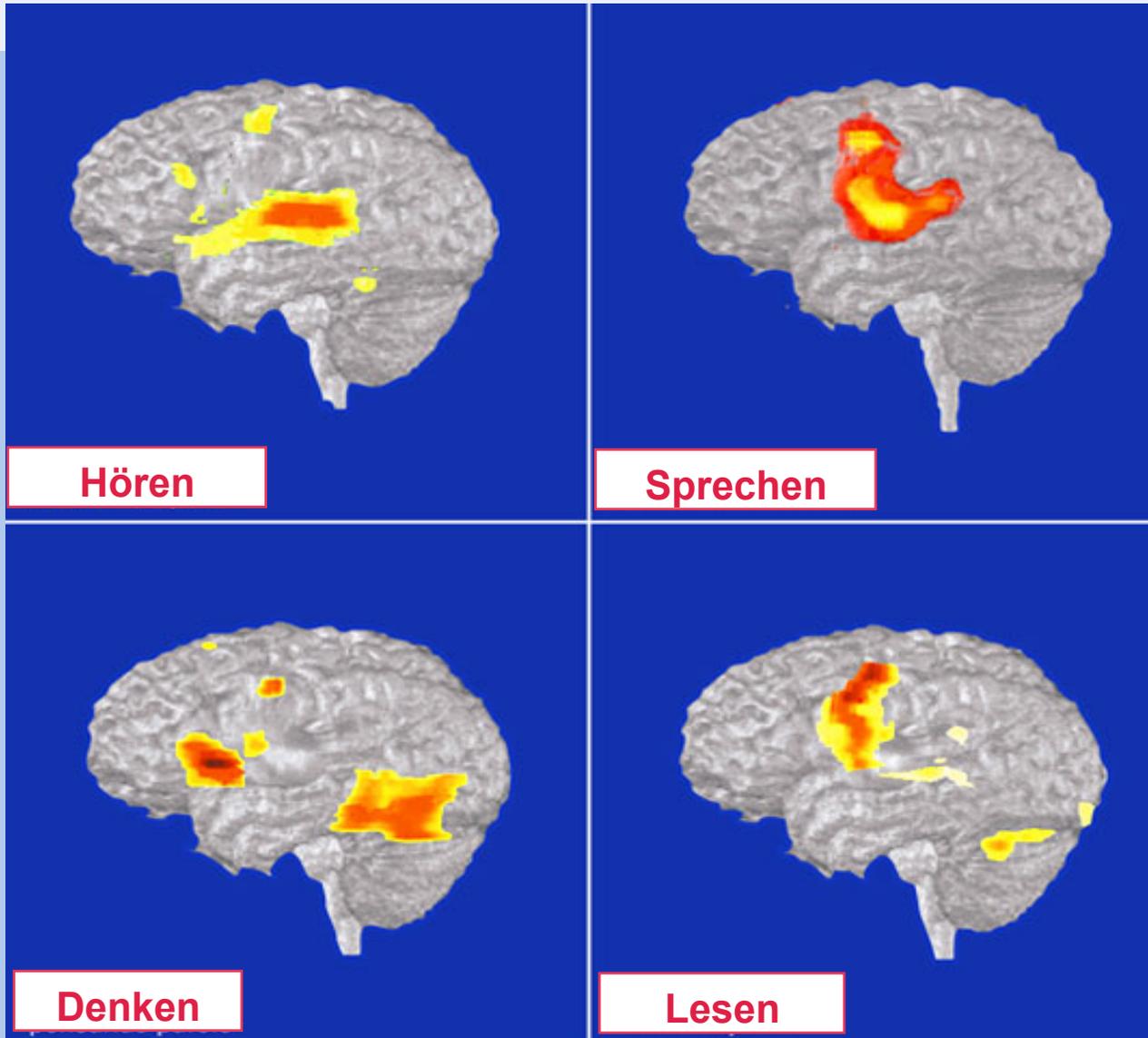


Mit Antimaterie zum Durchblick: Teilchenphysik in der Medizin

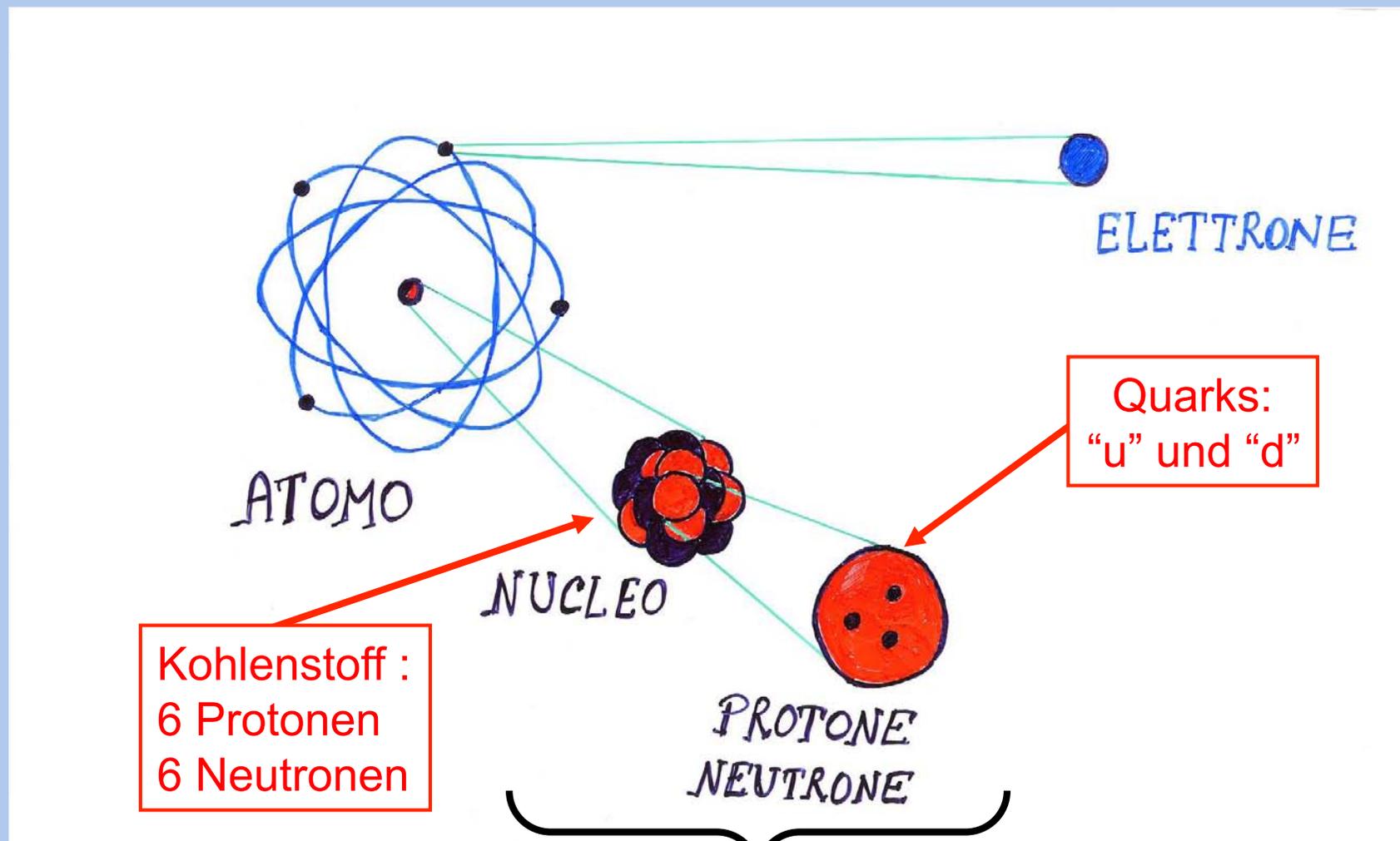
PD Dr Saverio Braccini

Albert Einstein Center for Fundamental Physics (AEC)
Laboratorium für Hochenergiephysik (LHEP)

Positronen-Emissions-Tomographie (PET)



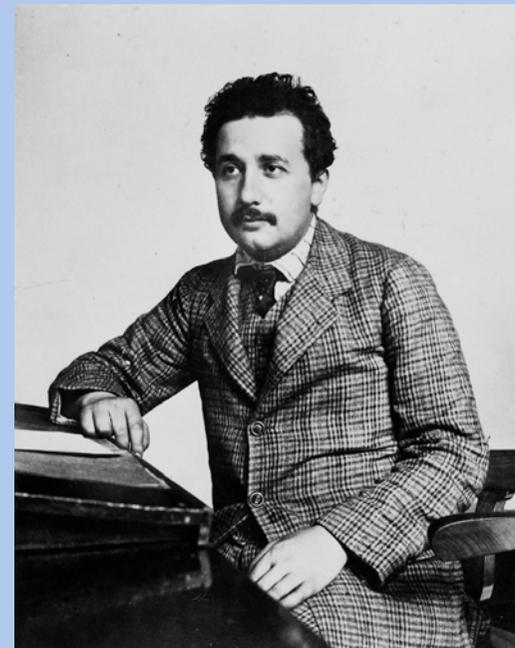
Die Materie



Quantenmechanik und Relativität



Max Planck
