Dynamic multipoles for the X-type undulator

Erik Wallén
ejwallen@lbl.gov

Tue 18 Feb 2020

Contents

Parameters of X-type

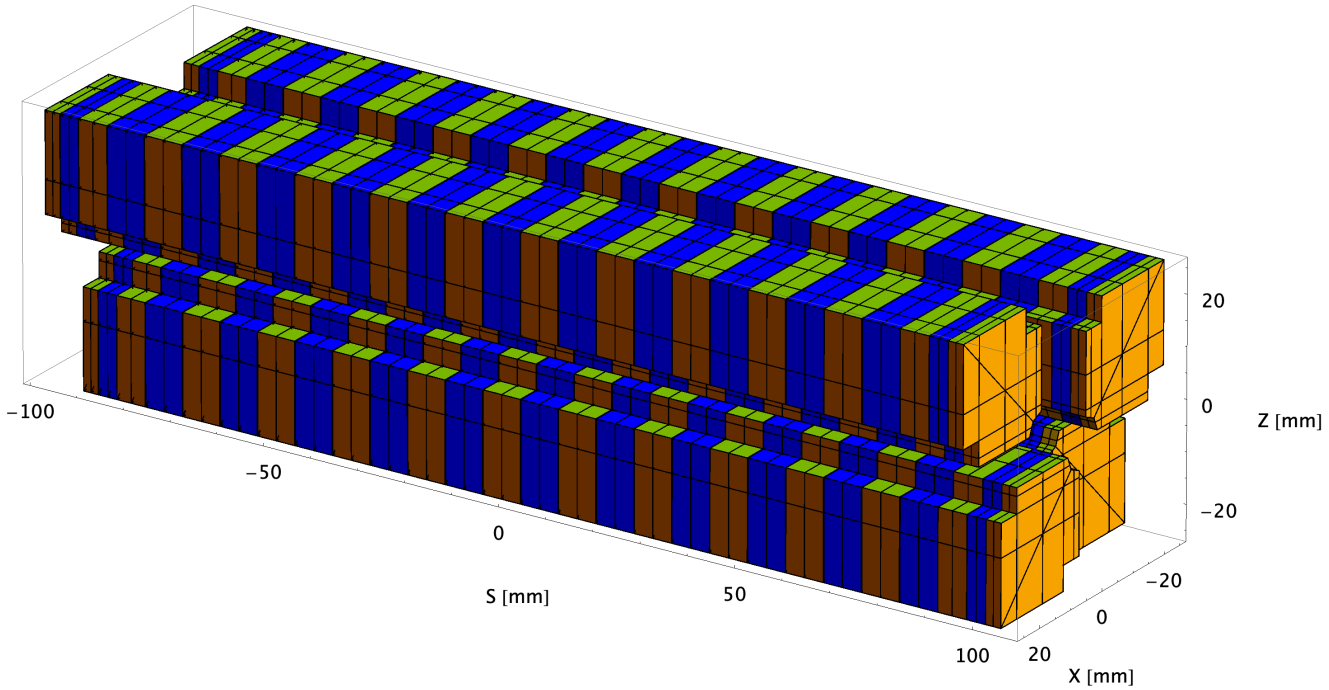
Main parameters		
Period Length	32	mm
Gap	9.5	mm
Length	3971	mm
Number of full poles	247	
Beam Energy	2.0	GeV

Geometry		
Width of magnets	25	mm
Height of magnets	25	mm
Thickness of magnets	7.9	mm
Coating thickness	0.01	mm
Gap between rows	2.0	mm

Magnet Material		
Type	Horizontal	Vertical
Make	VACODYM 776 TP	VACODYM 764 TP
Remanence typical	1.32 T	1.37 T
Remanence minimum	1.28 T	1.33 T
$\chi_{\parallel}$ Susceptibility	0.06	0.06
$\chi_{\perp}$ Susceptibility	0.17	0.17
H_{cJ} Intrinsic Coercivity	21 kOe	16 kOe

Model of the undulator

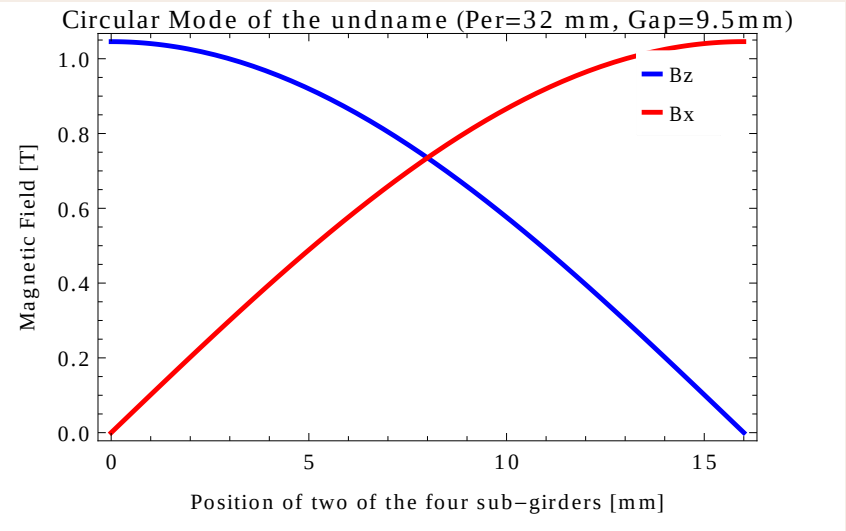
Radia [O. Chubar, P. Elleaume and J. Chavanne, "A 3D Magnetostatics Computer Code for Insertion devices". Journal of Synchrotron Radiation, 5:481-484, 1998.] has been used for the calculations. The model of the undulator, using the minimum remanence, is 194.5 mm long and contains 11 full size poles and the end sections.



The dynamic multiples are calculated by the method described in [P. Elleaume, "A New Approach to the Electron Beam Dynamics in Undulators and Wigglers", Proc. of European Particle Accelerator Conference 1992, EPAC 1992, Berlin, Germany, pp 661-663.].

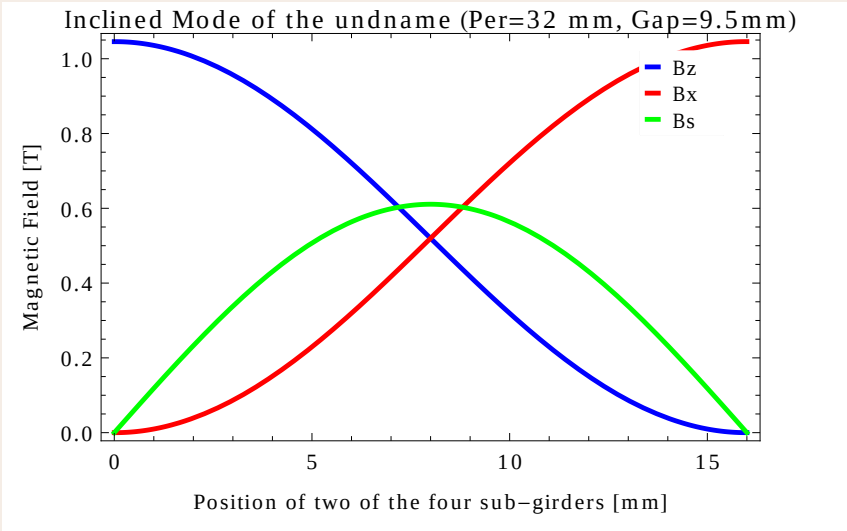
Modes of operation of the X-type undulator (Period = 32 mm, ∅ = 9.5 mm)

