Parametri nucleari

$\omega := 1$

$\omega i := 0.001$

$\Omega 1 := 393.4$

$\Omega 2 := 1952$

Funzione di sollecitazione ed accoppiamento

$s1 := 0.1 \cdot 10^{20}$

$\sigma v(Ti) := 5.1 \cdot 10^{-22} \cdot (\ln(Ti) - 2.1)$

I've modified some of these functions in the light of my manipulations below

$P(n, ni, Te) := 5 \cdot 10^{-37} \cdot [2 \cdot (ni - n)] \cdot (|Te|)^{0.5} \cdot \left(1.6 \cdot 10^{-19}\right)^{-1} \cdot \frac{2}{3} \cdot 10^{-3}$

$\omega eq(n, Te) := n \cdot \frac{\ln(18)}{2 \cdot 9.99 \cdot 10^{18} \cdot Te^{\frac{3}{2}}}$

$\omega e(ni) := \frac{1}{2.5 \cdot 10^{-21} \cdot ni \cdot 5^{\frac{1}{2}} \cdot 1.2^{2} \cdot 6}$

Modified versions - see further below for why I've done this

$P(Te) := 5 \cdot 10^{-37} \cdot \left[2 \cdot \left(\frac{s1}{\omega}\right)\right] \cdot (|Te|)^{0.5} \cdot \left(1.6 \cdot 10^{-19}\right)^{-1} \cdot \frac{2}{3} \cdot 10^{-3} \rightarrow 0.041666666666666666667 \cdot (|Te|)^{0.5}$

$\omega eq(m, Te) := m \cdot s1 \cdot \frac{\ln(18)}{2 \cdot 9.99 \cdot 10^{18} \cdot Te^{\frac{3}{2}}} \rightarrow \frac{0.50050050050050050005 \cdot m \cdot \ln(18)}{Te^{\frac{3}{2}}}$

$$\omega e(m) := \frac{1}{2.5\cdot 10^{-21}\cdot s1\cdot\left(m+\frac{1}{\omega}\right)\cdot 5^{\frac{1}{2}}\cdot 1.2^{2}\cdot 6} \rightarrow \frac{0.0231481481481481481481 48\cdot\sqrt{5}}{0.025\cdot m + 0.025}$$

These are your first two equations

$$s1 - n^{2}\cdot\sigma v(Ti) - \omega\cdot n = 0$$

$$2\cdot s1 - n^{2}\cdot\sigma v(Ti) - \omega\cdot ni = 0$$

Subtract the first from the second to get $s1 - \omega(ni - n) = 0$

or $ni = n + \frac{s1}{\omega}$

So get rid of ni in the equations to be solved. They then become:

$$s1 - n^{2}\cdot\sigma v(Ti) - \omega\cdot n = 0$$

$$(\Omega 1 + Ti)\cdot\frac{n^{2}\cdot\sigma v(Ti)}{n+\frac{s1}{\omega}} + \left(\omega - \omega eq(n,Te) - \omega i - \frac{2\cdot s1}{n+\frac{s1}{\omega}}\right)\cdot Ti + \omega eq(n,Te)\cdot Te = 0$$

$$\Omega 2\cdot\frac{n^{2}\cdot\sigma v(Ti)}{2\cdot\frac{s1}{\omega}} + \left(-\omega eq(n,Te)\cdot\frac{n+\frac{s1}{\omega}}{2\cdot\frac{s1}{\omega}} - \omega e\left(n+\frac{s1}{\omega}\right)\right)\cdot Te + \omega eq(n,Te)\cdot\frac{n+\frac{s1}{\omega}}{2\cdot\left(\frac{s1}{\omega}\right)}\cdot Ti - P(Te) = 0$$

The first of these can be solved to find n in terms of Ti

$$n(Ti) = \frac{-\omega + \sqrt{\omega^{2} + 4\cdot\sigma v(Ti)\cdot s1}}{2\cdot\sigma v(Ti)}$$

