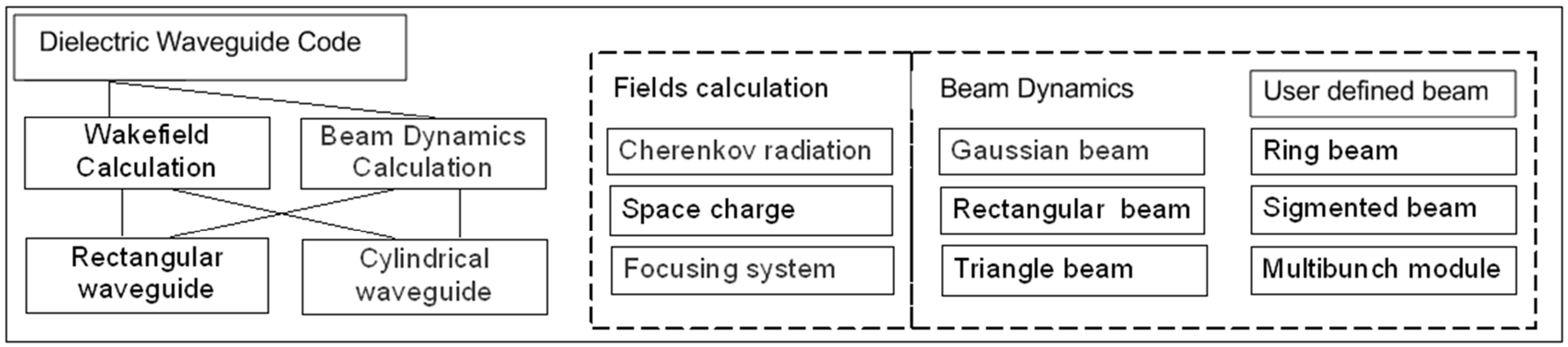
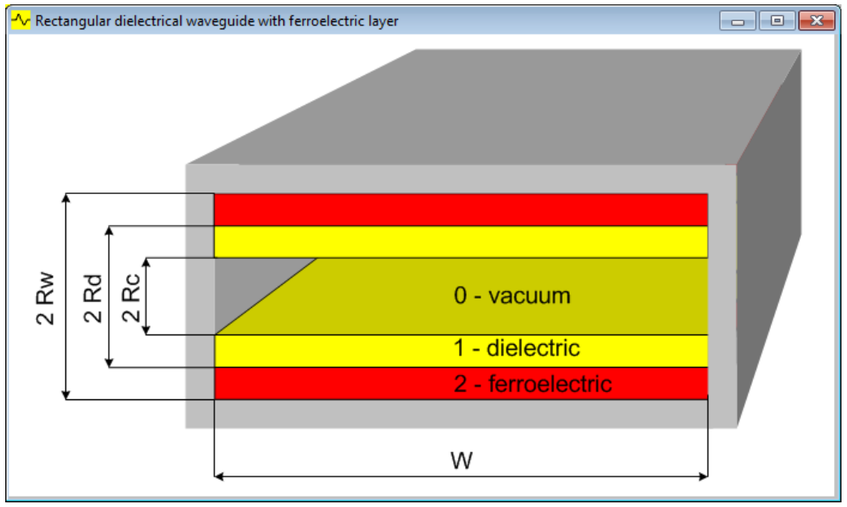
Short description of “Dielectric Waveguide” code

1. Introduction

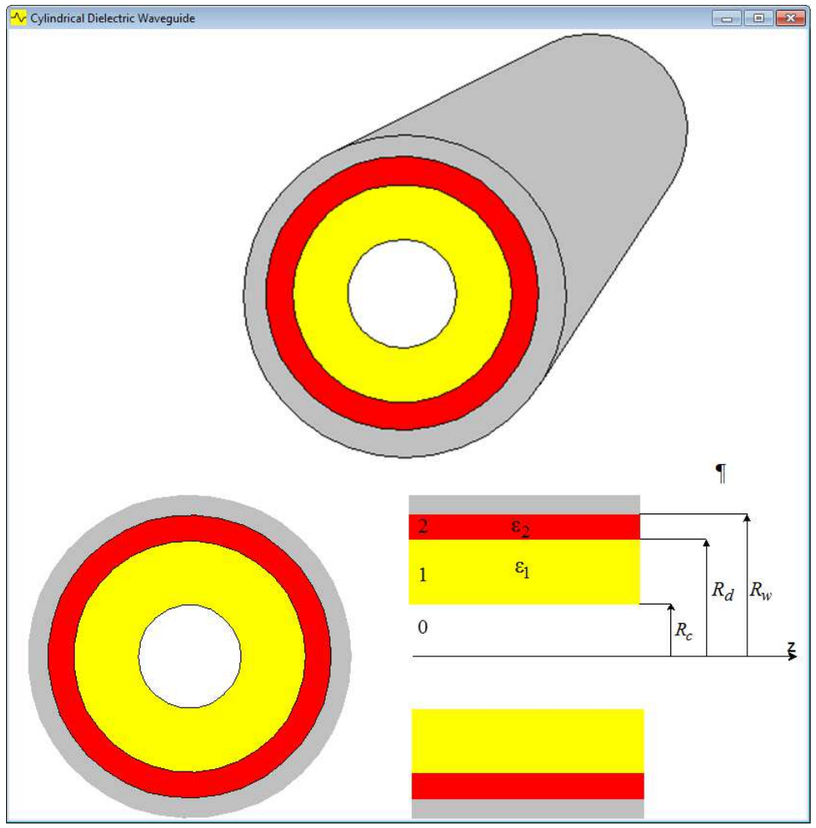
“Dielectric Waveguide” code is created for calculating Wakefield and Beam Dynamics in two layer dielectric waveguides with cylindrical and rectangular geometries (Pic.1-Pic.3)



Pic.1 Structure of code



Pic.2 Rectangular two-layer dielectric waveguide



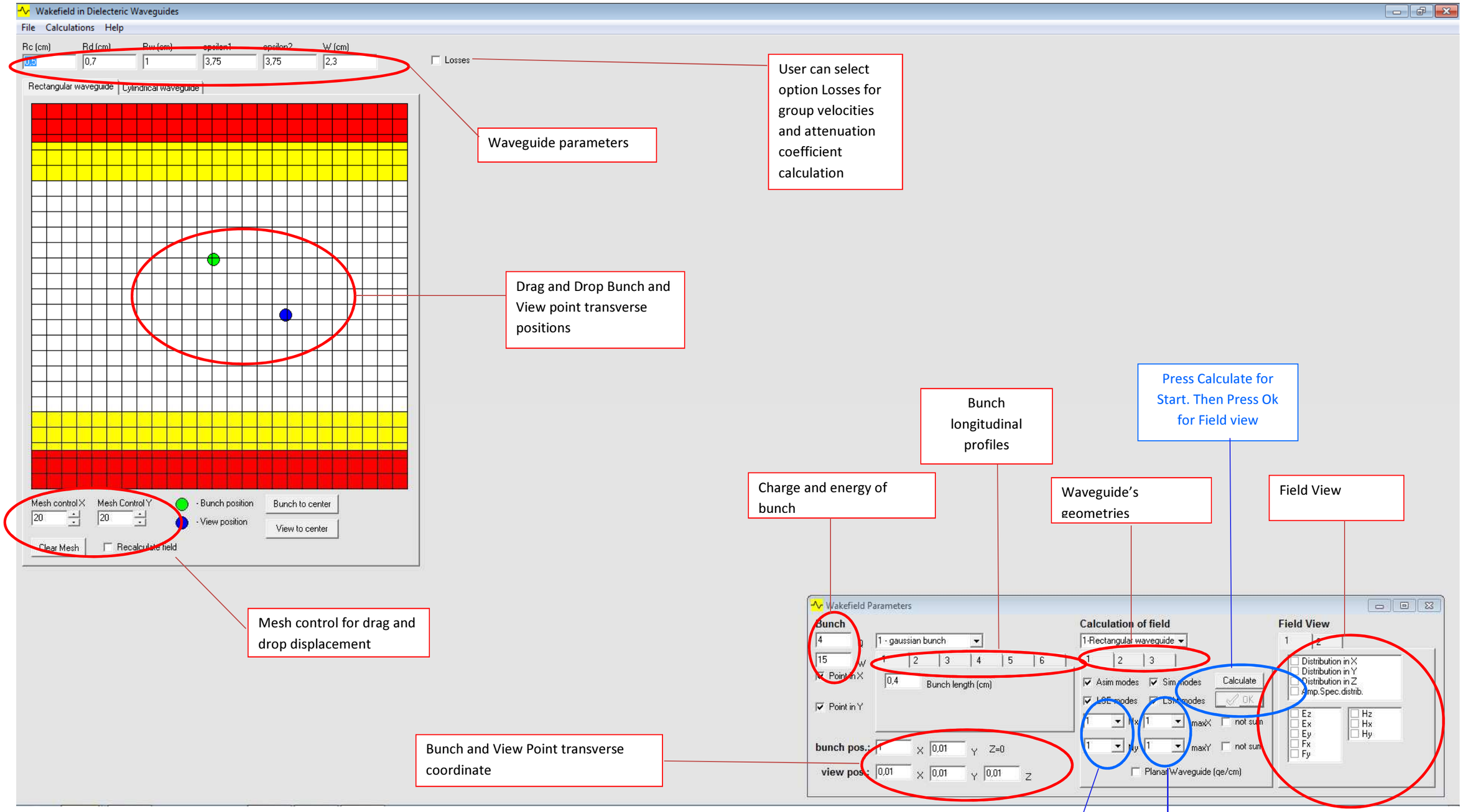
Pic.3 Cylindrical two-layer dielectric waveguide

