

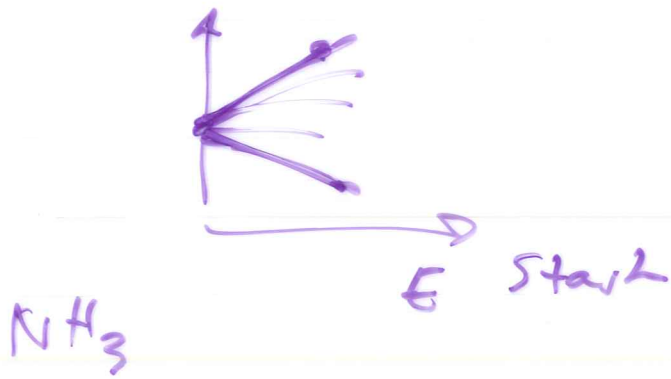
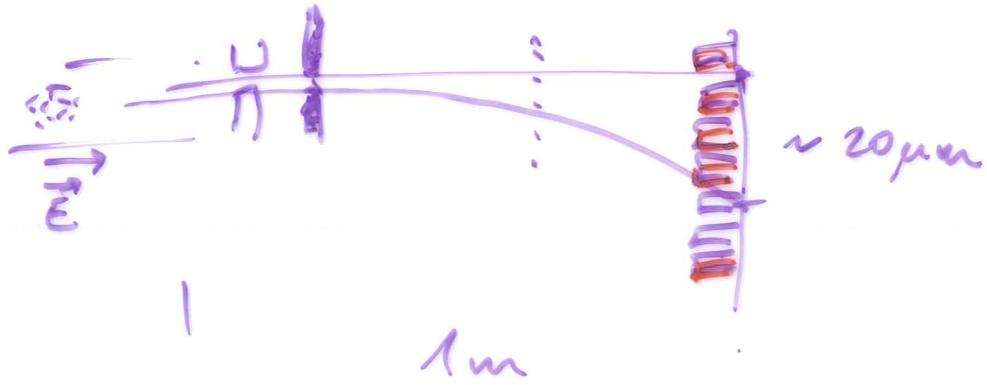
$$10^7 \frac{\bar{p}}{1s} \rightarrow 10^{14} \frac{\bar{p}}{1yr}$$

$$6 \cdot 10^{23} = 1g \quad 10^{10} \text{ Jahre} = 1g \frac{H}{\bar{p}}$$

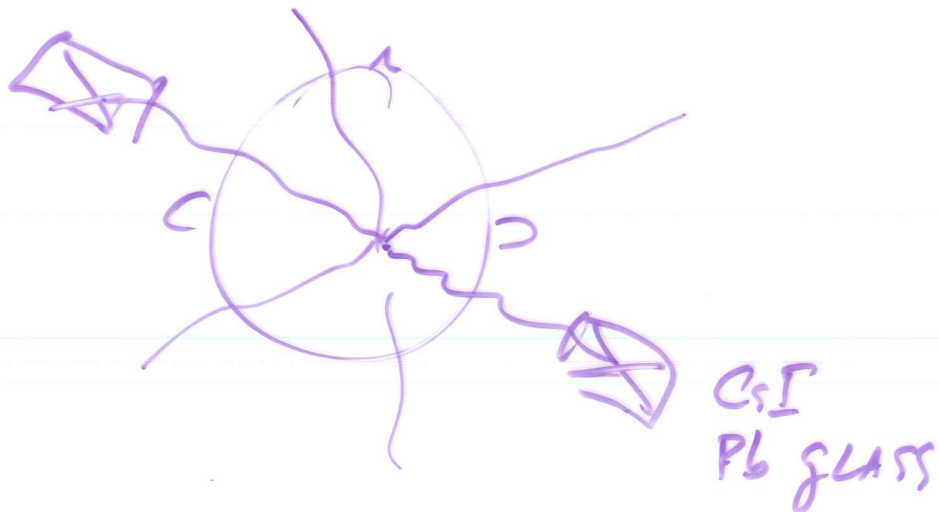
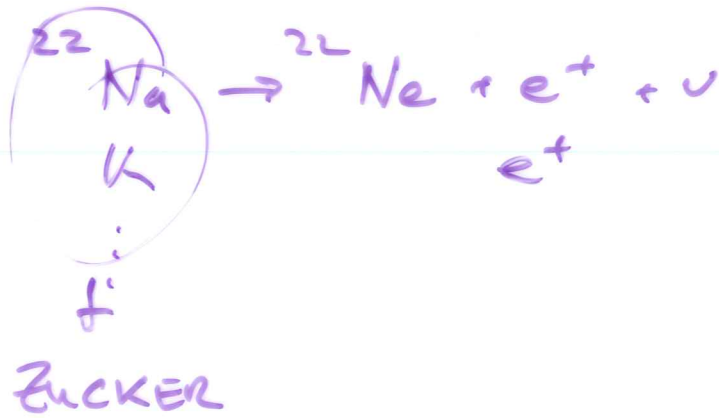
$$10kg Pu \rightarrow 100g m \rightarrow G$$

$$1g H \rightarrow 100\%$$

$\sim 100 \text{ mK}$



PET.

