NLC Damping Ring Impedance

- **Broad-band impedance**
  - Impedance budget
  - Single-bunch instabi ity: ongitudina & transverse
- **Narrow-band impedance**
  - Trapped modes in cavity, BPM ...
  - Coupled-bunch instability: longitu inal & transverse

Impedance budget

- Calculation of short-range wakefield for individual beamline components

- Determine loss parameter and inductance

- List of beamline components

Component	Quantity
RF Cavity	3
BPM	159
Ante-chamber slot	102
Bellows mask	102
Injection kicker	2
Transverse feedback kicker	2
Resistive Wall	300 m

MAFIA

P--:4016

#2DPLOT

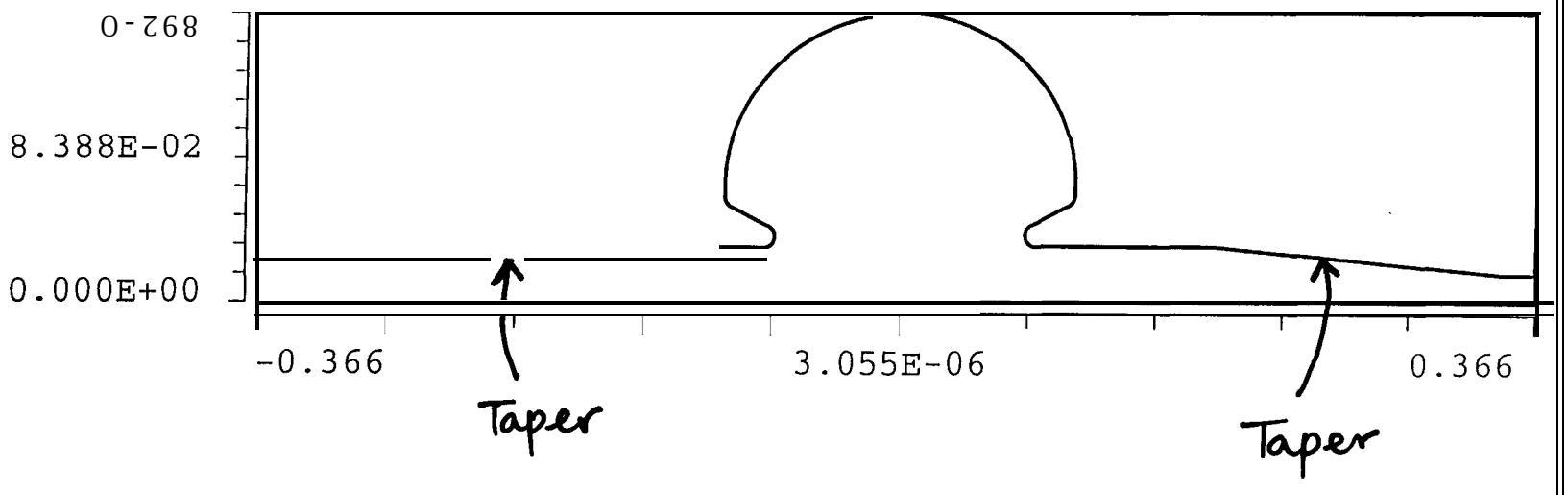
COORDINATES/M
FULL RANGE / WINDOW
R[0.0000, 0.16775]
[0.0000, 0.16775]
Z[-0.36600, 0.36601]
[-0.36600, 0.36601]

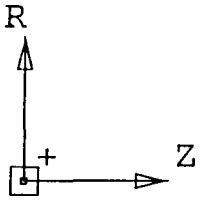
MATERIALS: 0,1,

-MESHLINE= 1
CUT AT =CONST.

FRAME: 1	03/08/99 - 10:00:22	VERSION[V4.016]	DR2DT.DRC
			NLC DAMPING RING CAVITY
			CUT PLOT OF THE MATERIAL DISTRIBUTION IN THE MESH

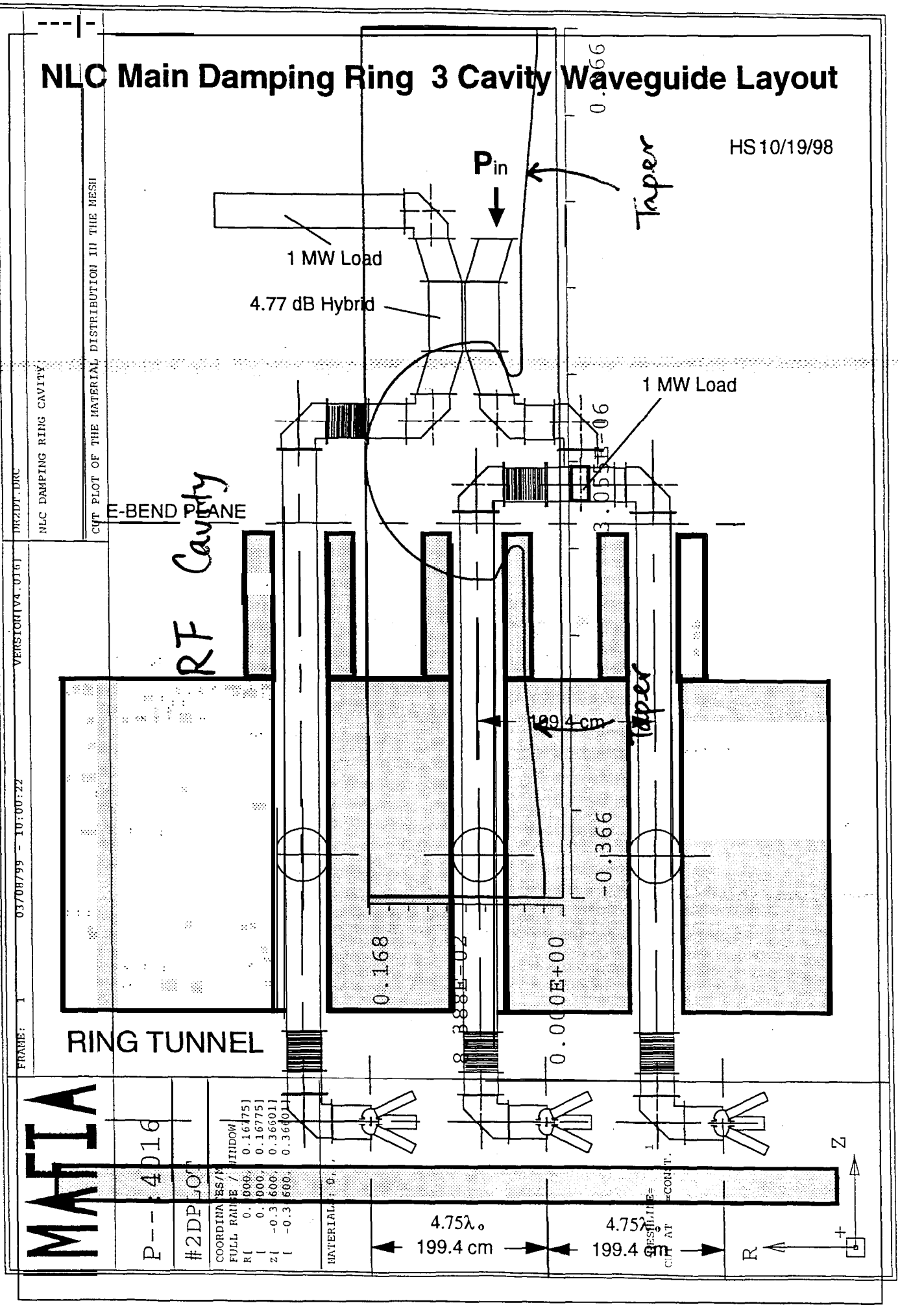
RF Cavity





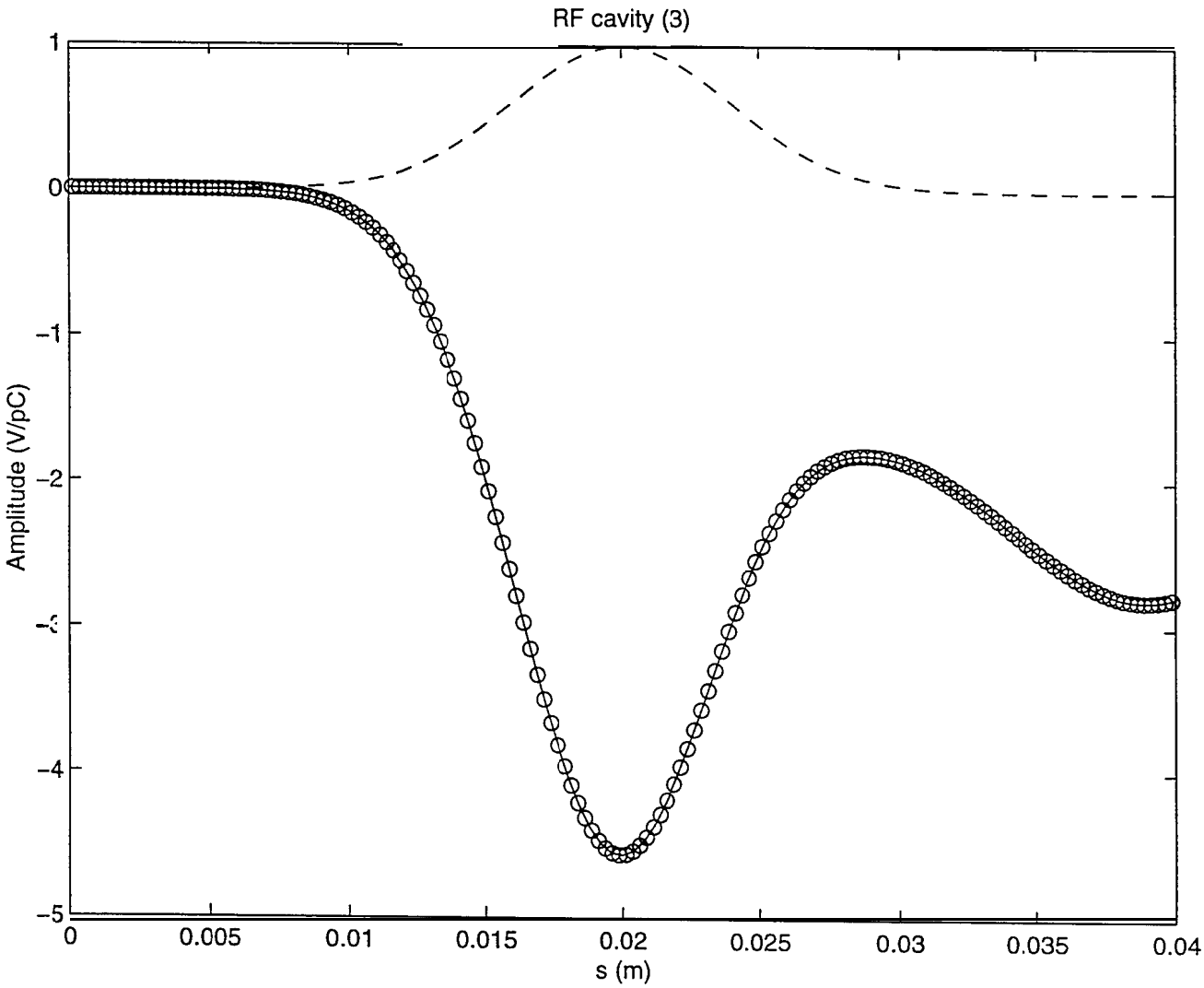
NLC Main Damping Ring 3 Cavity Waveguide Layout

HS 10/19/98



RF Cavity (3)

$k_\ell = 1.$ V/pC



Loss factor:

	Longitudinal (V/pC)	Transverse (V/pC/m)
Cavity	1.11	9.12
Taper	0.14	8.72

MAFIA

FRAME: 4 30/08/99 - 14:21:01 VERSION[V4.016]

T3.DRC

NLC DR BPM

CUT PLOT OF THE MATERIAL DISTRIBUTION IN THE MESH

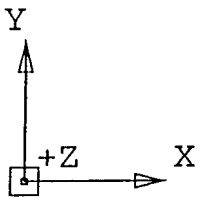
P--:4016

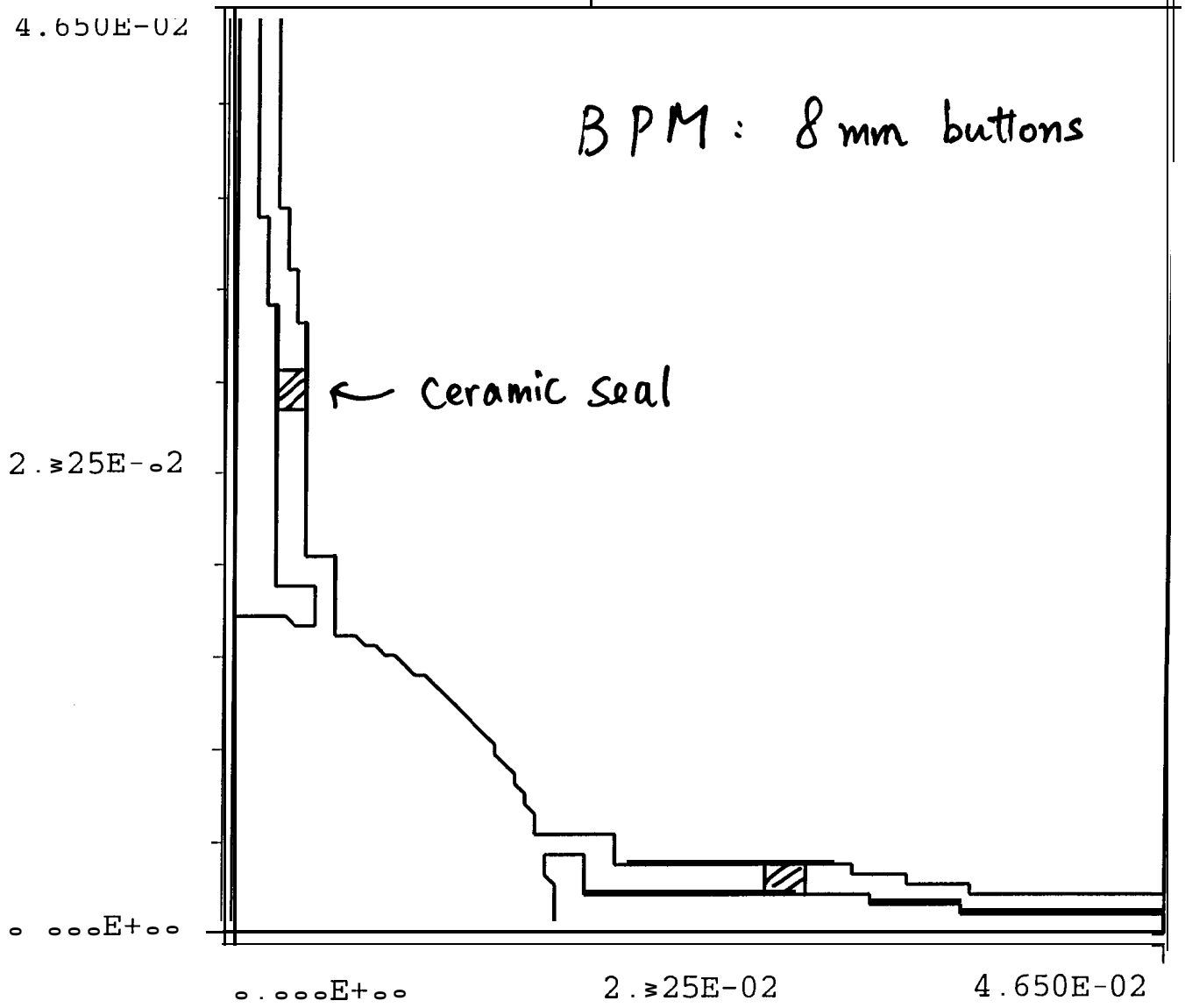
#2DPLOT

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000, 0.046500]
[0.0000, 0.046500]
Y[0.0000, 0.046500]
[0.0000, 0.046500]
Z[0.0000, 0.070000]
[0.035000, 0.035000]

MATERIALS: 0,1,2,

Z-MESHLINE= 71
CUT AT Z/M= 0.3500E-01

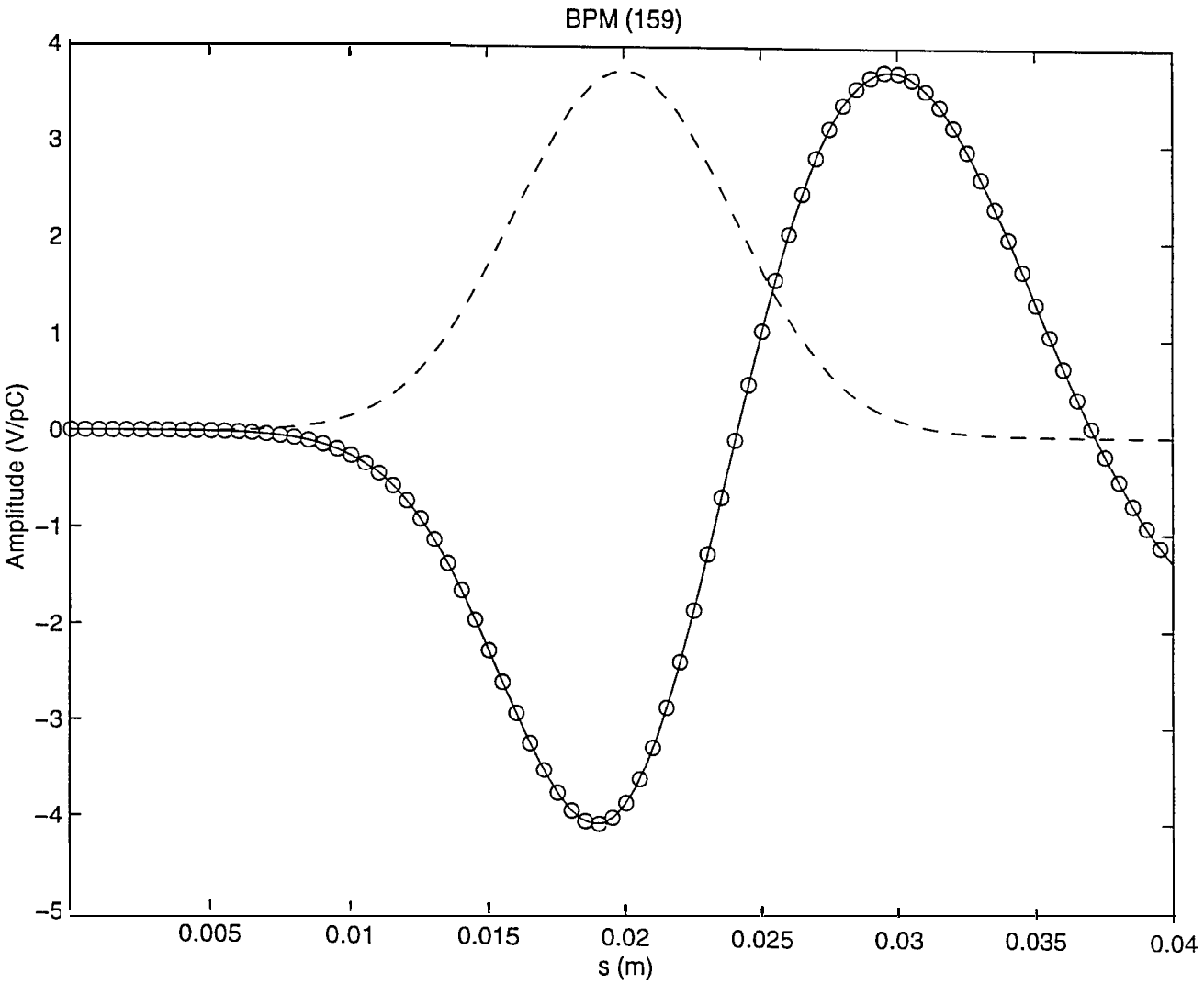




BPM (159)

$k_e = 0.014$ V/pC

$\mathcal{L} = 1.868 \times 10^{-2}$ nH



MAFIA

FRAME: 7 21/09/99 - 12:07:12 VERSION[V4.016] T3.DRC

Z COMPONENT OF WAKE POTENTIAL IN V [INDIRECT CALC.]

P--:4016

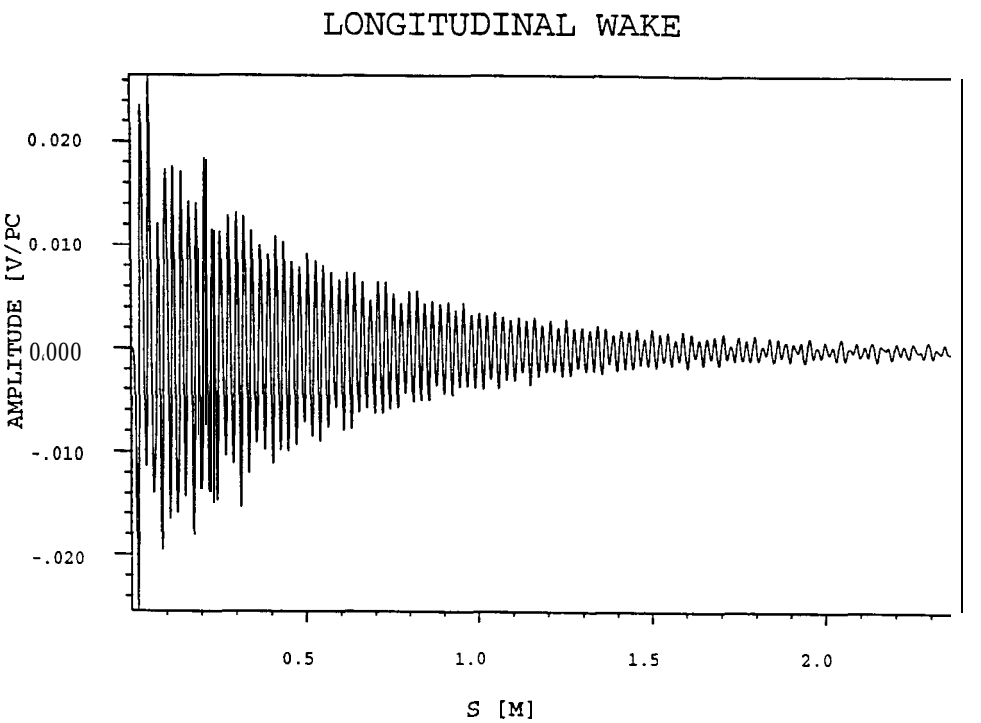
#1DGRAPH

ORDINATE: WZ
COMPONENT: Z

FIXED COORDINATES:
DIM.....MESHLINE
X 1
Y 1

ABSCISSA: GEOMWAKE
[BASE OF WZ]

REFERENCE COORDINATE: S
VARY.....MESHLINE
FROM 1
TO 4800



MAFIA

FRAME: 6 21/09/99 - 12:07:12 VERSION[V4.016] T3.DRC

[WZAM*[AFACTOR]]/[QBEAMAM*[BFACTOR]]

