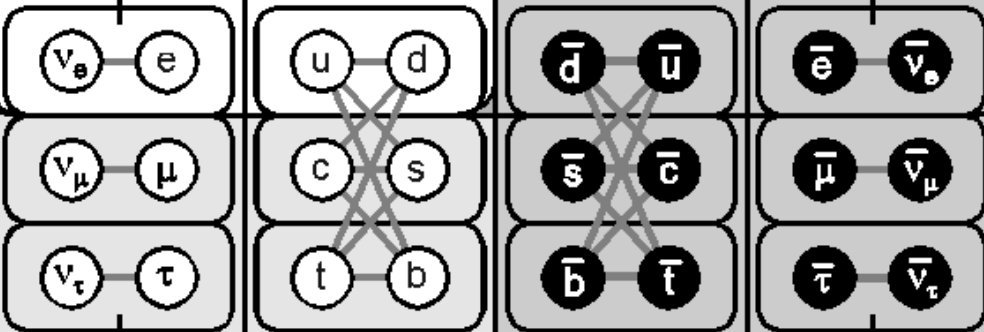
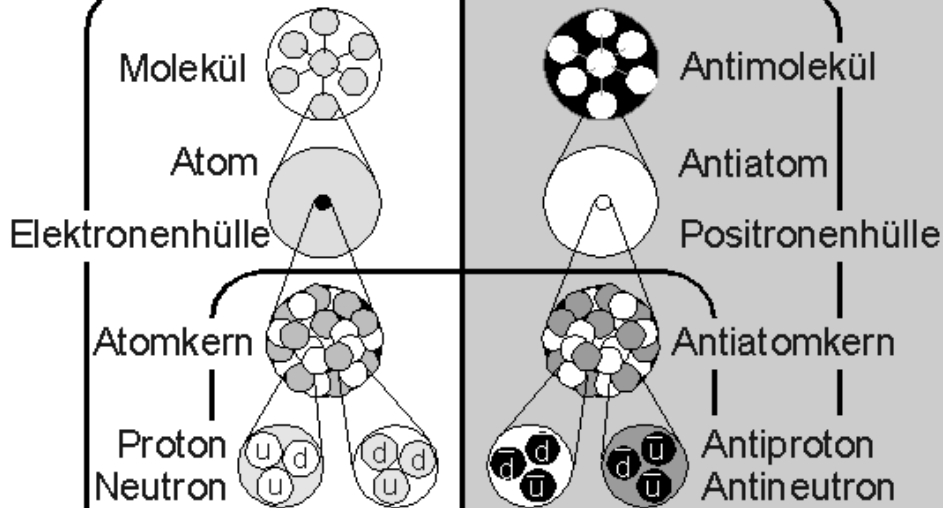


Stabil

### Materie

### Antimaterie



Ladung: 0    -1  
Leptonen

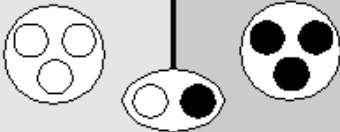
+2/3   -1/3  
Quarks

+1/3   -2/3  
Antiquarks

+1    0  
Antileptonen

( $\nu$  = Neutrino)  
( $e$  = Elektron)  
( $\mu$  = Myon)  
( $\tau$  = Tau)