2. Field Calculation

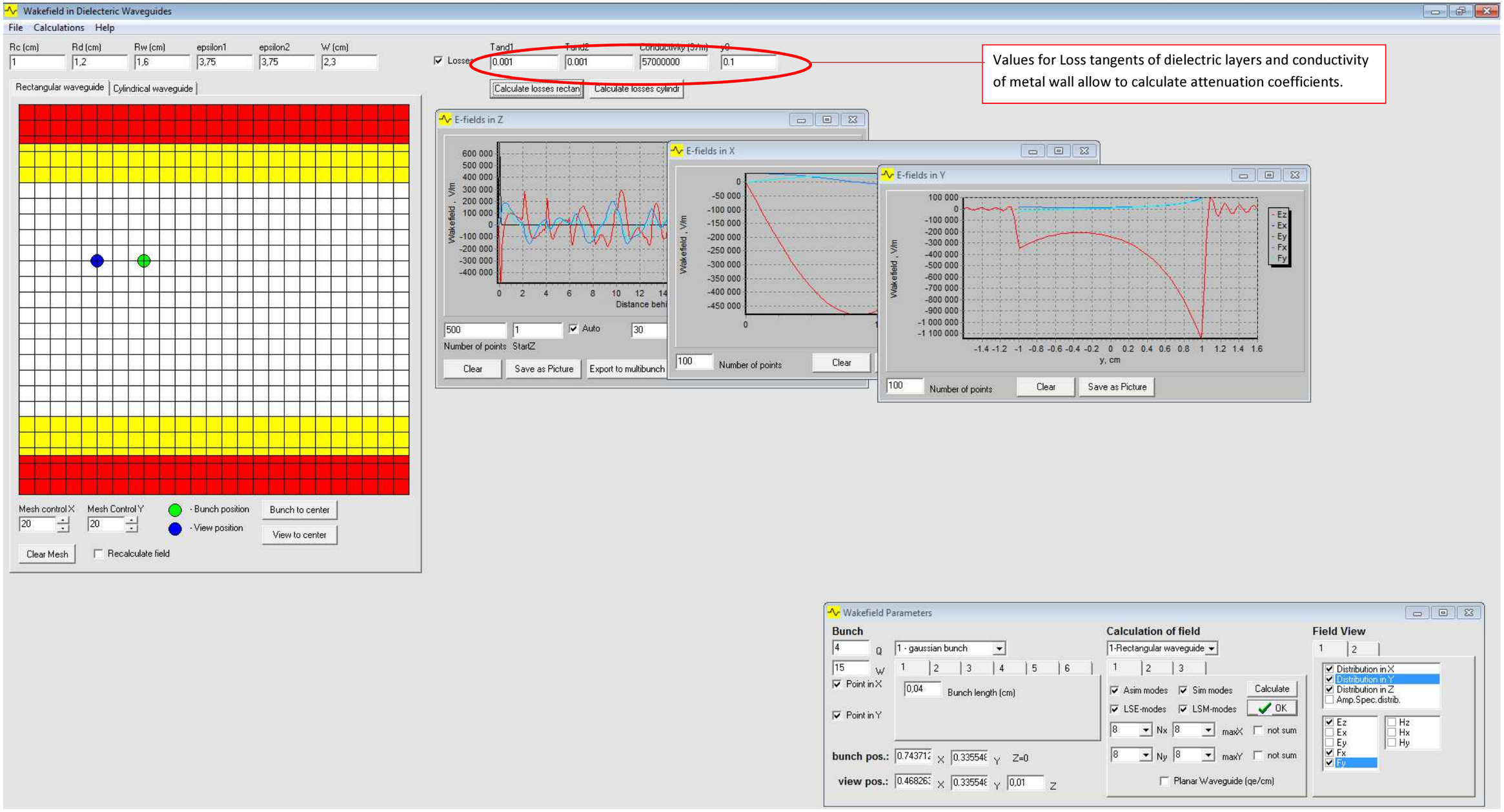
2.1. Main Window

When program start user see main window. User can choose type of waveguide, longitudinal profile of bunch, edit parameters of bunch, edit parameters of waveguides, select number of calculated modes, plot selected components of electromagnetic field. Calculation of wakefield is realized for transverse point bunch or transverse Gaussian bunch (options PointX and PointY). For rectangular geometry user have possibility to drag and drop transverse positions of bunch and view point.

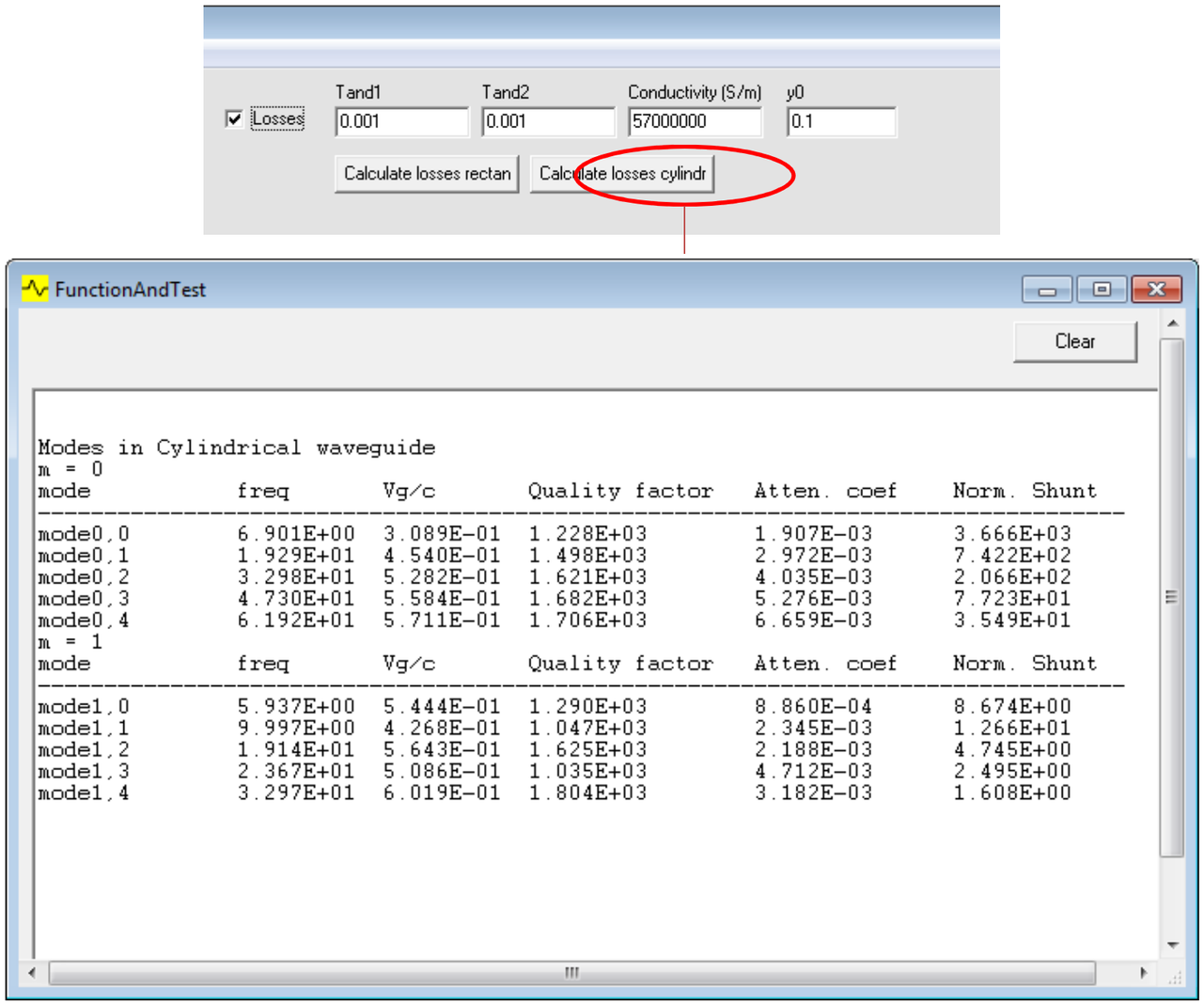
First of all, user have to press button “Calculate” for Green function calculation. This button has to be pressed every time when geometry parameters are changed. After “Calculate” is clicked program start to solve dispersion equation and calculate frequencies, amplitudes of Green function in range limited by MaxY and MaxX numbers. For others actions (plot field for example) user press button “Ok”.