P--:4016

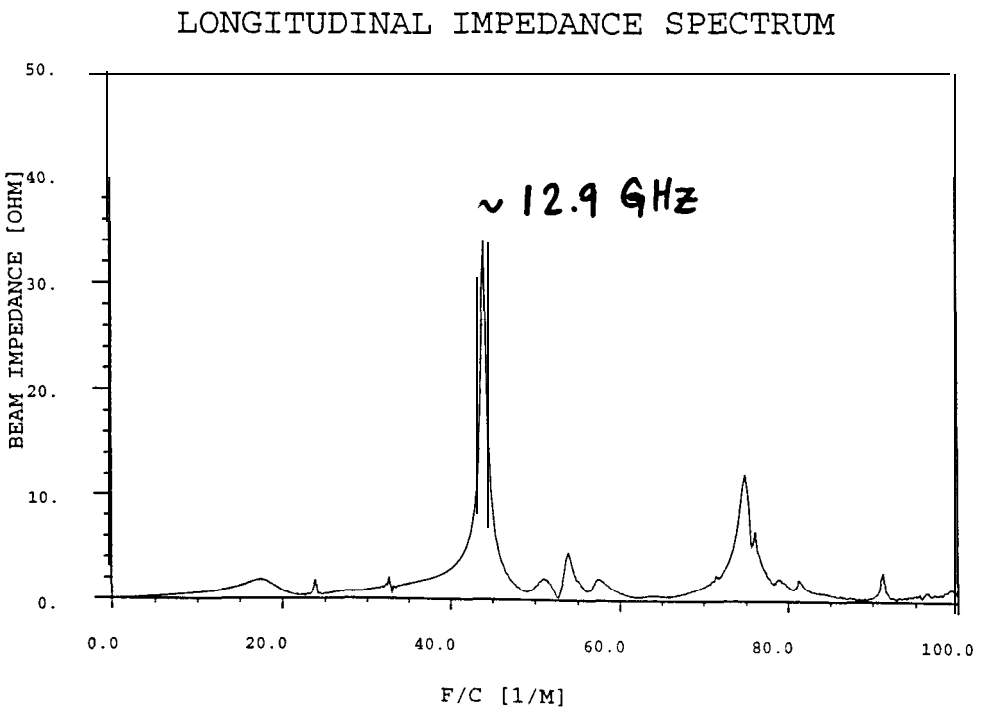
#1DGRAPH

ORDINATE: ZAM
COMPONENT: Z

FIXED COORDINATES:
DIM.....MESHLINE
X 1
Y 1

ABSCISSA: GEOMWAKE_F_13
[BASE OF ZAM]

REFERENCE COORDINATE: F
VARY.....MESHLINE
FROM 1
TO 8192



MAFIA

RAME: 2 21/09/99 - 12:07:12 VERSION(V4.016) T3.DRC

VOLTAGE MONITOR

?--:4016

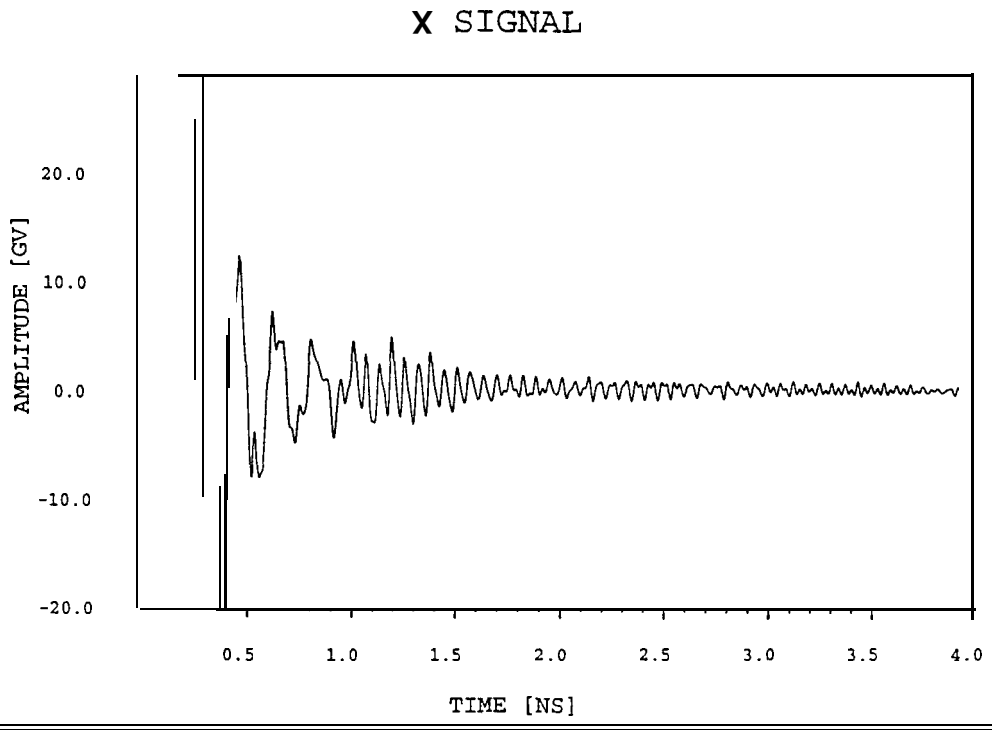
#1DGRAPH

RDINATE: VOLTAG_X
OMPONENT: -

IXED COORDINATES:
IM.....MESHLINE

BSCISSA: GEOMTIME
BASE OF VOLTAG_X]

EFERENCE COORDINATE: T
ARY.....MESHLINE
ROM 1
TO 32604



MAFIA

RAME: 5 21/09/99 - 12:07:12 VERSION(V4.016) T3.DRC

[VXAM*[AFACTOR]]/[IBEAMAM*[BFACTOR]]

P--:4016

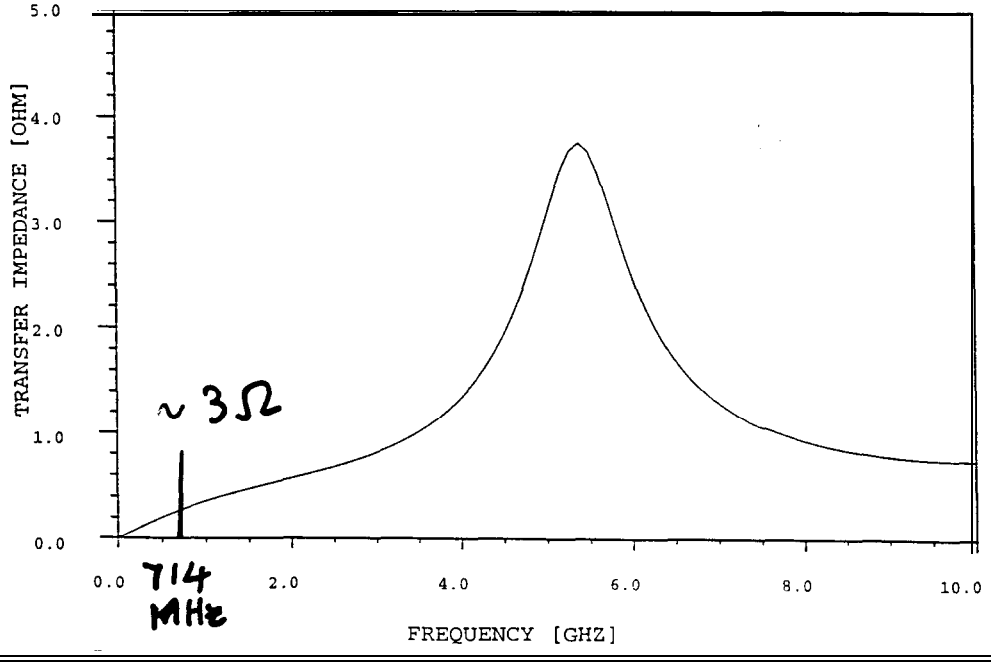
#1DGRAPH

RDINATE: TRANSFER
OMPONENT: -

IXED COORDINATES:
IM.....MESHLINE

BSCISSA: GEOMTIME_F_15
[BASE OF TRANSFER]

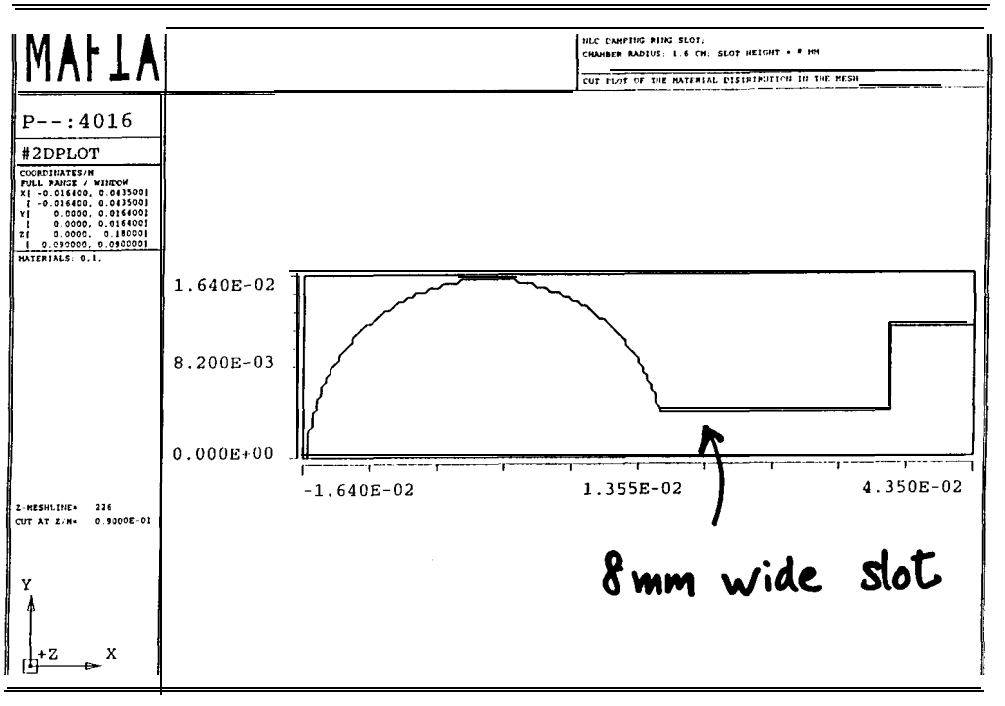
EFERENCE COORDINATE: F
ARY.....MESHLINE
ROM 1
TO 32604

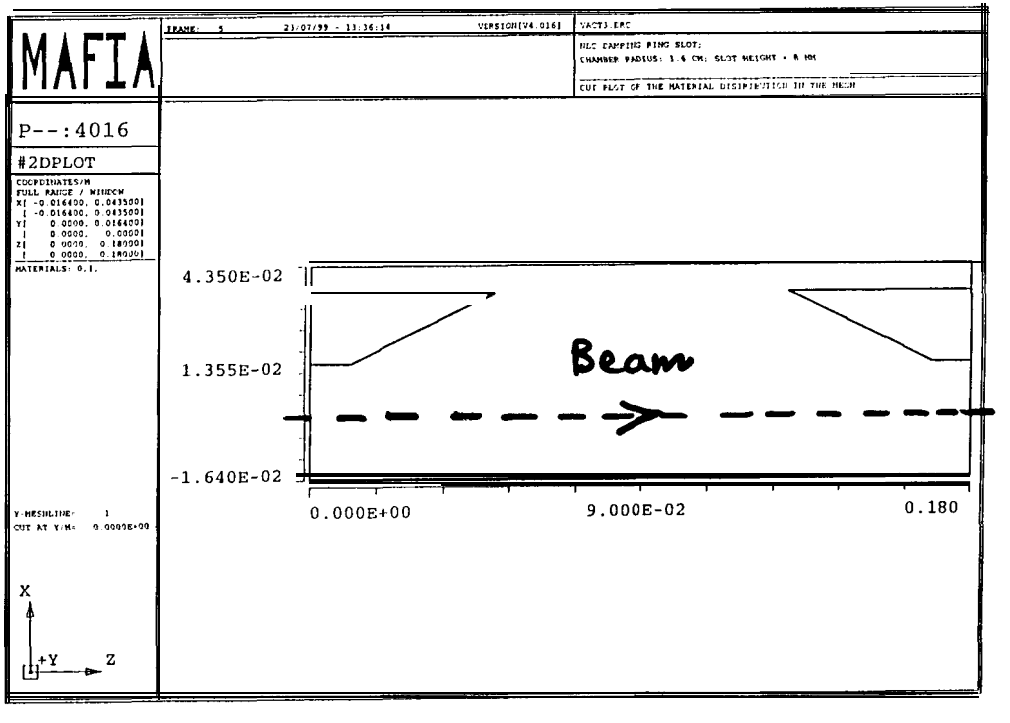


Ante-Chamber slot (102)

