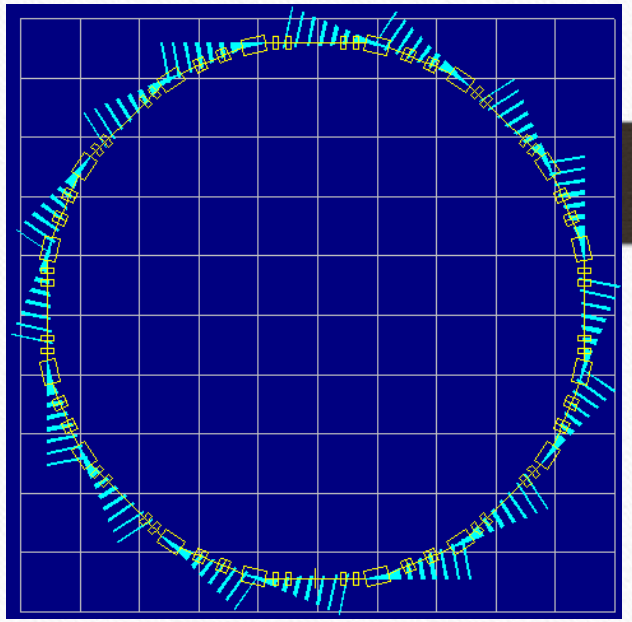
Synchrotron light source design

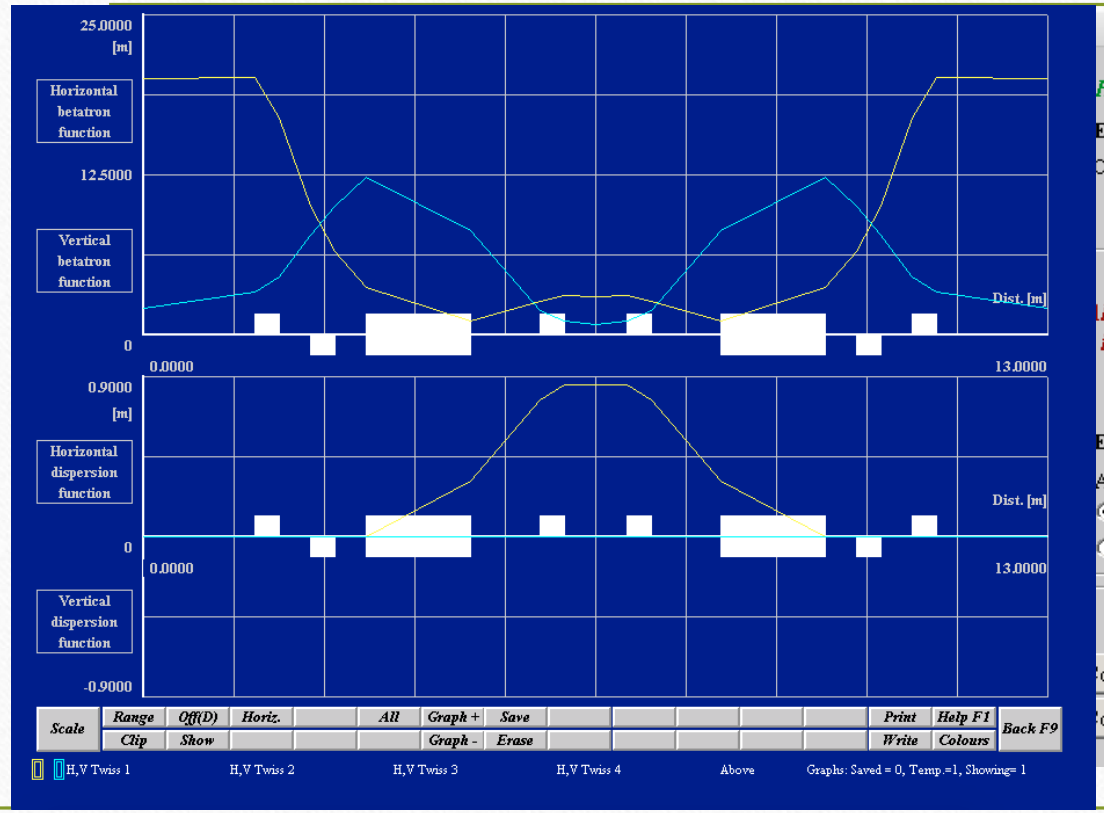
JUAS 2016

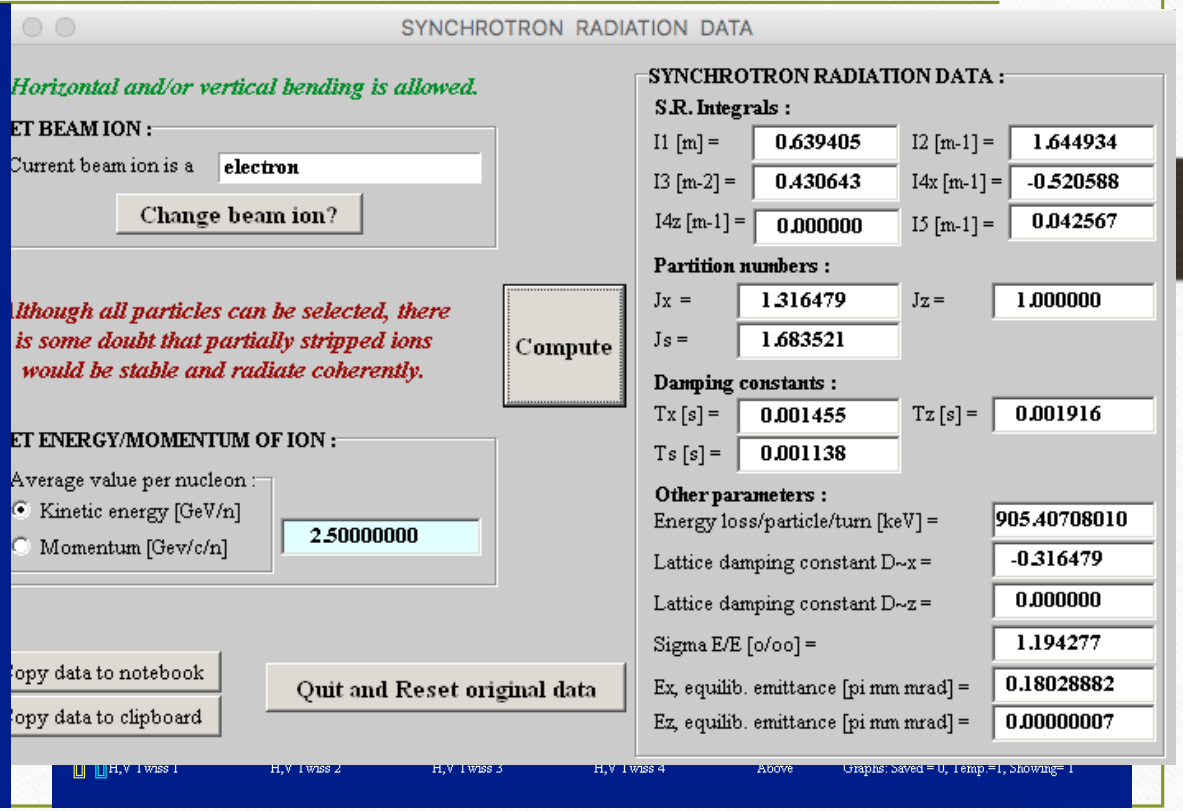
Design goal/process

- Create achromatic straight sections for the light source
- Use a tunnel of roughly 120m of 2πR -> R=19.1m
- 16 Magnets of $B_{dipole} = 1.4\,T$
- Energy 2.5 GeV
- Use a DBA for an octant cell