Nobelpreis 1918



Albert Einstein
Nobelpreis 1921

**Elementarteilchen
(Quanten) + $E = mc^2$ = ?**

1928: Eine überraschende Theorie ...



Paul Dirac
Nobelpreis 1933

$$(i\gamma \cdot \partial - m)\psi = 0$$

Elektronen
negative Ladung

Positronen
positive Ladung

Antimaterie!

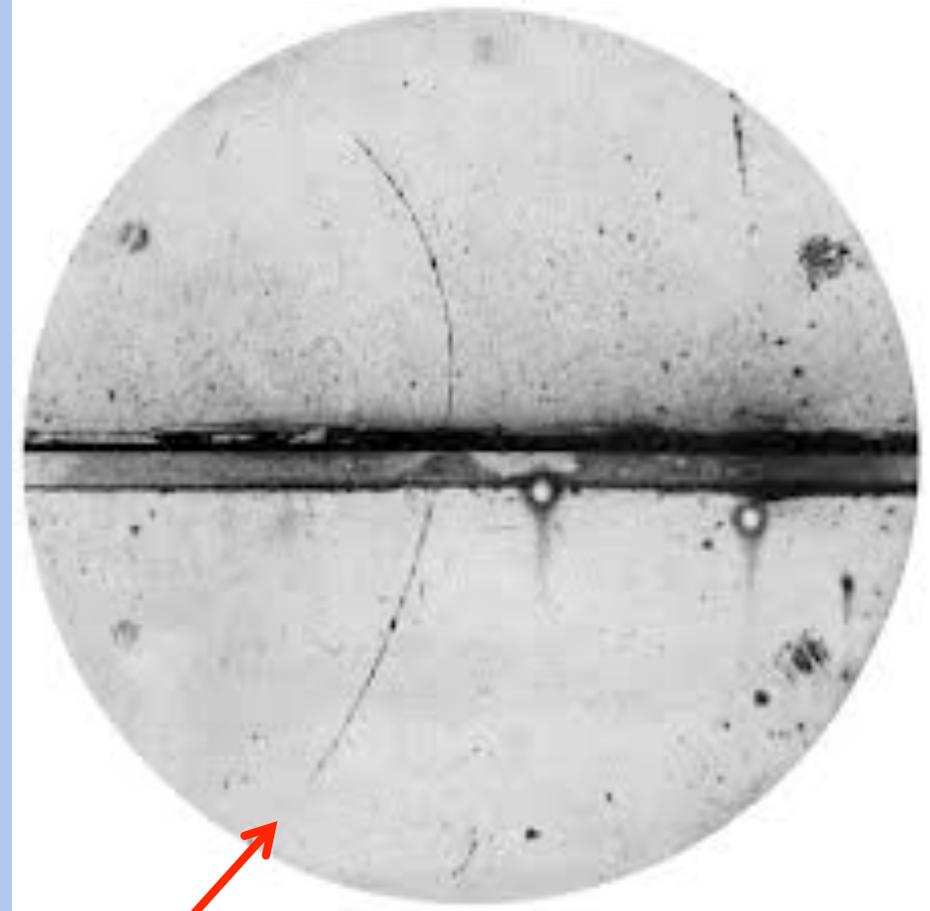
Spuren der Elektronen mit einer Nebelkammer



1932: Die Antimaterie ist da!



