

ln[1]:= << im_solver.m

Matched Envelope Solution -- IM Method

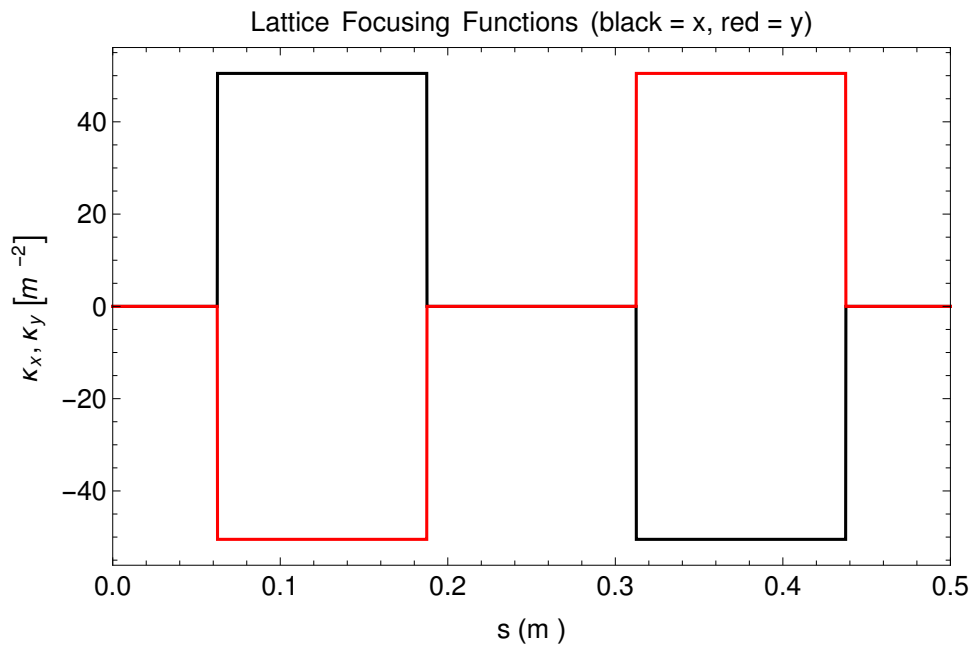
3-5-2015 by lund on localhost

Code Provided by Steve Lund

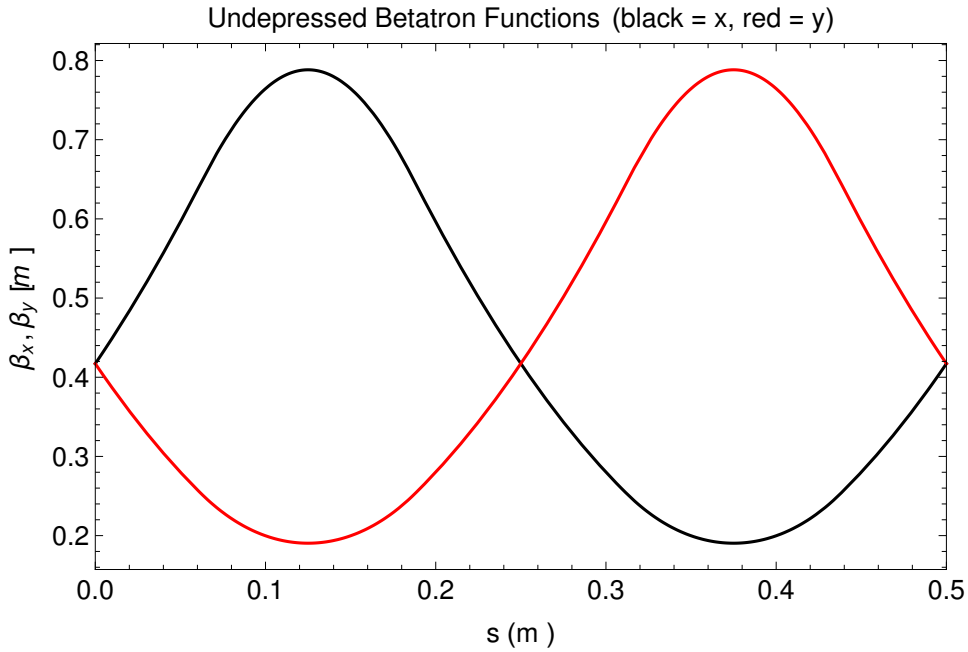
Michigan State University (MSU), Facility for Rare Isotope Beams (FRIB)