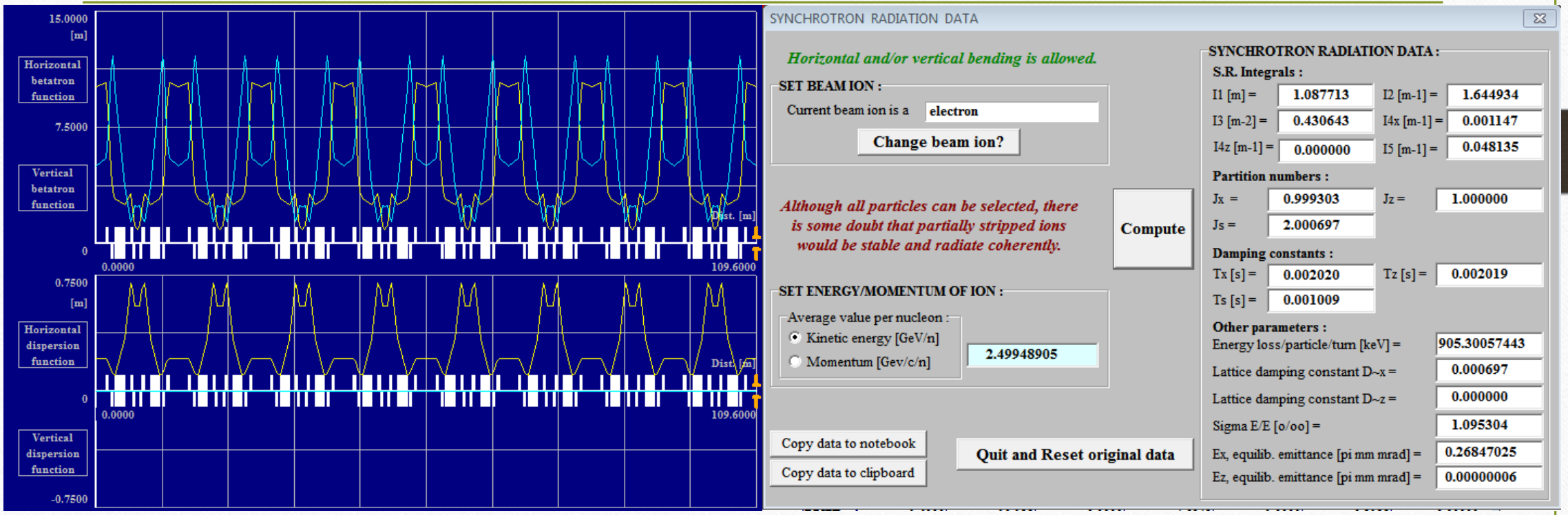


Designs
Jay

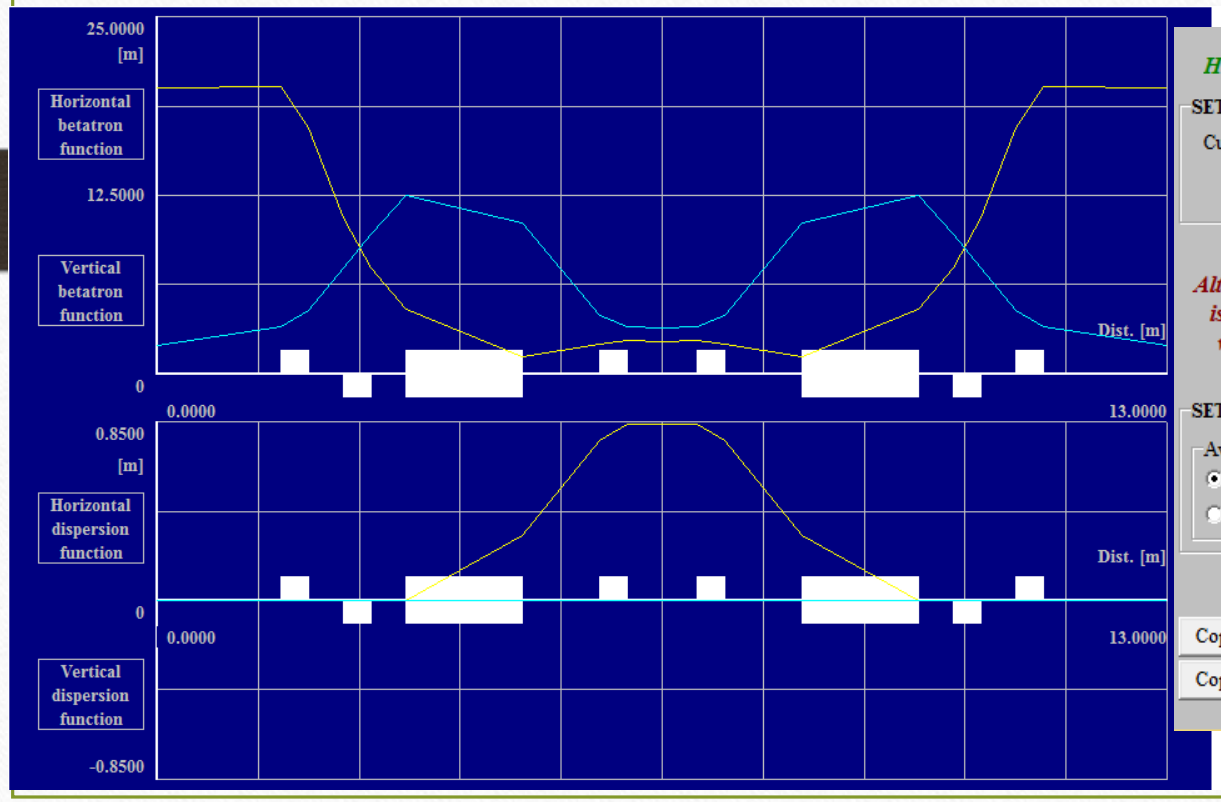

25.0000
[m]
Horizontal betatron function
12.5000
Vertical betatron function
0
0.0000
13.0000
Dist. [m]
0.9000
[m]
Horizontal dispersion function
0
0.0000
13.0000
Dist. [m]
Vertical dispersion function
-0.9000
Scale
Range
Clip
Off(D)
Show
Horiz.
All
Graph +
Graph -
Save
Erase
Print
Write
Help F1
Colours
Back F9
H,V Twiss 1
H,V Twiss 2
H,V Twiss 3
H,V Twiss 4
Above
Graphs: Saved = 0, Temp.=1, Showing= 1


SYNCHROTRON RADIATION DATA
Horizontal and/or vertical bending is allowed.
ET BEAM ION :
Current beam ion is a
electron
Change beam ion?
lthough all particles can be selected, there is some doubt that partially stripped ions would be stable and radiate coherently.
Compute
ET ENERGY/MOMENTUM OF ION :
Average value per nucleon :
Kinetic energy [GeV/n]
Momentum [Gev/c/n]
2.50000000
opy data to notebook
opy data to clipboard
Quit and Reset original data
SYNCHROTRON RADIATION DATA :
S.R. Integrals :
I1 [m] = 0.639405
I2 [m-1] = 1.644934
I3 [m-2] = 0.430643
I4x [m-1] = -0.520588
I4z [m-1] = 0.000000