Carl Anderson
Nobelpreis 1936

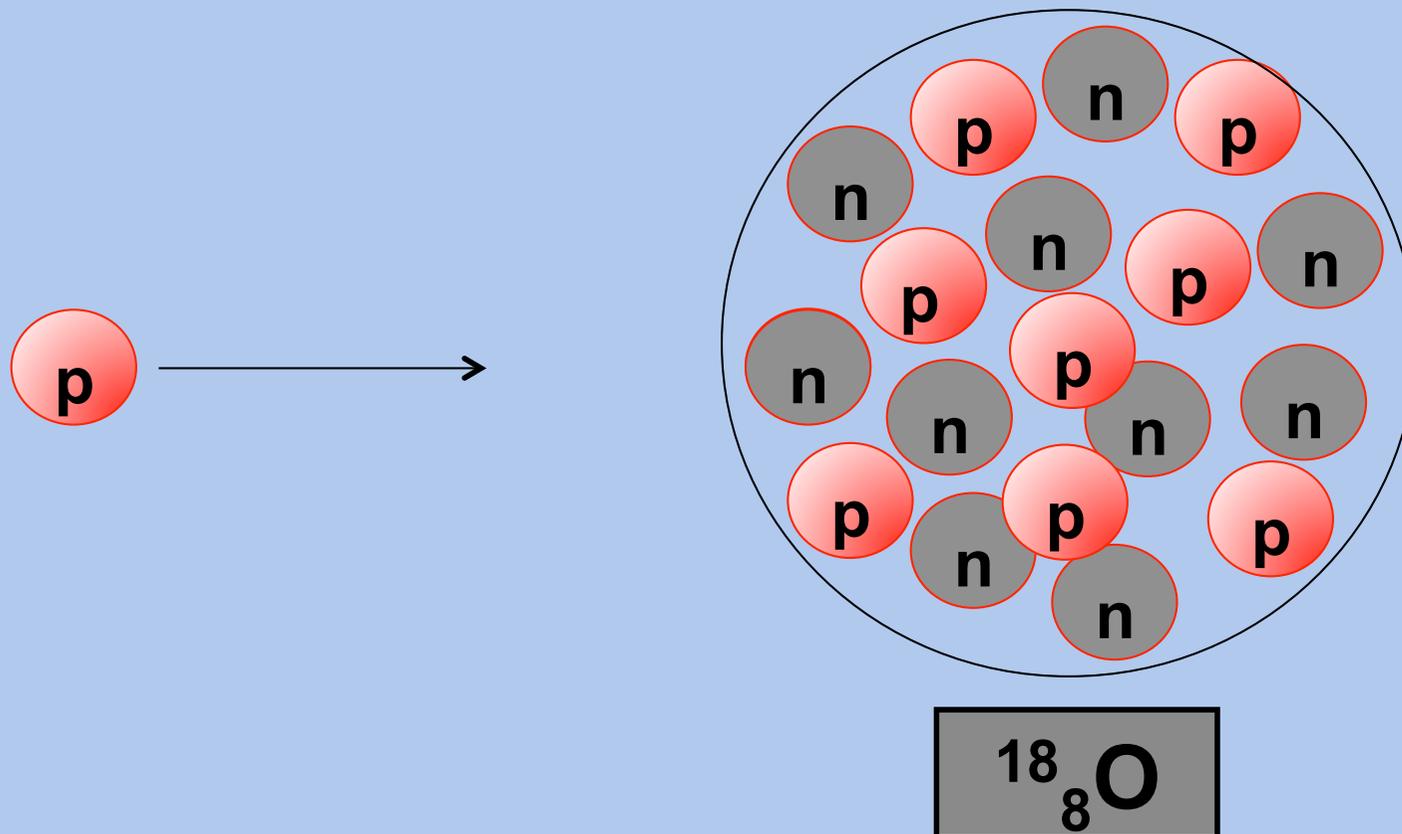


Positron!

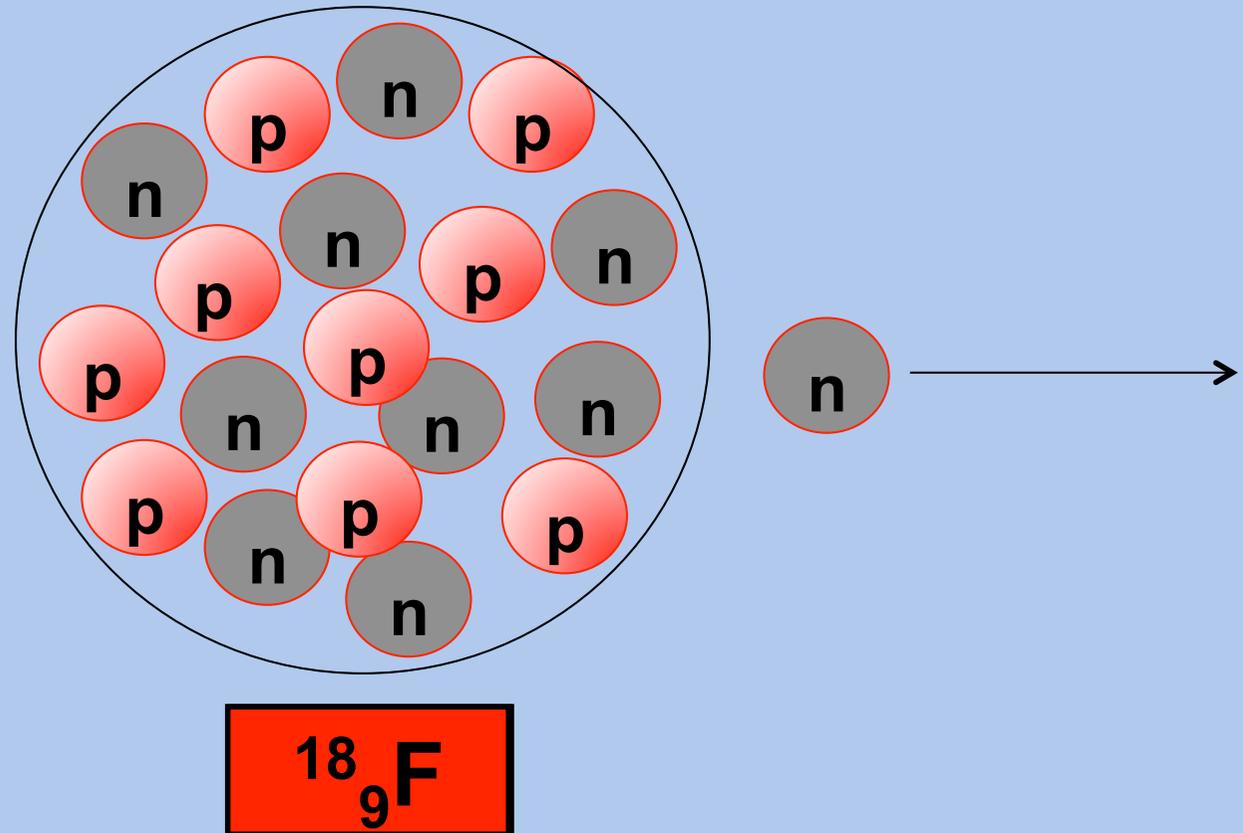
Elektron + Positron = ?