Helical mode



Circular polarization in the helical mode:
Symmetric phase = 8 mm

Inclined mode



45° polarization in the inclined mode:
Asymmetric phase = 8 mm

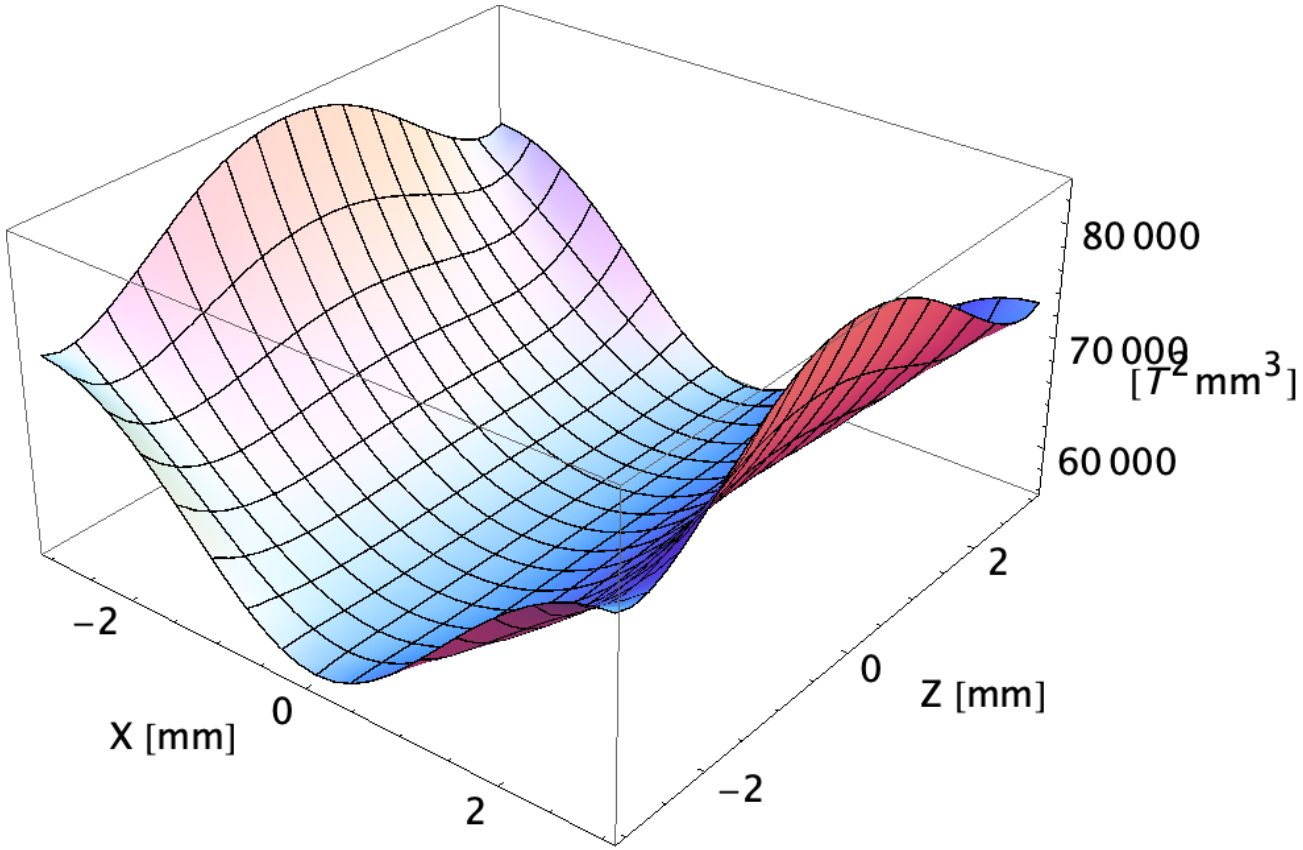
Planar mode, horizontal polarization: phase = 0 mm
Vertical mode, vertical polarization: phase = 16 mm

Effective fields, K-values, fundamental photon energies, and radiated power

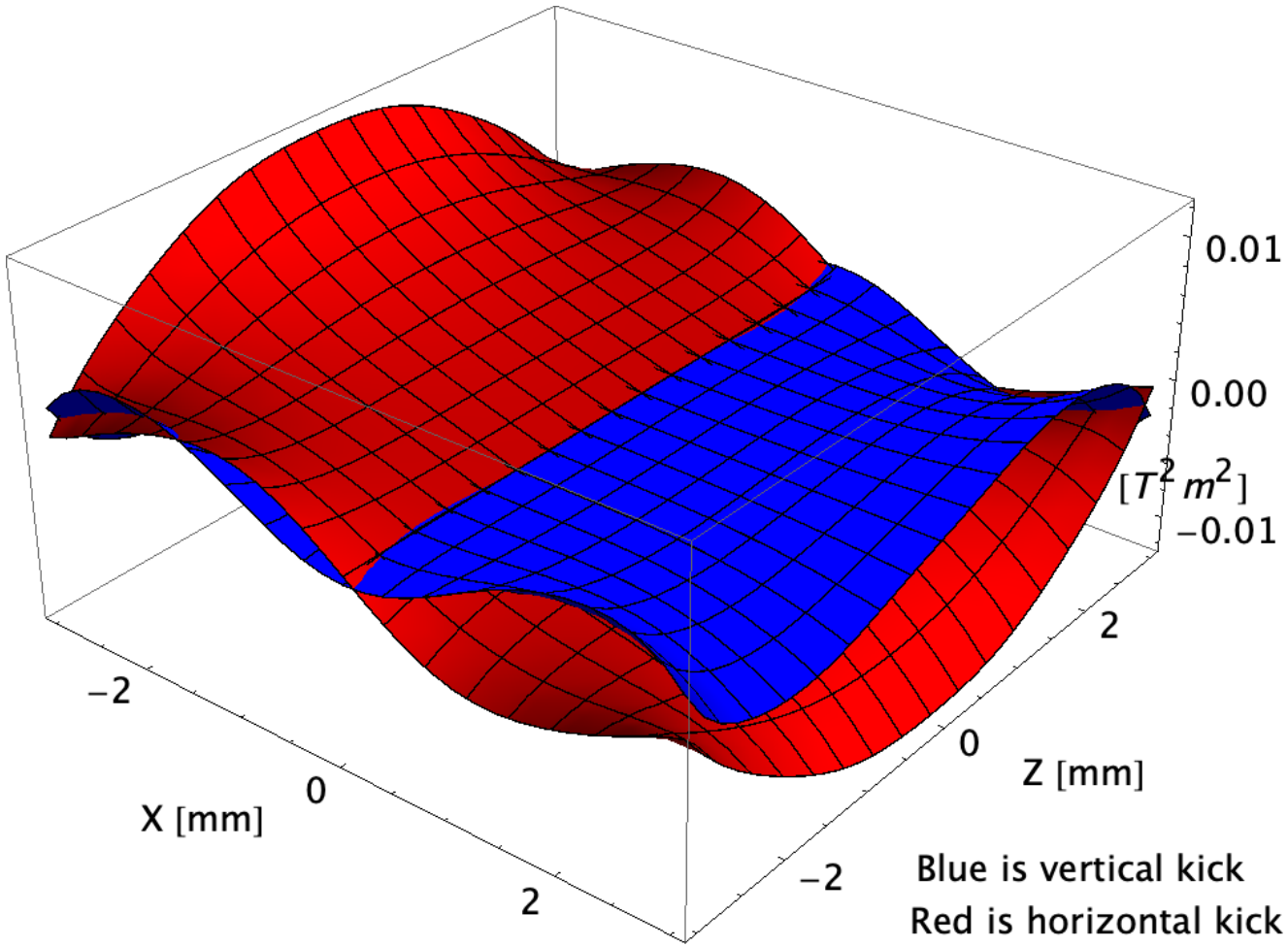
Mode	Phase [mm]	Effective vertical field [T]	Effective horizontal field [T]	K-value	Photon energy [eV]	Radiated power [kW]
Planar	0	1.046	0	3.13	201.8	5.49
Circular	8	0.735	0.735	3.11	203.8	5.43
Vertical	16	0	1.046	3.13	201.8	5.49
45° Incl	8	0.520	0.520	2.20	347.9	2.71

