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Superlans Code Family: Examples

The first example is the calculation of periodic structures by SLANS. The periodic structure in this case is a DAW structure. Only half of the structure cell geometry is input and is used in the calculation. The finite element mesh and two modes are shown in Figure 1 a-c. Figure 1d shows the dispersion curves for first five modes.

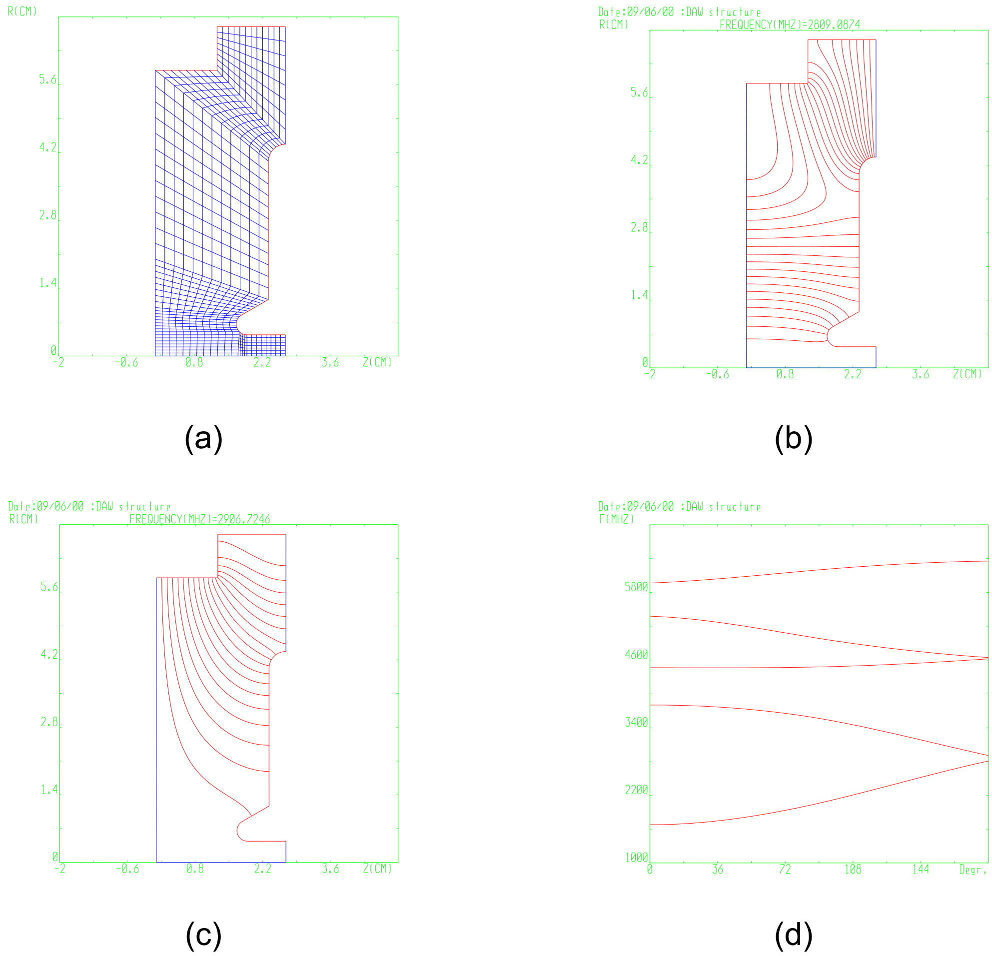
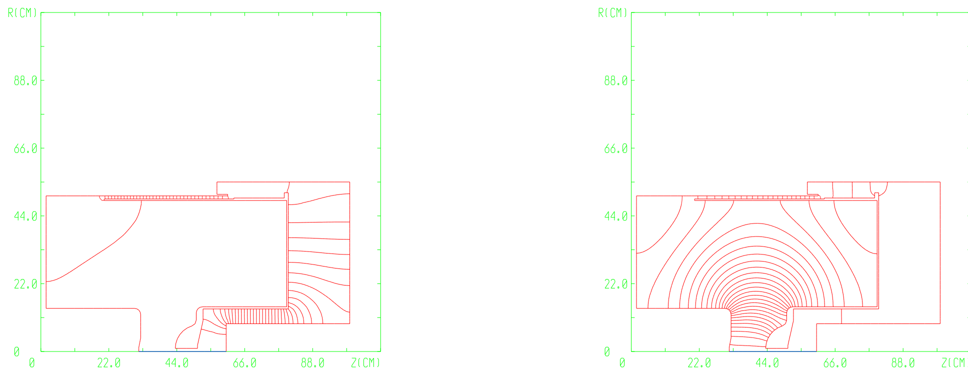