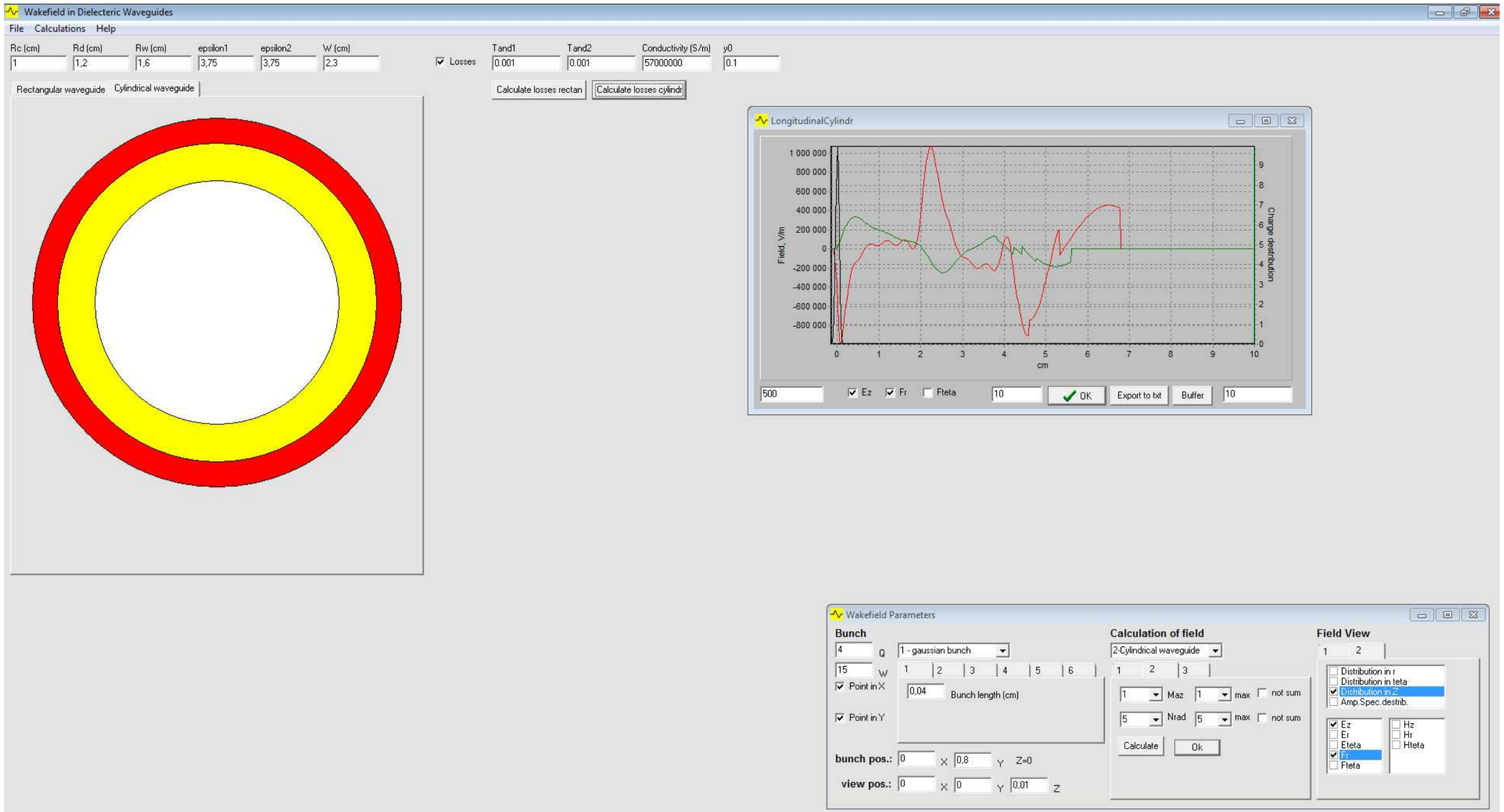
Pic. 4 Main Window for Rectangular waveguide



Pic. 5 Main Window with plots of electromagnetic field for Rectangular waveguide

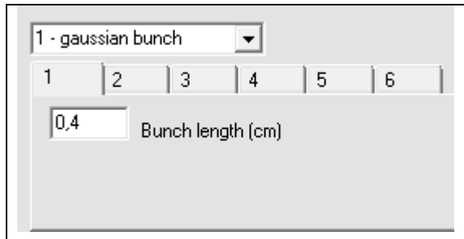


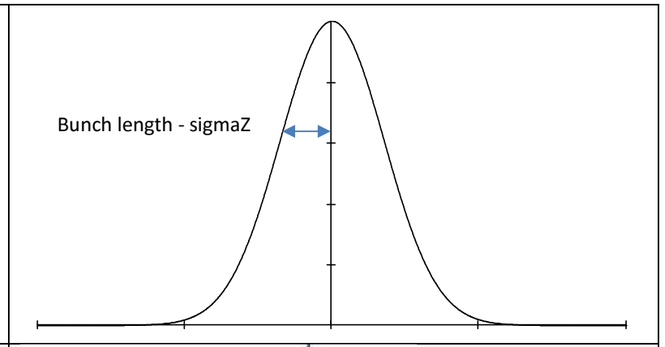
Pic. 6 Losses calculation

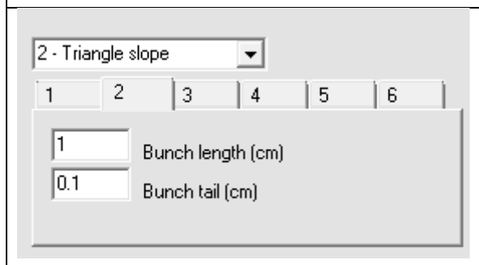


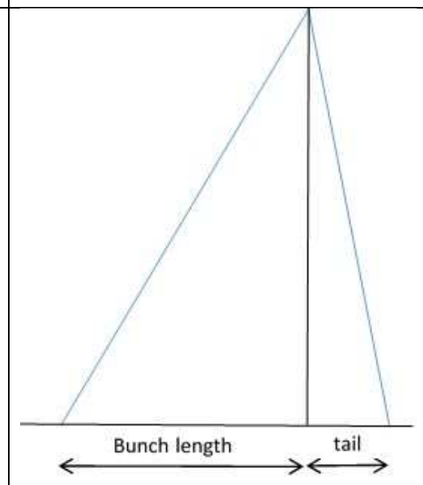
Pic. 7 Main Window with plots of electromagnetic field for Cylindrical waveguide