$k_\ell = 6.65 \times 10^{-4}$ V/pC

$L = 2.72 \times 10^{-3}$ nH

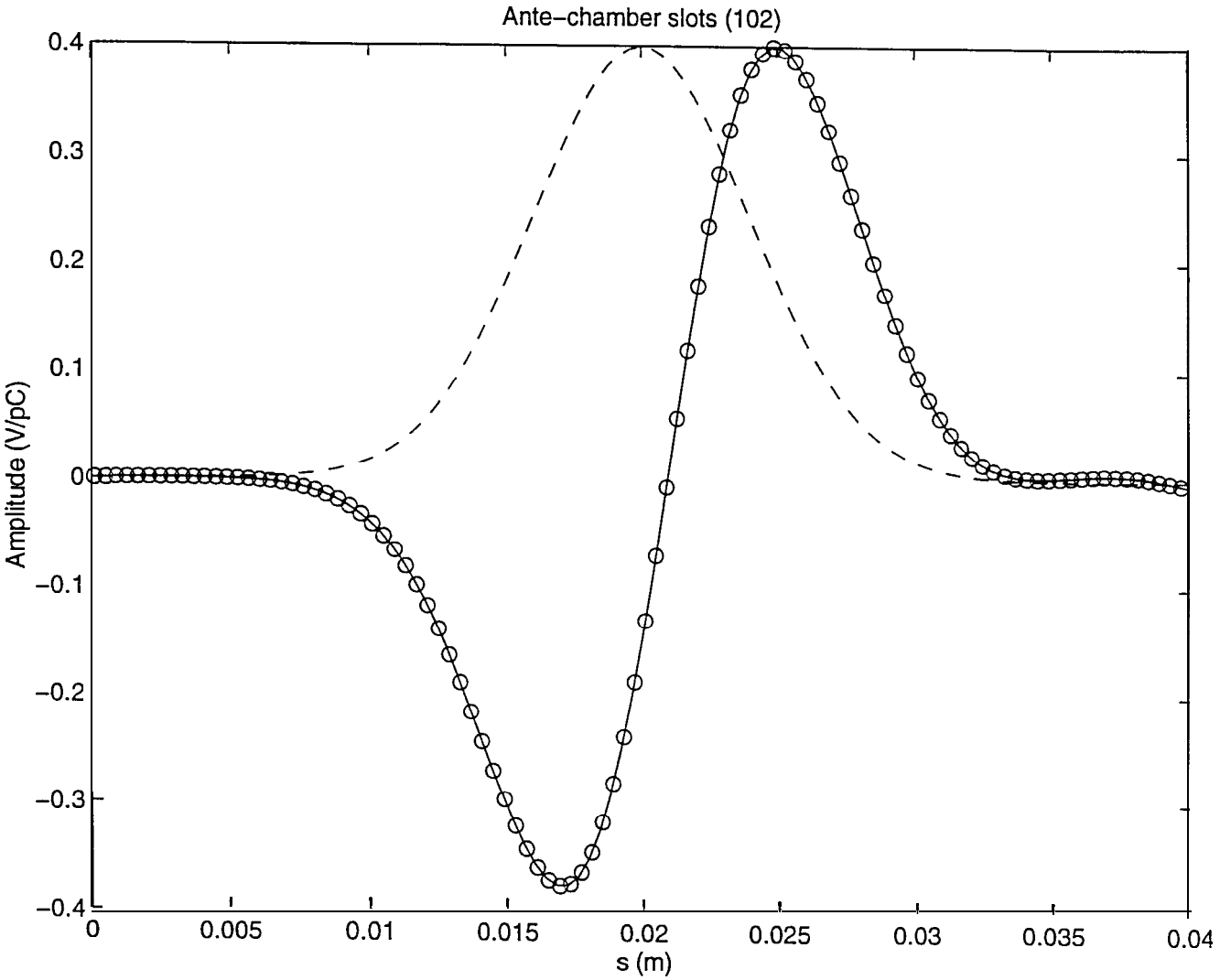




Ante-chamber slot (102)

$k_\ell = 6.65 \times 10^{-4}$ V/pC

$L = 2.72 \times 10^{-3}$ nH



MAFIA

FRAME: 5 20/09/99 - 12:11:04 VERSION[V4.020]

****** NO MAFIA FILE ALLOCATED ******

NLC DAMPING RING MASK

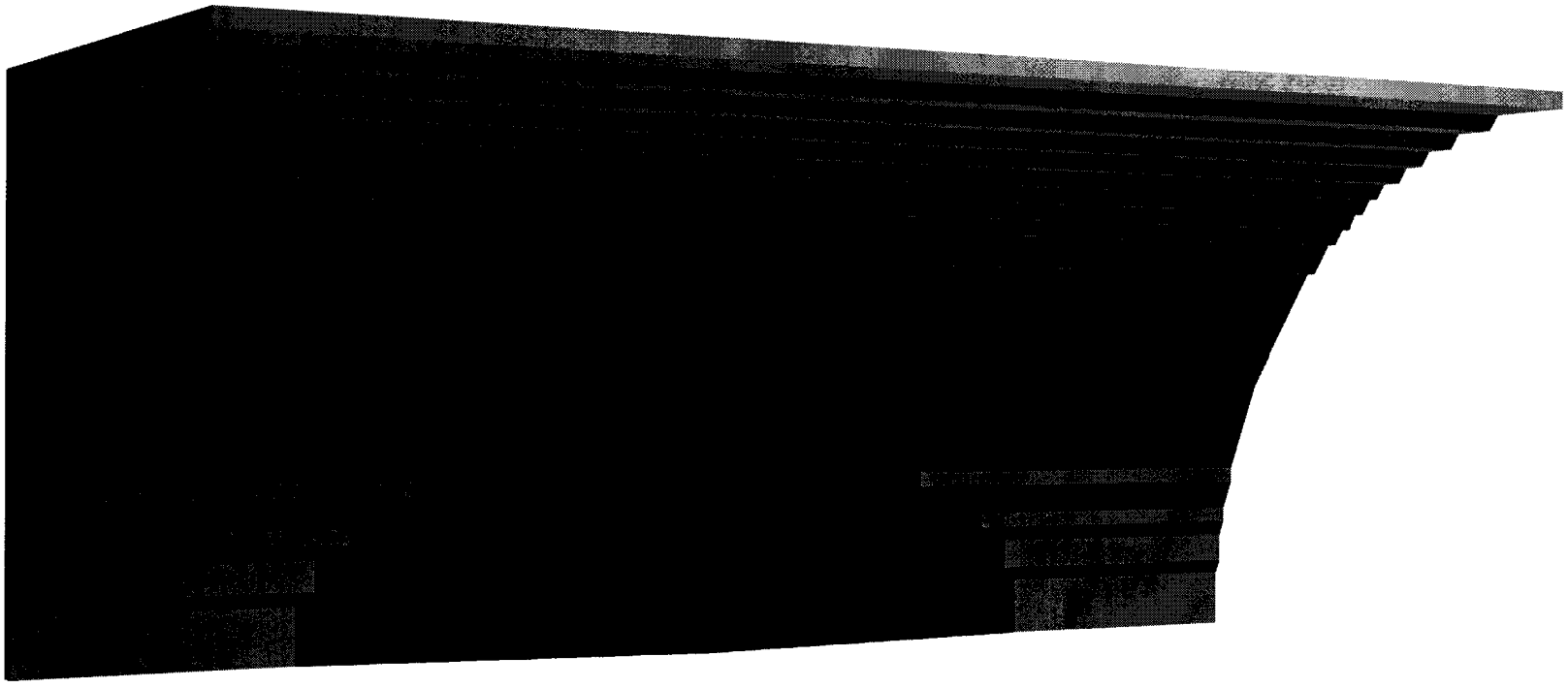
3D PLOT OF THE MATERIAL DISTRIBUTION IN THE MESH

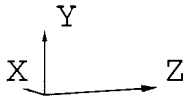
#VOLUME

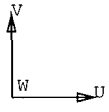
COORDINATES/M
FULL RANGE / WINDOW
X[-.016500, .016500]
[.0000, .016500]
Y[.0000, .016500]
[.0000, .016500]
Z[.0000, .18500]
[.072500, .11250]