The upper limit for the photon energy range for the fundamental harmonic is 1099.5 eV assuming a minimum K-value of 0.4.
The beam energy is 2. GeV and the beam current is 0.5 A.

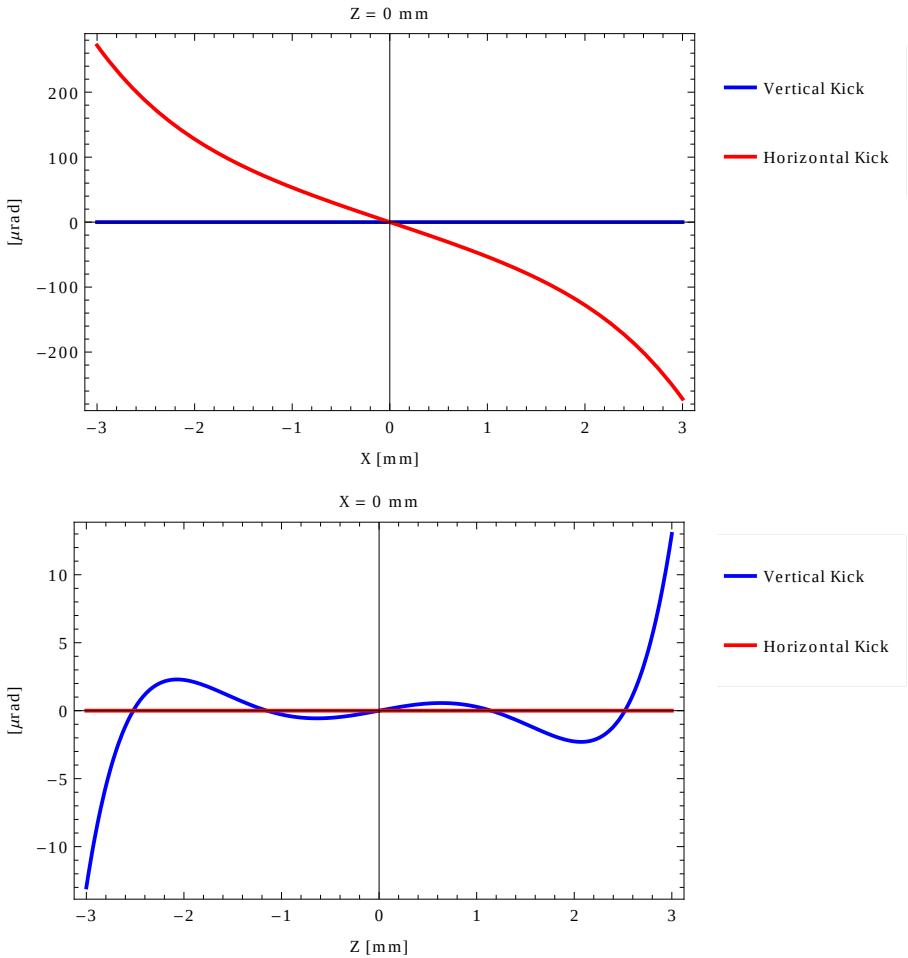
Focusing potential in the HP mode

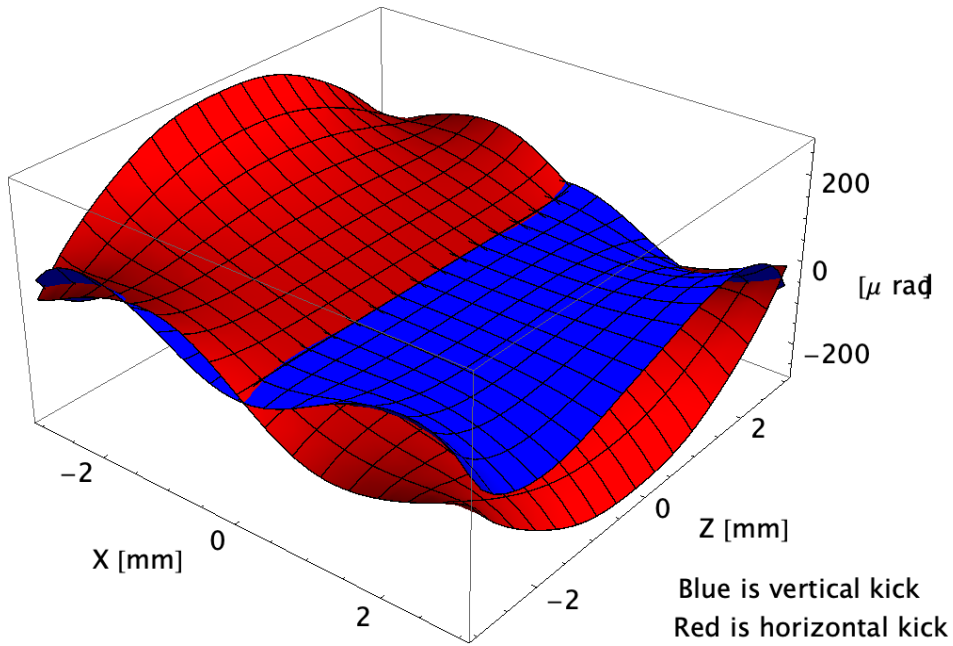


Kick map for the HP mode used for tracking [T^2m^2]