Transport Lattice

Lattice Type	Quadrupole
Undepressed Phase Advances [deg/period]	
x-plane, σ_{0x} [deg/period]	80.
y-plane, σ_{0y} [deg/period]	80.
Lattice Period, L_p [m]	0.5
Occupancy, η	0.5
Syncopation Factor, α ($\alpha = 1/2 \Rightarrow$ FODO)	0.5
Max Focusing Strength, $\text{Max}[\kappa_x, \kappa_y]$, [$1/m^2$]	50.492



Undepressed (Lattice) Betatron Function

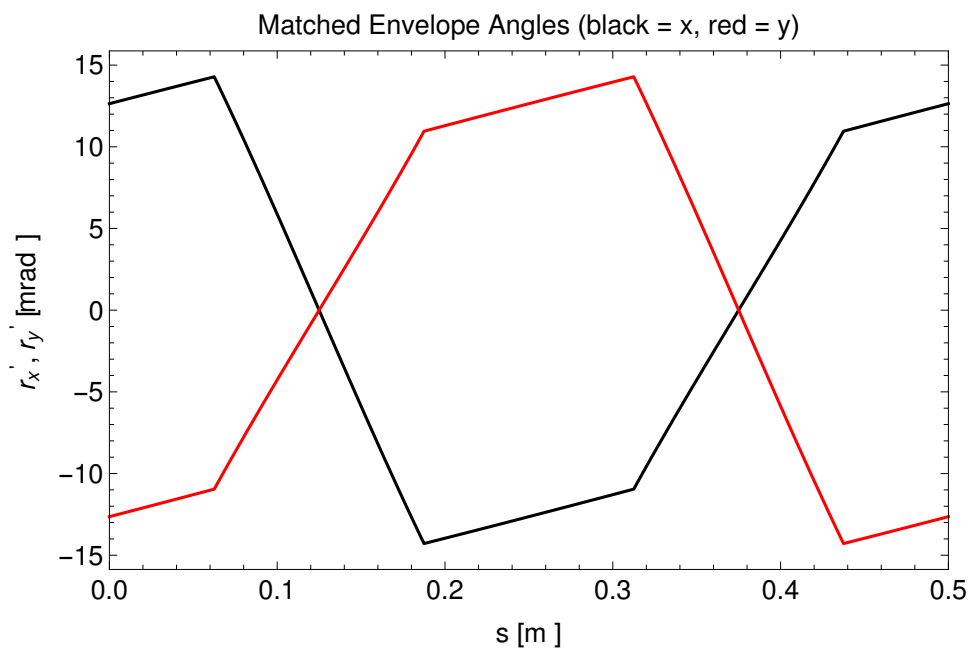
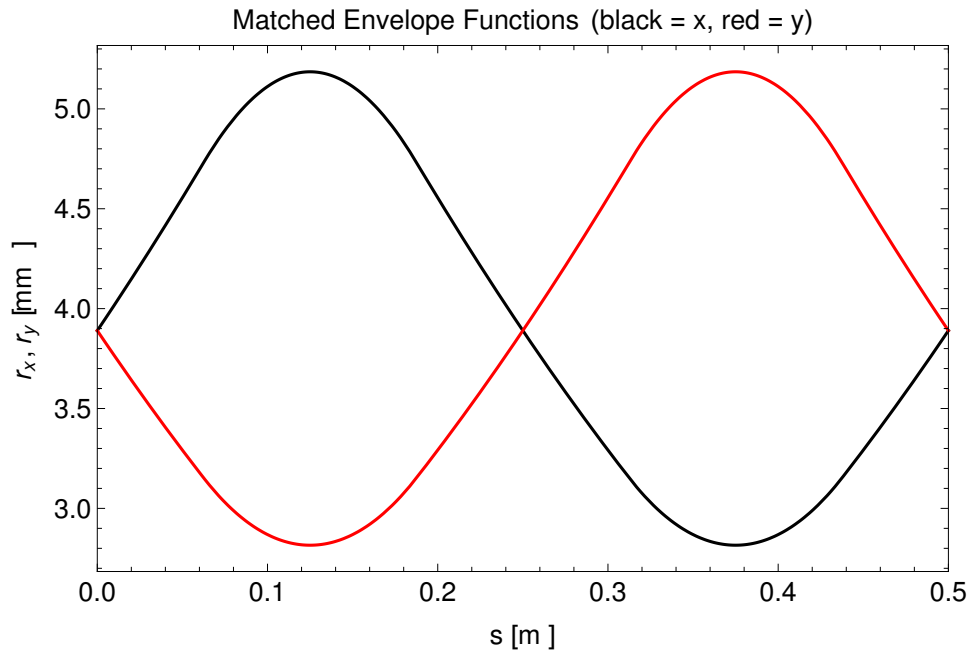


