Quantum Mechanics
Physics 237

Frank L. H. Wolfs
Department of Physics and Astronomy
University of Rochester

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Course Announcements

- Next week, April 19: exam # 3 (Chapters 9 – 11).
  - Review session: Monday 3.25 pm, B&L 106.
  - Extra office hours:
    - Sunday 5 pm – 7 pm: Porcelli, POA
    - Monday 10 am – 12 pm: Wolfs, B&L 203A
  - QA session is cancelled due to Covid.
- Last PHY 237 homework (# 10) is due on Friday.
- Today we will complete the discussion of Chapter 17 and start our discussion of Chapter 18. We will only cover Sections 18.1 – 18.5.

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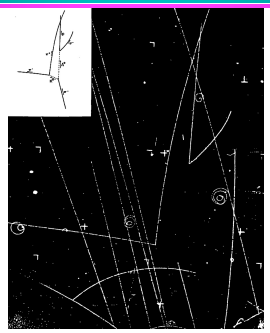
Production of strange particles.



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Groups of elementary particles that are stable or decay via the EM/WEAK decay.

Table 17-1. Particles that are Stable or Decay either Weakly or Electromagnetically

Generic Name	Particle Symbol	Rest Mass (MeV/c^2)	Lifetime (sec)	Charge Q	Intrinsic Spin s	Lepton Number L_e, L_μ, or L_τ	Baryon Number B	Intrinsic Parity P	Isospin T	Isospin z component T_z	Strangeness S
Photon	γ	0	stable	0	1	0	0	Odd	0, 1	0	0
Leptons	ν_e	0	stable	0	1/2	+1	0				
	$\bar{\nu}_e$	0	stable	0	1/2	−1	0				
	ν_μ	0	stable	0	1/2	+1	0				
	$\bar{\nu}_\mu$	0	stable	0	1/2	−1	0				
	e^-	0.511	stable	−1	1/2	+1	0				
	e^+	0.511	stable	+1	1/2	−1	0				
	μ^-	105.7	2.2×10^{-6}	−1	1/2	+1	0				
	μ^+	105.7	2.2×10^{-6}	+1	1/2	−1	0				
	τ^-	1784	5×10^{-13}	−1	1/2	+1	0				
	τ^+	1784	5×10^{-13}	+1	1/2	−1	0				
Mesons	π^+	139.6	2.6×10^{-8}	+1	0	0	0	Odd	1	+1	0
	π^0	135.0	8×10^{-17}	0	0	0	0	Odd	1	0	0
	π^-	139.6	2.6×10^{-8}	−1	0	0	0	Odd	1	−1	0
	K^+	493.8	1.2×10^{-8}	+1	0	0	0	Odd	1/2	+1/2	+1
	K^0	497.8	$\left(\begin{matrix}8.9 \times 10^{-11} \\ \text{and} \\ 5.2 \times 10^{-8}\end{matrix}\right)$	0	0	0	0	Odd	1/2	−1/2	+1
	$\bar{K}^0$	497.8		0	0	0	0	Odd	1/2	+1/2	−1
	K^-	493.8	1.2×10^{-8}	−1	0	0	0	Odd	1/2	−1/2	−1
	η^0	549	8×10^{-19}	0	0	0	0	Odd	0	0	0
	η'	958	2×10^{-21}	0	0	0	0	Odd	0	0	0
Baryons	p	938.3	stable	+1	1/2	0	+1	Even	1/2	+1/2	0
	n	939.6	925	0	1/2	0	+1	Even	1/2	−1/2	0
	Λ^0	1116	2.6×10^{-10}	0	1/2	0	+1	Even	0	0	−1
	Σ^+	1189	8.0×10^{-11}	+1	1/2	0	+1	Even	1	+1	−1
	Σ^0	1192	6×10^{-20}	0	1/2	0	+1	Even	1	0	−1
	Σ^-	1197	1.5×10^{-10}	−1	1/2	0	+1	Even	1	−1	−1
	Ξ^0	1315	2.9×10^{-10}	0	1/2	0	+1	Even	1/2	+1/2	−2
	Ξ^-	1321	1.6×10^{-10}	−1	1/2	0	+1	Even	1/2	−1/2	−2
	Ω^-	1672	8.2×10^{-11}	−1	3/2	0	+1	Even	0	0	−3

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The four basic interactions.

Table 17-2. The Observed Interactions

Name	Intrinsic Strength	Field Quantum: Name	Rest Mass	Spin	Range	Sign
Strong (nuclear)	1	Pion	$\sim 10^2$ MeV/c^2 (with heavier mesons for repulsive core)	0	$\sim 10^{-15}$ m (with smaller repulsive core)	Attractive overall (but with repulsive core)
Electro magnetic	10^{-2}	Photon	0	1	Long ($\propto 1/r$)	Attractive or repulsive
Weak (β decay)	10^{-14}	Intermediate boson	$\sim 10^5$ MeV/c^2	1	$\sim 10^{-18}$ m	Not applicable
Gravitational	10^{-40}	Graviton	0	2	Long ($\propto 1/r$)	Always attractive

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6 Minute 03 Second Intermission.

- Since paying attention for 1 hour and 15 minutes is hard when the topic is physics, let's take a 6 minute 03 second intermission.
- You can:
  - Stretch out.
  - Talk to your neighbors.
  - Ask me a quick question.
  - Enjoy the fantastic music.

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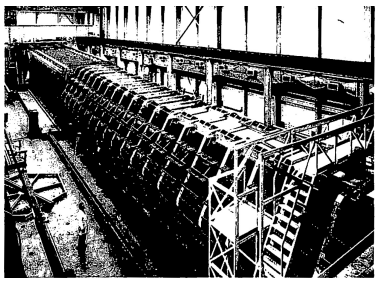
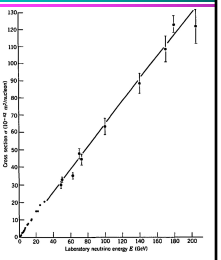
Neutrino-nucleon scattering.





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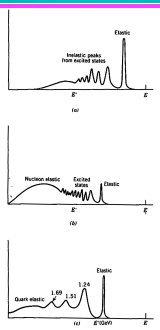
Electron-nucleon scattering.



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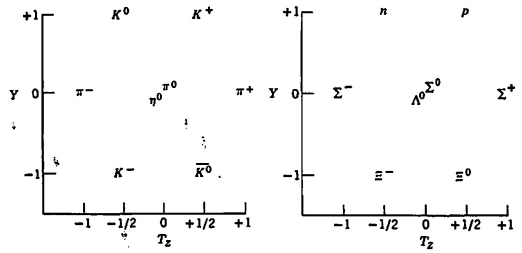
SU(3).



Odd parity, Spin 0 Even parity, Spin 1/2

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ENOUGH FOR TODAY?

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