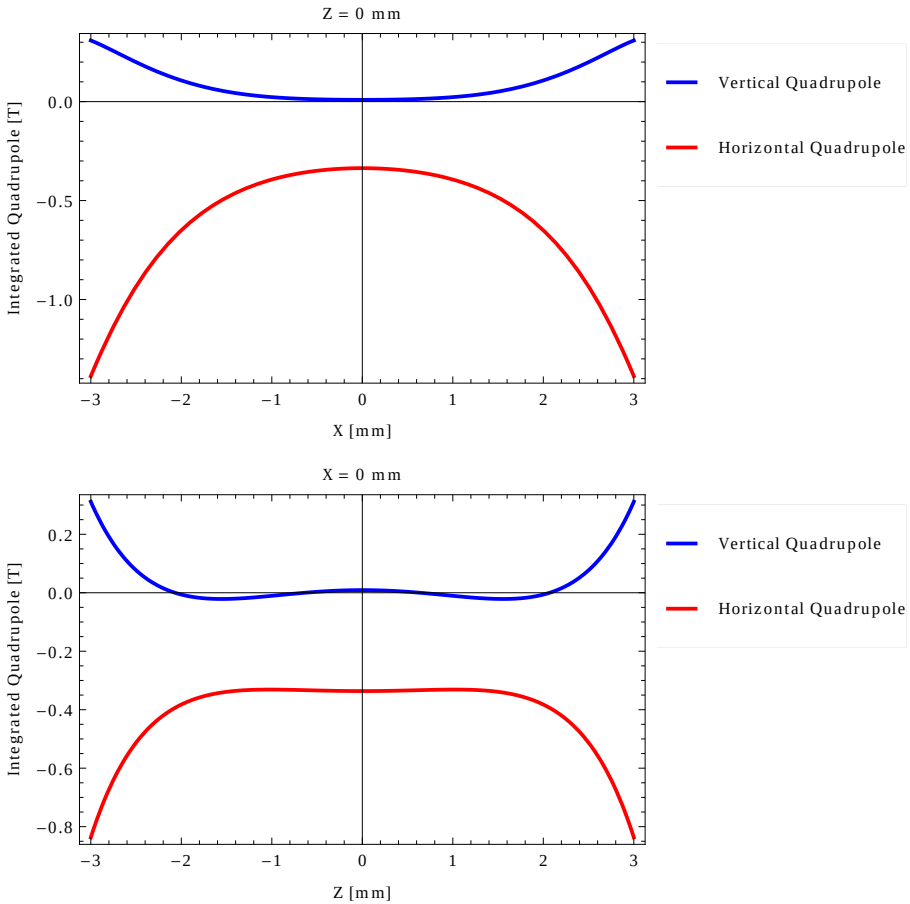


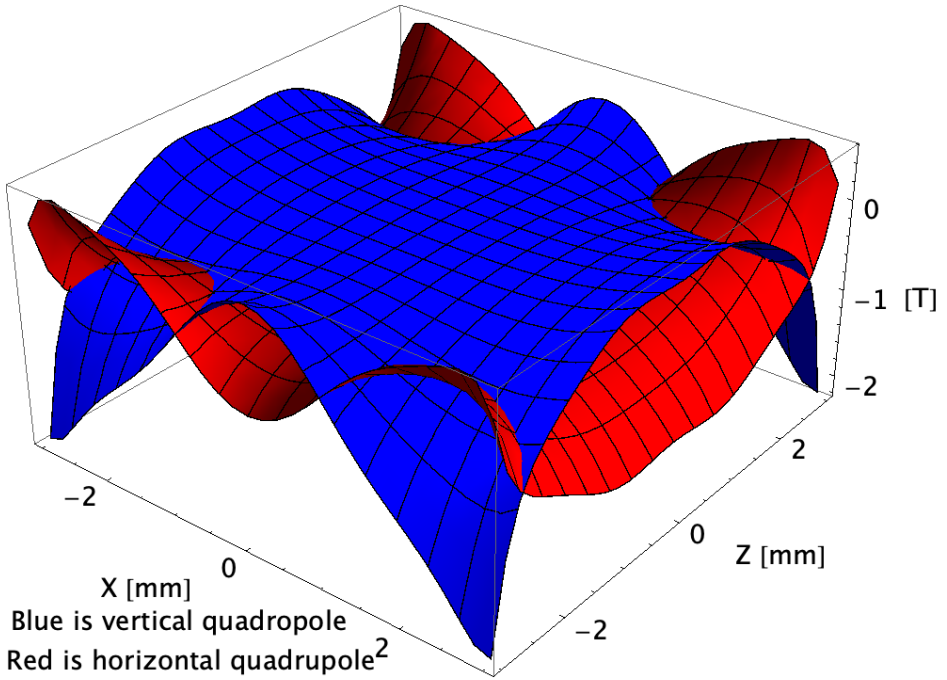
Kick map in the HP mode [μrad]



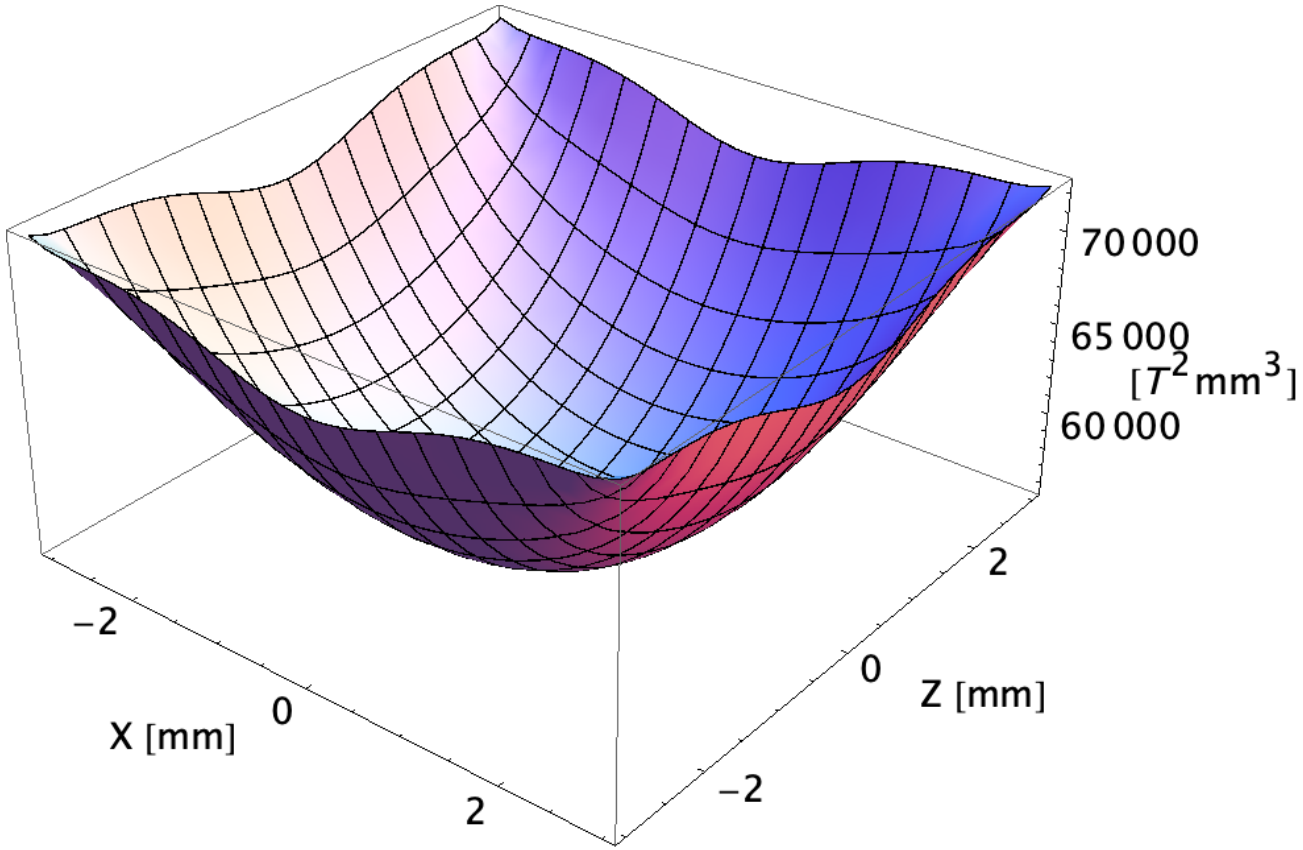


Integrated quadrupole strength map in the HP mode [T]