Wie kann man Positronen erzeugen?

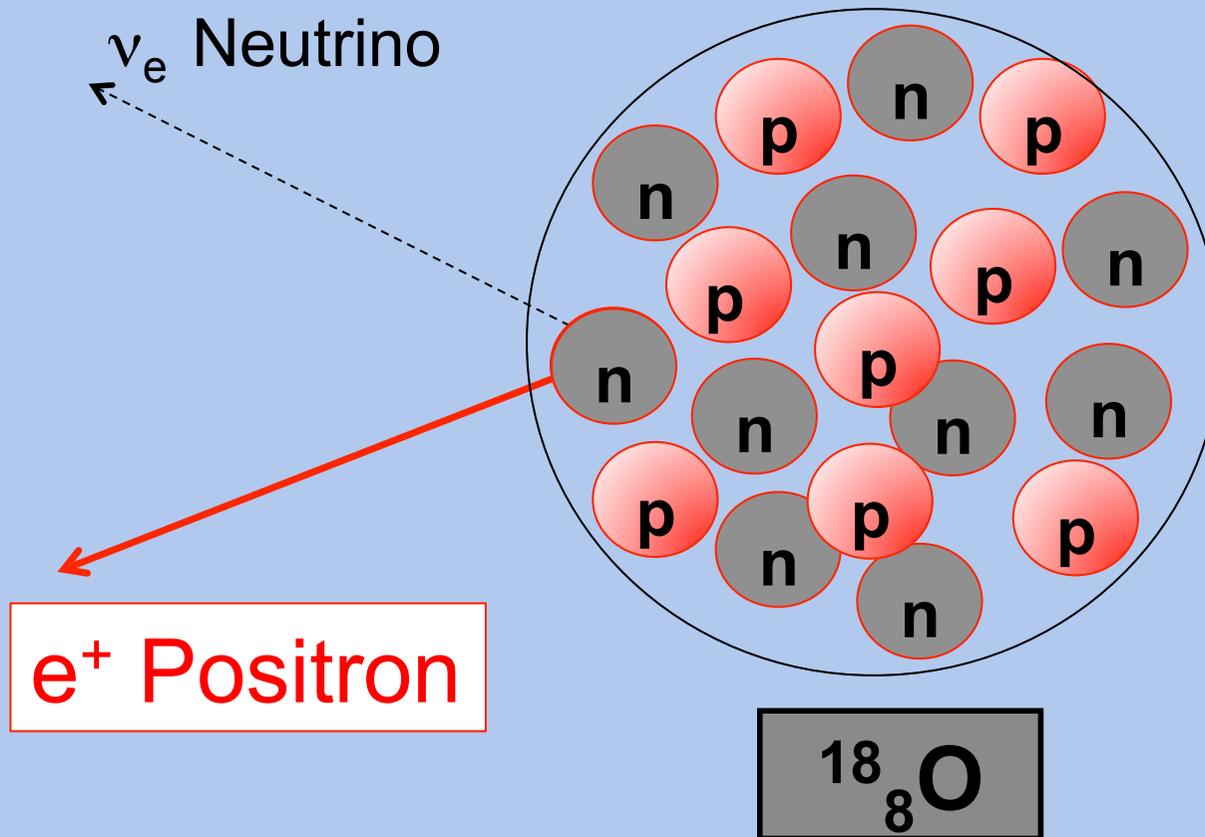


Wie kann man Positronen erzeugen?



^{18}F ist instabil (Halbwertszeit 110 min.)

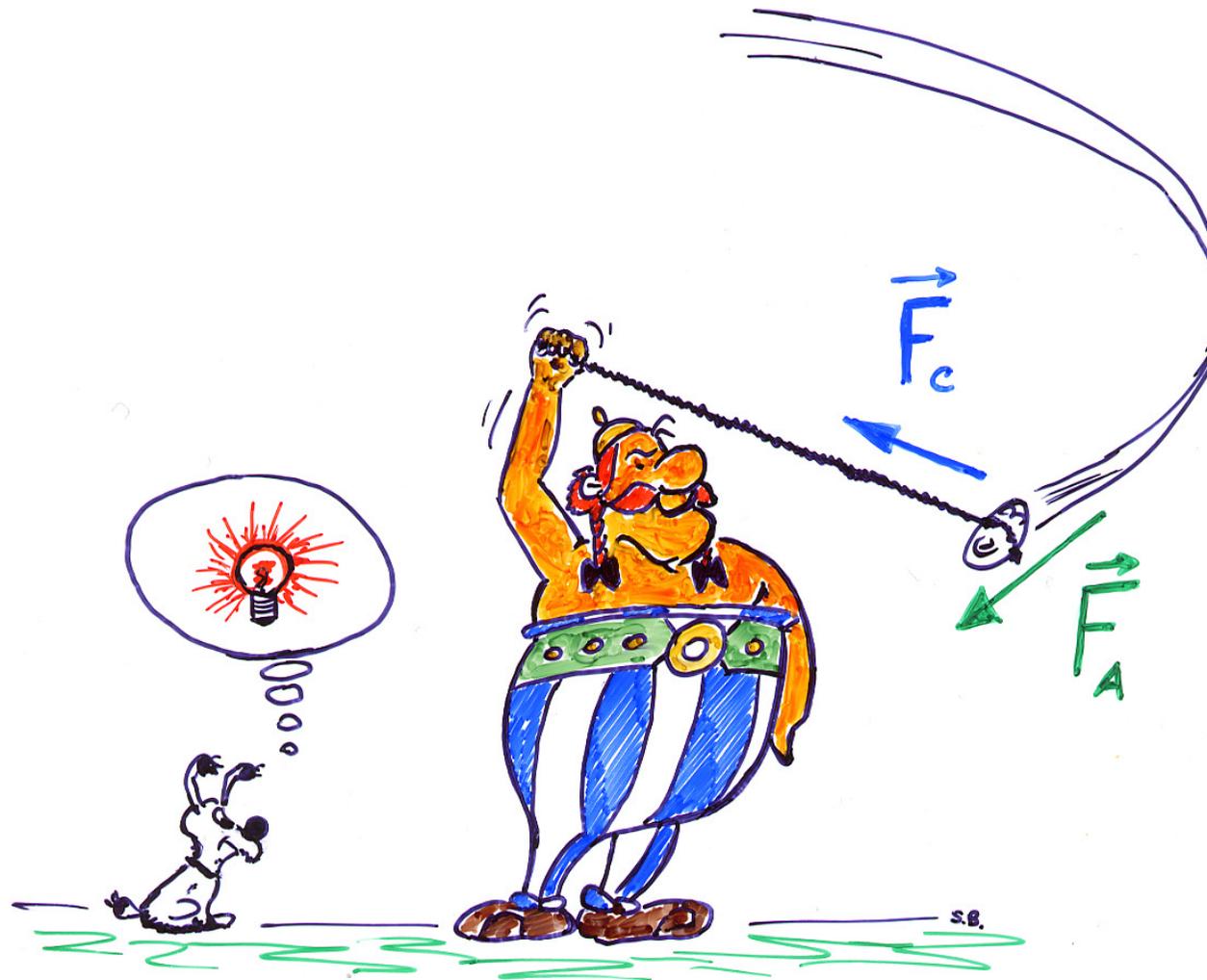
Wie kann man Positronen erzeugen?