	x-Horizontal	y-Vertical
Max[β_x], Max[β_y] [m]	0.78829	0.78829
s-locations of Maxs [mm]	125.	375.
Min[β_x], Min[β_y] [m]	0.1904	0.1904
s-locations of Mins [mm]	375.	125.

Beam Properties

Dimensionless Perveance, Q	$1. \times 10^{-4}$
RMS Edge Emittances [mm -mrad]:	
ϵ_x	7.6203
ϵ_y	7.6203
Depressed Phase Advances [deg/period]	
x-plane, σ_x [deg/period]	16.
y-plane, σ_y [deg/period]	16.
Tune Depressions:	
σ_x / σ_{0x}	0.2
σ_y / σ_{0y}	0.2

Matched Solution



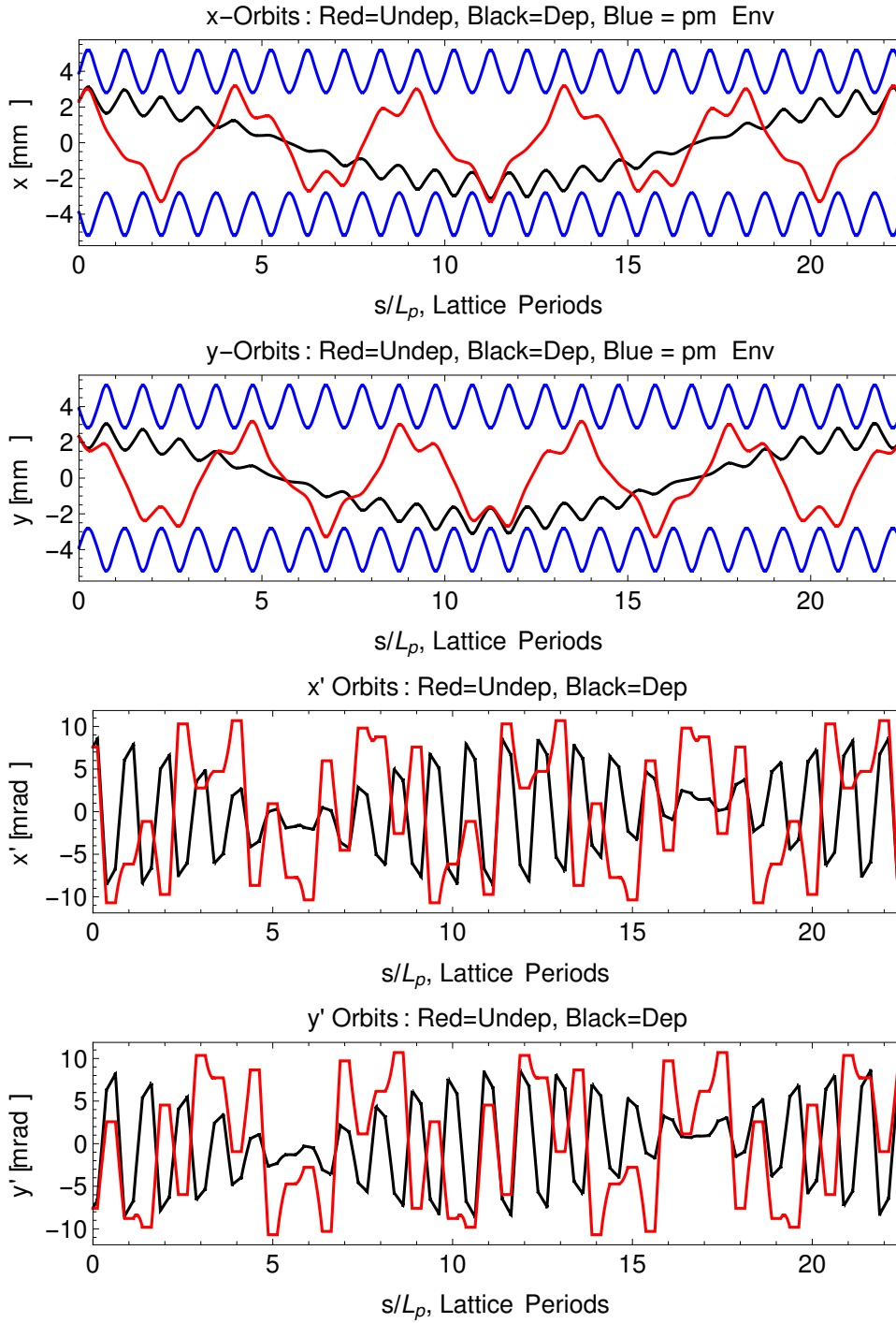
	x-Horizontal	y-Vertical
Radii, $r_x = 2 \langle x^2 \rangle^{1/2}$, $r_y = 2 \langle y^2 \rangle^{1/2}$:		
Avg (Lattice Period), $\overline{r_x}$, $\overline{r_y}$ [mm]	3.9438	3.9438
Max, Max[r_x], Max[r_y] [mm]	5.1856	5.1856
s-locations of Maxs [mm]	125.	375.
Min, Min[r_x], Min[r_y] [mm]	2.8156	2.8156
s-locations of Mins [mm]	375.	125.
Angles, r_x' , r_y' :		
Max, Max[r_x'], Max[r_y'] [mrad]	14.285	14.285
s-locations of Maxs [mm]	62.5	312.5
Min, Min[r_x'], Min[r_y'] [mrad]	-14.285	-14.285
s-locations of Mins [mm]	187.5	437.5
Matching Conditions		
Radii, $r_x[0]$, $r_y[0]$ [mm]	3.89	3.89
Angles, $r_x'[0]$, $r_y'[0]$ [mrad]	12.639	-12.639
Average Radius Measures:		
$\sqrt{\overline{r_x r_y}}$ [mm]	3.8587	
$(\overline{r_x} + \overline{r_y})/2$ [mm]	3.9438	