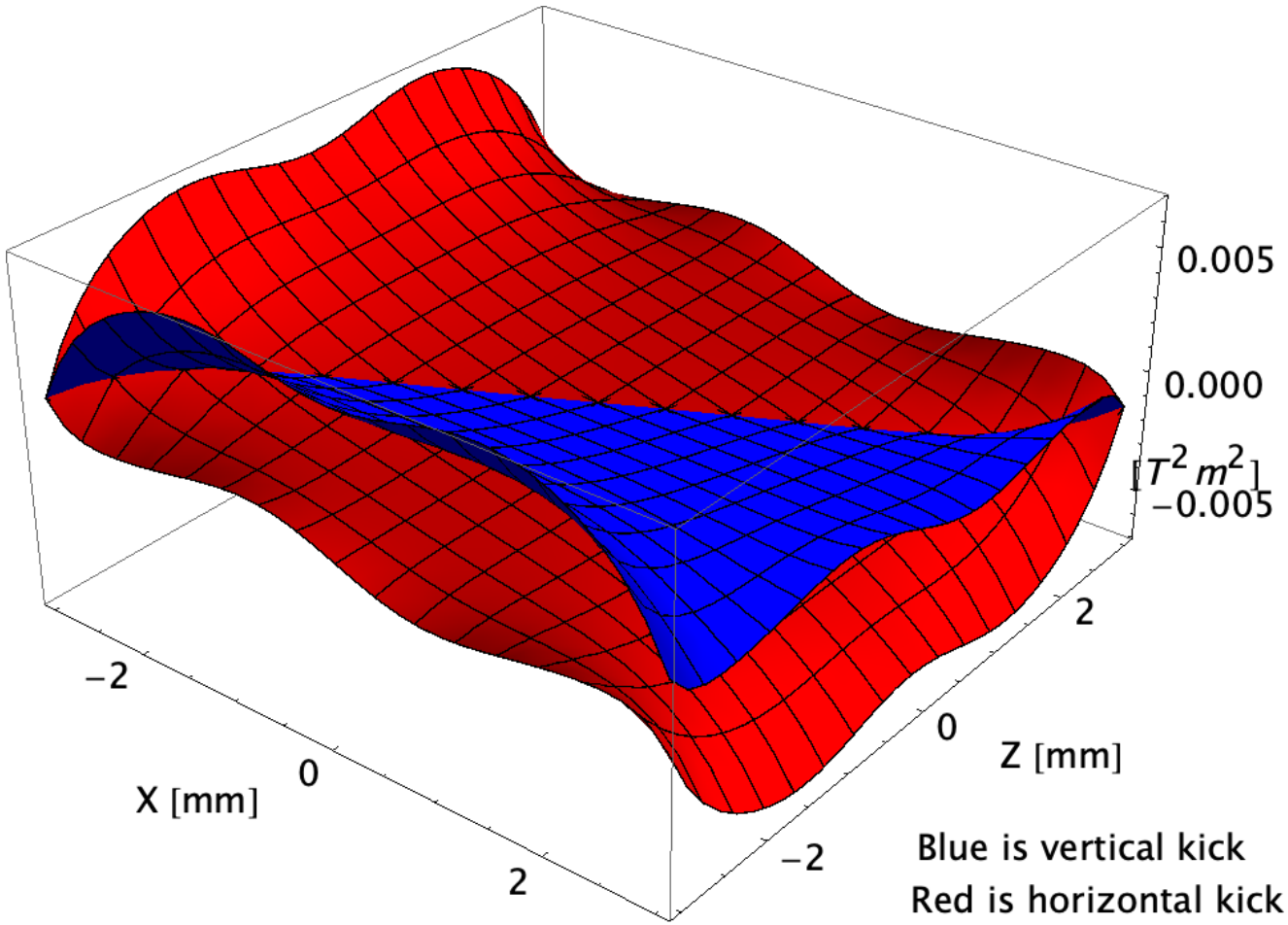




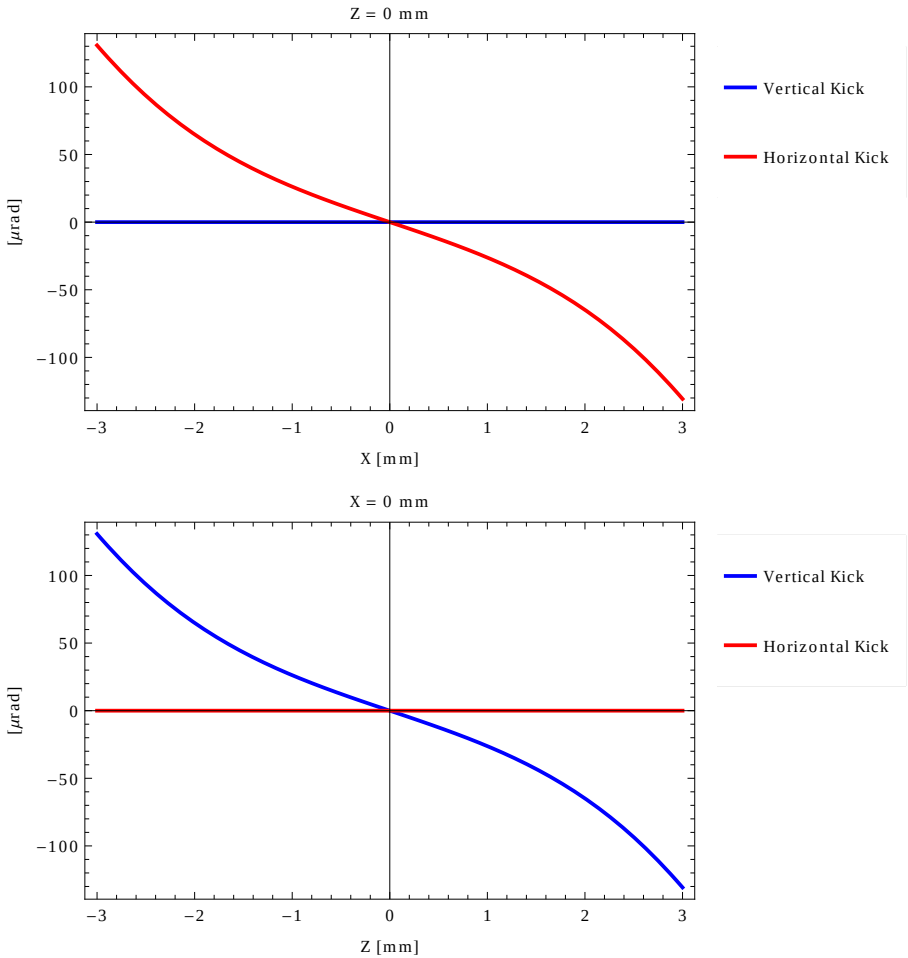
Focusing potential in the CP mode

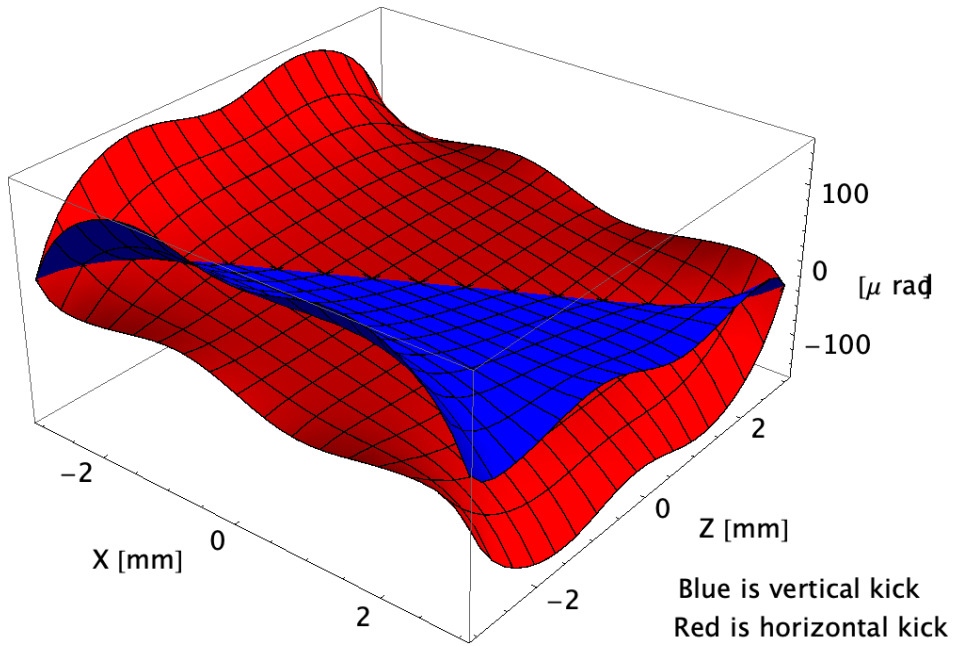