Figure 1. DAW structure calculation; a: finite element mesh, b-c: first two modes, d: dispersion curves for the first five modes.

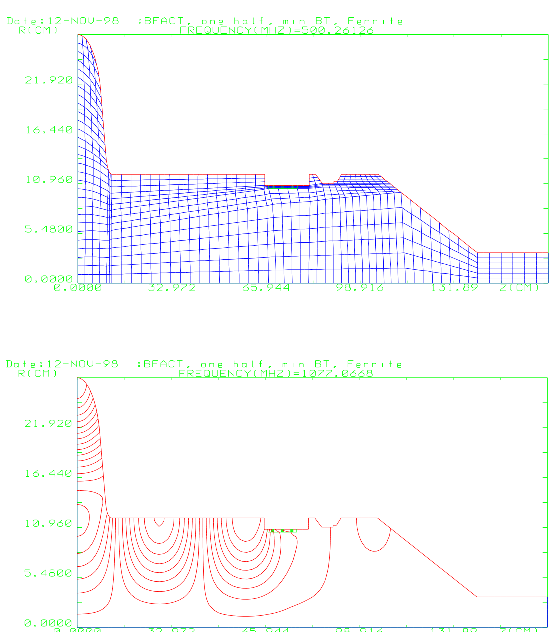
The second example demonstrates the calculation of modes in the RF cavity of the industrial accelerator ILU-10, developed at Budker INP. The internal part is electrically isolated from the outer part and has a constant voltage applied to suppress multipactor. Figure 2 shows the field maps for two modes. The second mode is the operating mode.



(a) (b)

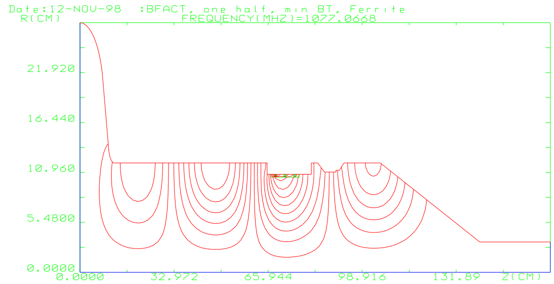
Figure 2. Simulation of the cavity of the ILU-10 accelerator; a: lowest mode, b: operating mode.

The following example illustrates the simulation of a superconducting single mode cavity by CLANS. This is one variant of the superconducting 500 MHz cavity with ferrite HOM dumper for CESR. Half of the cavity geometry is used. The possibility of solving the self-consistent problem when the properties of HOM loads depend on the frequency permits calculation of the low quality factor “ghost” modes that are connected with loads. Figure 3 shows the finite element mesh for this geometry and the field map for two HOMs; one of them is a “ghost” mode.

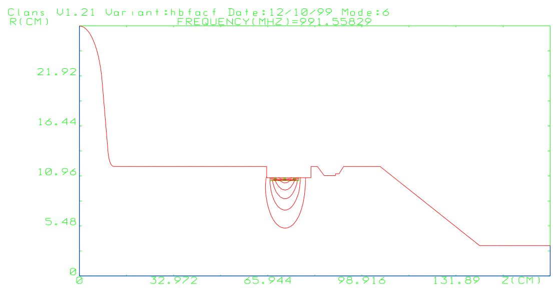


(a)