SYMBOL: CCYLINDE_1
TIME.....: 1.0000
MATERIALS: 1,2,

Bellows mask



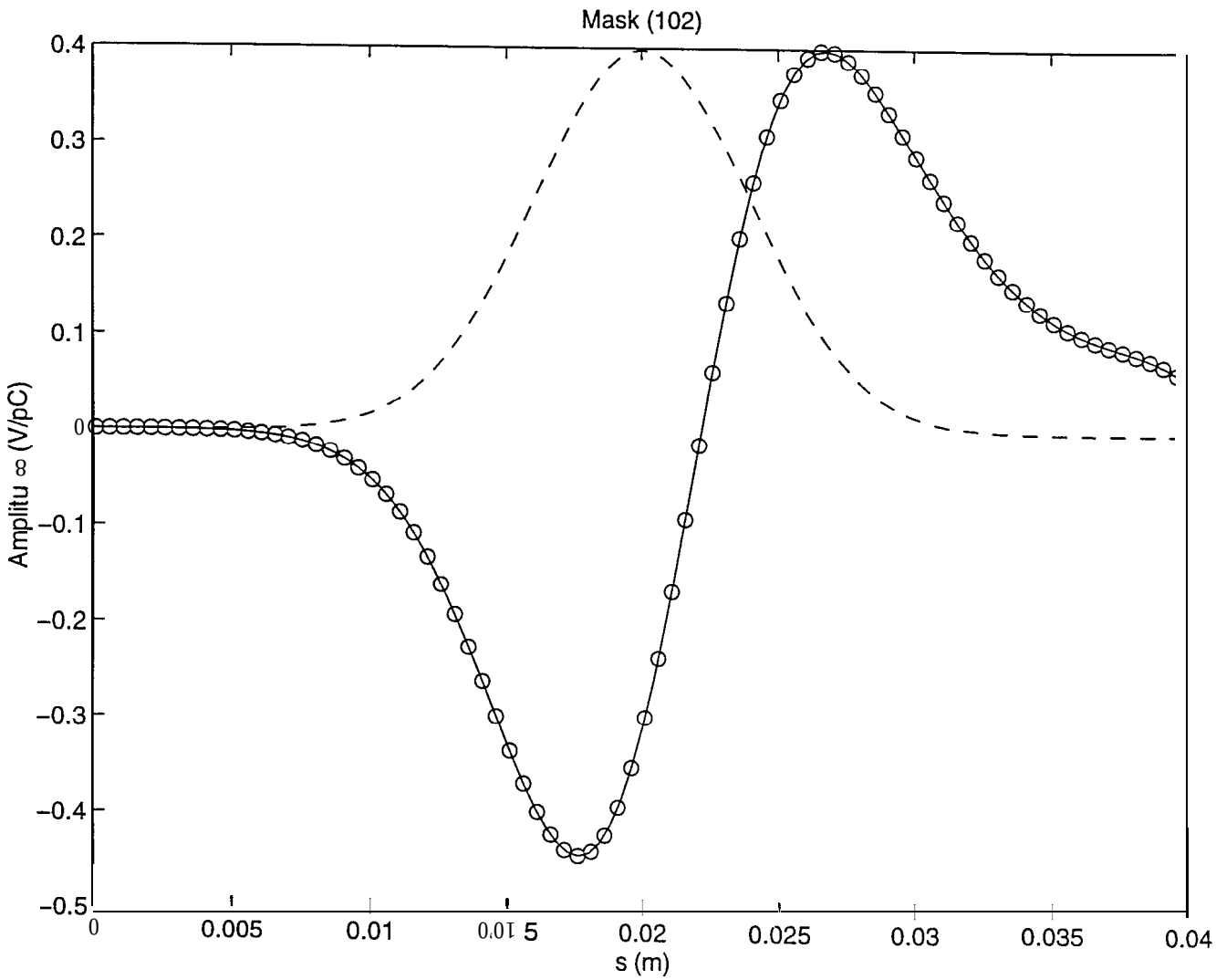


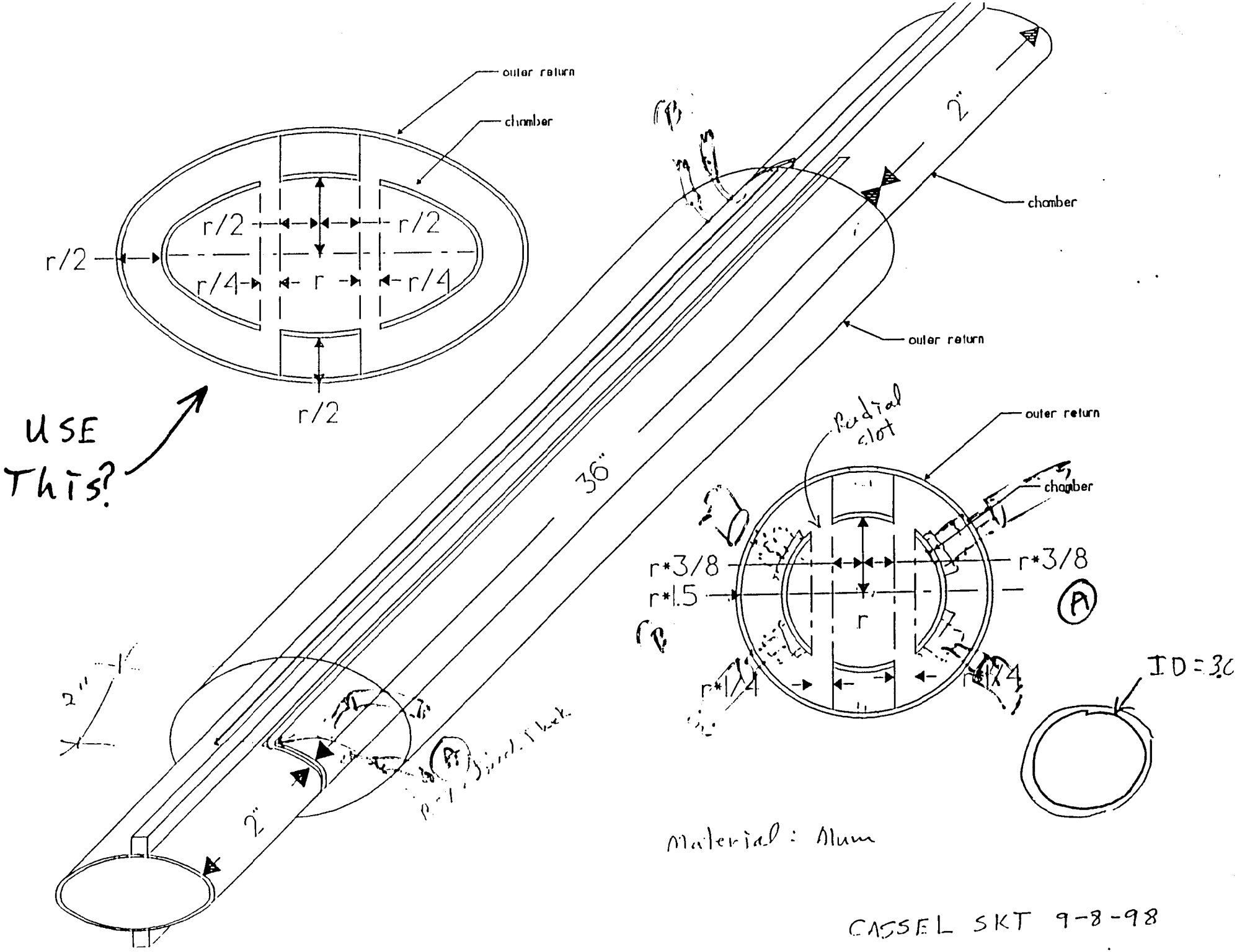


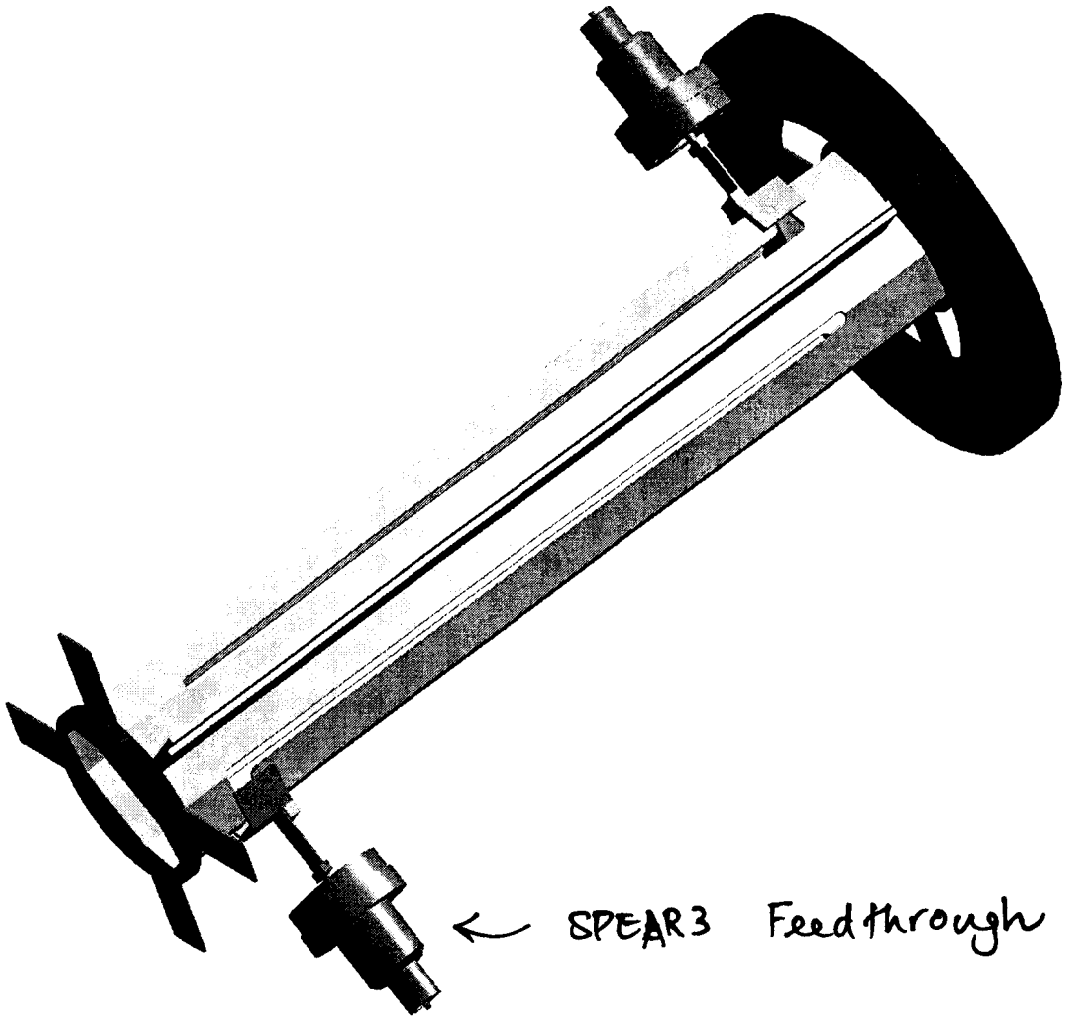
Bellows mask (102)

$k_\ell = 1.645 \times 10^{-3}$ V/pC

$L = 3.91 \times 10^{-3}$ nH




outer return
chamber
r/2
r/2
r/2
r/4
r
r/4
r/2
USE
This?
2"
chamber
outer return
36"
2"
2"
radial slot
outer return
chamber
r*3/8
r*3/8
r*1.5
r
r*1/4
r*1/4
ID=3.0
Material: Alum
CASSEL SKT 9-8-98


SPEAR3 Feedthrough

MAFIA

FRAME: 10 16/09/99 - 11:28:47 VERSION[V4.017]