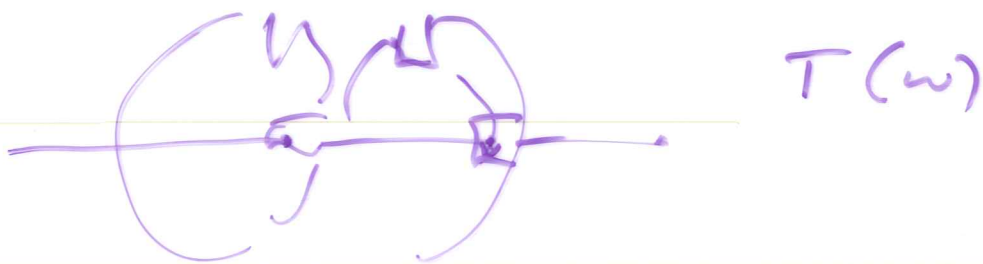


$$\textcircled{10} \quad \textcircled{10} \quad \rightarrow \quad 10^3 \bar{H} / s$$

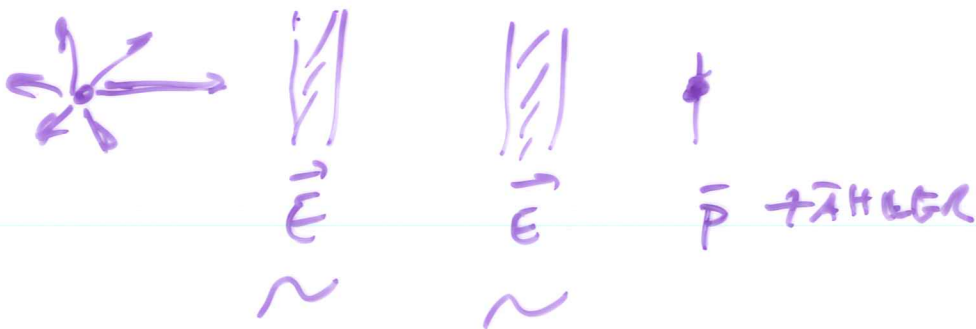
$$\bar{p} \quad e^+$$

$$10^4 \quad 10^8$$

$T(\bar{H})$ FIZEAU APPARATUS



$$\bar{H} (n \approx 20) \xrightarrow[E \text{ (100-1000V)}]{} \bar{p} + e^+$$



$$T(\bar{H}) \sim 100 - 1000 \text{ K}$$

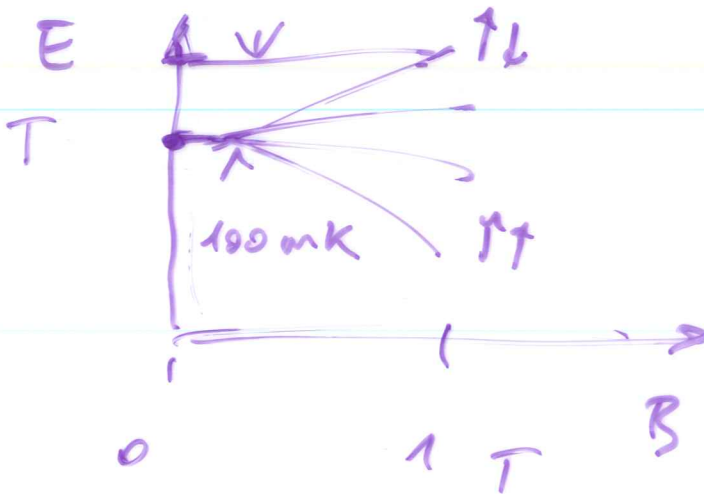
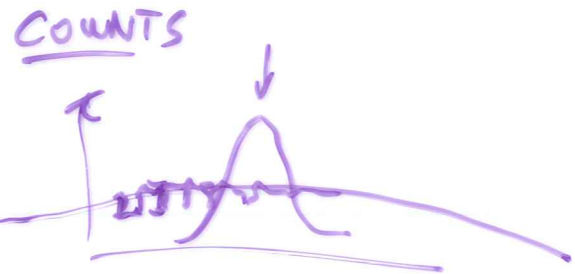
ATRAP, ALPHA

$$2s \rightarrow 1s : 10^{-15}$$

$$N = 10^6 : 10^3$$

$$\frac{10^{-15}}{10^{-18}}$$

- ✓ 1) \bar{H} HERSTELLEN
- ~~2)~~ \bar{H} EINFANGEN
- ~~3)~~ \bar{H} KÜHLEN - $1 \mu\text{K}$
- ~~4)~~ 121 nm CW LASER



