STANDARD DEFINITIONS FOR NUMERICAL SOLUTION OF HEAT TRANSPORT EQUATIONS

Notations:

a) Diffusion coefficients:

Electrons: χ_e

Ions: χ_{ion} (The sum over ion species: $n_i\chi_i$ is writen NION χ_{ion})

NION = NM1 + NM2 + NIMP (Note: includes impurities, excludes fast ions)

b) Convection term:

Electrons: Flow multiplication factor: γ_e (usually set equal to 3/2)

Convection source term: C_e (usually set equal to 0)

Ions: Flow multiplication factor: γ_{ion} (usually set equal to 3/2)

Convection source term: C_{ion} (usually set equal to 0)

c) Boundary conditions:

In the following, the variable TE and TI (in eV) are determined self-consistently as solution of the diffusion equations (6) and (7) using as boundary condition the measured TE and TI at rho = 0.9.

d) Source terms:

2)Volume differential:

V' = (VOLUME) / ρ

3) Electron particle flow is defined as a solution of:

$$\overline{\rho}\,\Gamma_e = V'[\,SNBIE + PGASZ * SWALL - DNER]$$

4) Simplified ion particle flow:

$$\Gamma_{ion} = \Gamma_e \;/\; PGASZ$$

5) Equipartition coupling coefficient :

(from NRL Handbook simplified for me << mi):

$$Q_{ei} = \frac{3}{2}\, NE\, \alpha_{ei}\, k\, [TE - TI]$$

$$\alpha_{ei} = 3.169\ 10^{-15} \ln(\Lambda) \frac{1}{T_e^{3/2}} \left[\frac{PGASZ^2}{PGASA} NM1 + \frac{BGASZ^2}{BGASA} NM2 + \frac{PIMPZ^2}{PIMPA} NIMP \right]$$

$$\ln(\Lambda) = 30.908 - \ln\left(\frac{NE^{1/2}}{TE}\right)$$

$$k = 1.6\ 10^{-19}$$

6) Electron heat transport equations:

a) Heat source terms:

$$Q_e = QNBIE + QICRHE + QECHE + QLHE + QIBWE + QOHM + QFUSE - QWALLE - QRAD$$

b) Diffusion equation:

$$\frac{}{\rho}\left[-V'\, GRHO2\, NE\, \chi_e \frac{}{\rho} TE + \gamma_e\, \Gamma_e\, TE \right] = V'\left[-NE\, TE\, C_e - Q_{ei} + Q_e - DWER \right]$$

7) Ion heat transport equation:

a) Heat source terms:

$$Q_{ion} = QNBII + QICRHI + QECHI + QLHI + QIBWI + QFUSI - QWALLI$$

b) Diffusion equation (summed over all ion species):

$$\frac{}{\rho}\left[-V'\, GRHO2\, NION\, \chi_{ion} \frac{}{\rho} TI + \gamma_{ion}\, \Gamma_{ion}\, TI \right] =$$

$$V'\left[NION\, C_{ion}\, TI + Q_{ei} + Q_{ion} - DWIR \right]$$