CAVEL Reference Manual

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1. Introduction

The program CAVEL simulates the motion of ELectrons inside an RF CAVity. The cavity is assumed to be azimuthally symmetric. The cavity may be immersed in a 2D or 3D external magnetic field. The cavity boundary coordinates and RF fields come from SuperFish.

2. Input parameters

The program looks for the input file CAVEL.INP . This file contains the input parameters in Fortran namelist format.

ASCRF	(I)	Specifies left-right symmetry of the SuperFish cavity (0) 0: symmetric cavity 1: not symmetric
BNDNAME	(A)	Name of SuperFish file containing the cavity boundary coordinates
CSCALE	(R)	Normalization factor for external magnetic field (1.0)
EPSSTEP	(R)	Requires stepping accuracy (1d-5)
LAUNCH	(I)	Specifies electron launch conditions (1) 1: launch at maximum electric field location 2: use specified launch parameters
MAGDIM	(I)	Specifies dimensions of external magnetic field (2) 2: azimuthally symmetric field 3: 3D field
MAGNAME	(A)	Name of external magnetic field map
MAXSTEPS	(I)	Maximum number of allowed steps for each track (2000)
NFIX	(I)	Maximum number of fixed steps near cavity boundary (10)
NPHI	(I)	Number of RF phase angles (1)
NTEMP	(I)	Number of random “temperature” related launches (1)
PHILO	(R)	Starting RF phase angle [deg]
PHISTP	(R)	Step in RF phase angle [deg]
PSURF	(R)	Initial momentum perpendicular to the surface when LAUNCH=1 [MeV/c]
PYLAUNCH	(R)	Initial p_Y when LAUNCH=2 [MeV/c]
PZLAUNCH	(R)	Initial p_Z when LAUNCH=2 [MeV/c]
RFNAME	(A)	Name of file containing SuperFish RF fields

RFNRM	(R)	Normalization factor for cavity RF field (1.0)
RLAUNCH	(R)	Initial radius when LAUNCH=2 [m]
RSKIP	(I)	Number of RTUPLE steps to skip in output file (1)
RTUPLE	(L)	If true => write out electron parameters while stepping thru cavity (false)
SIGP	(R)	Width of Gaussian momentum distribution at surface [MeV/c] (0.)
STEP	(R)	Initial time step [s] (1d-10)
STEPMAX	(R)	Maximum allowed time step [s] (1d-9)
STEPMIN	(R)	Minimum allowed time step [s] (1d-12)
ZLAUNCH	(R)	Initial axial position when LAUNCH=2 [m]
ZOFF	(R)	Axial offset of the center of the RF cavity in the coordinate system of the external magnetic field

3. Input files

3.1 Cavity boundary file

This file is identified using the BNDNAME parameter. The boundary information is contained in the SuperFish file OUTAUT.TXT . The maximum number of boundary points is 1000 for left-right symmetric cavities and 2000 for non-symmetric cavities.

3.2 Cavity RF fields

This file is identified using the RFNAME parameter. The RF filed information is obtained by running the SuperFish postprocessor and requesting a Parmela output file with the extension T7. The cavity field map can have a maximum of 150 radial and 150 axial field points.

3.3 External magnetic fields

For azimuthally symmetric fields the input has the same format as used by ICOOL SOL model 6. The required format of the field map is

Title	(A80)	
# of z grid points	(I)	{1-5000}
# of r grid points	(I)	{1-100}
i, j, z_i, r_j, $BZ_{i,j}$, $BR_{i,j}$	(I, R)	

The field map can have a maximum of 5000 axial points and 100 radial points. A compatible field grid can be conveniently prepared in SLD version 1.09 or later by giving the GRID command, saving the data to an external file, and then editing out the field map.

For 3D fields the input has the same format as used by ICOOL STUS model 3.

title	(a80)	
mxg	(I)	number of x grid points {<101}
myg	(I)	number of y grid points {<101}
mzg	(I)	number of z grid points {<501}
href	(R)	curvature [m^{-1}]
(xgr(i),i=1,mxg)	(R)	x grid points [m]
(ygr(i),i=1,myg)	(R)	y grid points [m]
(zgr(i),i=1,mzg)	(R)	z grid points [m]
i j k Bx By Bz	(I,R)	x-index, y-index, z-index, corresponding field values [T]

The field map can have a maximum of 500 points along z, 100 steps along x and 100 steps along y.

4. Output files

4.1 Log file

A log file, which may contain error information, is written to CAVEL.LOG .

4.2 Output file

Electron trajectory information for the starting and ending points are written to CAVEL.DAT . If RTUPLE is true, additional information along the trajectory inside the cavity is also written to CAVEL.DAT . The following information is recorded on this file:

Particle number
Step number
Flag
Position x, y, z [m]
Momentum p_x, p_y, p_z [MeV/c]
Time [s]
Step [s]
Distance to boundary [m]
Initial phase [deg]
Thermal surface momentum dp_x, dp_y, dp_z [MeV/c]
Total magnetic field B_x, B_y, B_z [T]
Electric field E_x, E_y, E_z [V/m]

5. Program execution flags

0	good tracking
-10	exceeded maximum number of allowed steps (fatal)
1	Runge-Kutta stepper wants to use a step size less than HMIN (warning)
2	tracking driver wants to use a step size less than HMIN (warning)
3	this step went outside the cavity surface (informative)