Kick map for the CP mode used for tracking [T^2m^2]

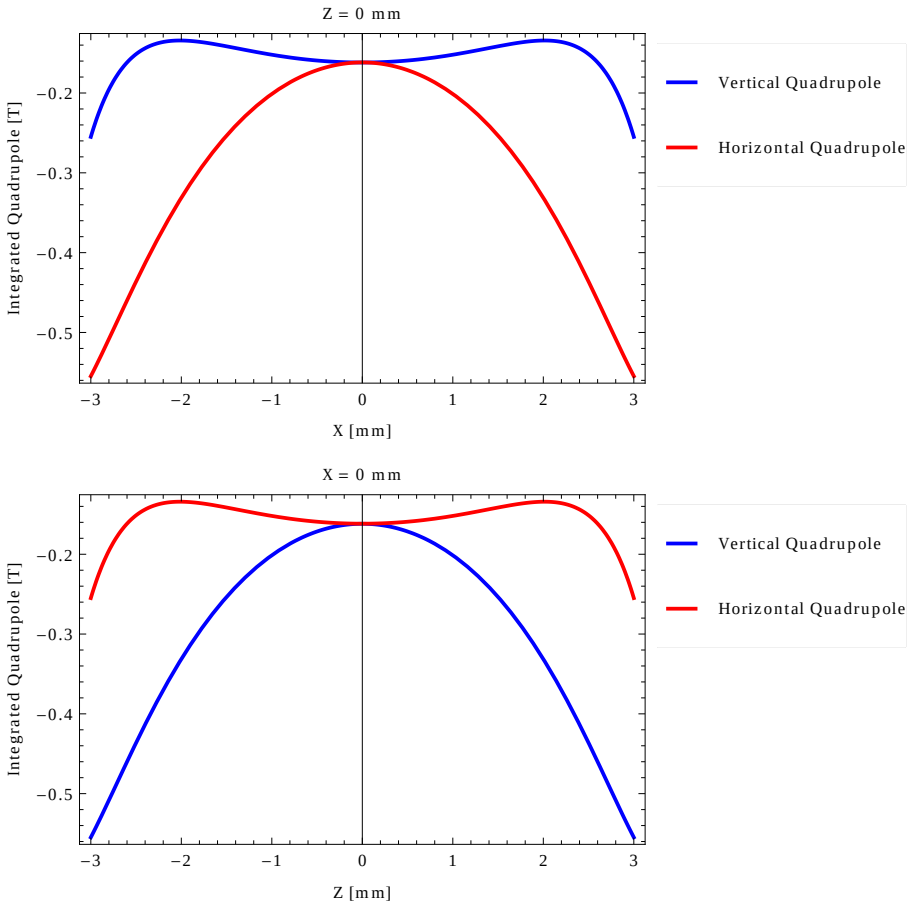


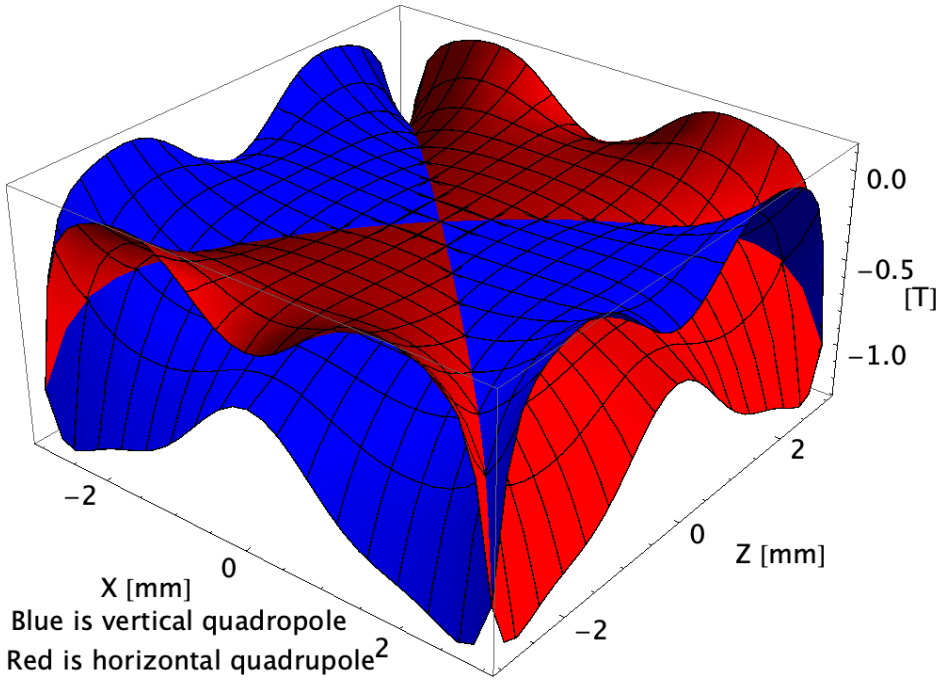
Kick map in the CP mode [μrad]