The positive solution is presumably required

In the other two equations we can replace $\sigma v\cdot n^{2}$ where it occurs by $s1 - \omega\cdot n$ to get

$$(\Omega 1 + Ti)\cdot\frac{s1 - \omega\cdot n}{n + \frac{s1}{\omega}} + \left(\omega - \omega eq(n,Te) - \omega i - \frac{2\cdot s1}{n + \frac{s1}{\omega}}\right)\cdot Ti + \omega eq(n,Te)\cdot Te = 0$$

$$\Omega 2\cdot\frac{s1 - \omega\cdot n}{2\cdot\frac{s1}{\omega}} + \left(-\omega eq(n,Te)\cdot\frac{n + \frac{s1}{\omega}}{2\cdot\frac{s1}{\omega}} - \omega e\left(n + \frac{s1}{\omega}\right)\right)\cdot Te + \omega eq(n,Te)\cdot\frac{\frac{n}{s1} + \frac{s1}{\omega}}{2\cdot\left(\frac{s1}{\omega}\right)}\cdot Ti - P(Te) = 0$$

The above three equations can be written as

$$m(Ti) := \frac{-\omega + \sqrt{\omega^2 + 4\cdot\sigma v(Ti)\cdot s1}}{2\cdot\sigma v(Ti)\cdot s1}$$

this function is obtained by dividing n by s1

and

$$(\Omega 1 + Ti)\cdot\frac{1 - \omega\cdot\frac{n}{s1}}{\frac{n}{s1} + \frac{1}{\omega}} + \left(\omega - \omega eq(n,Te) - \omega i - \frac{2}{\frac{n}{s1} + \frac{1}{\omega}}\right)\cdot Ti + \omega eq(n,Te)\cdot Te = 0$$

$$\Omega 2\cdot\frac{1 - \omega\cdot\frac{n}{s1}}{2\cdot\frac{1}{\omega}} + \left(-\omega eq(n,Te)\cdot\frac{\frac{n}{s1} + \frac{1}{\omega}}{2\cdot\frac{1}{\omega}} - \omega e\left(\frac{n}{s1}\right)\right)\cdot Te + \omega eq(n,Te)\cdot\frac{\frac{n}{s1} + \frac{1}{\omega}}{2\cdot\left(\frac{1}{\omega}\right)}\cdot Ti - P(Te) = 0$$

Now with $m = \frac{n}{s1}$ and simplifying equations and functions (already done above) even more:
Note: m is the function above, but I've just written it as m in the next two equations for clarity. It needs to be written fully in the solve block.

$$(\Omega 1 + Ti)\cdot\frac{1 - \omega\cdot m}{m + \frac{1}{\omega}} + \left(\omega - \omega eq(m,Te) - \omega i - \frac{2}{m + \frac{1}{\omega}}\right)\cdot Ti + \omega eq(m,Te)\cdot Te = 0$$

$$\Omega 2\cdot\frac{1 - \omega\cdot m}{2\cdot\frac{1}{\omega}} + \left(-\omega eq(m,Te)\cdot\frac{m + \frac{1}{\omega}}{2\cdot\frac{1}{\omega}} - \omega e(m)\right)\cdot Te + \omega eq(m,Te)\cdot\frac{m + \frac{1}{\omega}}{2\cdot\left(\frac{1}{\omega}\right)}\cdot Ti - P(Te) = 0$$

Solve the last two for Ti amd Te

Initial guesses

$Ti := 100$

$Te := 10$

Given

$$(\Omega 1 + Ti)\cdot\frac{1 - \omega\cdot m(Ti)}{m(Ti) + \frac{1}{\omega}} + \left(\omega - \omega eq(m(Ti), Te) - \omega i - \frac{2}{m(Ti) + \frac{1}{\omega}}\right)\cdot Ti + \omega eq(m(Ti), Te)\cdot Te = 0$$

$$\Omega 2\cdot\frac{1 - \omega\cdot m(Ti)}{2\cdot\frac{1}{\omega}} + \left(-\omega eq(m(Ti), Te)\cdot\frac{m(Ti) + \frac{1}{\omega}}{2\cdot\frac{1}{\omega}} - \omega e(m(Ti))\right)\cdot Te + \omega eq(m(Ti), Te)\cdot\frac{m(Ti) + \frac{1}{\omega}}{2\cdot\left(\frac{1}{\omega}\right)}\cdot Ti - P(Te) = 0$$

$$\begin{pmatrix} Ti \\ Te \end{pmatrix} := Find(Ti, Te)$$

$$\begin{pmatrix} Ti \\ Te \end{pmatrix} = \begin{pmatrix} 86.908 \\ 13.037 \end{pmatrix}$$

so $m(Ti) = 0.988$

therefore $n := m(Ti)\cdot s1$ $n = 9.882\times 10^{18}$

and $ni := n + \frac{s1}{\omega}$ $ni = 1.988\times 10^{19}$