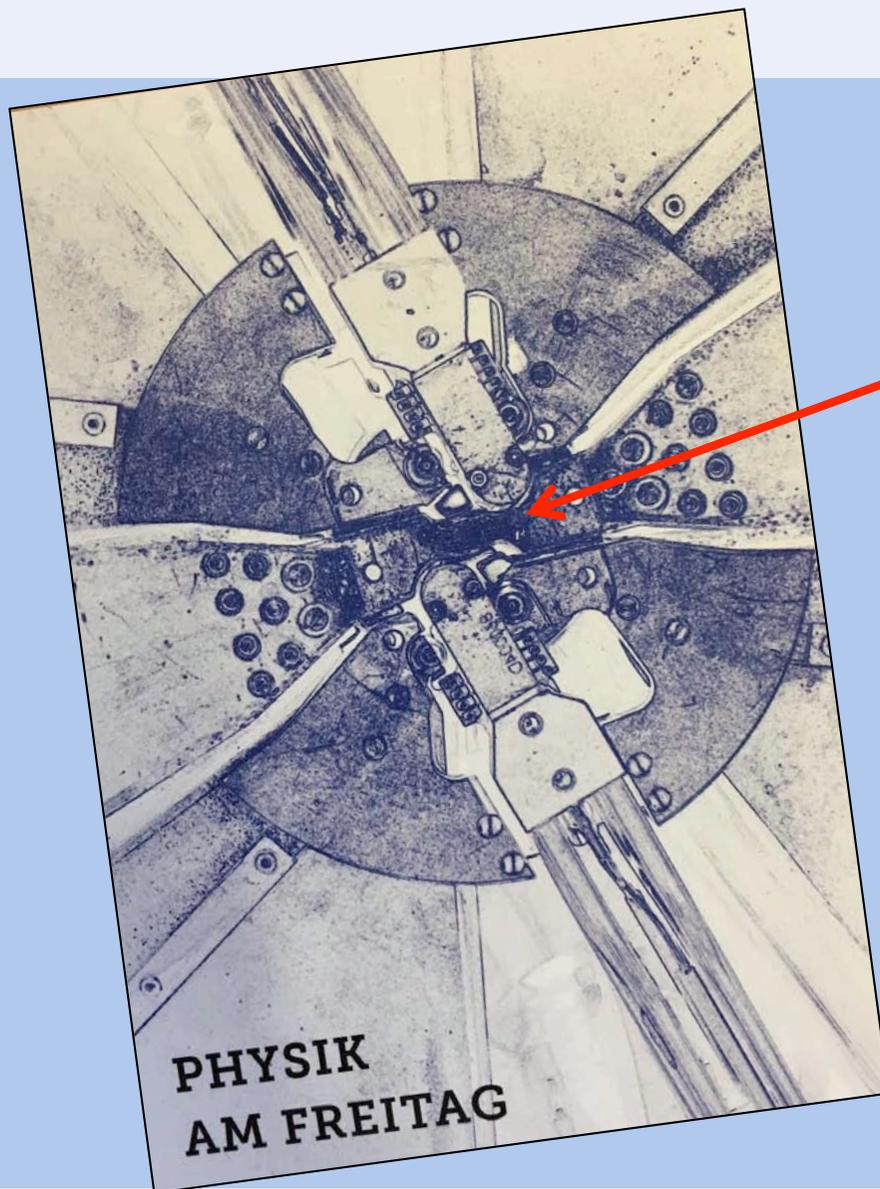
Das Zyklotron im Inselspital



Das Zyklotron ...



Alles beginnt mit Materie ...