I5 [m-1] = 0.042567
Partition numbers :
Jx = 1.316479
Jz = 1.000000
Js = 1.683521
Damping constants :
Tx [s] = 0.001455
Tz [s] = 0.001916
Ts [s] = 0.001138
Other parameters :
Energy loss/particle/turn [keV] = 905.40708010
Lattice damping constant D~x = -0.316479
Lattice damping constant D~z = 0.000000
Sigma E/E [o/oo] = 1.194277
Ex, equilib. emittance [pi mm mrad] = 0.18028882
Ez, equilib. emittance [pi mm mrad] = 0.00000007

Design
Eleonora



Designs
Francesco



Horizontal and/or vertical bending is allowed.

SET BEAM ION :

Current beam ion is a: electron

Change beam ion?

Although all particles can be selected, there is some doubt that partially stripped ions would be stable and radiate coherently.

Compute

SET ENERGY/MOMENTUM OF ION :

Average value per nucleon :

- (•) Kinetic energy [GeV/n]
- ( ) Momentum [Gev/c/n]

2.50000000

Copy data to notebook

Copy data to clipboard

Quit and Reset original data

SYNCHROTRON RADIATION DATA :

S.R. Integrals :

I1 [m] =	0.635594	I2 [m-1] =	1.644934
I3 [m-2] =	0.430643	I4x [m-1] =	-0.449548
I4z [m-1] =	0.000000	I5 [m-1] =	0.054639

Partition numbers :

