years!

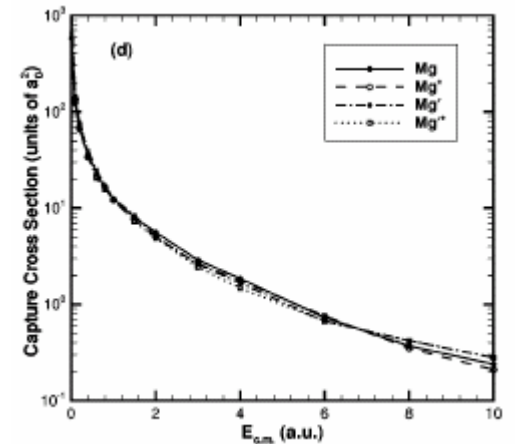
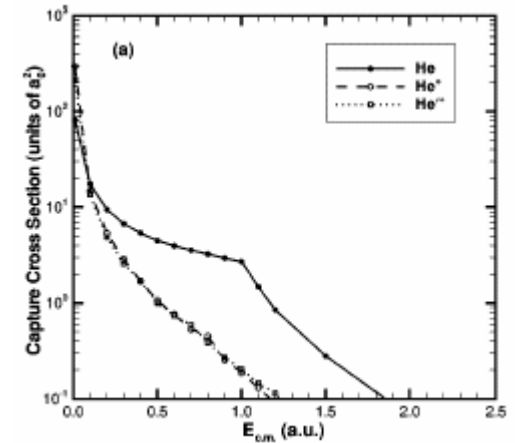
# $\bar{p}$ -Ion Recomb. & Nuclear Structure of RI

Formation of  $\bar{p}$ RI in vacuum

Residual nuclei & the recoil momentum

$\pi^+/\pi^-$  measurements: Indep of cold ann.

RI ions could be transported  
from the low energy case to  
FLAIR area



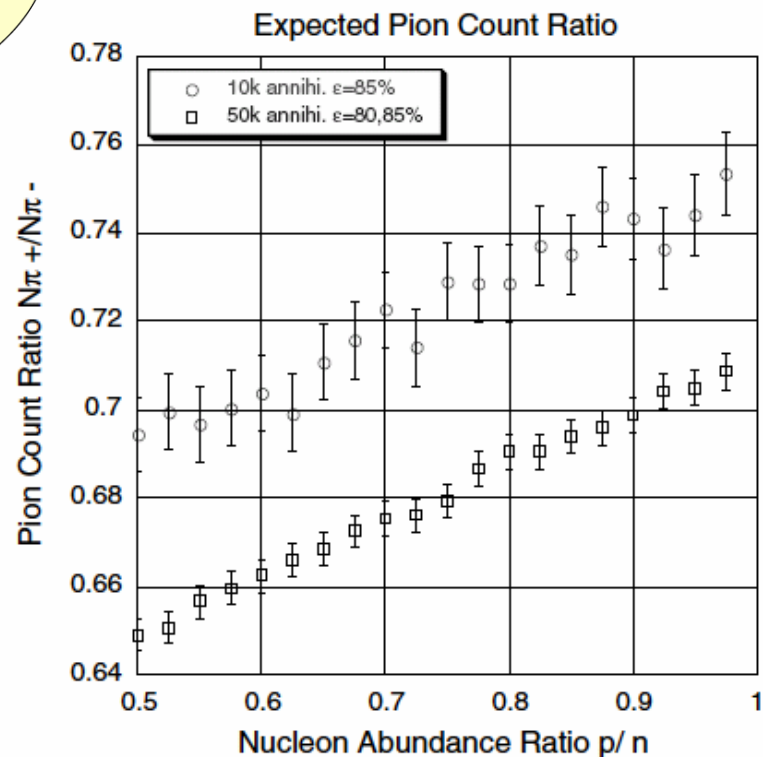
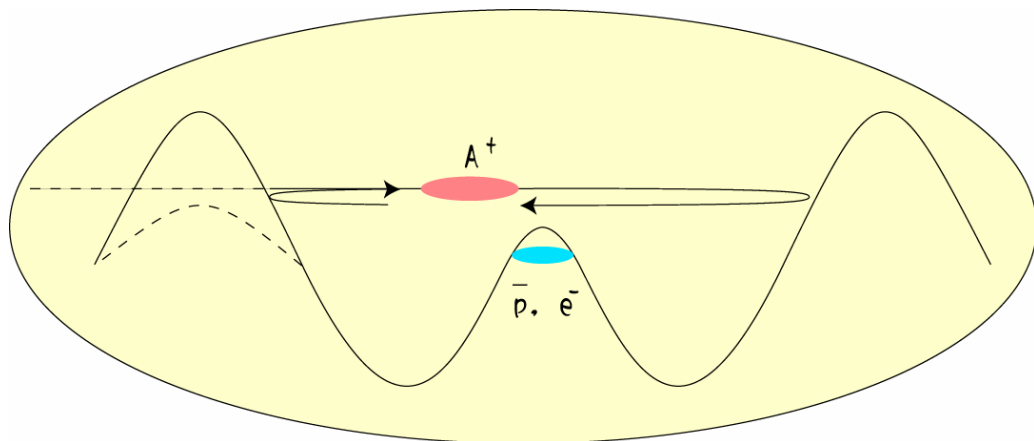


Fig. 3. The simulated ratio of detected pion numbers as function of the abundance of protons and neutrons. Circles indicate the case of  $10^4$  annihilations with an 85% overall pion detection efficiency, while boxes indicate the case of  $5 \times 10^4$  annihilations with an 80% detection efficiency for  $\pi^+$  and 85% for  $\pi^-$ . Error bars indicate statistical errors including a 10% background event rate.