Matched Solution -- Numerical Parameters

Parameterization Case	1
Specified Fractional Tolerance	$1. \times 10^{-6}$
Achieved Fractional Tolerance	2.0448×10^{-7}
Iterations Needed	6
CPU Time for Solution [sec]	22.9647

Characteristic x- and y-Plane Orbits

Single Particle CS Invariants (includes space-charge):	
ϵ_x [mm -mrad]	2.7433
ϵ_y [mm -mrad]	2.7433
Axial Coordinates:	
Initial s_i [m]	0.
Final s_f [m]	11.25
Initial Conditions Undep and Dep	
x-plane	
$x[s_i]$ [mm]	2.334
$x'[s_i]$ [mrad]	7.5832
y-plane	
$y[s_i]$ [mm]	2.334
$y'[s_i]$ [mrad]	-7.5832
Final Conditions Undepressed	
x-plane	
$x[s_f]$ [mm]	2.3869
$x'[s_f]$ [mrad]	-8.6597
y-plane	
$y[s_f]$ [mm]	2.3869
$y'[s_f]$ [mrad]	8.6597
Final Conditions Depressed	
x-plane	
$x[s_f]$ [mm]	2.3308
$x'[s_f]$ [mrad]	-7.5143
y-plane	
$y[s_f]$ [mm]	2.3307
$y'[s_f]$ [mrad]	7.5139



Envelope Linear Stability

Continuous Limit Mode Phase Advances:
(x-y plane averages)

σ_+ [deg/period] 115.38
 σ_- [deg/period] 84.664

Linear Eigenvalues $\{|\lambda|, \text{Arg}[\lambda]\}$ $\{[1], [\text{deg}]\}$:

λ_1 1. 87.461
 λ_2 1. -87.461
 λ_3 1. 116.28
 λ_4 1. -116.28

Mode Symmetry [Lund and Bukh, PRSTAB (2004)]: Class A

Eigen Modes:

Mode 1:
 σ_1 [deg/period] {272.54, 243.72, 116.28, 87.461}
 γ_1 1
Mode 2:
 σ_2 [deg/period] {272.54, 243.72, 116.28, 87.461}
 γ_2 1

Linear Perturbation Eigenvalues

