**Code *frictionForceIntegration (fFI)*  Description**

Main goal of the code is to reproduce the dependence of the friction force on ion velocity. This is supposed to be done in 3 different approaches:

1. Direct integration of the friction force along the Larmor trajectory of the electron;

2. Integration of the frictional force along the trajectory of the Larmor "circles";

3. Integration using Magnus expansion to calculate the transmitted momentum.

The results of the first approach will be used as "control" for the next two.

Description of the code

1. The following initial values are given:

* Magnetic field . It determines the Larmor frequency ;
* Number  steps per each Larmor turn. It determines the step over time ;
* Longitudinal and transversal Temperatures of the electrons, . They determine the rms velocities  respectively;
* Electron beam density . It determines the critical impact parameter  and radius  of the neutralization;
* Angle (its tangent ), connecting the impact parameter  of the flight of an electron near the ion with the length  of the part of the trajectory on which they interact.

1. Preparation of auxiliary data (arrays) used for subsequent integration of the friction force:

* 1-D array  with  entries for each value of the transversal velocity of the electrons (Gaussian distribution with ). It determines the following arrays of the same dimension: current Larmour radius , minimal impact parameter , maximal impact parameter  (using the calculated values of the Debye radius  and radius of the shielding );
* 1-D array  with  entries for each value of the longitudinal velocity of the electrons (Gaussian distribution with );
* 2-D array of  with  (first index) and  (second index) entries for each value of the transversal velocity and impact parameter. It determines the 2-D array  (the same dimensions) of the length of the interaction between the ion and electron;
* 3-D array  with  (first index),  (second index) and  (third index) entries for each value of the transversal velocity, impact parameter and longitudinal velocity. This array determines the 3-D array  (the same dimensions) of the total number of the time steps for integration along the trajectory of the electron.

1. Flow chart of the code (first approach):