Jx =	1.273293	Jz =	1.000000
Js =	1.726707		

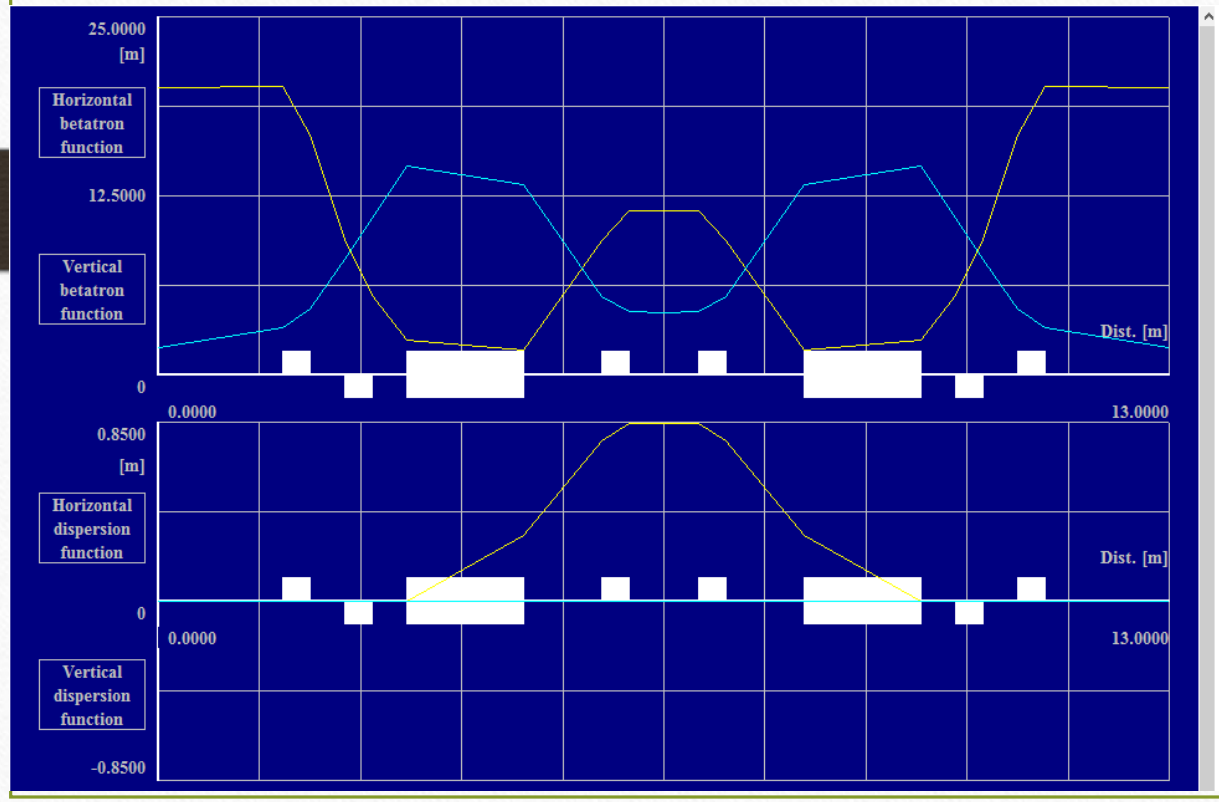
Damping constants :

Tx [s] =	0.001505	Tz [s] =	0.001916
Ts [s] =	0.001109		

Other parameters :

Energy loss/particle/turn [keV] =	905.40708010
Lattice damping constant D~x =	-0.273293
Lattice damping constant D~z =	0.000000
Sigma E/E [o/oo] =	1.179247
Ex, equilib. emittance [pi mm mrad] =	0.23926774
Ez, equilib. emittance [pi mm mrad] =	0.00000008

Designs
Pierre



tal and/or vertical bending is allowed.

M ION :

beam ion is a electron

Change beam ion?

h all particles can be selected, there
e doubt that partially stripped ions
be stable and radiate coherently.

Compute

RGY/MOMENTUM OF ION :

value per nucleon :

ic energy [GeV/n]

entum [Gev/c/n]

2.50000000

to notebook

to clipboard

Quit and Reset original data

SYNCHROTRON RADIATION DATA :

S.R. Integrals :

I1 [m] =	0.636701	I2 [m-1] =	1.644934
I3 [m-2] =	0.430643	I4x [m-1] =	-0.470137
I4z [m-1] =	0.000000	I5 [m-1] =	0.014107

Partition numbers :

Jx =	1.285809	Jz =	1.000000
Js =	1.714191		

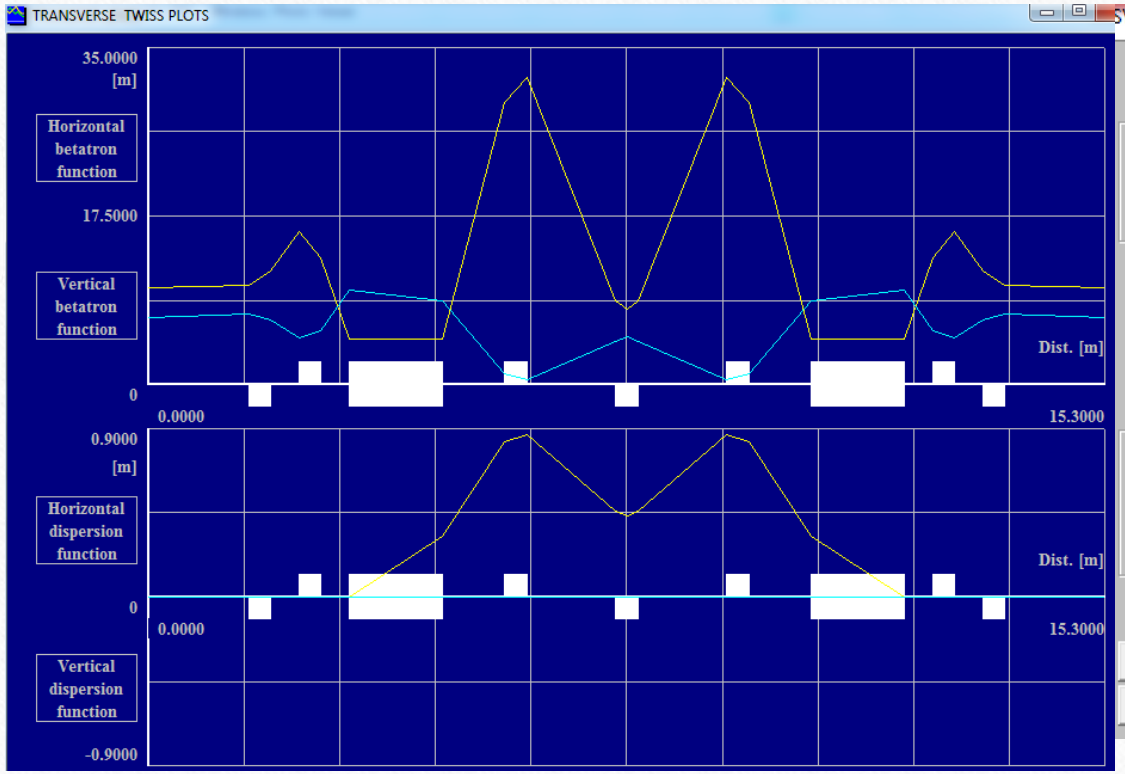
Damping constants :