****** NO MAFIA FILE ALLOCATED ******

NLC DR INJECTION KICKER

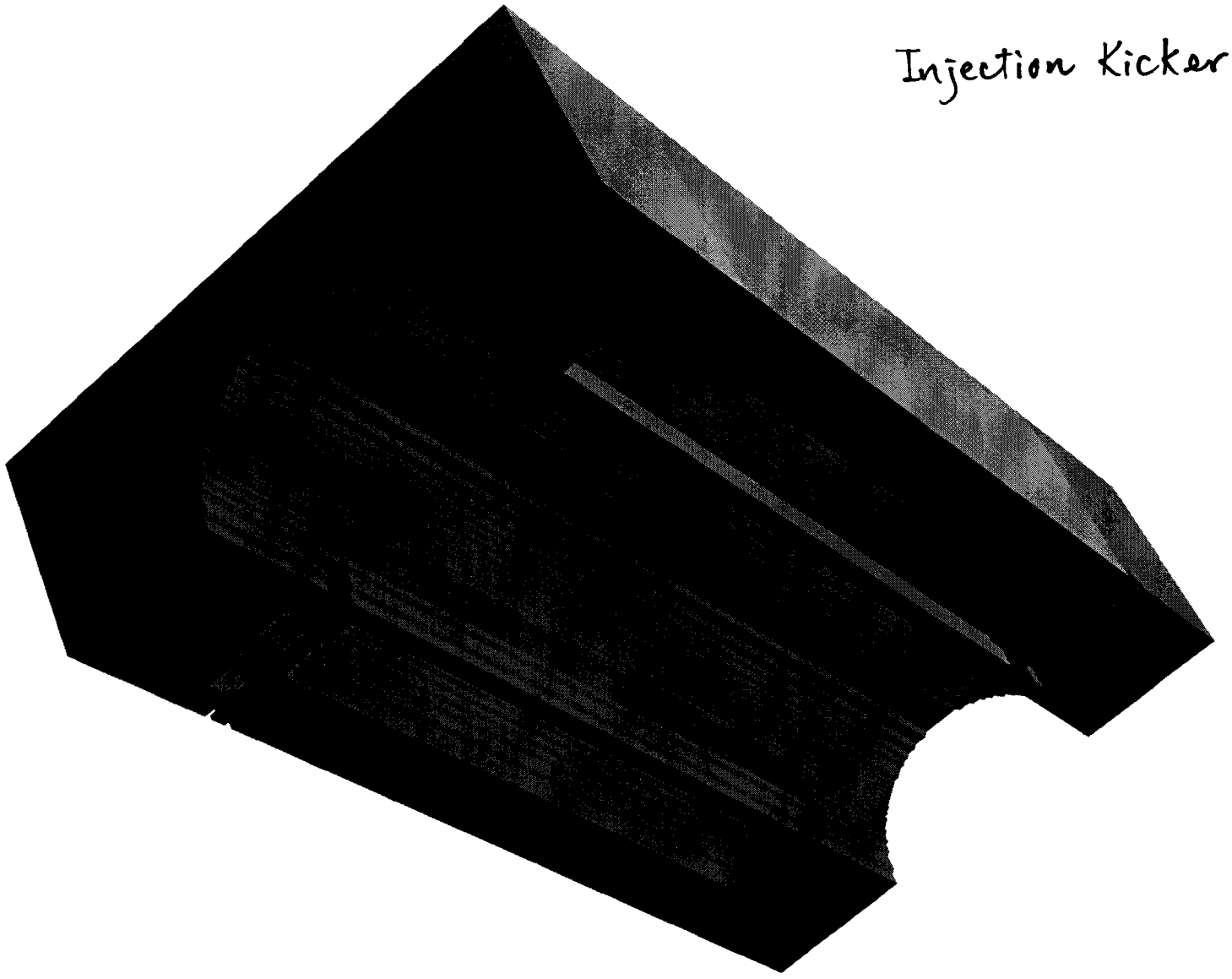
3D PLOT OF THE MATERIAL DISTRIBUTION IN THE MESH

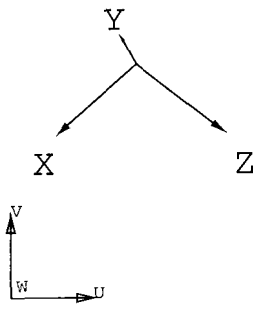
M--:4017

#VOLUME

COORDINATES/M
FULL RANGE / WINDOW
X[-.036735, .036735]
[-.036735, .036735]
Y[.0000, .028500]
[.0000, .028500]
Z[.0000, .13144]
[.0000, .13144]

SYMBOL: CCYLINDE_7
TIME.....: 1.0000
MATERIALS: 1,2,





MAFIA

FRAME: 9 16/09/99 - 09:39:53 VERSION[V4.017]

****** NO MAFIA FILE ALLOCATED ******

NLC DR INJECTION KICKER

CUT PLOT OF THE MATERIAL DISTRIBUTION IN THE MESH

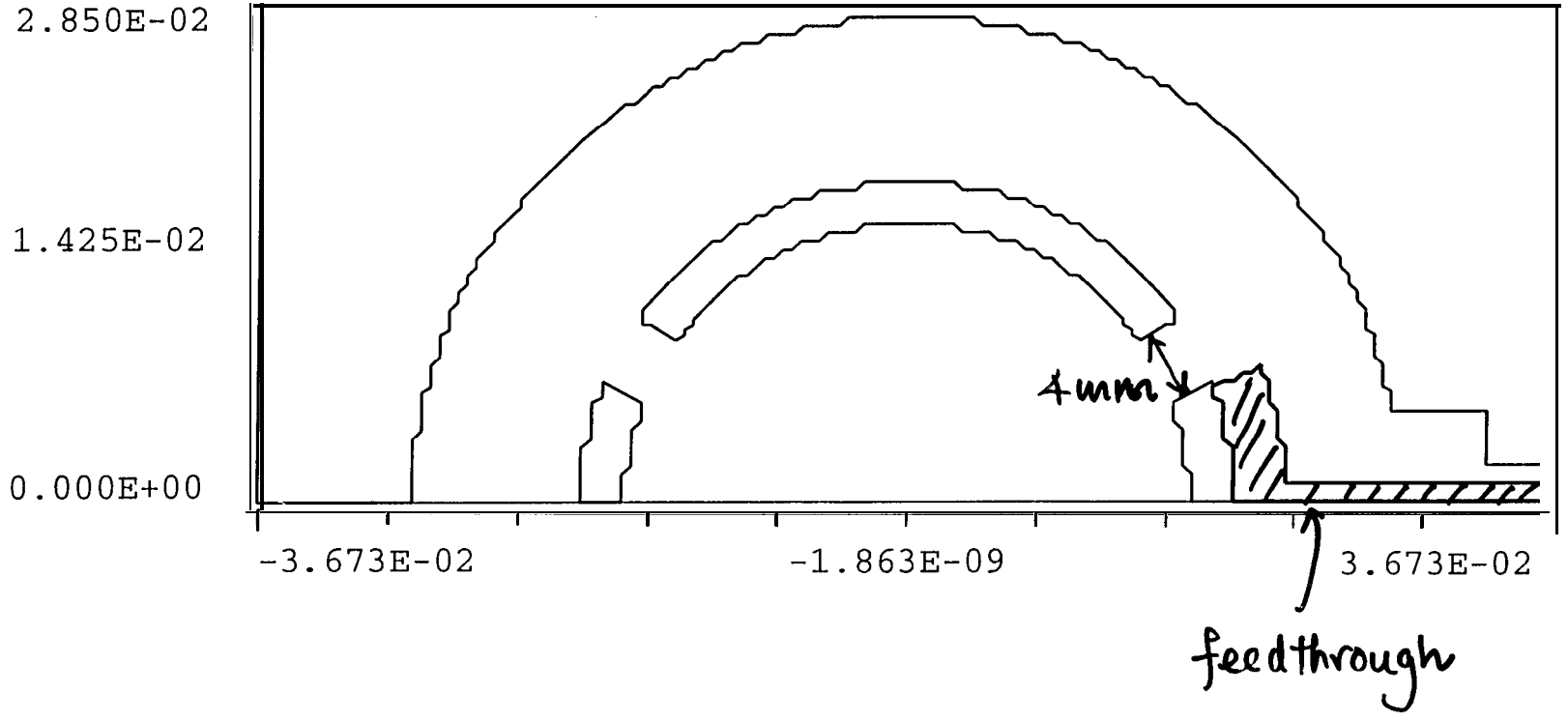
M--:4017

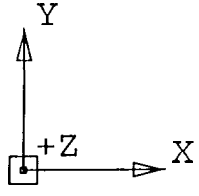
#2DPLOT

COORDINATES/M
FULL RANGE / WINDOW
X [-.036735, .036735]
[-.036735, .036735]
Y[.0000, .028500]
[.0000, .028500]
Z[.0000, .12744]
[.022000, .022000]

MATERIALS: 1,2,

Z-MESHLINE= 17
CUT AT Z/M= .2200E-01

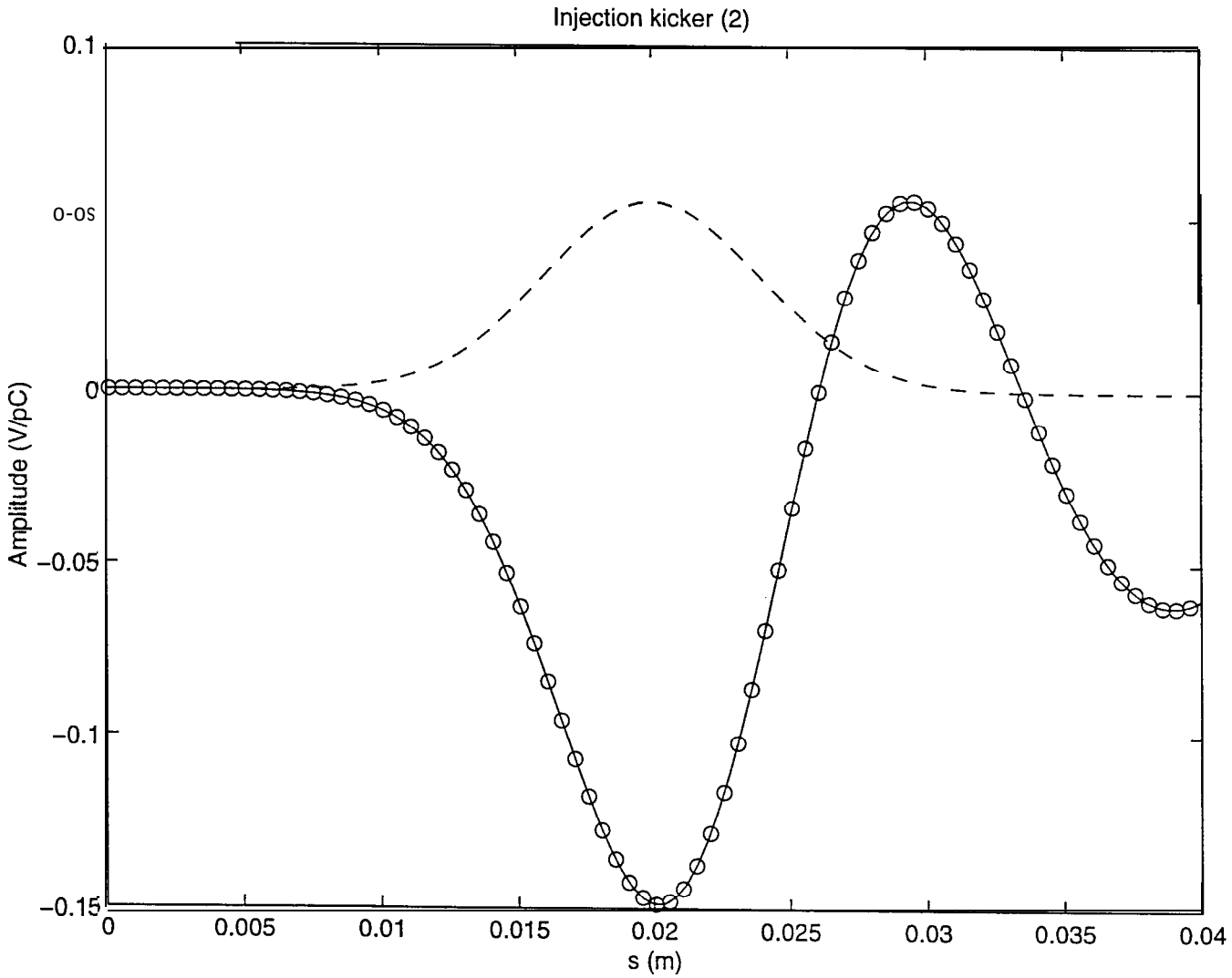




Injection kicker (2)