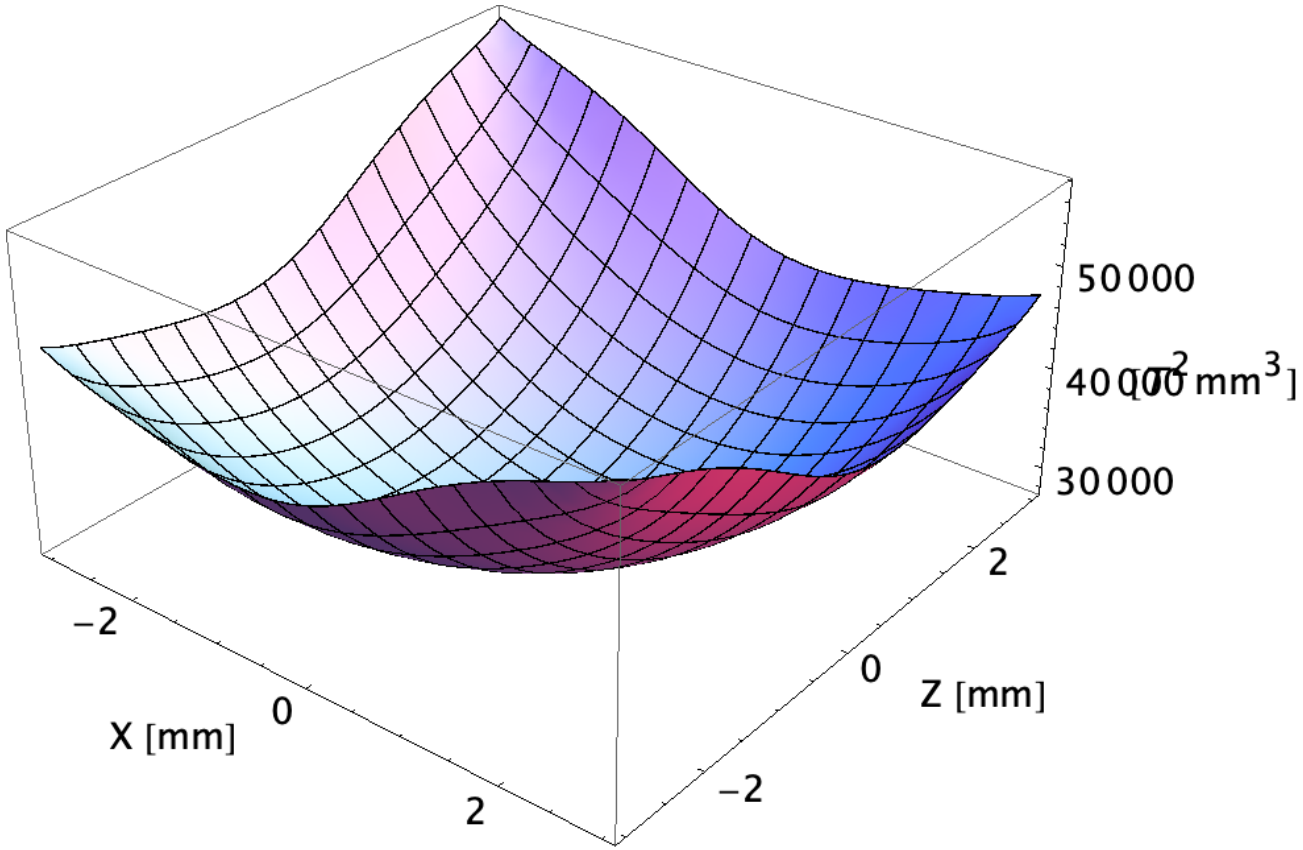


Integrated quadrupole strength map in the CP mode [T]