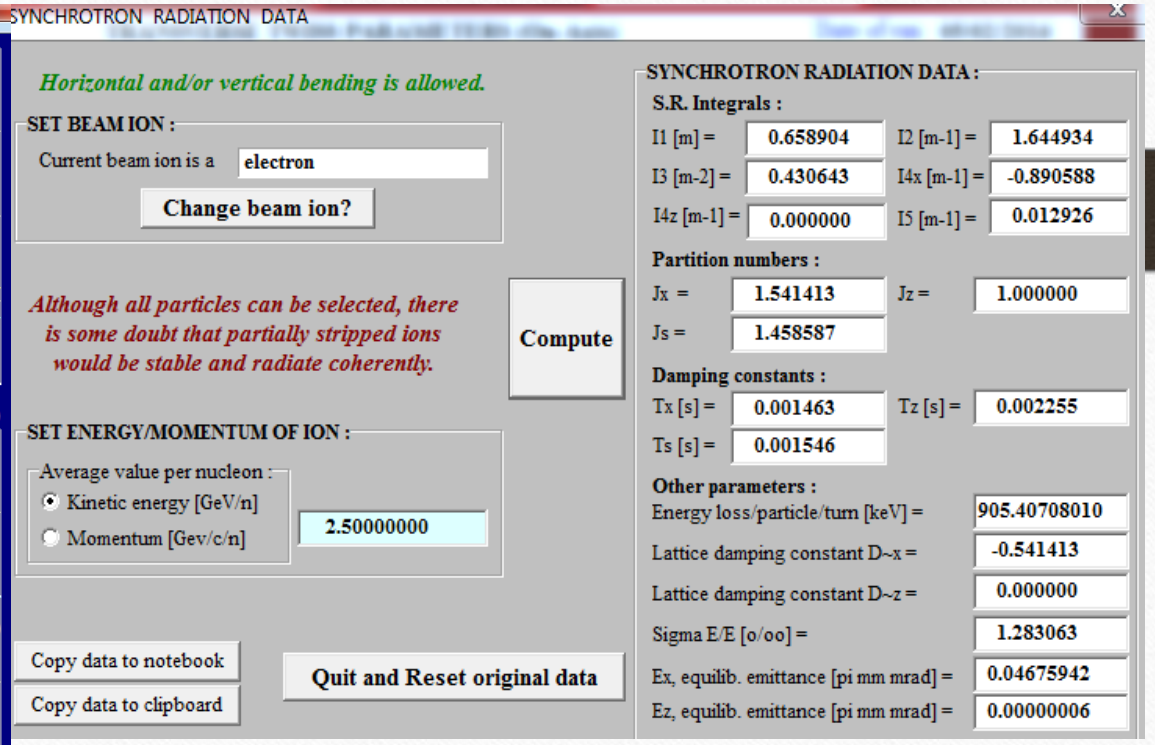
Tx [s] =	0.001490	Tz [s] =	0.001916
Ts [s] =	0.001118		

Other parameters :

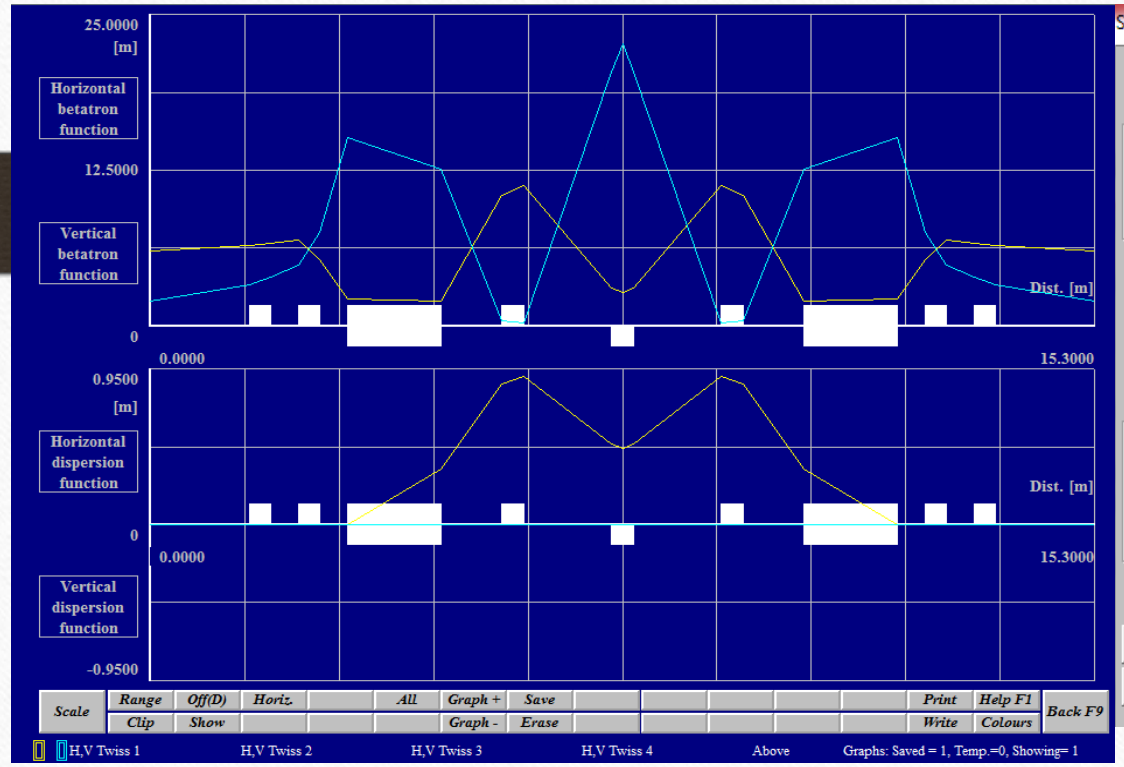
Energy loss/particle/turn [keV] =	905.40708010
Lattice damping constant D~x =	-0.285809
Lattice damping constant D~z =	0.000000
Sigma E/E [o/oo] =	1.183544
Ex, equilib. emittance [pi mm mrad] =	0.06117246
Ez, equilib. emittance [pi mm mrad] =	0.00000010