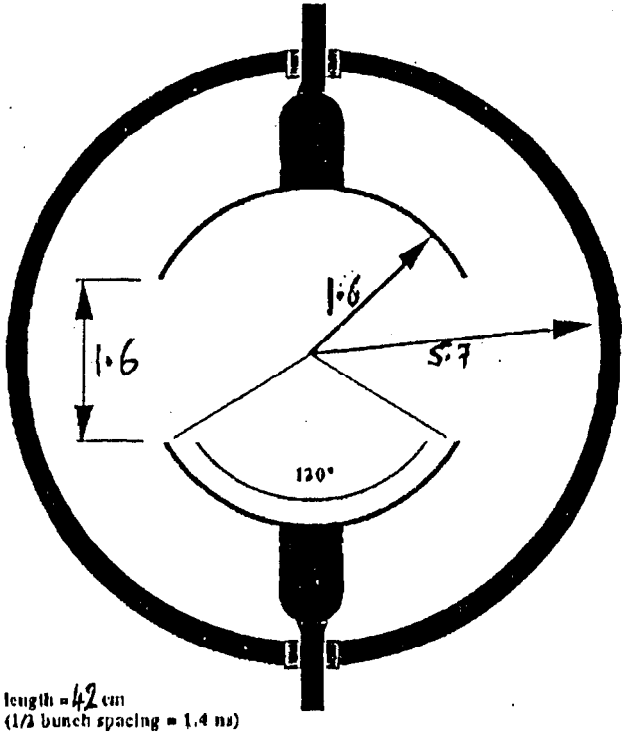
$k_\ell = 4.786 \times 10^{-2}$ V/pC

$L = 0.0546$ nH



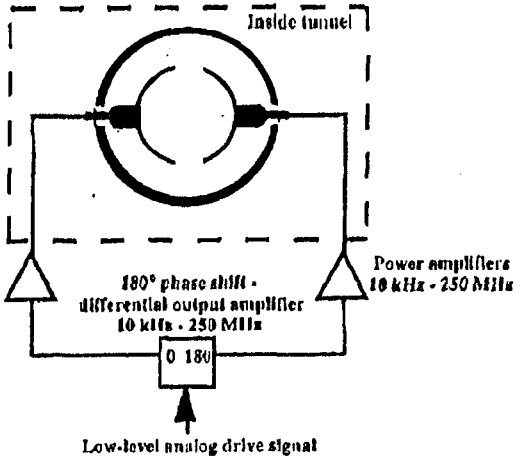
NLC DR Baseband kickers

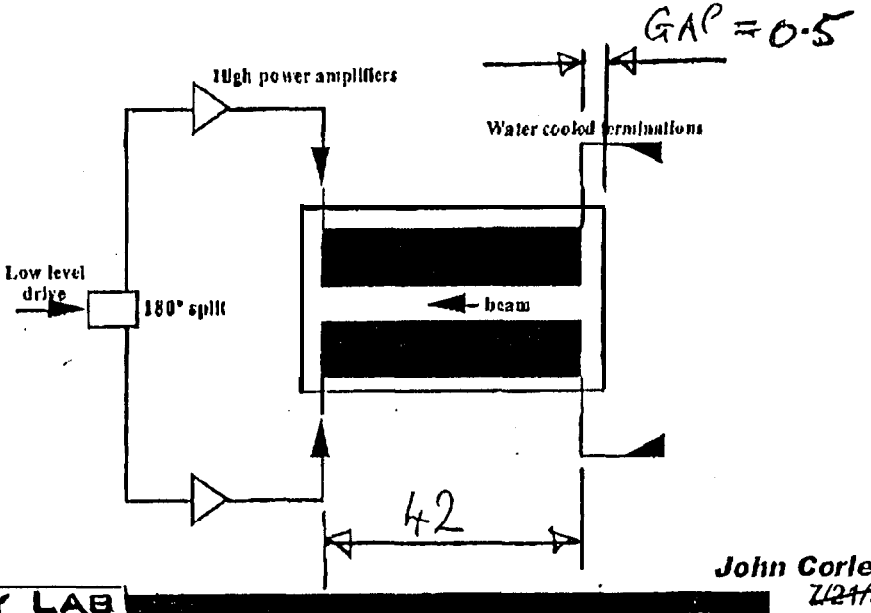
- Stripline kickers



length = 42 cm
(1/2 bunch spacing = 1.4 ns)

DIMENSIONS IN cm





MAFIA

FRAME: 7 22/09/99 - 14:06:19 VERSION[V4.016]

****** NO MAFIA FILE ALLOCATED ******

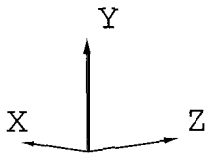
NLC DR INJECTION KICKER

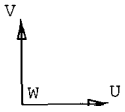
3D PLOT OF THE MATERIAL DISTRIBUTION IN THE MESH

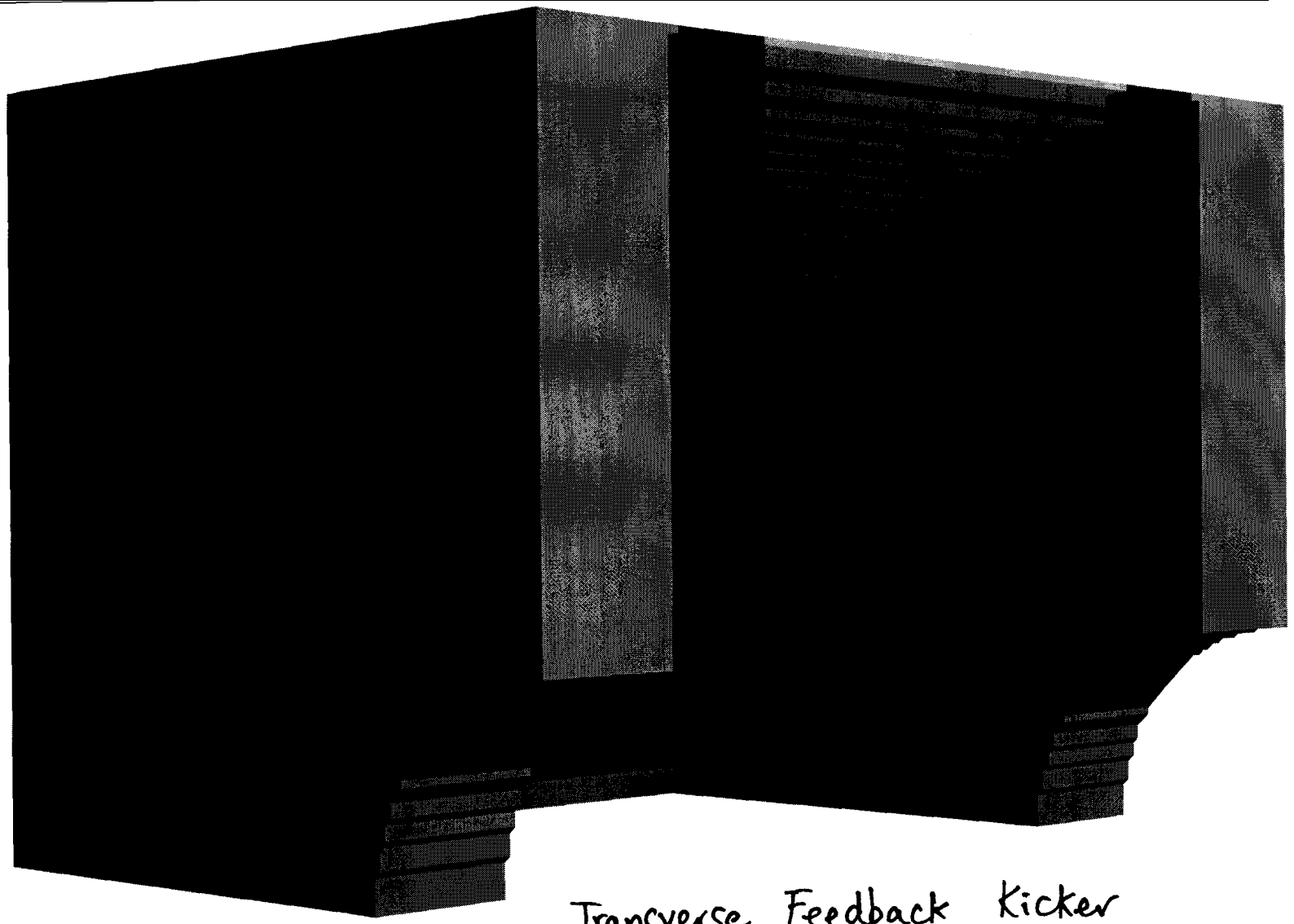
#VOLUME

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000, 0.057500]
[0.0000, 0.057500]
Y[0.0000, 0.057500]
[0.0000, 0.057500]
Z[0.0000, 0.14700]
[0.033750, 0.11325]

SYMBOL: CCYLINDE_2
TIME.....: 0.00000E+00
MATERIALS: 1,3,





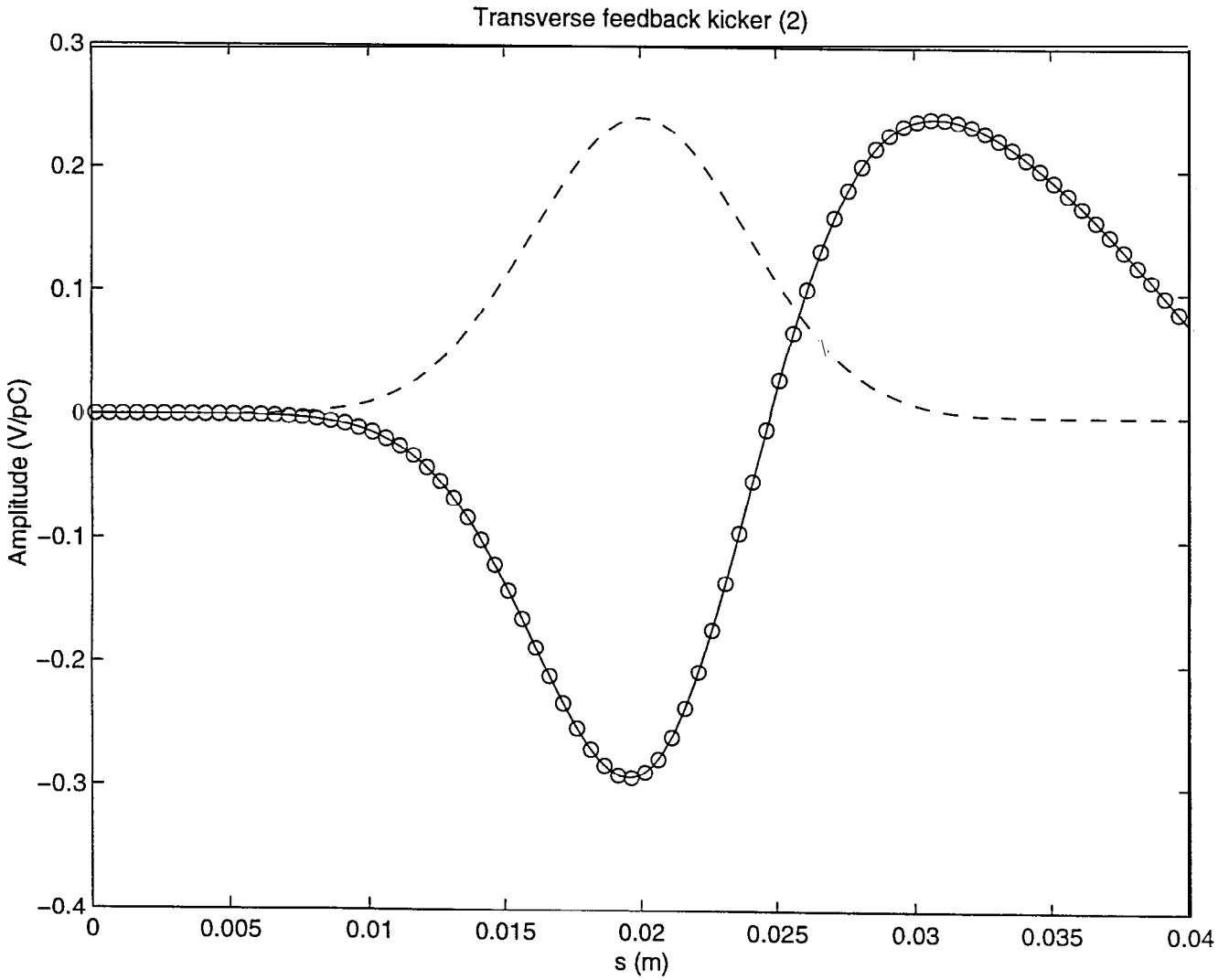


Transverse Feedback Kicker

Transverse Feedback kicker (2)