Quelle von H^- Ionen

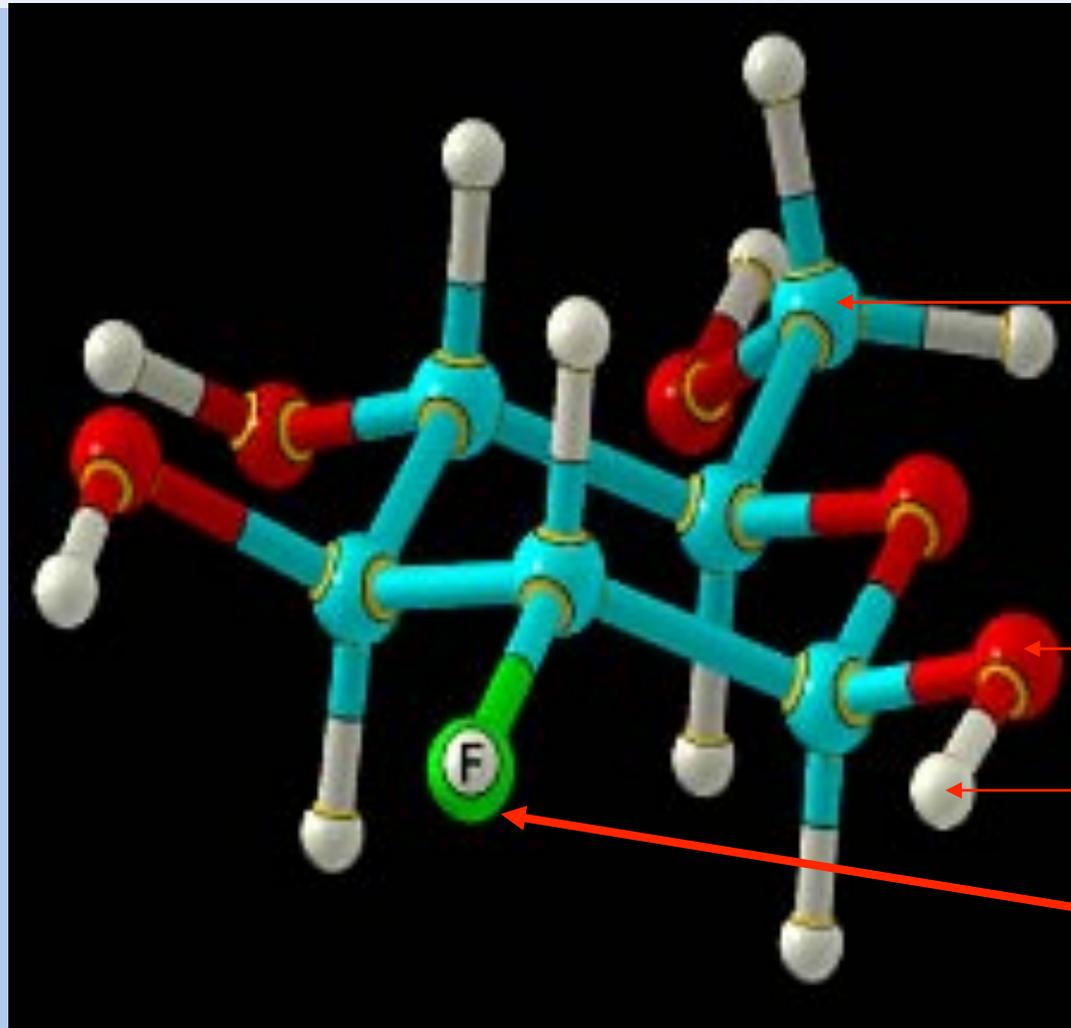
H^- : 1 Proton + 2 Elektronen

Film: Mr Ion



<https://www.youtube.com/watch?v=zD1fnNAmAPk>

FDG: Eine besondere Art von Zucker



C

O

H

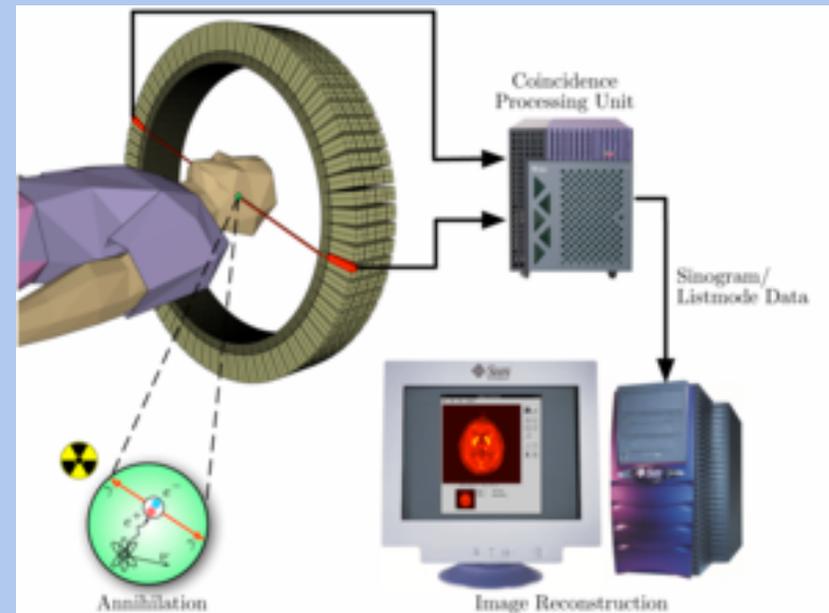
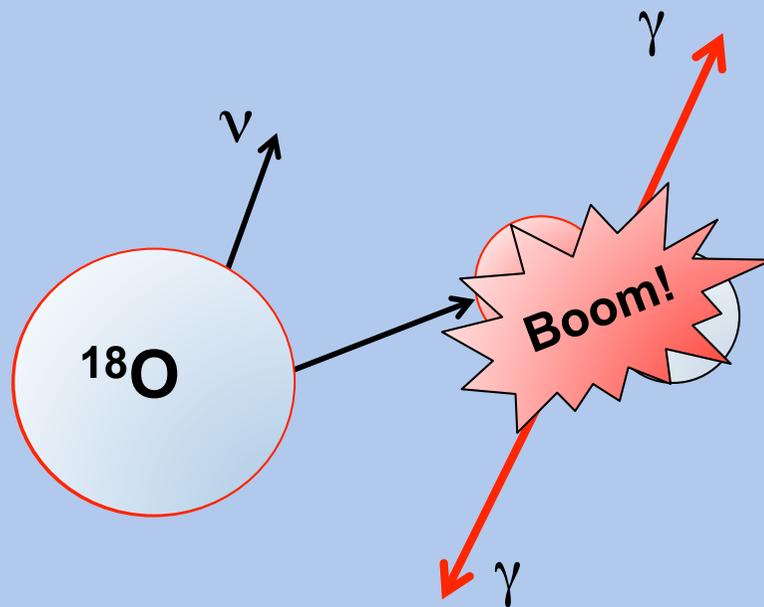
18F

2-deoxy-2-[¹⁸F]fluoro-D-glucose (¹⁸FDG)

Die Radiopharmazie



Positronen-Emissions-Tomographie (PET)



Positronen-Emissions-Tomographie (PET)

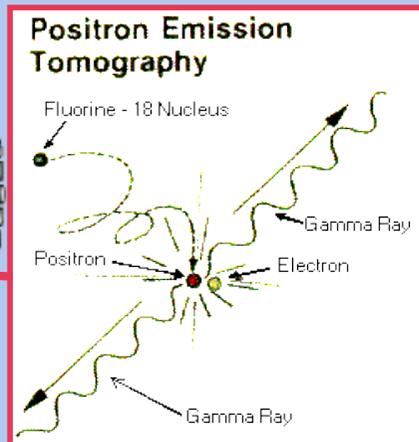
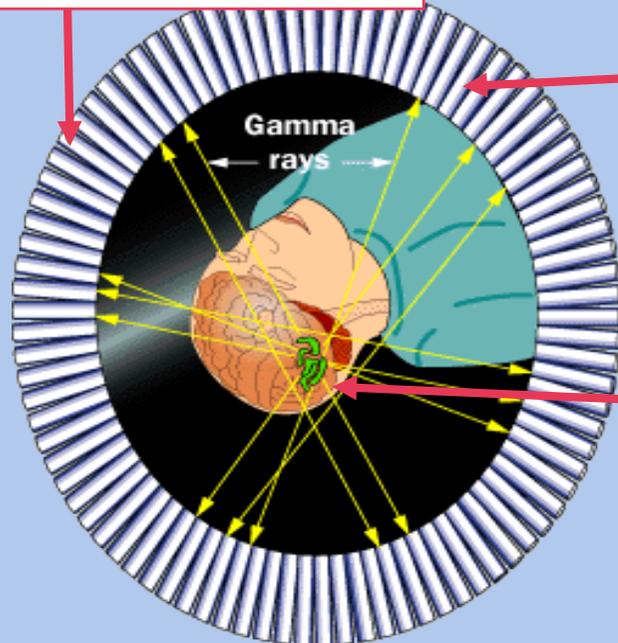


