This is much like Eqs. (2.4.8) and (2.4.9), except that we have not cancelled factors of i on both sides of these equations, because at this point we have not yet decided whether P and T are linear and unitary or antilinear and antiunitary.

The decision is an easy one. Setting $\rho = 0$ in Eq. (2.6.4) gives

$$\mathsf{P}\, iH \mathsf{P}^{-1} = iH\,,$$

where $H \equiv P^0$ is the energy operator. If P were antiunitary and antilinear then it would anticommute with i, so $\mathsf{P}H\mathsf{P}^{-1} = -H$. But then for any state Ψ of energy $E > 0$, there would have to be another state $\mathsf{P}^{-1}\Psi$ of energy $-E < 0$. There are no states of negative energy (energy less than that of the vacuum), so we are forced to choose the other alternative: *P is linear and unitary, and commutes rather than anticommutes with H.*

On the other hand, setting $\rho = 0$ in Eq. (2.6.6) yields

$$\mathsf{T}\, iH \mathsf{T}^{-1} = -iH\,.$$

If we supposed that T is linear and unitary then we could simply cancel the is, and find $\mathsf{T}H\mathsf{T}^{-1} = -H$, with the again disastrous conclusion that for any state Ψ of energy E there is another state $\mathsf{T}^{-1}\Psi$ of energy $-E$. To avoid this, we are forced here to conclude that *T is antilinear and antiunitary.*

Now that we have decided that P is linear and T is antilinear, we can conveniently rewrite Eqs. (2.6.3)–(2.6.6) in terms of the generators (2.4.15)–(2.4.17) in a three-dimensional notation

$$\mathsf{P}\mathbf{J}\mathsf{P}^{-1} = +\mathbf{J}\,, \tag{2.6.7}$$

In particular, it is possible that the degeneracy indicated by the label $\pm$ may be the same as the particle–antiparticle degeneracy, so that the antiparticle (as defined by CPT) of the state $\Psi_\pm$ is $\Psi_\mp$. In this case, CP would have the unconventional property of *not* interchanging particles and antiparticles. As far as these particles are concerned, CP and T would be what are usually called P and CT. But this is not merely a matter of definition; on other particles CP and T would still have their usual effect.

No examples are known of particles that furnish unconventional representations of inversions, so these possibilities will not be pursued further here. From now on, the inversions will be assumed to have the conventional action assumed in Section 2.6.