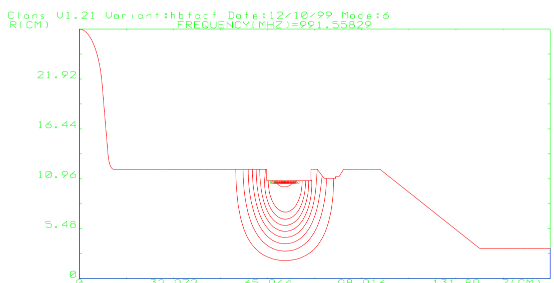
(b)



(c)



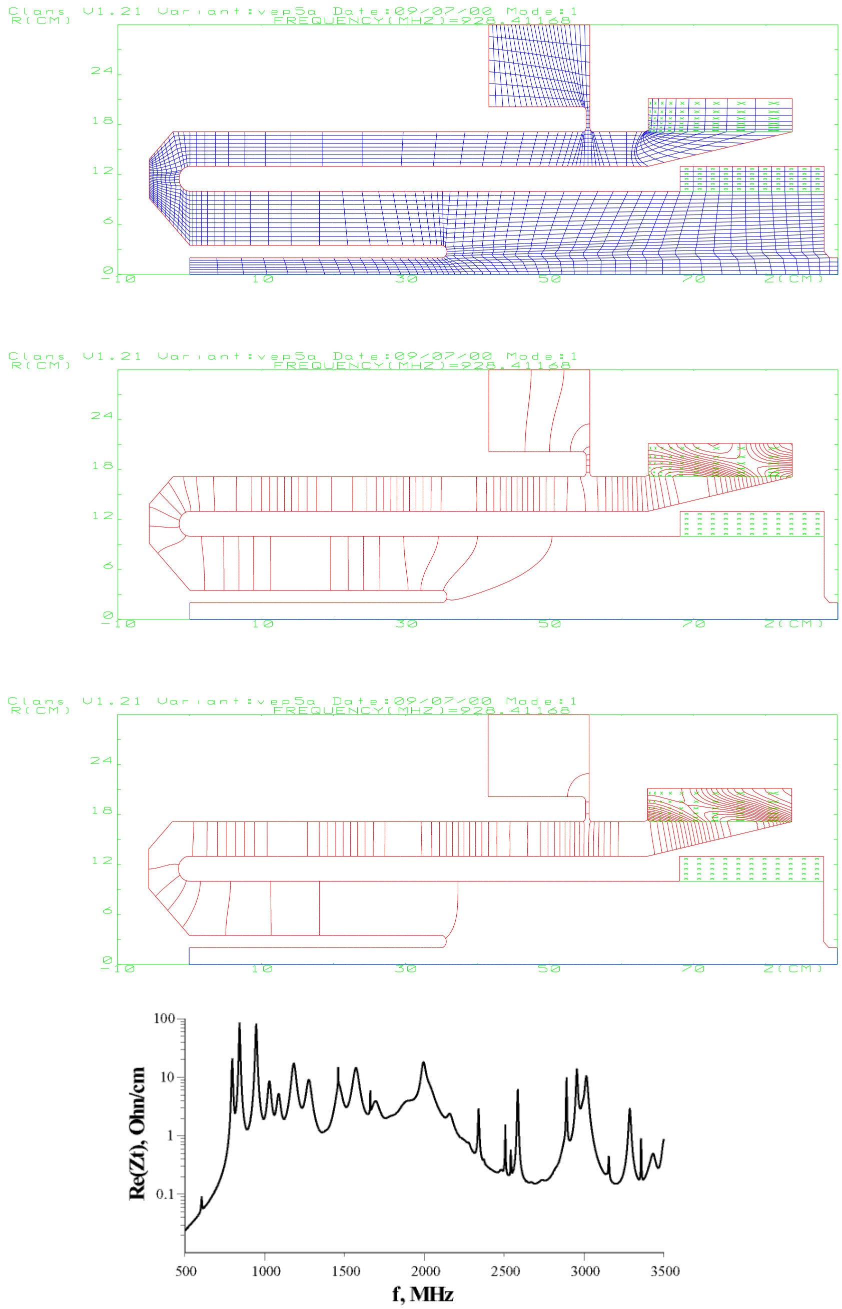
(d)



(e)

Figure 3. CESR superconducting cavity calculation. a: finite element mesh, b: real part of the electric field of a high order mode, c: imaginary part of the electric field of a high order mode, d: real part of the electric field of a “ghost” mode, e: imaginary part of the electric field of a “ghost” mode.