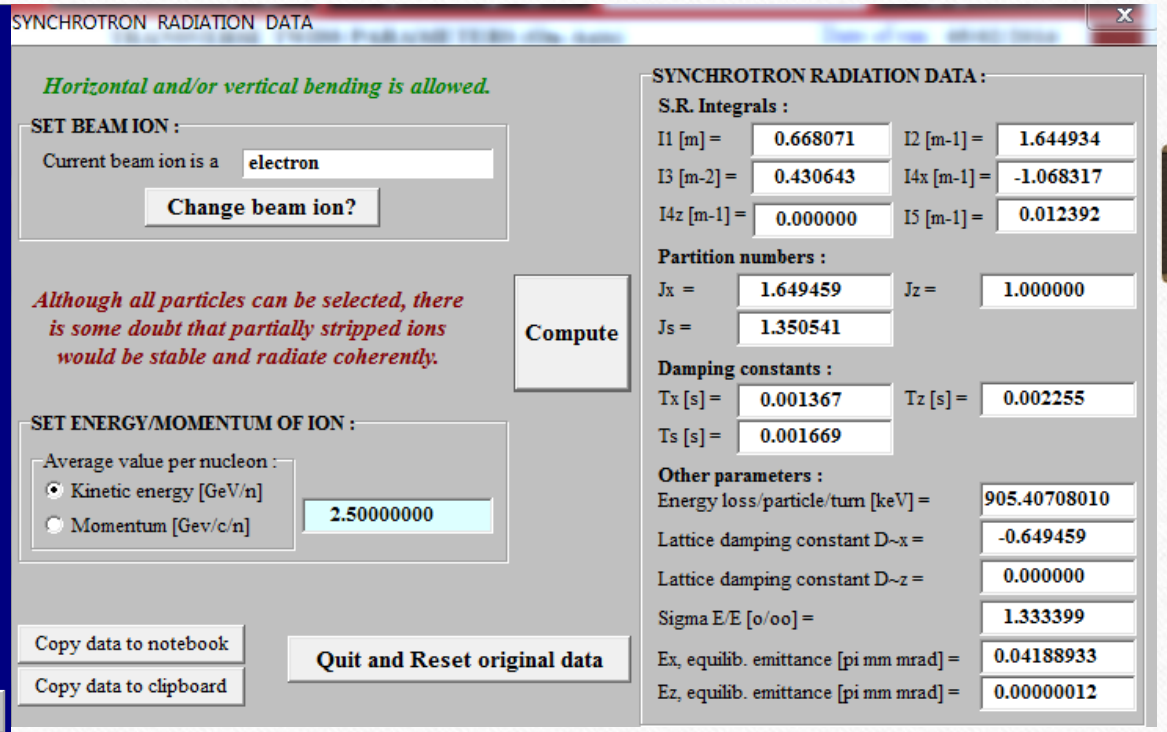
Design
Eleftherios



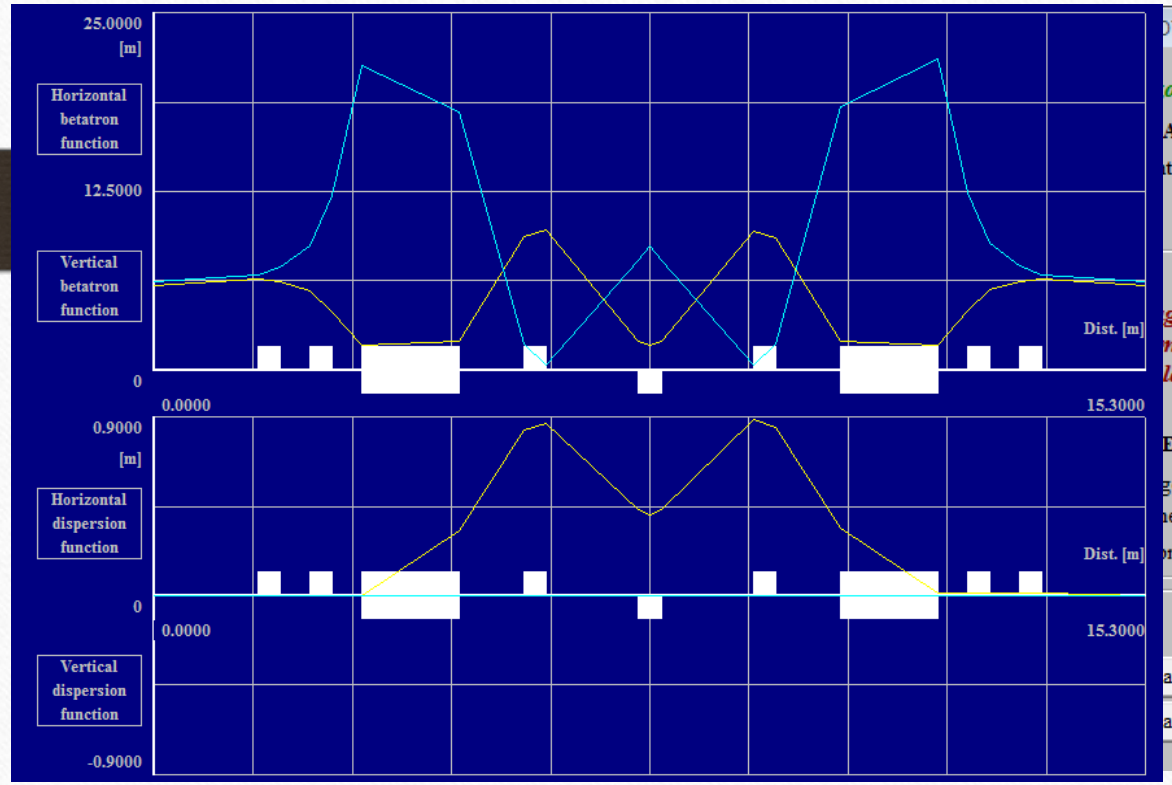


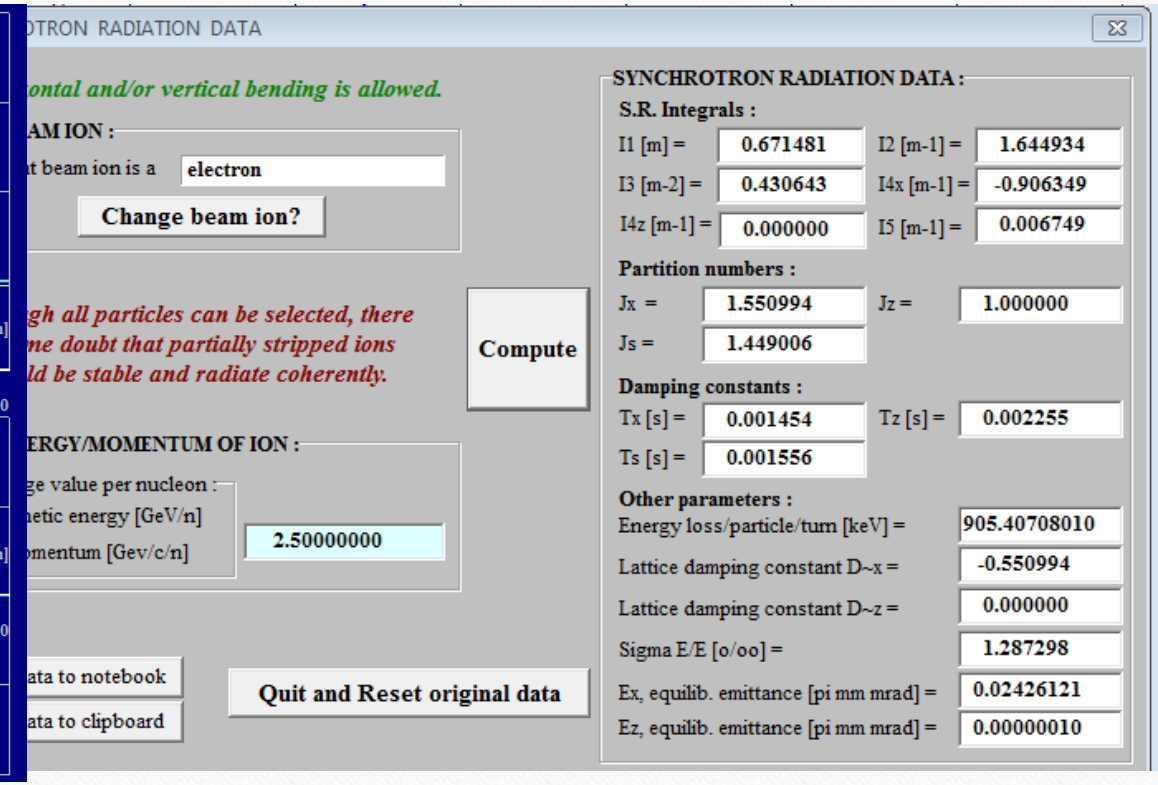
Design
Eleftherios





Design
Eleftherios





NUMERICAL MATCHING

Options File Minimisation Tables Graphs Output Help

Selection:	Status:	Lattice OK with ion	Beam ion: electron	
		Quad fringe-field Off	1.000000 [GeV/n](entry)	On-axis orb
		HJM chromaticity eqn	Non-space charge optics	

