11.3 Universal Radiative Transport Equation and the Equilibrium Principle

For the purposes of this section, let us refer to the thirteen quantities studied so far as the standard concepts (namely N(z,6,0)) H(z,±) J% h(z,±) , h (z) , K(z,6,~) , K(z,±) , k(z,±) , k(z) , and R(z,-)). A directed standard concept is any of the preceding, standard concepts except h(z) and K(z) .

The evidence gathered in the preceding discussions may now be assembled in the form of:

THE UNIVERSAL RADIATIVE TRANSPORT EQUATION AND THE EQUILIBRIUM PRINCIPLE. Let X be an arbitrarily stratified source--free plane-parallel medium with arbitrary incident lighting conditions. Let " & Z)
' r
denote any one o f the standard concepts. Then associated with (z) are two functions e_a(z) and &,(z), the attenuation and equilibrium functions for r(z), respectively. The standard concept F(z) together with (f_a(z) and (2_q(z) satisfy the functional relation

de z) = u (Z) 16 e(z) -- (z) I EC (Z) - e(Z)
z a a

w~,ere P(z) and 6 are known parameters depending on C.~(z) . The relation (I) is the univer8-a2 radiative transport equation. (It is degenerate if 6 = o ; and normalized if U

If. Oz) is a directed standard concept and p (z) > o then:

4 whenever C (z) > C_q (z)

(2)'

and i f e(z) is any standard concept, and X is eventually homogeneous, then:

a ~~) = limn-*Co e_a (Z)

exis is ,

= ^{lim}n+~C a (z) exists,

eq (^{00})

and.

I

imz->-We(z). = C' (00)

.

The proof of the statements (1) , (2) , (3) , and (4) have essentially been covered in the preceding discussions either directly (as in the case of (1)), or indirectly by references to the appropriate portions of the present work (as in the case of (2)--(4)),. Table 1 below gives the explicit forms of p(z) and S for the thirteen standard-concepts: An examination of Table 1 shows that if R(z,-) is removed from the list of standard concepts, a considerable simplification is effected in the form of (1). However, in the interests of completeness we have included R (z , --) within the purview o f (1), and we note that by a change o f z - scale, the equation is normalizable.

TABLE 1
Standard Cases of the Universal Radiative Transport Equation