

Particle Physics & Cosmology

Physics 457 at [University of Michigan](#)

EVAN CARPENTER

Winter Semester 2022

Jan 5th	Lecture 1: <i>First Day</i>	p. 2
Jan 7th	Lecture 2: <i>Second Day</i>	p. 2
Jan 12th	Lecture 3: <i>Finishing Special Relativity</i>	p. 2
Jan 14th	Lecture 4: <i>Fundamental Forces</i>	p. 2

Lecture 1. (Jan 5th) *First Day*

eV is energy required to move 1 e^- through 1 V

We can set $c, \hbar, k_B = 1$ A result of that is being able to describe all quantities in terms of energies or inverse energies.

Lecture 2. (Jan 7th) *Second Day*

eV are a thng

Natural units are thing

Dimension	SI	Planck	Natural
Energy	1.602×10^{-10} J	1 GeV	1 GeV
Mass	1.783×10^{-27} kg	1 GeV/ c^2	1 GeV
Momentum	5.33×10^{-19} kg*m/s	1 GeV/ c	1 GeV
Distance	1.973×10^{-16} m	$\hbar c$ GeV	1 GeV $^{-1}$
Time	5.33×10^{-19} kg*m/s	1 GeV/ c	1 GeV $^{-1}$
Mass Density	2.322×10^{20} kg/ m^3		1 GeV 4

Table 1: Units

Proper time is Δt_0 with the clock at rest in that frame

Time dilation is $\Delta t = \gamma \Delta t_0$ in the frame

Proper length is Δx_0 with the clock at rest in that frame

Length Contraction is $\Delta x = \Delta x_0 / \gamma$ in the frame

Lecture 3. (Jan 12th) *Finishing Special Relativity*

Invariant vs constant and how they are different.

Different relationships for beta and gamma

Lorentz transform in matrix form as boost.

E from beam at target and from two beams: pros and cons of cost and statistics and max energy.

Lecture 4. (Jan 14th) *Fundamental Forces*

Stable particles! Proton is only quark combo that's stable! Possibly make baryon template for Tikz? Baryon has odd number of valence (?) quarks