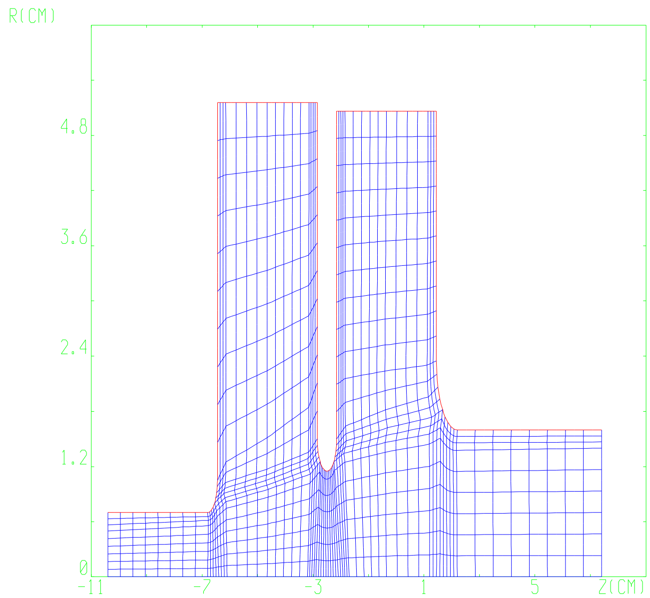
Another example is a “warm” single mode cavity designed at Budker INP for the new VEPP-2000 project. The operating frequency of the cavity is 170 MHz. The HOM dumpers are made from conductive ceramics. The CLANS code has been used to investigate the cavity spectrum and to calculate the longitudinal resonance impedance. Figure 4 shows the finite element mesh, the field map for one high order mode and the impedance distribution.



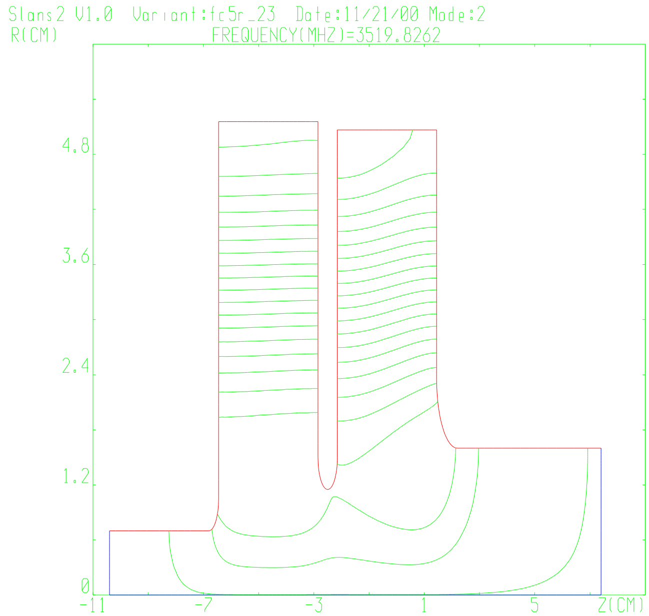
(a) (b) (c) (d)

Figure 4. Example of a single mode cavity calculation for the VEPP-2000 project. a: finite element mesh; b: real part of the electric field of a high order mode; c: the imaginary part of the electric field of a high order mode; d: longitudinal resonance impedance.