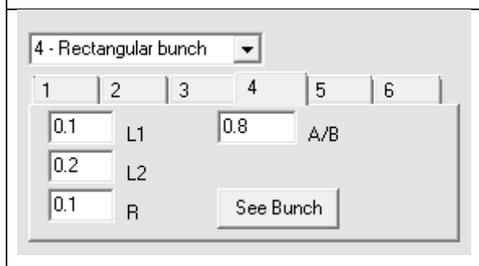
2.2. Bunch Profiles

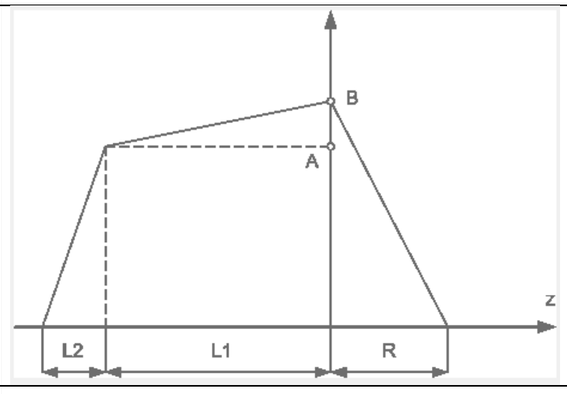


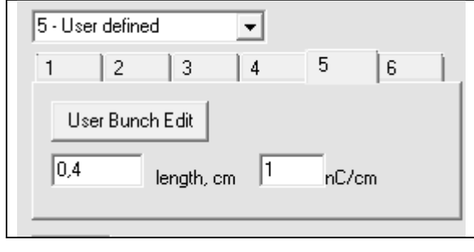






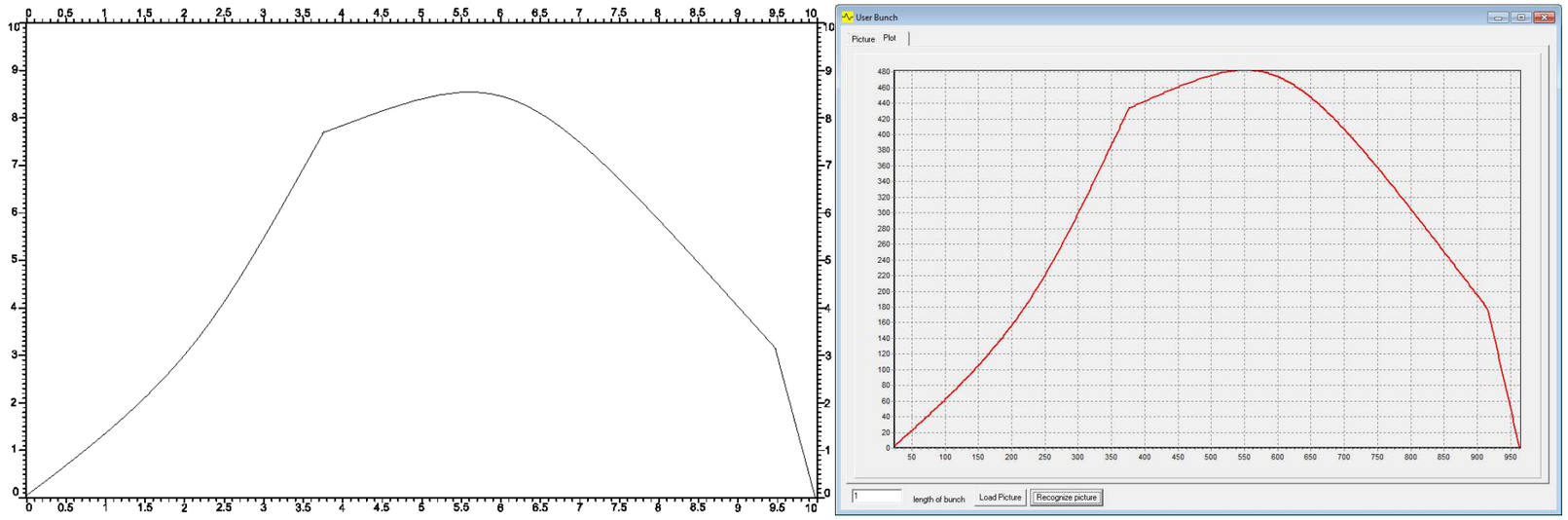




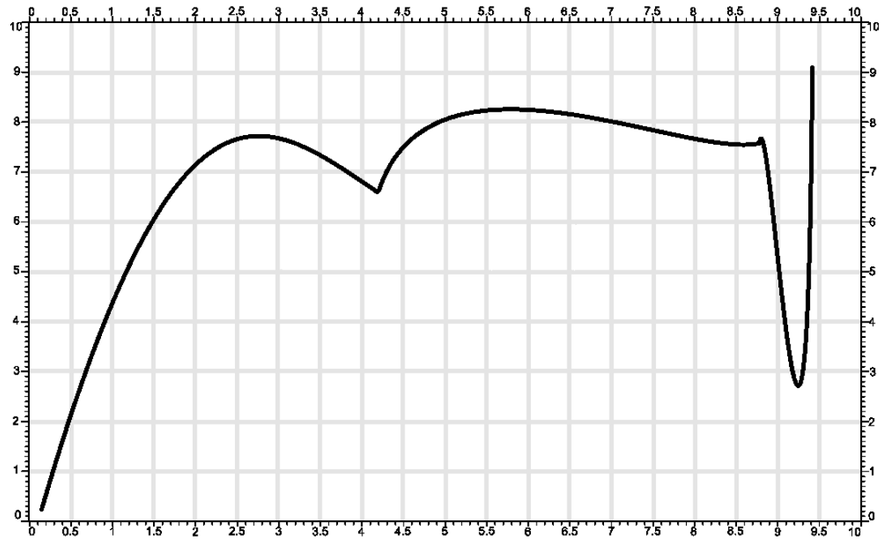


See next Page

User bunch profile

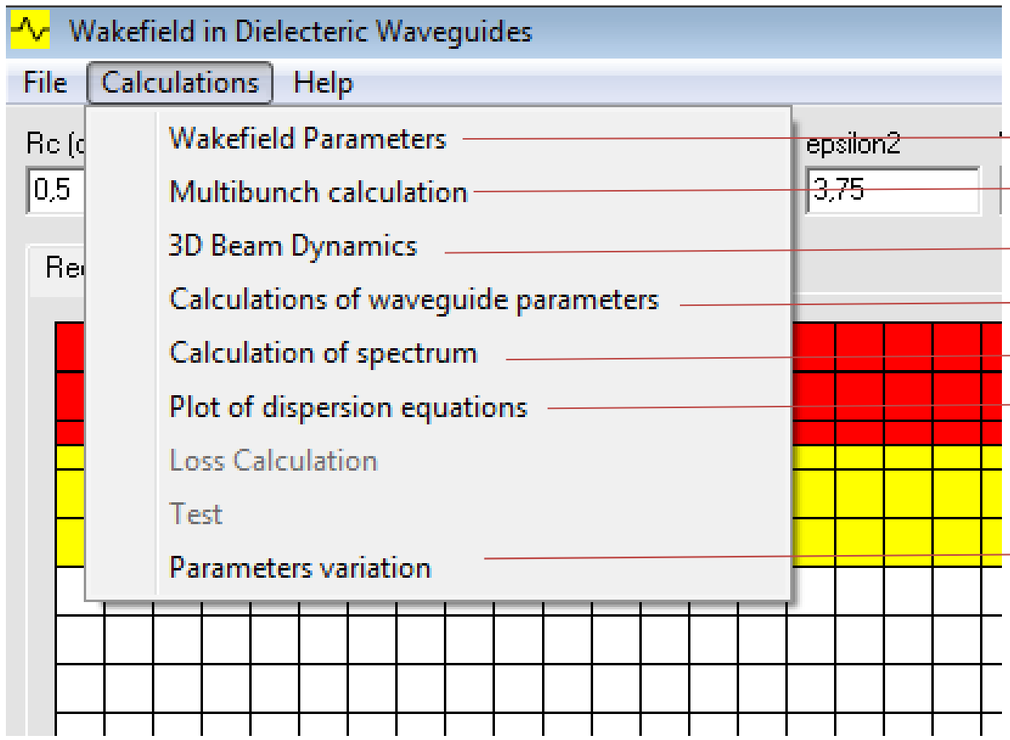


Pic. 8 Recognizing picture (left) for creation user bunch profile in program (right)



Pic. 9 User can draw bunch profile in any Graphical program on template mesh

2.3. Menu of Main Window



Open window Wakefield Parameters if it closed

Run Multibunch Module (Click Link)

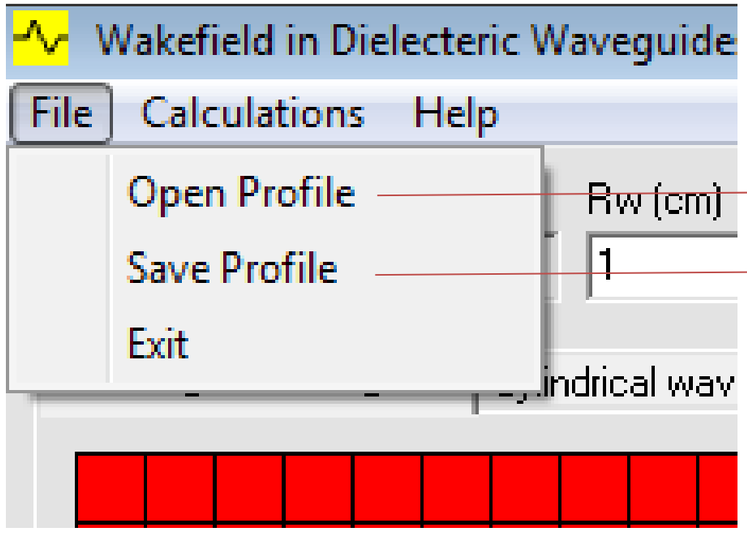
Run Beam Dynamics Module

Run Module which allow to calculate waveguide's parameters (N4 in table 1)

Run Module which allow to calculate Spectrum for Rectangular Waveguide (N1 in table 1)

Run Module which allow to plot dispersion equation of Rectangular Waveguide ((N2 in table 1))

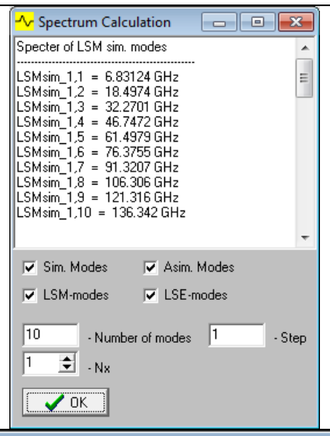
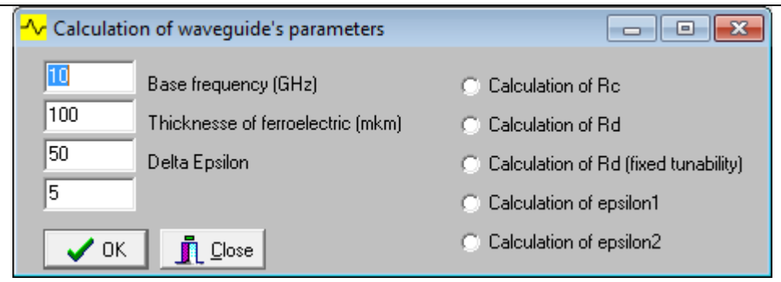
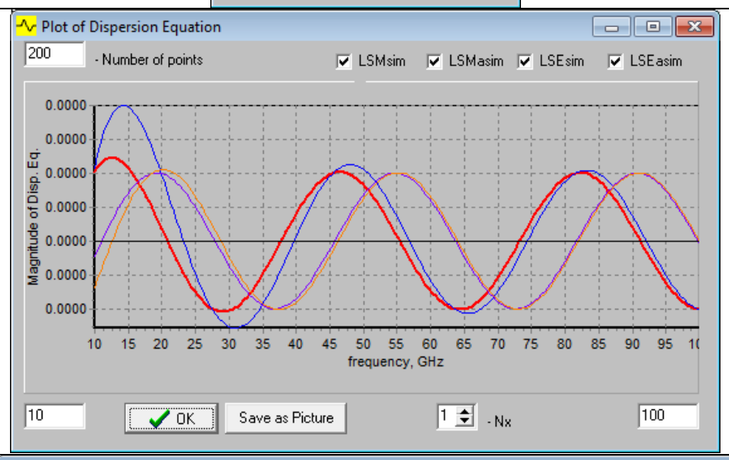
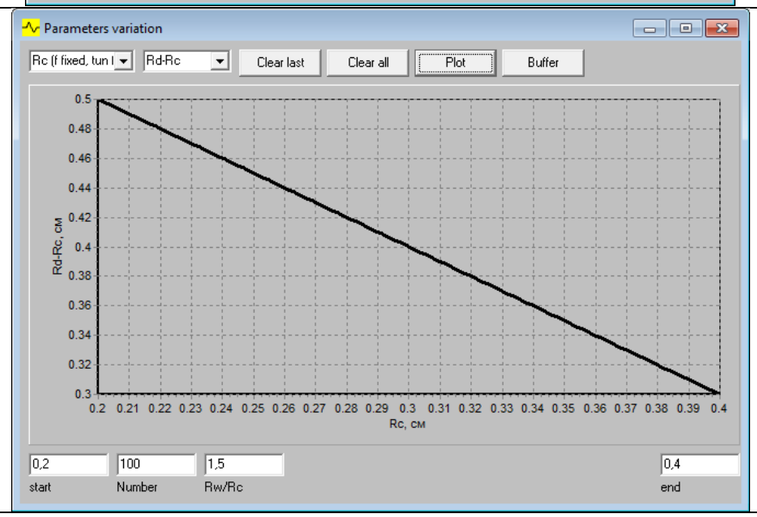
Run Module which allow to plot different dependences of field parameters from waveguide parameters (Under construction, N3 in table 1)