Quit

File name : projectRingWorking

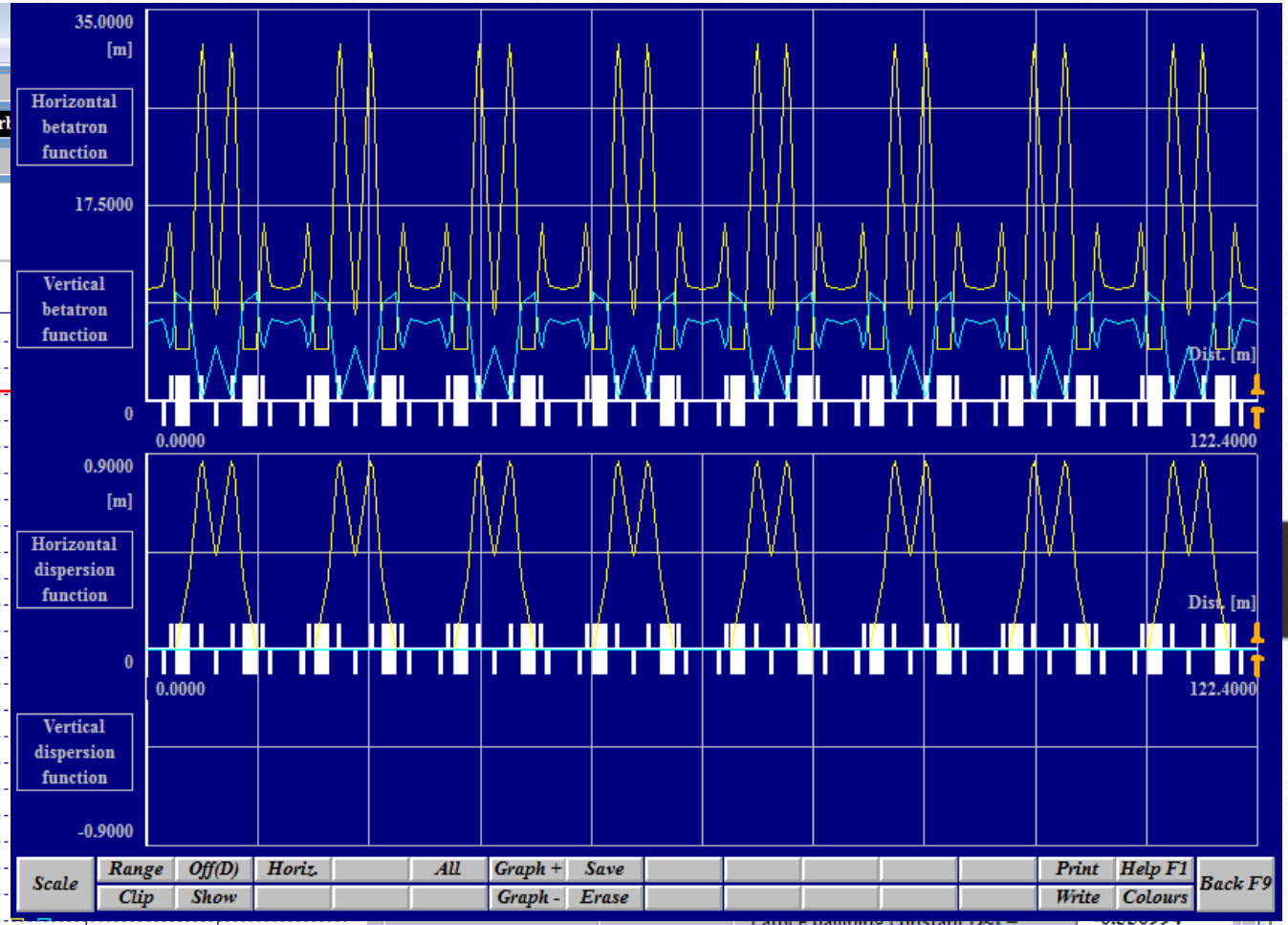
Treated as: transfer line

User title: lightsource

DEFINING BOUNDARY CONDITIONS

Alias		Parameter		Entry point 1	Mid-point 1 11	Mid-point 2 12	Exit point 21
	1	Beta-x [m]	Existing	5.95221634	1.74935234	2.00444984	5.95603227
	2		Wanted	5.95145101	10.00000000	5.95145101	..bx in = bx out.
Grid	3		Weight	N.A.	0.00000000	0.00000000	....No weight....
	4	Alpa-x	Existing	0.00000000	0.00397789	-1.52452719	0.00793246
	5		Wanted	0.00000000	-0.04975858	0.00000000	0.00000000
	6		Weight	N.A.	0.00000000	0.00000000	10.00000000
	7	Beta-z [m]	Existing	6.24135448	8.73735794	7.64461797	6.20352386
	8		Wanted	6.24898240	10.00000000	6.24898240	..bz in = bz out.
	9		Weight	N.A.	1.00000000	1.00000000	....No weight....
	10	Alpa-z	Existing	0.00000000	0.01523279	5.95504874	0.02976218
	11		Wanted	0.00000000	0.00000000	0.00000000	0.00000000
	12		Weight	N.A.	0.00000000	0.00000000	10.00000000
	13	D-x [m]	Existing	0.00000000	0.40681254	0.43461412	0.00141717
	14		Wanted	0.00000000	0.47206529	0.00000000	0.00000000
	15		Weight	N.A.	0.00000000	0.00000000	10.00000000
	16	DD-x	Existing	0.00000000	0.00544653	0.31573286	-0.00590060
	17		Wanted	0.00000000	0.00000001	0.00000000	0.00000000
	18		Weight	N.A.	0.00000000	0.00000000	100.00000000
	19	D-z [m]	Existing	0.00000000	0.00000000	0.00000000	0.00000000
	20		Wanted	0.00000000	0.00000000	0.00000000	0.00000000
	21		Weight	N.A.	0.00000000	0.00000000	0.00000000
	22	DD-z	Existing	0.00000000	0.00000000	0.00000000	0.00000000
	23		Wanted	0.00000000	0.00000000	0.00000000	0.00000000
	24		Weight	N.A.	0.00000000	0.00000000	0.00000000
	25	mu-x [rad]	Existing	0.00000000	3.10126431	3.19691035	6.20254156
Notes	26		Wanted	0.00000000	3.21906905	0.00000000	6.43754647
	27		Weight	N.A.	0.00000000	0.00000000	0.00000000
	28	mu-z [rad]	Existing	0.00000000	3.24189429	3.26284588	6.48409498
	29		Wanted	0.00000000	3.40741296	0.00000000	6.81482592

V 4.0 | 20 | WinAGILE



Lattice damping constant D~x =

Lattice damping constant D~z = 0.000000

Sigma E/E [o/oo] = 1.287298

Quit and Reset original data

Ex, equilib. emittance [pi mm mrad] = 0.02426121

Ez, equilib. emittance [pi mm mrad] = 0.00000010

Design goal/process

- Create achromatic straight sections for the light source
- Use a tunnel of roughly 120m of 2πR -> R=19.1m
- 16 Magnets of $B_{dipole} = 1.4\ T$
- Energy 2.5 GeV
- Power radiated by a beam of current 100mA = 58.57 KW
- Use a DBA for an octant cell
- Wiggler $L = 2\ m$
- Wave length λ = 2 mm
- Energy radiated by a wiggler of 2 m long * number of electrons (13.6 x 10^8)/Turn = 4.96 mW