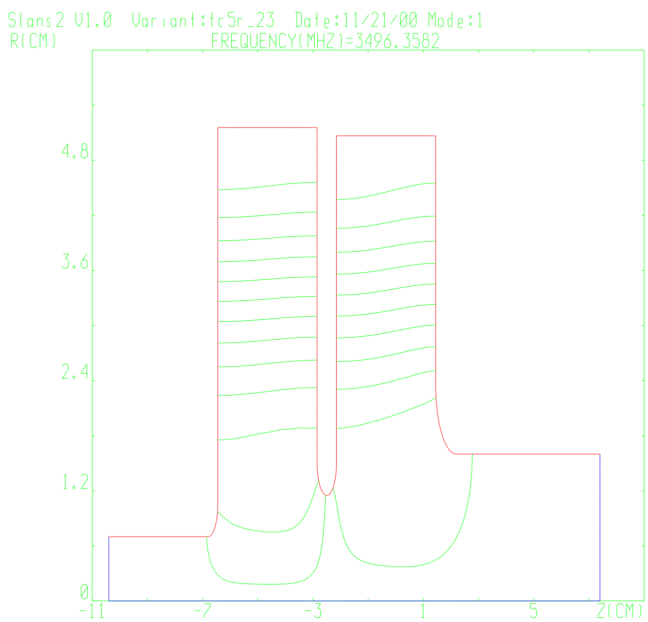
The SLANS2 code is actively used for the calculation of cavities for RF generators – magnicons. The operating modes in this generator are dipole modes in deflection cavities and a quadrupole mode in the output cavity. SLANS2 produced high accuracy field calculations that were then used in another code for beam dynamics simulations in a magnicon. An example of a simulation of the penultimate cavity of a 7 GHz magnicon is shown in Figure 5. The finite element mesh and the field map of the dipole mode are shown.



(a)



(b)



(c)

Figure 5. Example of a penultimate magnicon cavity calculation; a: finite element mesh; b: field map of cophasal dipole mode; c: field map of counterphasal dipole mode.

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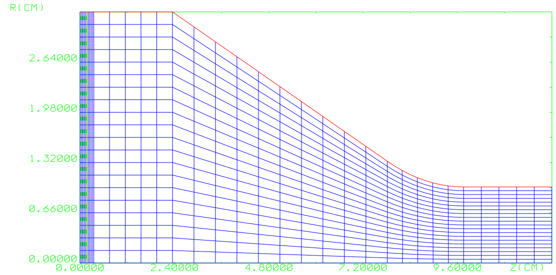
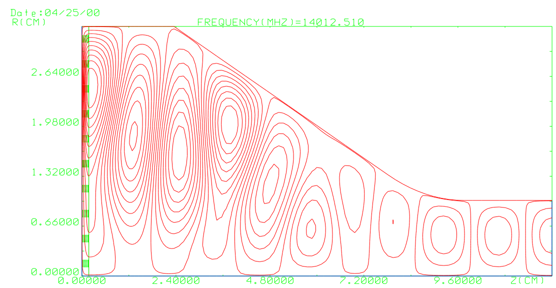


(a)



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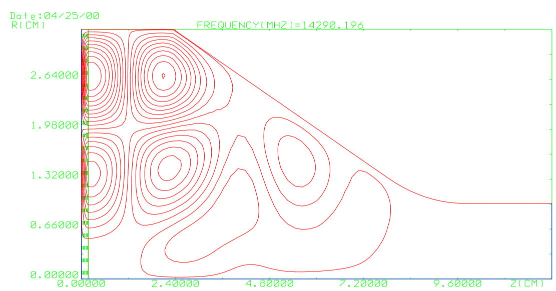
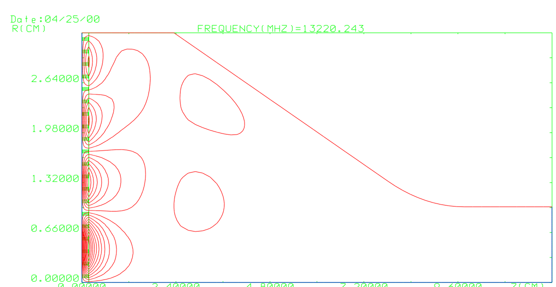


(c)



(d)

Figure 6. Example of a high power RF window calculation; a: finite element mesh; b: field map of a traveling dipole mode; c: field map of a captured dipole mode; d: “ghost” dipole mode.

Another example is calculation the dipole modes in a high-power RF window. One of the problems is the existence of “ghost” modes in the ceramic window. SLANS2 permits the calculation of this class of modes. Figure 6 shows the finite element mesh for half of a window and three modes, one of them corresponding to a “ghost” mode.