Load all program values from file

Save all program values from file

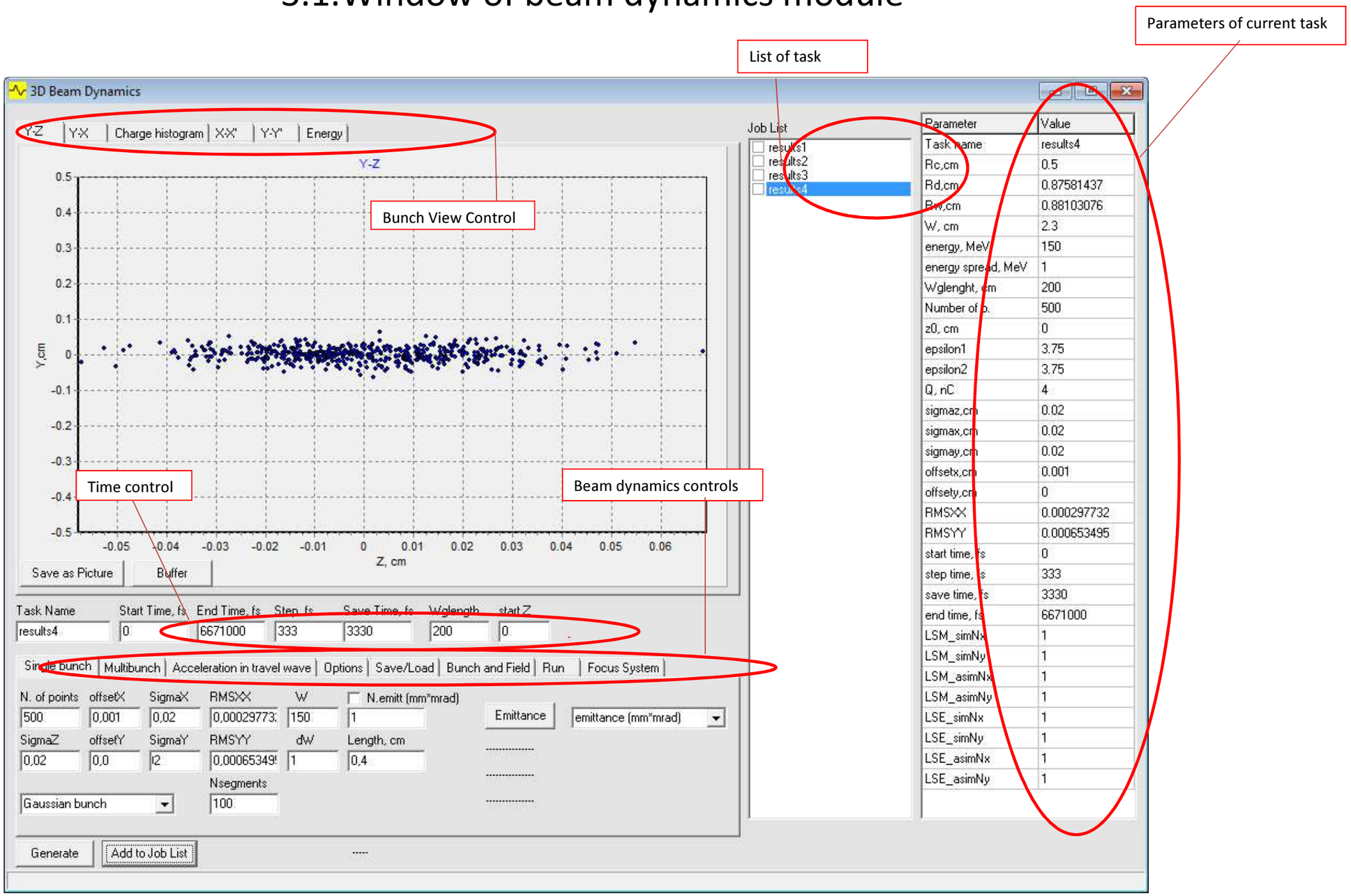
Table 1

1.	 Spectrum Calculation Specter of LSM sim. modes LSMsim_1,1 = 6.83124 GHz LSMsim_1,2 = 18.4974 GHz LSMsim_1,3 = 32.2701 GHz LSMsim_1,4 = 46.7472 GHz LSMsim_1,5 = 61.4979 GHz LSMsim_1,6 = 76.3755 GHz LSMsim_1,7 = 91.3207 GHz LSMsim_1,8 = 106.306 GHz LSMsim_1,9 = 121.316 GHz LSMsim_1,10 = 136.342 GHz Sim. Modes Asim. Modes LSM-modes LSE-modes 10 - Number of modes 1 - Step 1 - Nx OK	4.	 Calculation of waveguide's parameters 10 Base frequency (GHz) 100 Thicknesse of ferroelectric (mkm) 50 Delta Epsilon 5 OK Close Calculation of Rc Calculation of Rd Calculation of Rd (fixed tunability) Calculation of epsilon1 Calculation of epsilon2
2.	 Plot of Dispersion Equation 200 - Number of points LSMsim LSMasim LSEsim LSEasim Magnitude of Disp. Eq. 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 1 frequency, GHz 10 OK Save as Picture 1 - Nx 100		
3.	 Parameters variation Rc (f fixed, tun l Rd-Rc Clear last Clear all Plot Buffer Rd-Rc, см 0.5 0.48 0.46 0.44 0.42 0.4 0.38 0.36 0.34 0.32 0.3 0.2 0.21 0.22 0.23 0.24 0.25 0.26 0.27 0.28 0.29 0.3 0.31 0.32 0.33 0.34 0.35 0.36 0.37 0.38 0.39 0.4 Rc, см 0,2 start 100 Number 1,5 Rw/Rc 0,4 end		

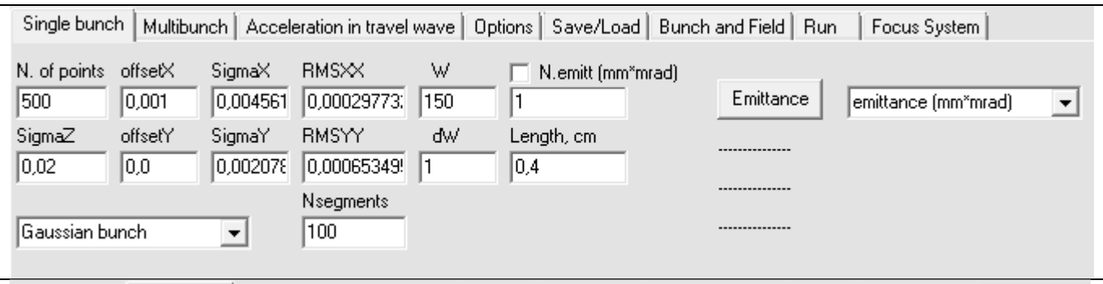
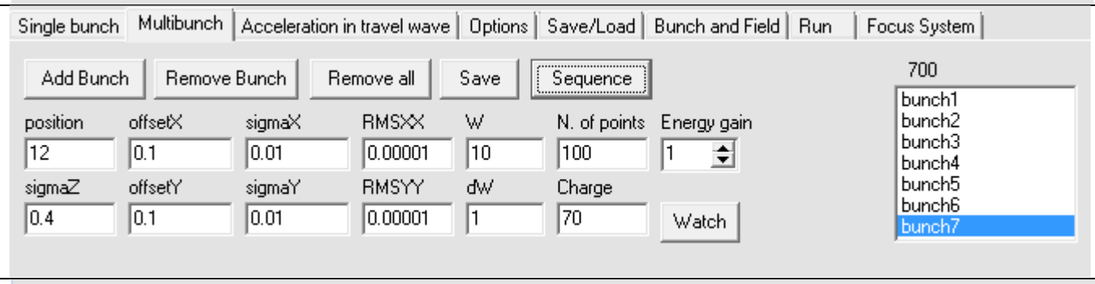
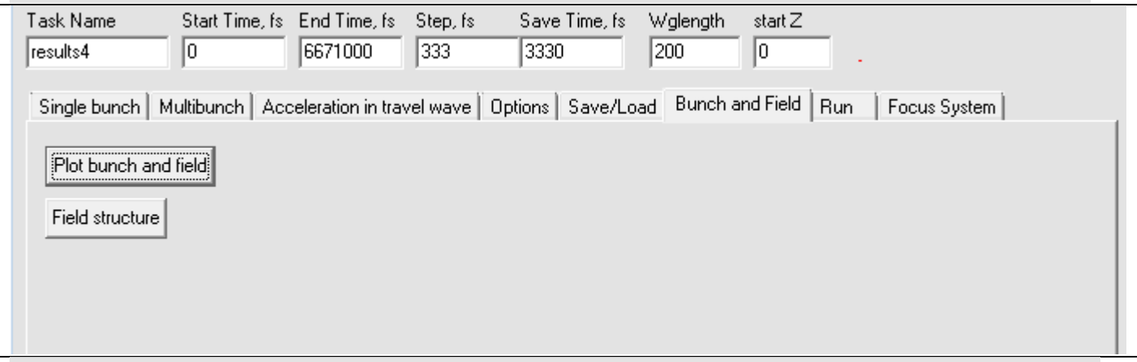
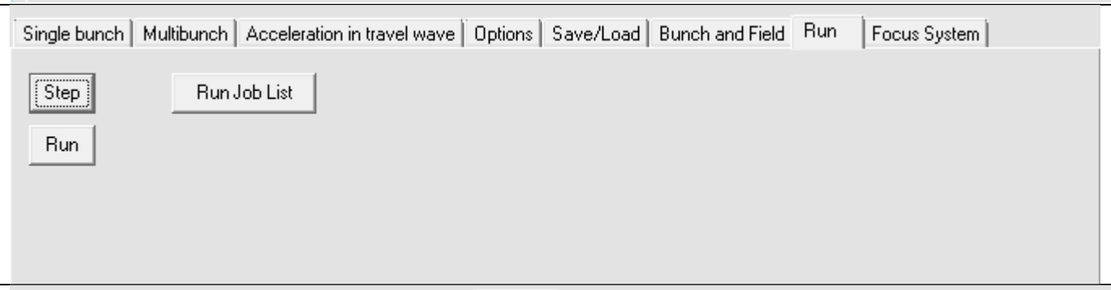
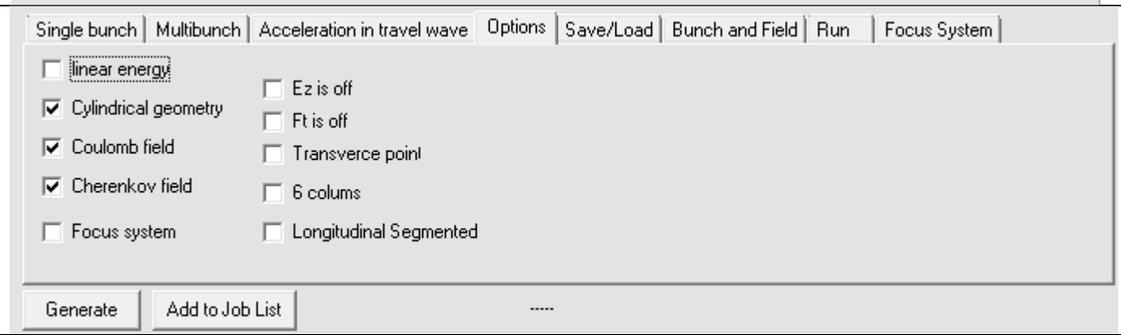
3. Beam Dynamics module