Teilchendetektoren

3. PET Scanner

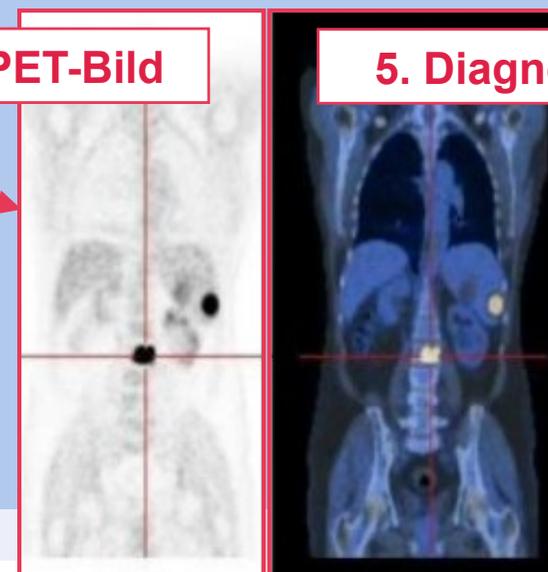
2. Radiopharmazie

1. Zyklotron

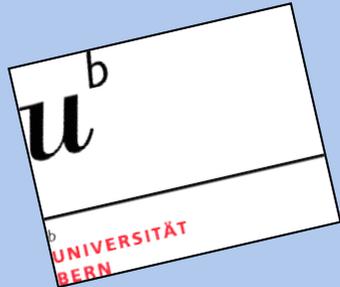


4. PET-Bild

5. Diagnose



Produktion + Multi-disziplinäre Forschung



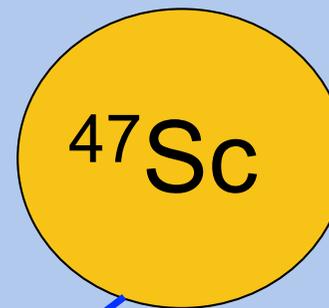
Therapy + Diagnostics = Theranostics

Scandium Isotope



e^+ Positron

PET Diagnostik



e^- Elektron

Therapie

Ionenspuren (Nebelkammer)