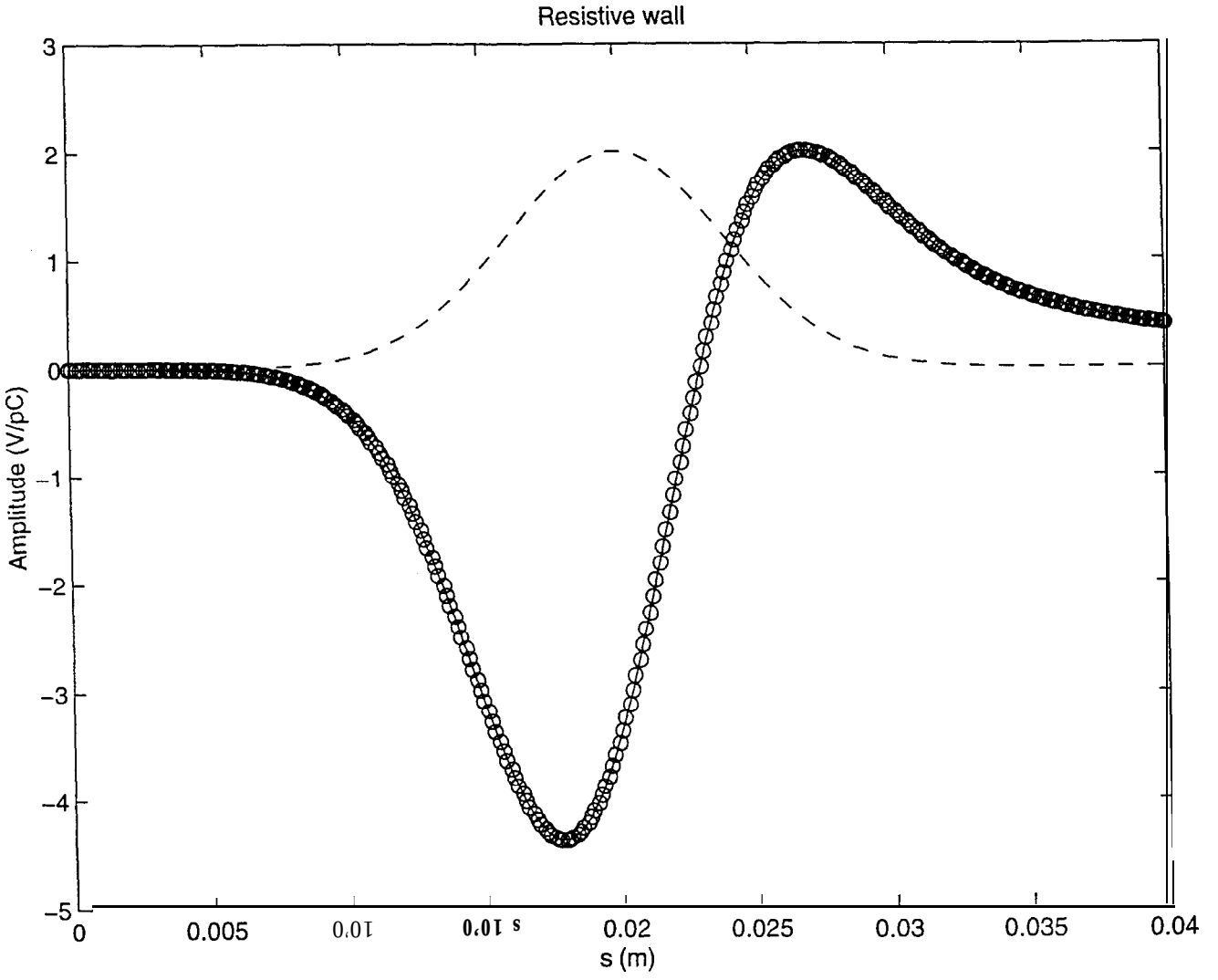
$k_\ell = 8.56 \times 10^{-2}$ V/pC

$L = 0.107$ nH

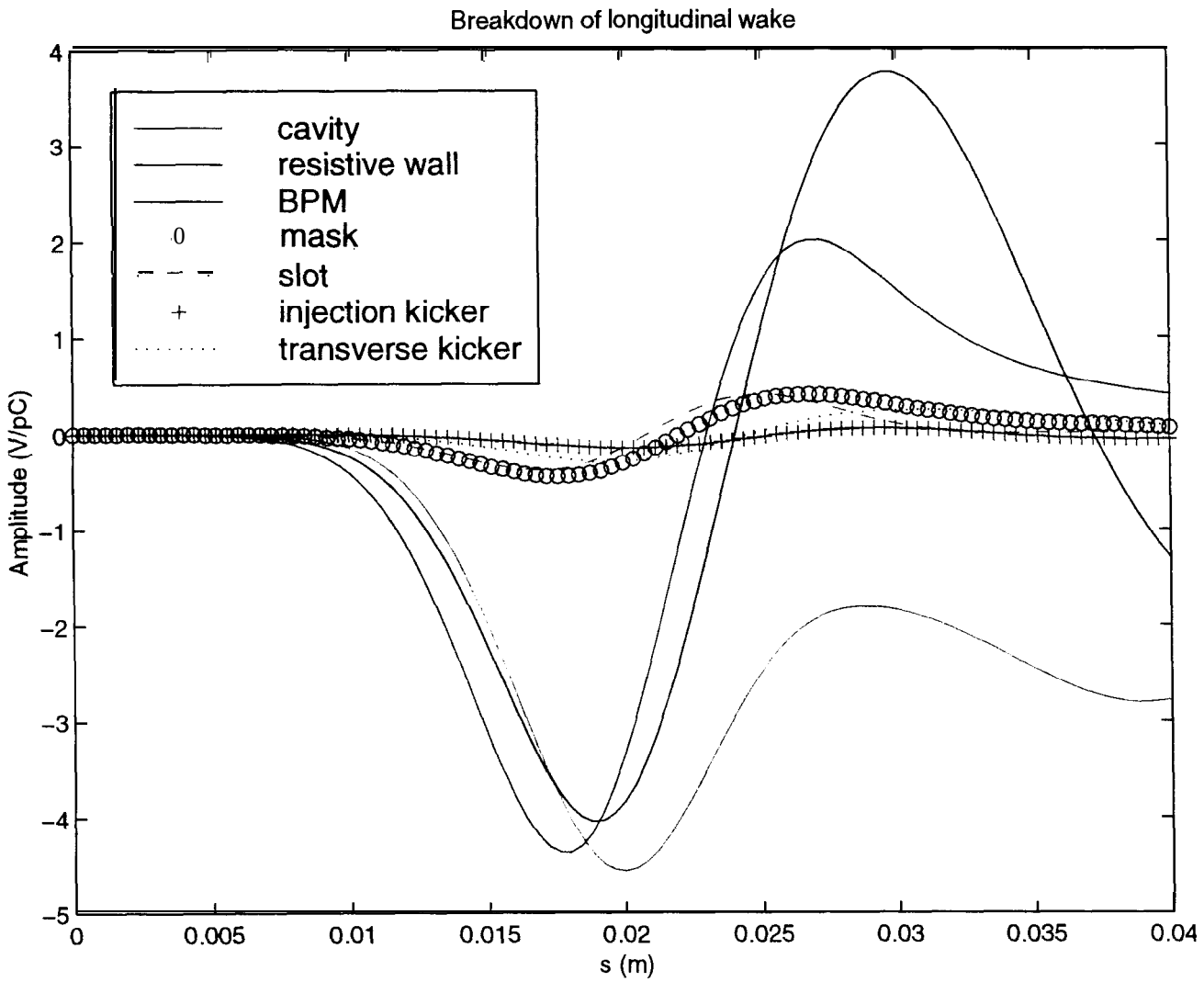


Resistive Wall : 250 m vacuum chamber
50 m wiggler
Aluminum

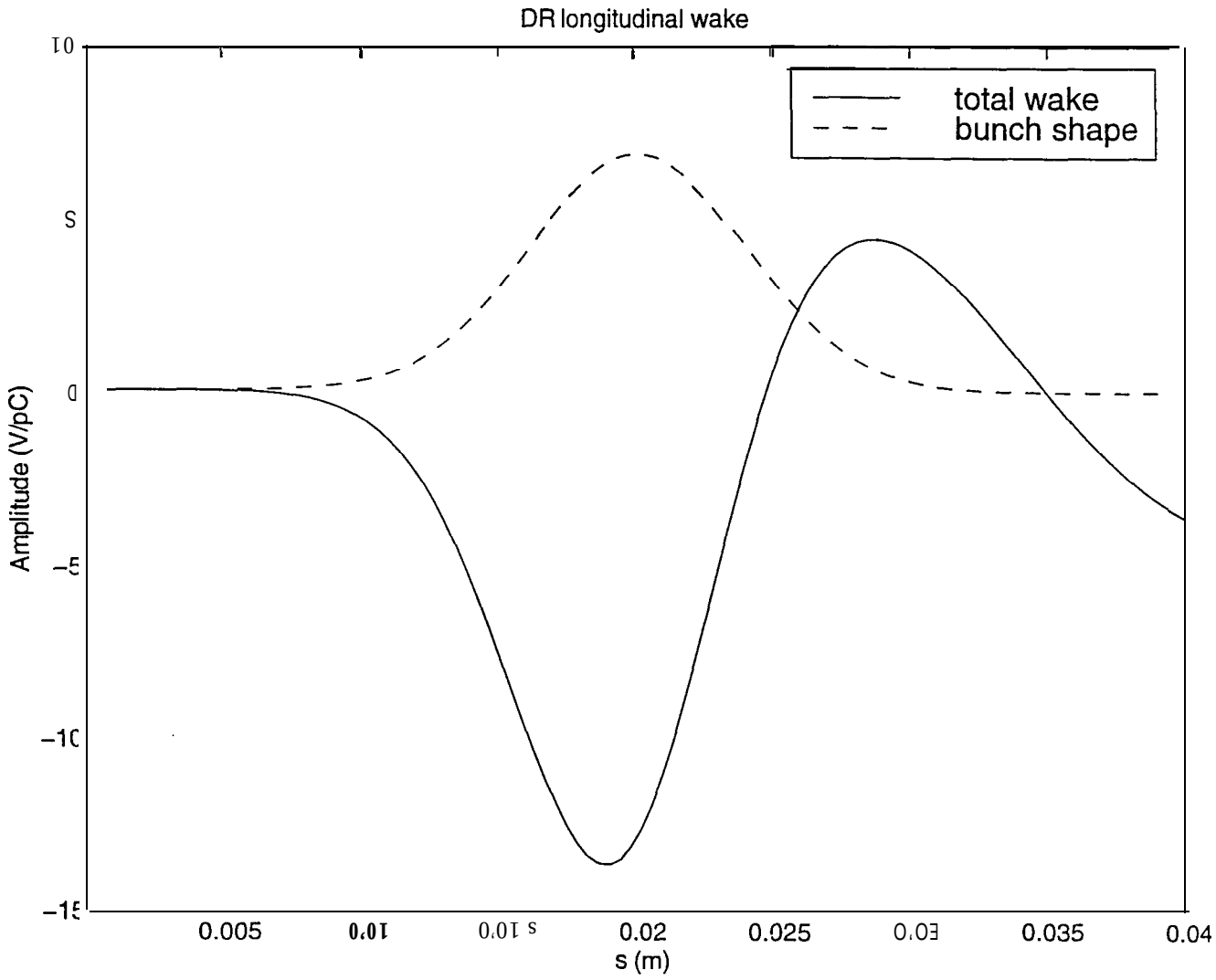
$k_\ell = 2.002$ V/pC



Breakdown of Longitudinal Wakefield



Damping Ring Wakefield



Summary of impedance budget

Component	Loss factor (V/pC)	Inductance (nH)
RF Cavity	3.330	
BPM	2.226	2.970
Ante-chamber slot	0.068	0.277
Bellows mask	0.068	0.326
Injection kicker	0.096	0.109
Transverse feedback kicker	0.171	0.214
Resistive Wall	2.002	
Total	8.061	3.896

- PEP-II HER ring: Loss factor = 4.67 V/pC

  Inductance = 33.1 nH