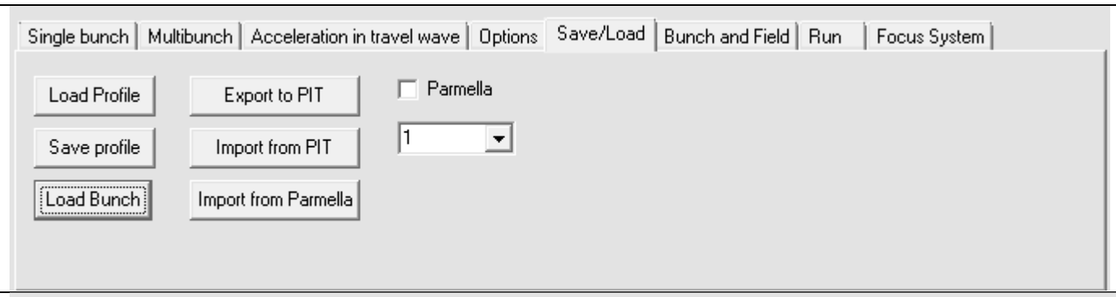
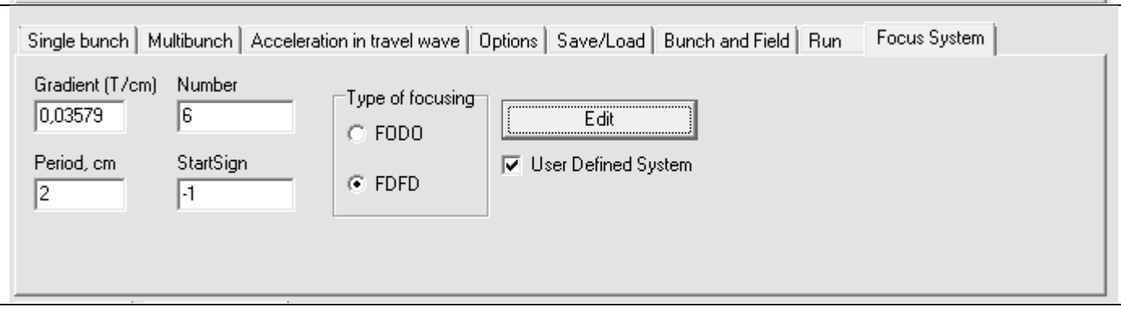
This module consist algorithm for beam dynamics calculations according to macroparticle methods.