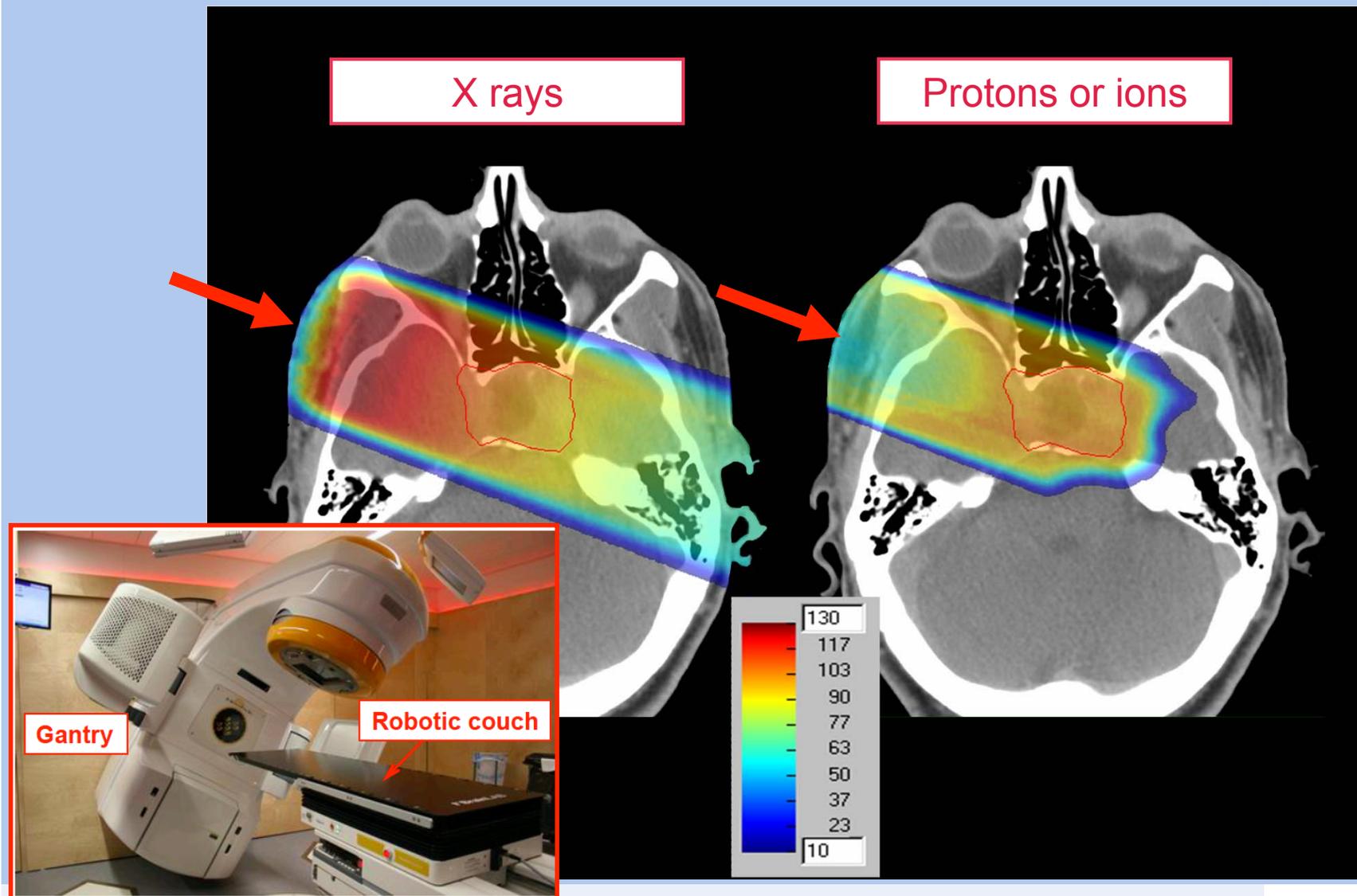


Ionen und Elektronen



$$m_{\text{Ion}} \gg m_e$$

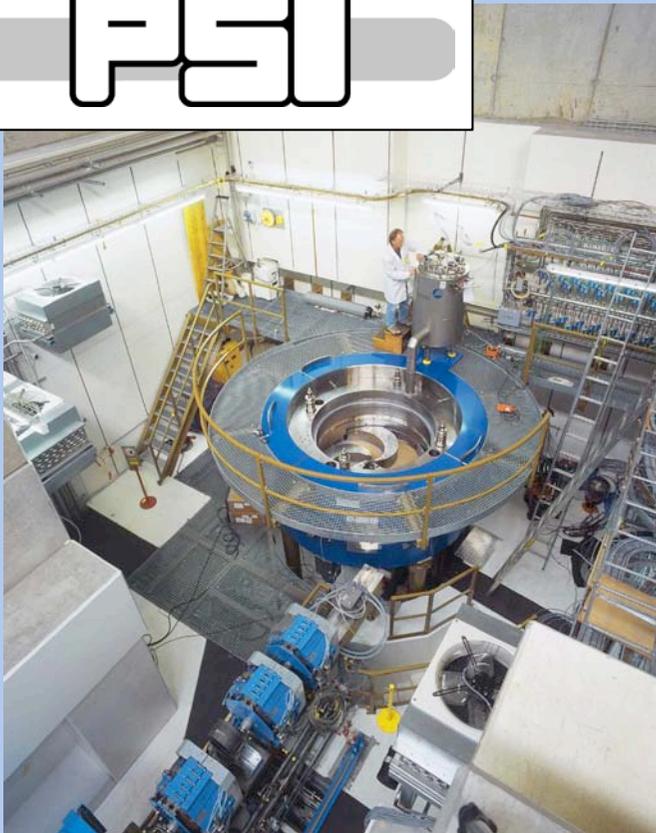
Strahlentherapie



Protonentherapie am PSI

PAUL SCHERRER INSTITUT

PSI



Zyklotron



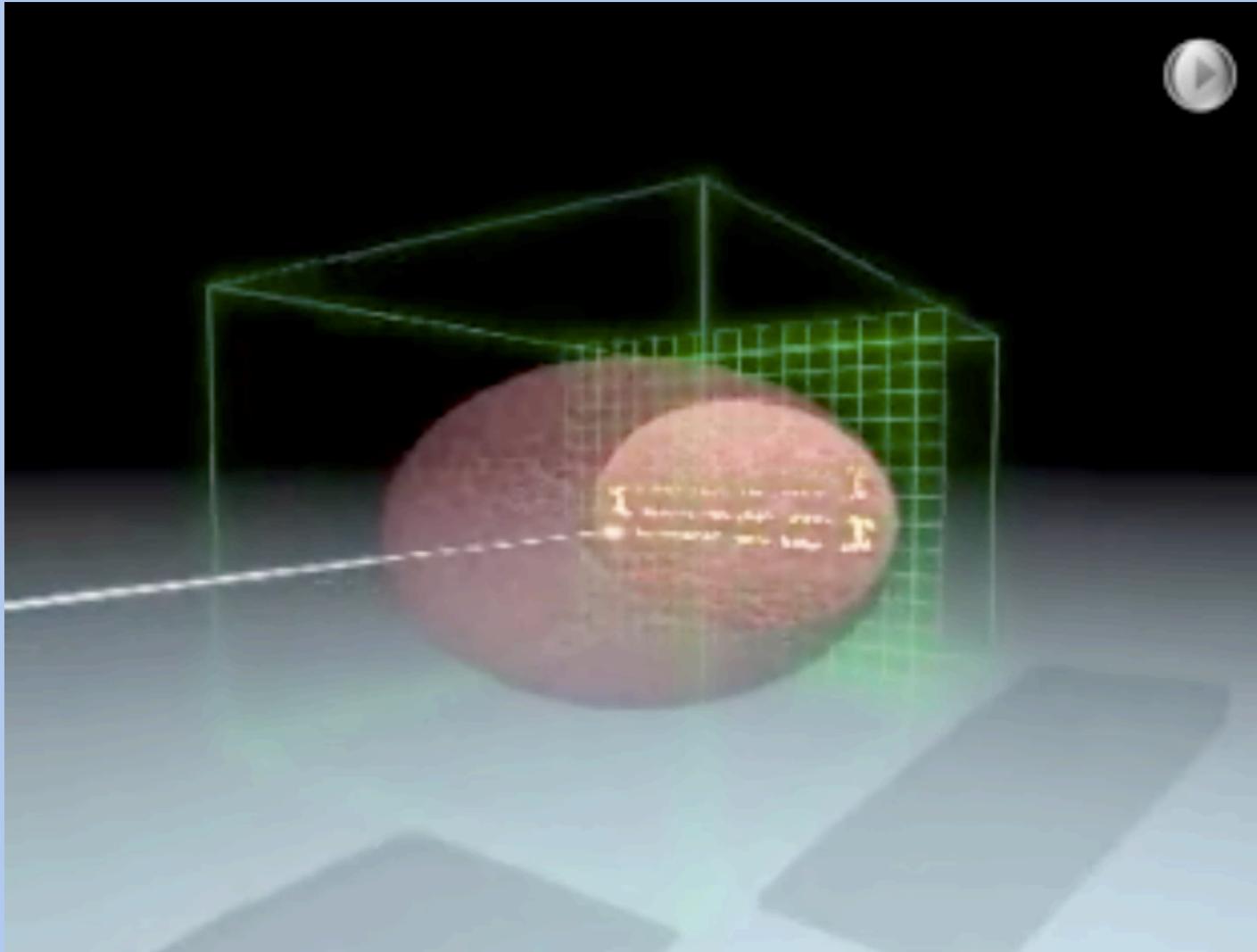
Gantry

Protonentherapie

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^b
UNIVERSITÄT
BERN

AEC
ALBERT EINSTEIN CENTER
FOR FUNDAMENTAL PHYSICS



Mit Antimaterie zum Durchblick ...

