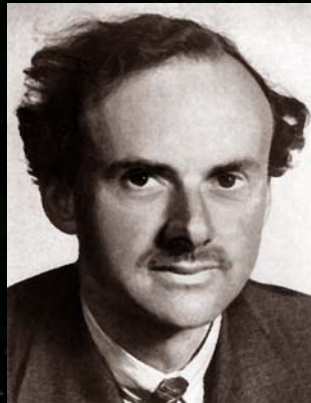


Positron Annihilation Lifetime Spectroscopy (PALS)

Paul Dirac
Nobelprize 1933



Carl Anderson
Nobelprize 1936



Positron Lifetime in Solids

The positron e^+ is the only antiparticle which is available without major efforts from radioactive β -decay. Positrons were discovered in 1932 by Carl D. Anderson, who gave the positron its name. The discovery was made by passing cosmic rays through a cloud chamber which was equipped with a strong magnet to determine the momentum (and charge) of the particles. The existence of positrons was first postulated theoretically in 1928 by Paul Dirac as a consequence of the Dirac equation.

The positron annihilates with electrons under emission of γ -quanta. The lifetime of positrons in solid matter depends on the specific electron density which can be determined by this method. Positronium is formed in two different states: Ortho-Positronium ($\uparrow\uparrow$; triplet state 3S_1) and Para-Positronium ($\uparrow\downarrow$; singlet state 1S_0) which differ in lifetime by a factor of 1120; the singlet state having a mean lifetime of 125 ps, and the triplet state 142 ns. In metals the conduction electrons behave like an electron gas and the annihilation takes place as with free electrons because no bound state is possible and the positron is effectively screened by the conduction electrons. In isolators the positron lifetime is prolonged because of the much lower electron density. In this experiment the lifetime in aluminum (or copper) and Teflon is determined by applying fast timing methods. The γ -decay of 1.27 MeV from a ^{22}Na positronium source can be used as a timing signal to start the time-to-amplitude-converter (TAC) for the decay time measurement. The lifetimes to be measured are in the range of 100 picoseconds up to several nanoseconds and therefore ultrafast time measurement methods have to be applied.

Positron Lifetime in Solids : Required Knowledge

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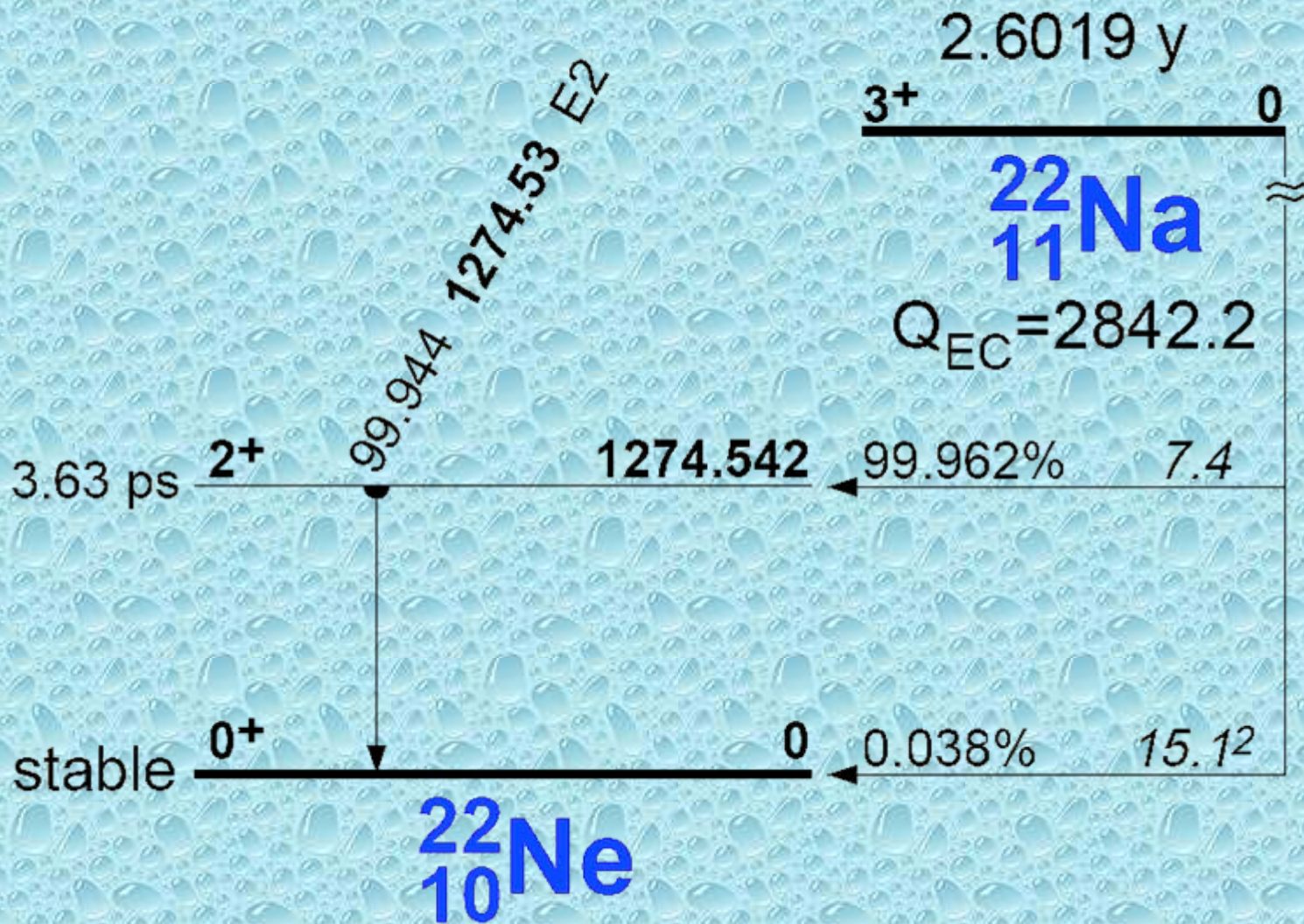
Positron Lifetime in Solids : Tasks and Goals

- **Set-up**
- **Produce**
- **Set-up**
- **Determine**
- **Determine**
- **Determine energy**
- **Determine the**

- **Measure energy**
- **Determine**
- **Compare energy**

WARNINGS

- **Be careful.**
- **Shut down**
- **Never touch**
- **Remove source after measurement**



Lebensdauerspektrum in Teflon