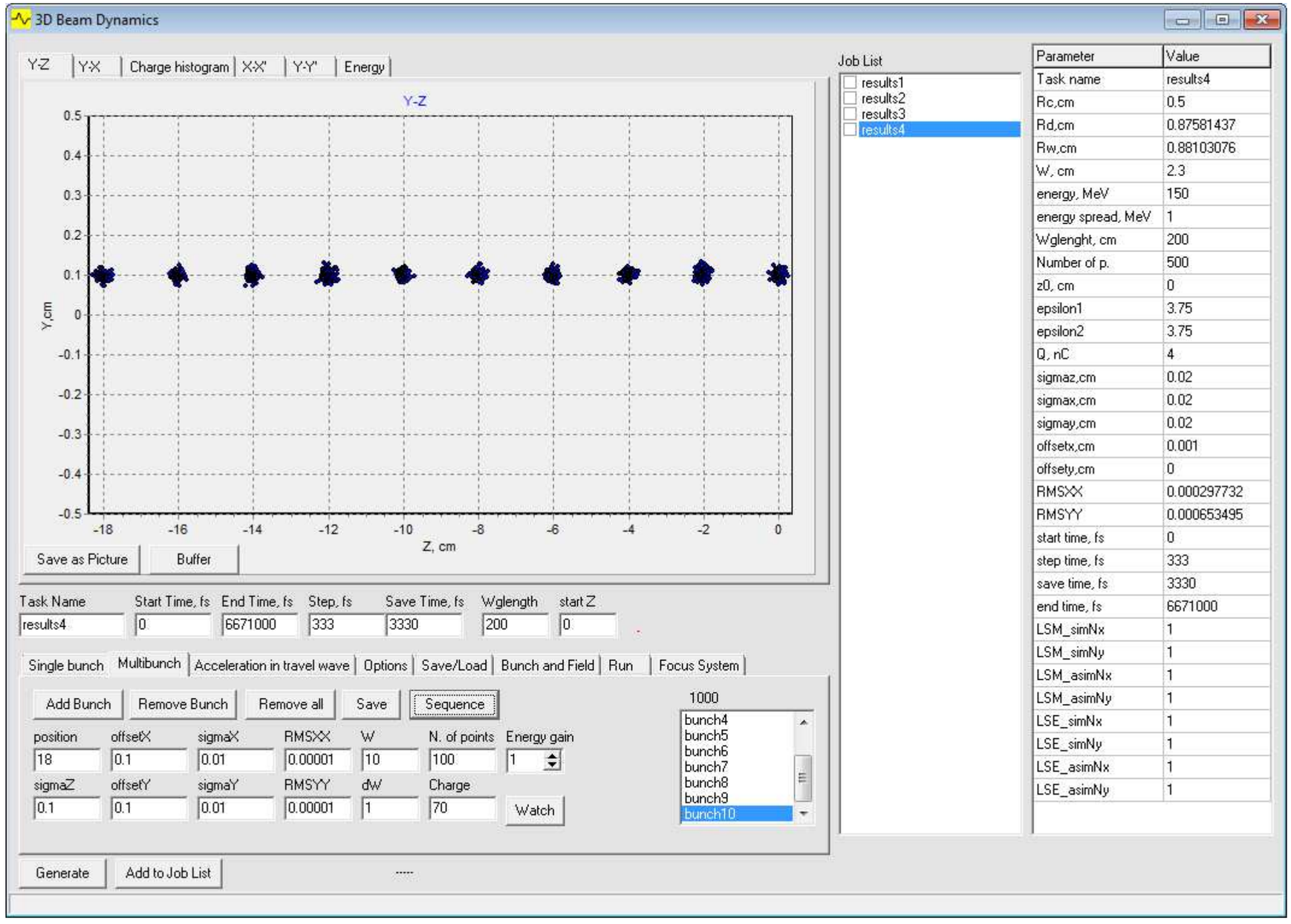
3.1.Window of beam dynamics module



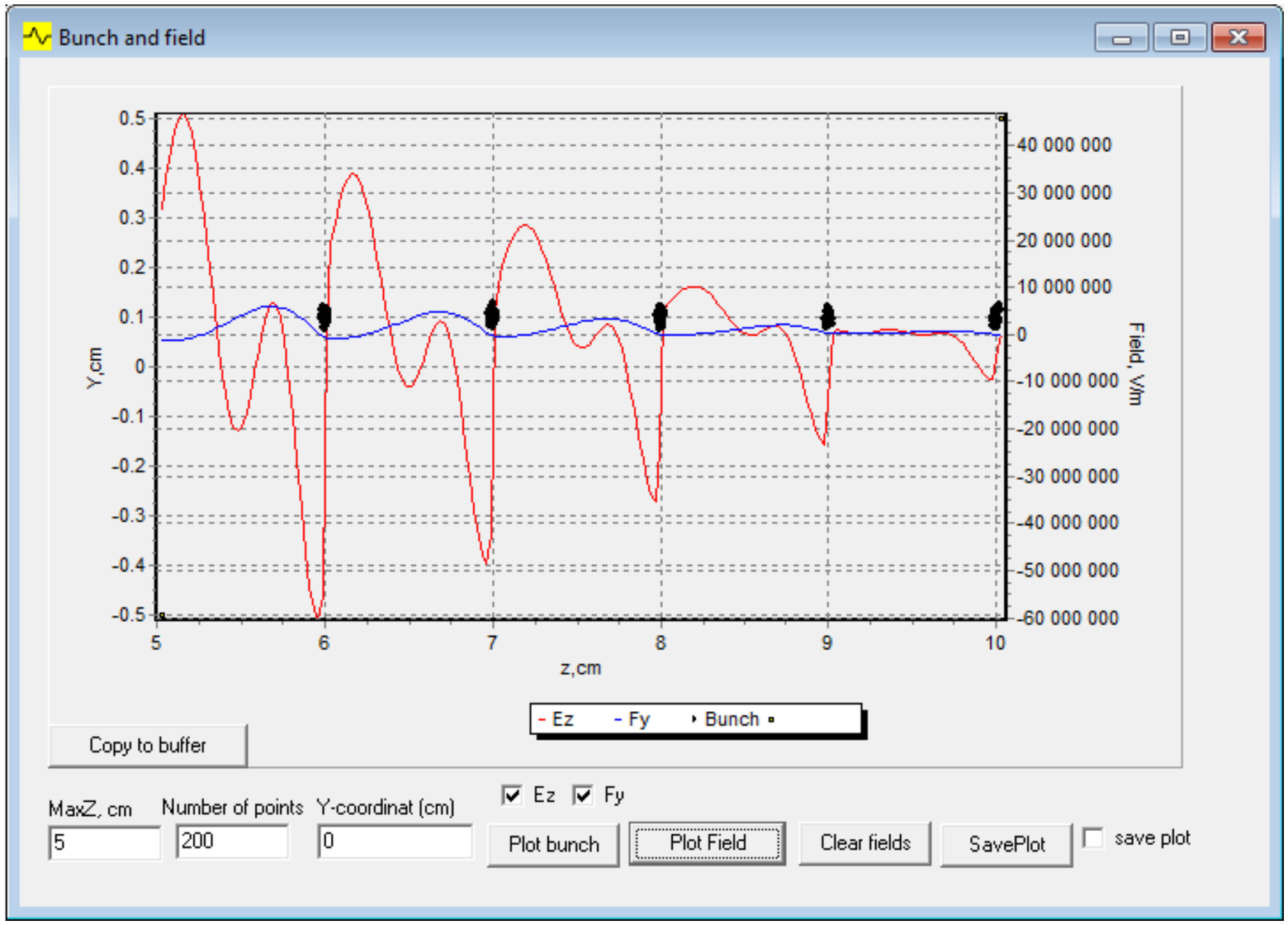
Pic. 10 Window of Beam Dynamics Module

1) Single bunch generation	
2) Multibunch generation (See Pic.10)	
3) User can see beam dynamics and plot on same chart (Pic.11)	
4) Panel for running beam dynamics. User can calculate dynamics by steps or run calculation on full time range. If user press “Run Job List” then calculation results will be saved in folder Data. Names of folders are names of tasks in Job List. There is code “BBU View” for watching these results.	
5) Panel with calculation options. User can define energy spread in bunch, choose geometry of waveguide, switch on/off space charge calculation, Cherenkov filed, focus system, longitudinal and transverse field.	

6) This panel is made for saving values of beam dynamics and for import/export data from others codes.	
7) This panel is for creating and editing of focus system (see Pic.12)	

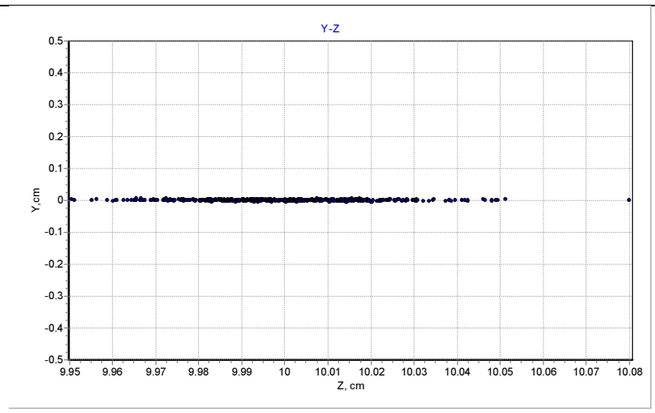
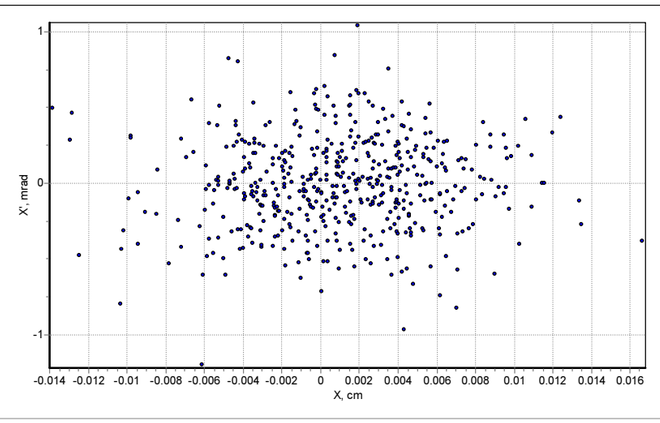
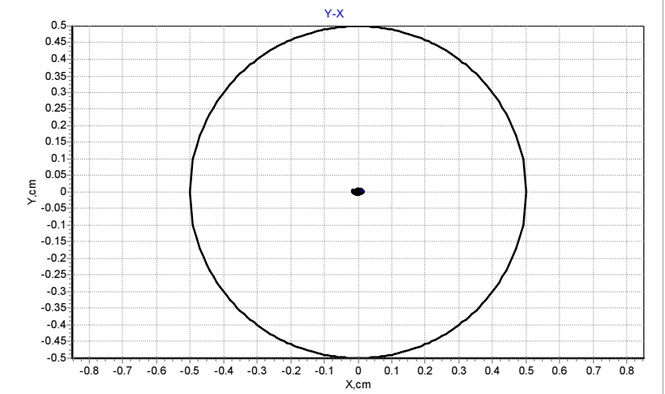
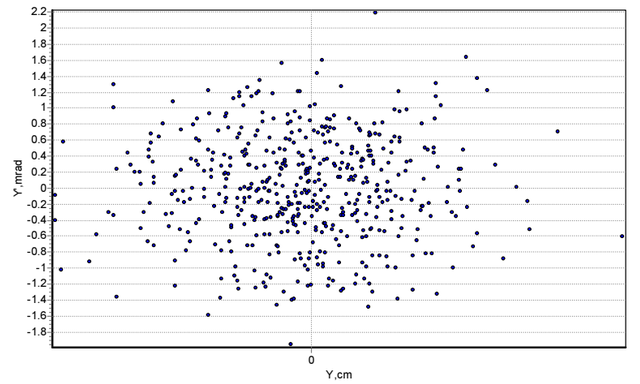
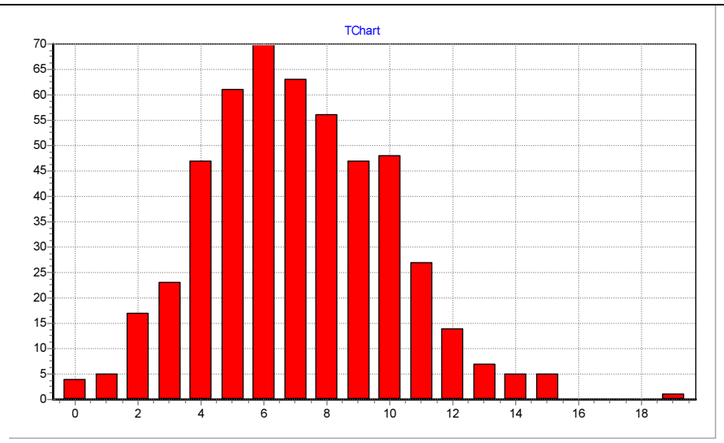
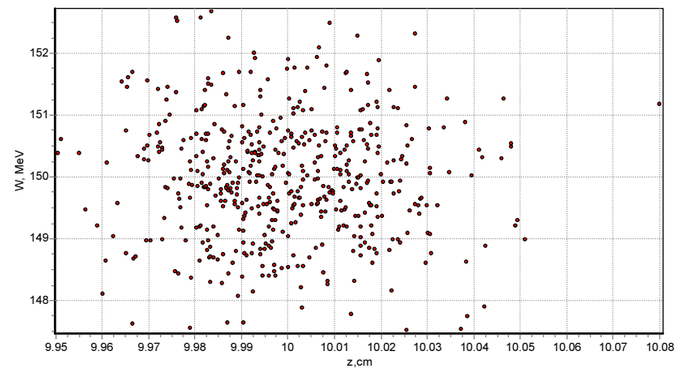