Baryonen    Antibaryonen

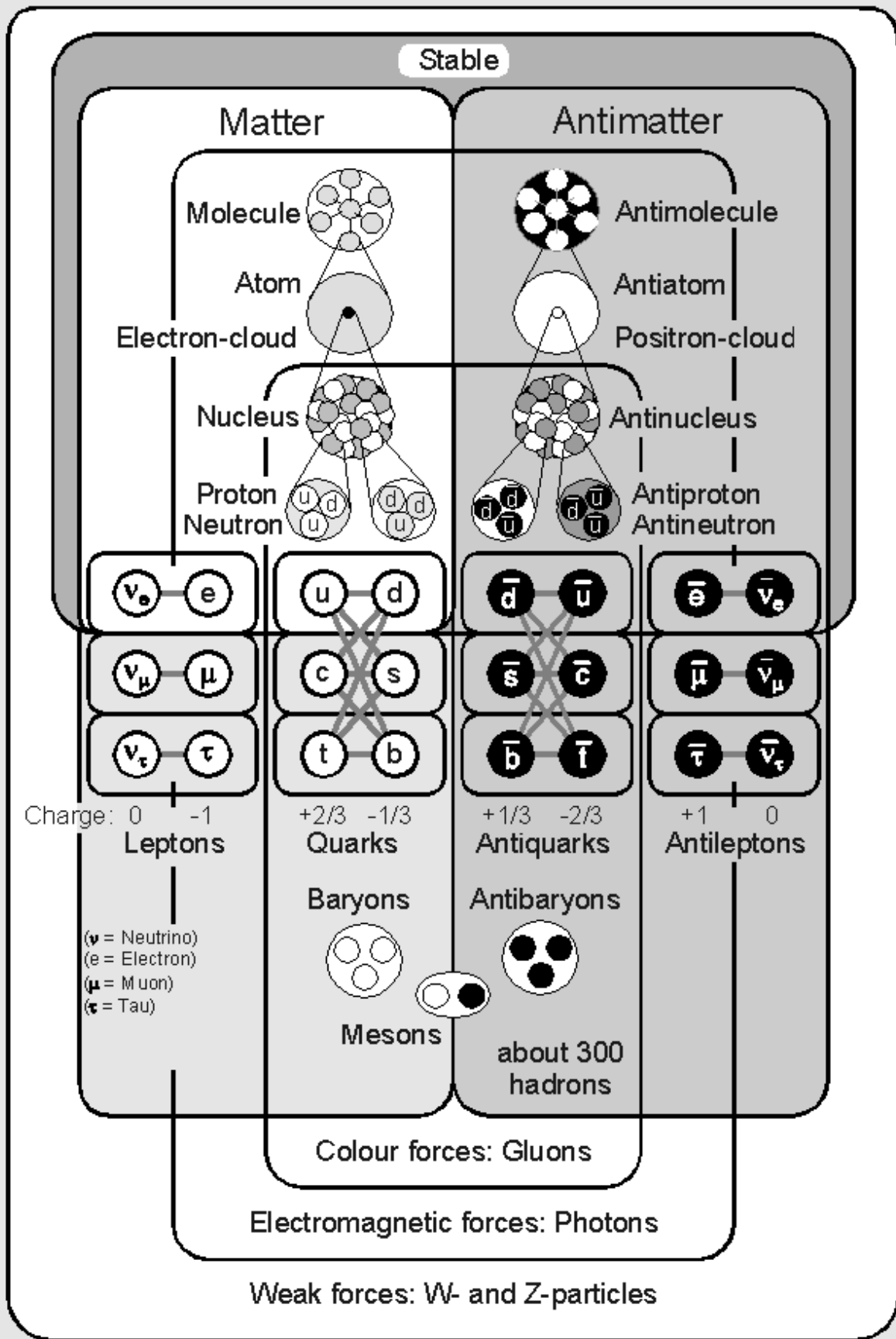


Mesonen    etwa 300 Hadronen

Farbkraft: Gluonen

elektromagnetische Kraft: Photonen

schwache Kraft: W- und Z-Teilchen



udhe-5.odt

Verbindungen aus u-, d- und s-Quarks (und ihren Antiteilchen) mit ganzzahliger elektrischer Ladung.

Seltsamkeit

+1			$u\bar{s}$	$u\bar{s}$	
			$u\bar{u}$		
0		$d\bar{u}$	$d\bar{d}$	$u\bar{d}$	
			$s\bar{s}$		
-1		$s\bar{u}$	$s\bar{d}$		
+3				$\overline{sss}$	
+2			$\overline{dss}$	$\overline{dss}$	
+1		$\overline{uus}$	$\overline{uds}$	$\overline{dds}$	
0	$\overline{uuu}$	$\overline{uud}$	$\overline{udd}$	$\overline{ddd}$	
0		$ddd$	$udd$	$uud$	$uuu$
-1		$dds$	$uds$	$uus$	
-2		$dss$	$uss$		
-3		$sss$			
Ladung:	-2	-1	0	+1	+2

Teilchen:

Anti-Kaon

Pion, Eta

Kaon

Omega-Plus

Anti-Xi

Anti-Lambda, Anti-Sigma

Anti-Nukleon, Anti-Delta

Nukleon, Delta

Lambda, Sigma

Xi

Omega-Minus

Gell-Mann und Zweig, 1964

Combinations of u-, d- and s-quarks with integer charge

Strangeness

+1		$d\bar{s}$	$u\bar{s}$
		$u\bar{u}$	
0	$d\bar{u}$	$d\bar{d}$	$u\bar{d}$
		$s\bar{s}$	
-1	$s\bar{u}$	$s\bar{d}$	

Particle:

K (neutral and positive)

$\pi^0, \pi^+, \pi^-, \eta^0$

K (neutral and negative)