- RUDBERG ATOME ($n \approx 30$)

- $T(\bar{H})$

AMS

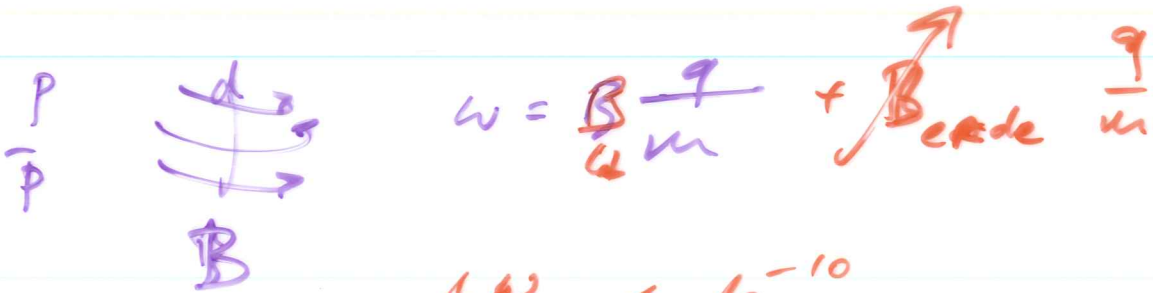
SSF random

$\bar{p}, p, \dots, C, \bar{C}$



$p\bar{p} \rightarrow \pi, \delta$
 $e^+e^- \rightarrow \gamma\gamma$ 511 keV

m, q, z, \vec{p}

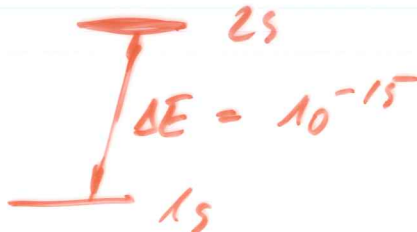


$$\omega = \frac{Bq}{\omega m} + \frac{B}{c} \frac{q}{m}$$

$$\frac{\Delta \omega}{\omega} < 10^{-10}$$

$$\Delta(m, \bar{m}) \leq 10^{-18}$$

- m, \bar{m}
- $(q\bar{q}) = K^0, S^0 = NA62, LHCb, \dots$
- $(p+e^-) = H$
- $(\bar{p}+e^+) = \bar{H}$

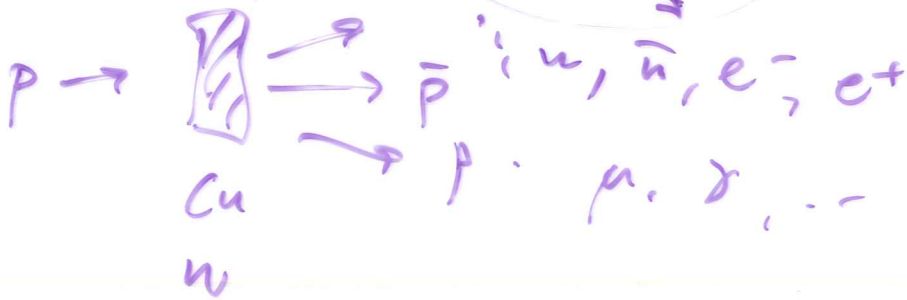
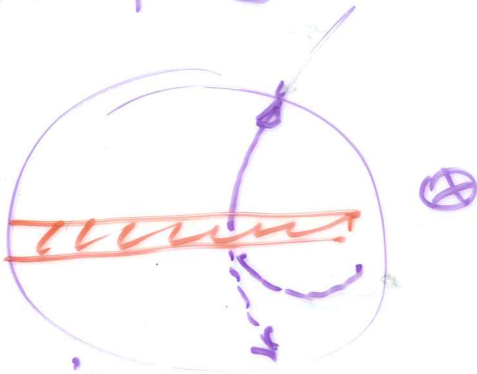


$$E = mc^2 + \bar{m}c^2$$

1928 DIRAC $\rightarrow -e^-$
 $\rightarrow +e^+$

1932 ANDERSON

1955 CERN



$$E_{kin} \rightarrow m + \bar{m}$$