Pic. 10 Window of Beam Dynamics Module for Multibunch mode

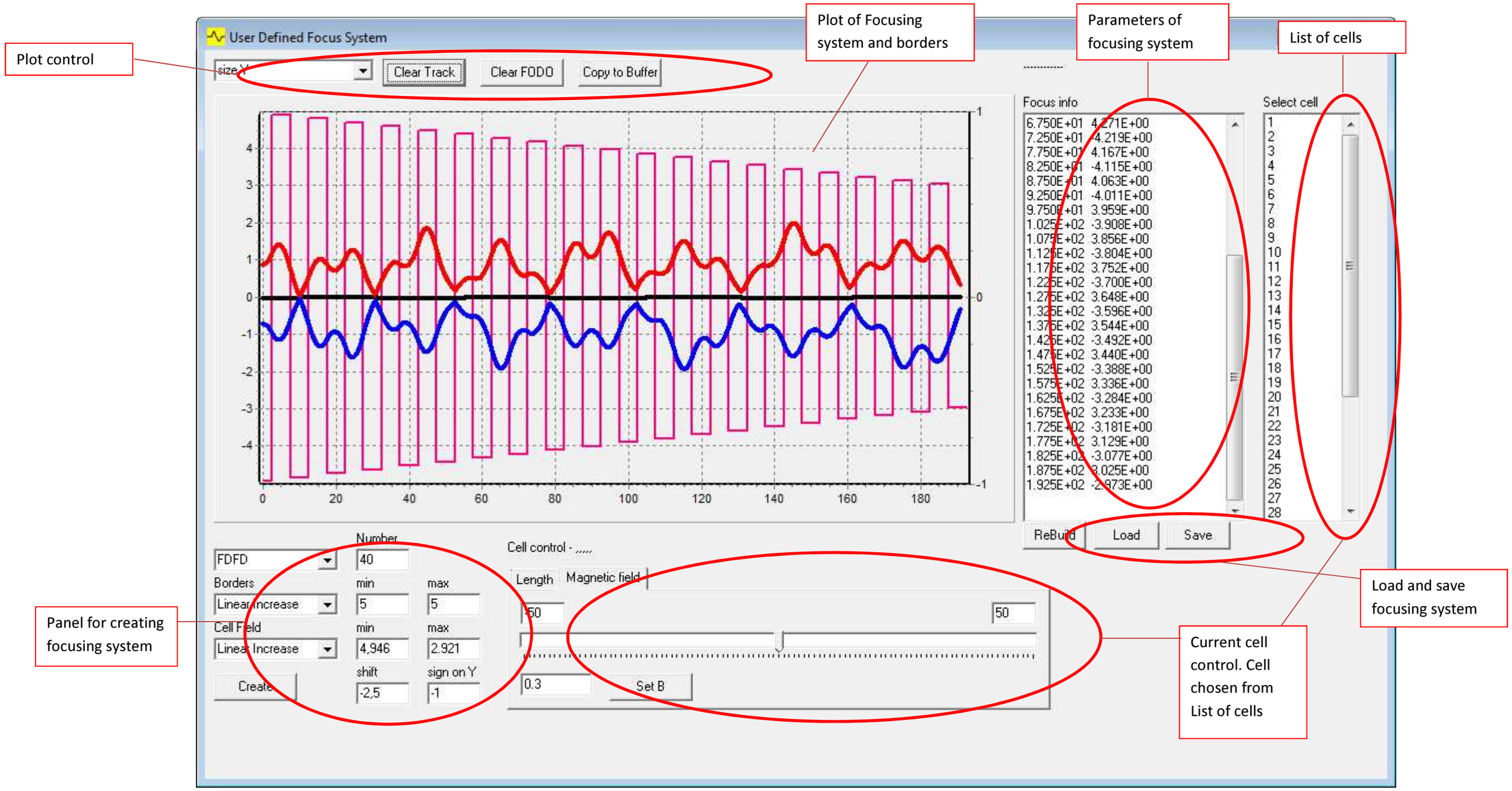


Pic. 11 Window with chart where bunches and field are presented.

Bunch View controls

Longitudinal View of bunch		Phase space on X coordinate	
Transverse View of bunch		Phase space on Y coordinate	
Charge histogram		Energy distribution in bunch	

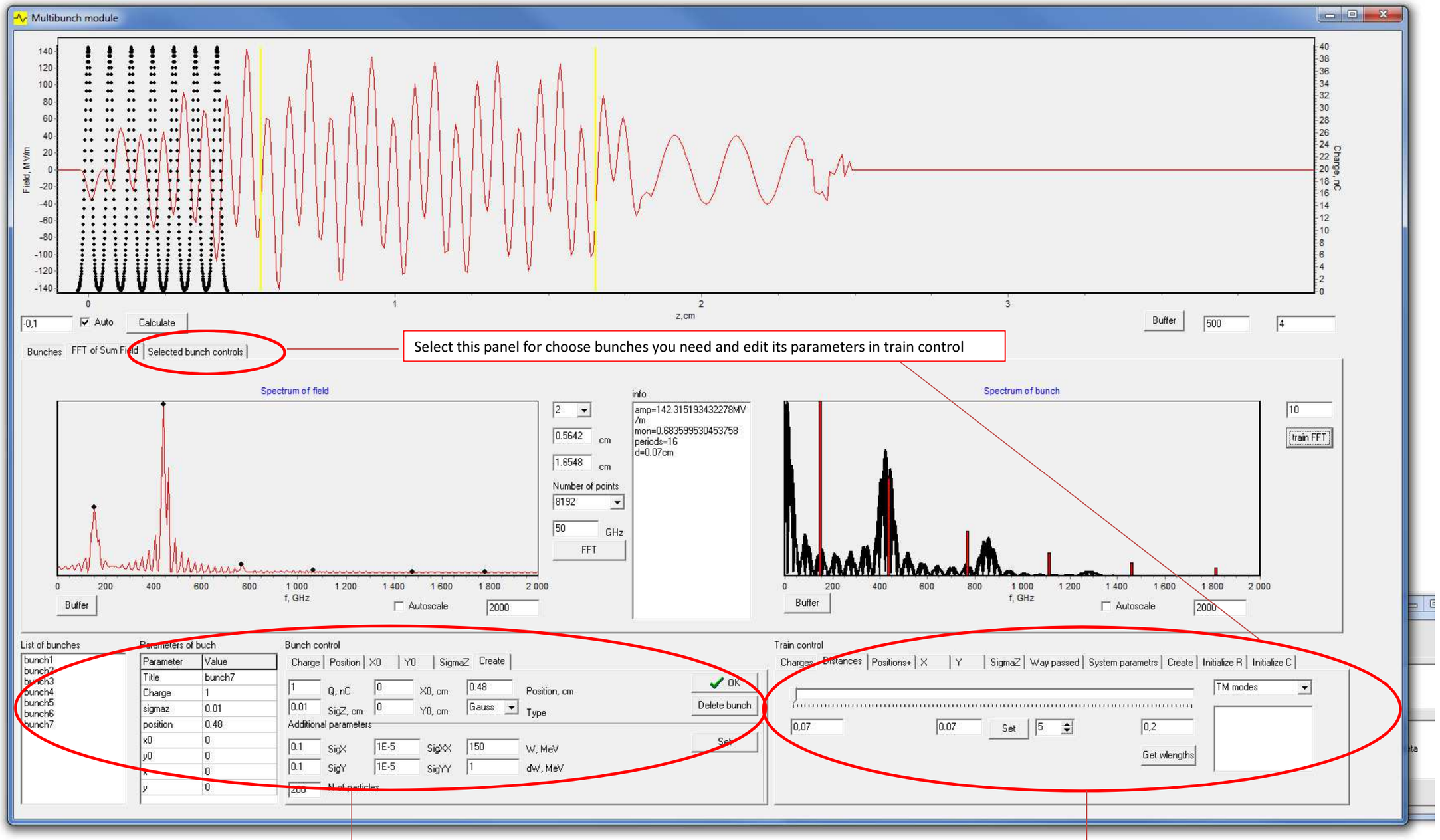
3.2. Focusing system



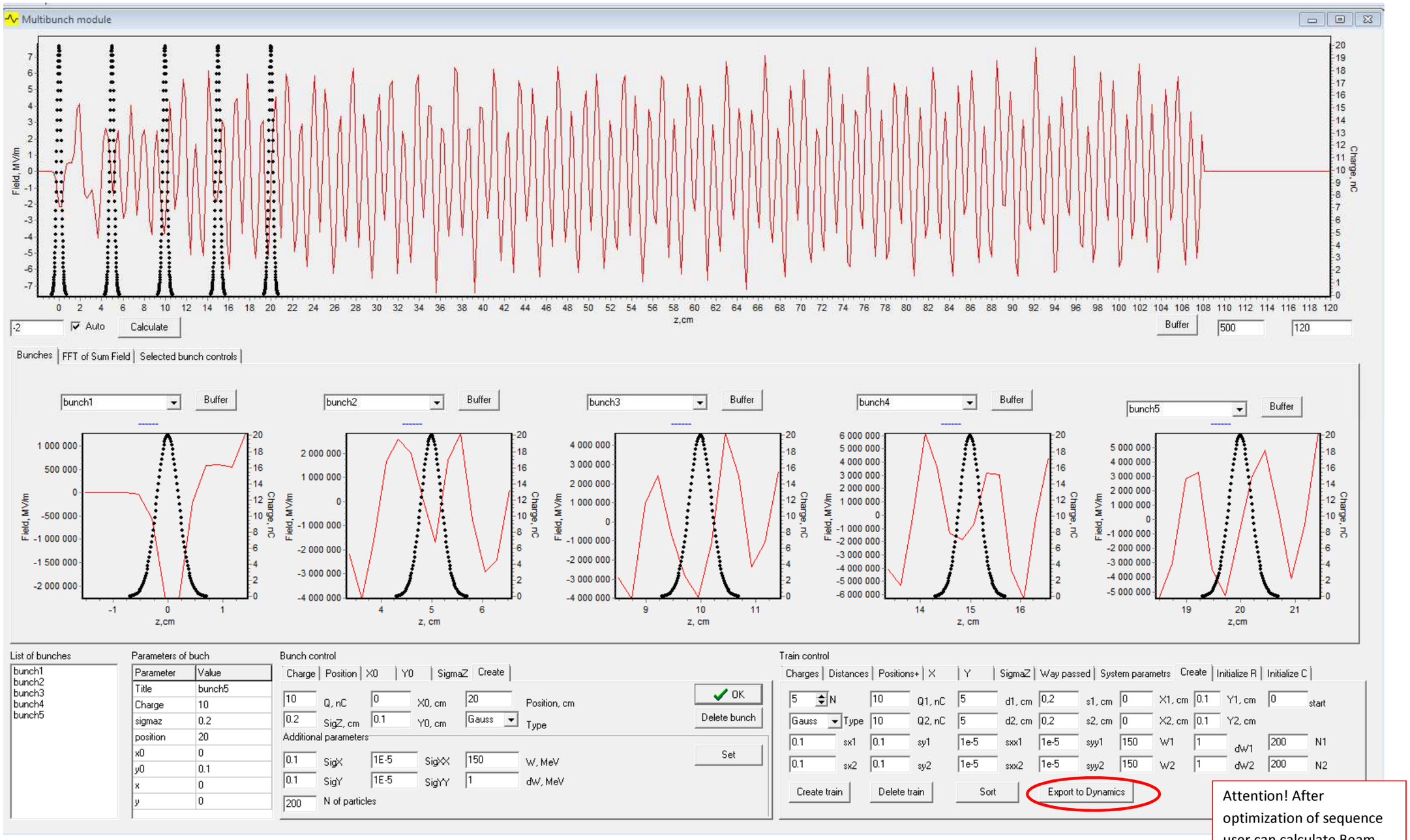
Pic. 12 Window for focusing system control

4.Multibunch module

This module allows to calculate field created by sequence of bunches. User can create any numbers of bunches, control its parameters, watch bunches in selected windows, calculate spectrum of wakefield and export data tom beam dynamics Module. Start work with panels “Initialize”. Then user can add bunch or train of bunches.



Pic. 13 Window for focusing system control



Attention! After optimization of sequence user can calculate Beam Dynamics!

Pic. 14 Window of Multibunch module. User can see bunches in sequence or in different windows