+3				$\bar{s}\bar{s}\bar{s}$	
+2			$\bar{d}\bar{s}\bar{s}$	$\bar{d}\bar{s}\bar{s}$	
+1		$\bar{u}\bar{u}\bar{s}$	$\bar{u}\bar{d}\bar{s}$	$\bar{d}\bar{d}\bar{s}$	
0	$\bar{u}\bar{u}\bar{u}$	$\bar{u}\bar{u}\bar{d}$	$\bar{u}\bar{d}\bar{d}$	$\bar{d}\bar{d}\bar{d}$	
0		$d\bar{d}\bar{d}$	$u\bar{d}\bar{d}$	$u\bar{u}\bar{d}$	$u\bar{u}\bar{u}$
-1		$d\bar{d}\bar{s}$	$u\bar{d}\bar{s}$	$u\bar{u}\bar{s}$	
-2		$d\bar{s}\bar{s}$	$u\bar{s}\bar{s}$		
-3		$s\bar{s}\bar{s}$			

Charge: -2 -1 0 +1 +2

Omega-Plus

Anti-Xi

Anti-Lambda, Anti-Sigma

Anti-Nukleon, Anti-Delta

Nukleon, Delta

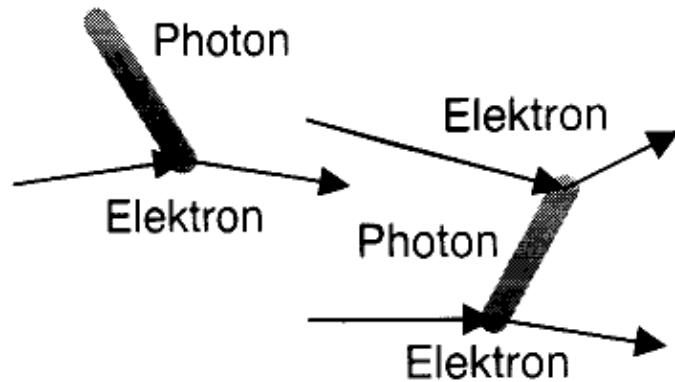
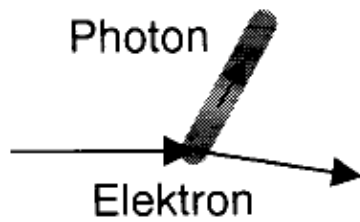
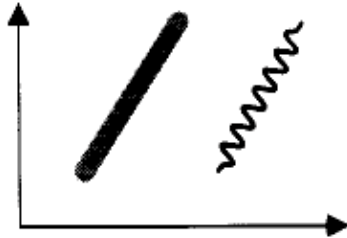
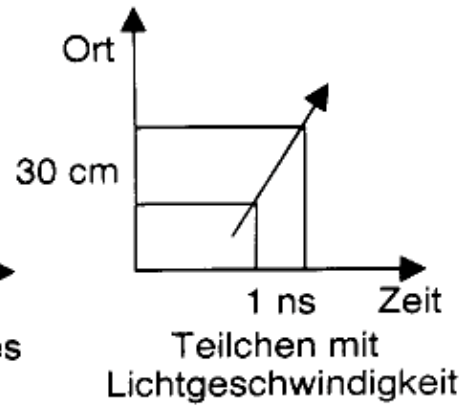
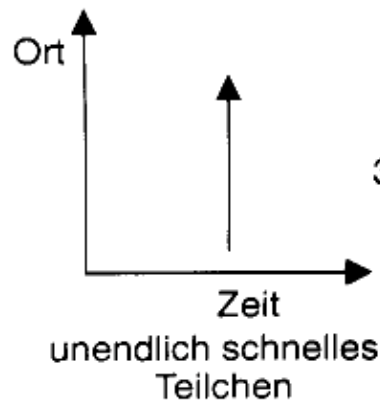
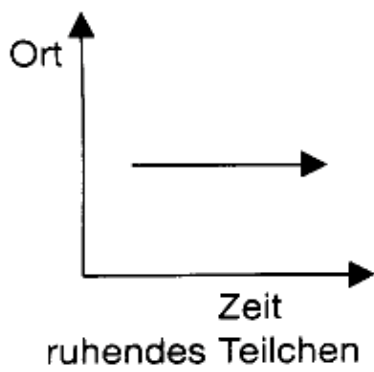
Lambda, Sigma

Xi

Omega-Minus

Gell-Mann and Zweig, 1964

# Die magischen Hieroglyphen





Glashow



Salam



Weinberg

# GSW

1967-1968: Theorie der elektroschwachen Kräfte

El.-magn. Kraft: **Photon** ( $m = 0$ )  
Schwache Kraft: **W-Plus-Teilchen**  
**W-Minus-Teilchen**  
**Z-Null-Teilchen (?)**  
W und Z sind so schwer wie Eisenatome.

