**Reconstruction Tungsten profile by using ‘tracing’ method**

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1. Physical model

Assuming the local relation between flux and gradient is one-to-one, it can be described as follow:

(1)



here, n is the particle density; is the particle flux; is the particle gradient; and D and V are diffusion coefficient and convection velocity.

So the relation between impurity flux and gradient is derived according to Eq. (1):

(2)



where the impurity is tungsten.

For obtaining the transport coefficients from scanning a/Ln\_imp in TGLF, it becomes useful to write Eq. (2) as:

(3)



where: . (4)



In the state of free of source, which means , then



. (5)



Assuming (6)



the profile is determined by the following equation:

. (7)



1. Method

Based on our situation, the cases, which are used to add tungsten, have already run the ONETWO-EFIT-TGYRO to get steady-state. So the first step Brian said (‘ I take the TGYRO solution once it is converged, and the TGYRO simulation does not have W.’) could be ignored.

All the examples show here are based on background plasma of iter01 from gacode/tgyro/tools/input/iter01.

1. Add tungsten at a concentration of nW/ne=1e-9 as the last kind of ions in input.profiles of TGYRO. Re-run TGYRO with 0 iteration, just to map the solution to TGLF inputs at all radii.
2. At each radius, run TGLF scanning varying a/Ln\_imp from 0.0 to 1.0 with 6 steps to see if flux is linear and get slope and offset.

One example with radius of 0.6 shows here:



As can be seen, the electron particle flux keeps unchanged with varying the impurities density gradient (left figure), which indicates the level of impurities is of 'trace', the background turbulence is note effected. The impurities particle flux has perfect linear relationship with the its own density gradient, suggesting the availability of the method.

1. Assuming the slope and offset are denoted by S and O, respectively, according to Eq. (3):

 . (8)

So the transport coefficients of impurity are:

 (9)

Note both S and O has the dimension of gyrobohm particle flux of unit . So the  and  obtained here is of the experiment unit  and .

1. According to Eq. (7), the impurity profile could be obtained.