Besondere Regeln:

**Leptonenzahlerhaltung!**

**Generationswechsel nur mit W!**

**Betazerfall:**  
**Neutron => Proton + Elektron**  
**+ ?**

**Energie? Impuls?**  
**Drehimpuls?**



Pauli



Fermi

**Neutrino, 1930**

**Poltergeist, 1956**

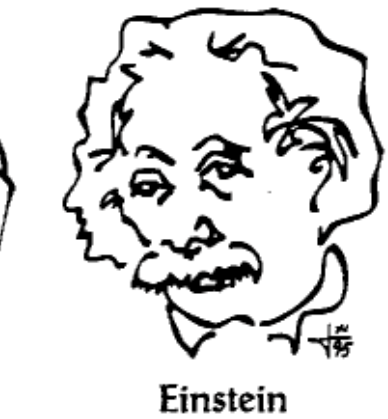
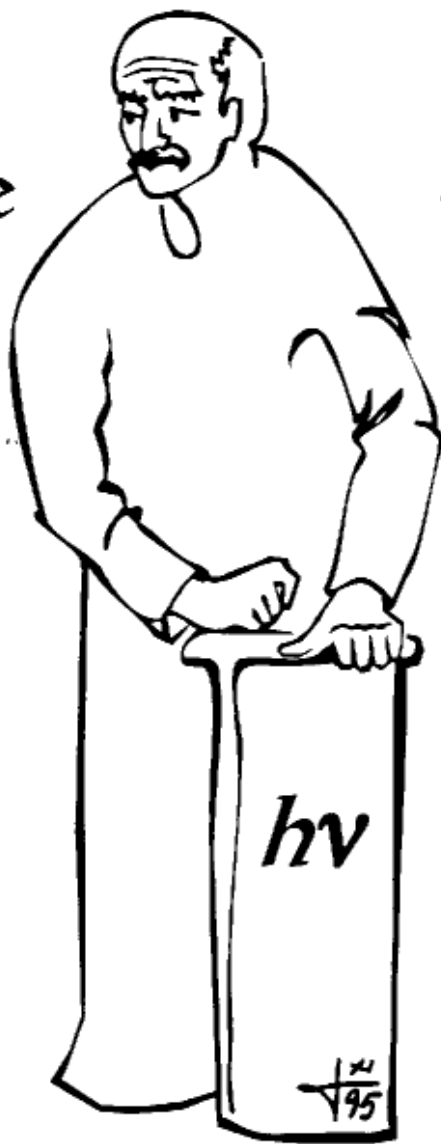


Reines



Cowan

# Die Quantenrunde



Planck, 1900...



1928-30

Elektron -Antielektron



Feynman



Schwinger



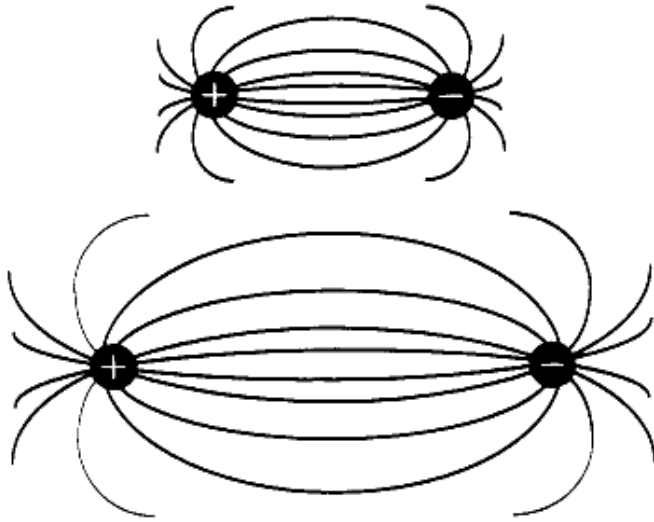
Tomonaga

# QED

Quantenelektrodynamik

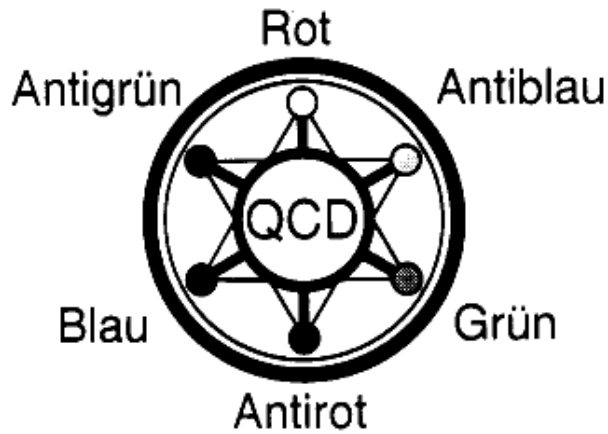
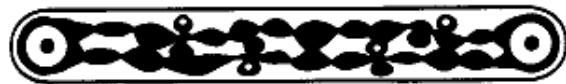
1944-1948

# Glukonen und Farbkräfte



# QCD

Quanten-  
Chromo-  
Dynamik



≡