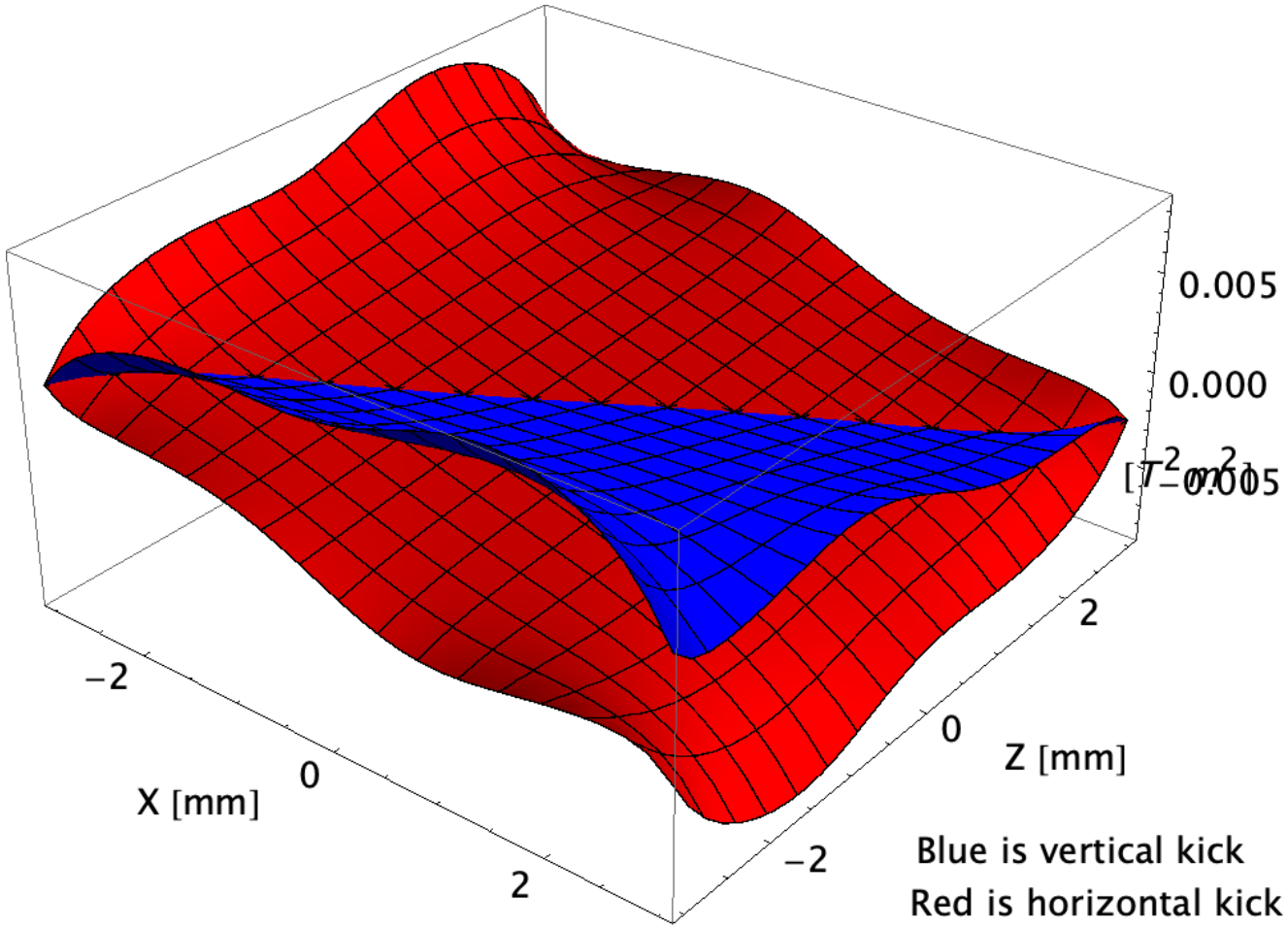




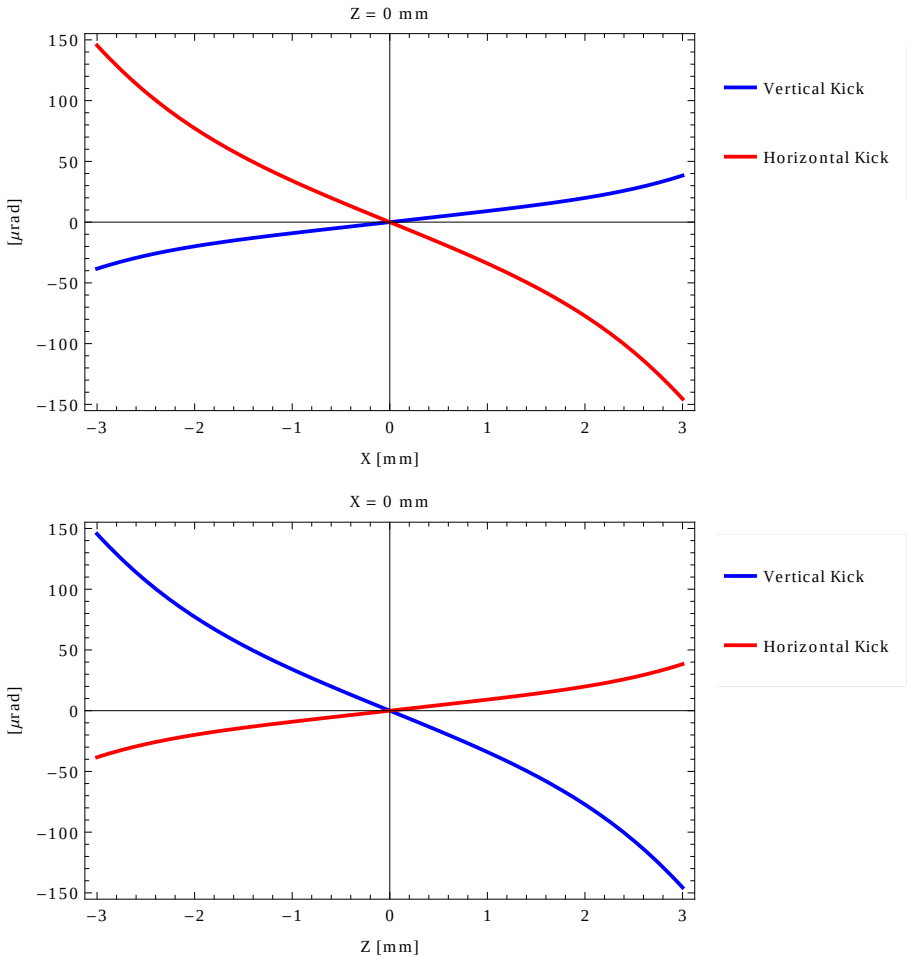
Focusing potential in the IP mode

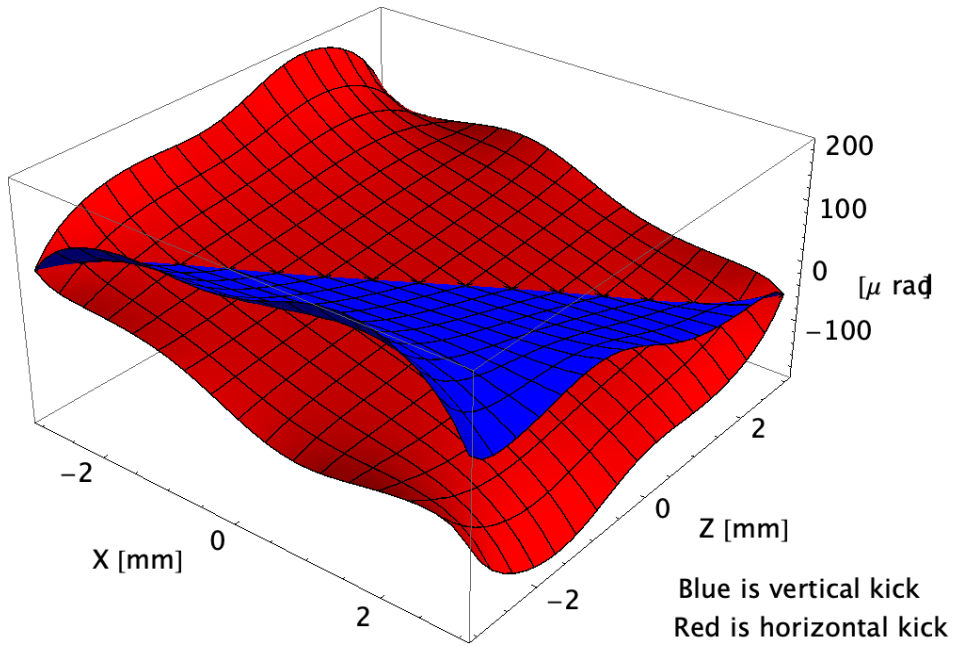


Kick map for the IP mode used for tracking [T^{2}m^2]

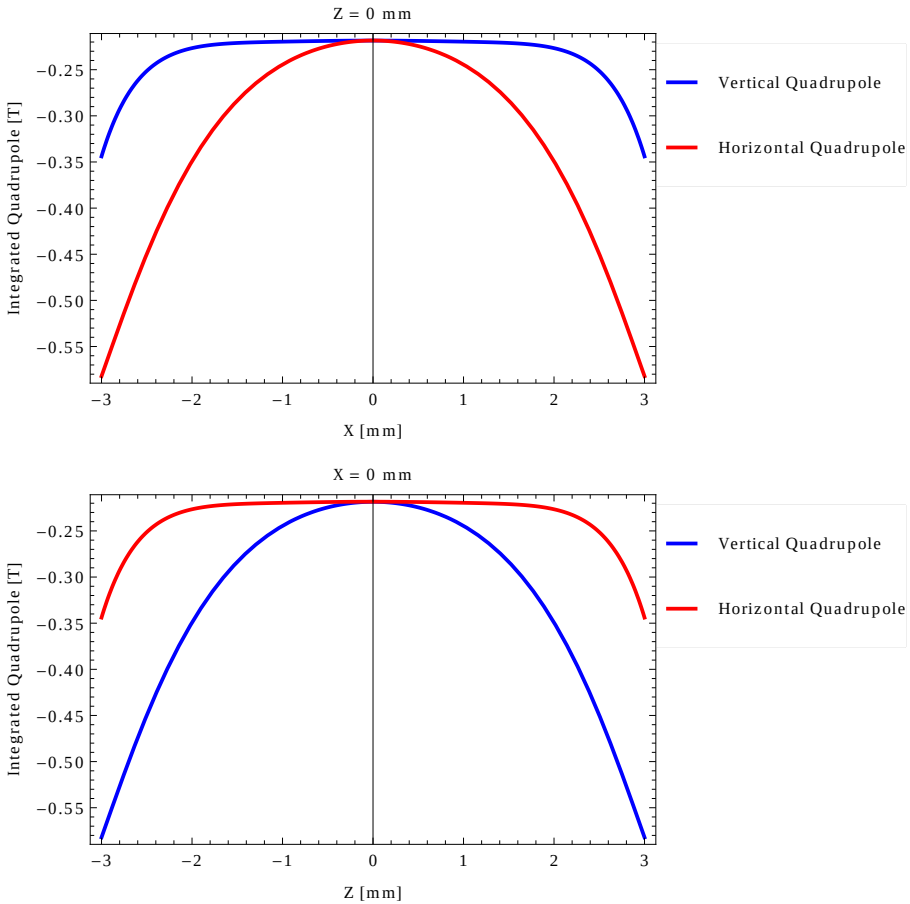


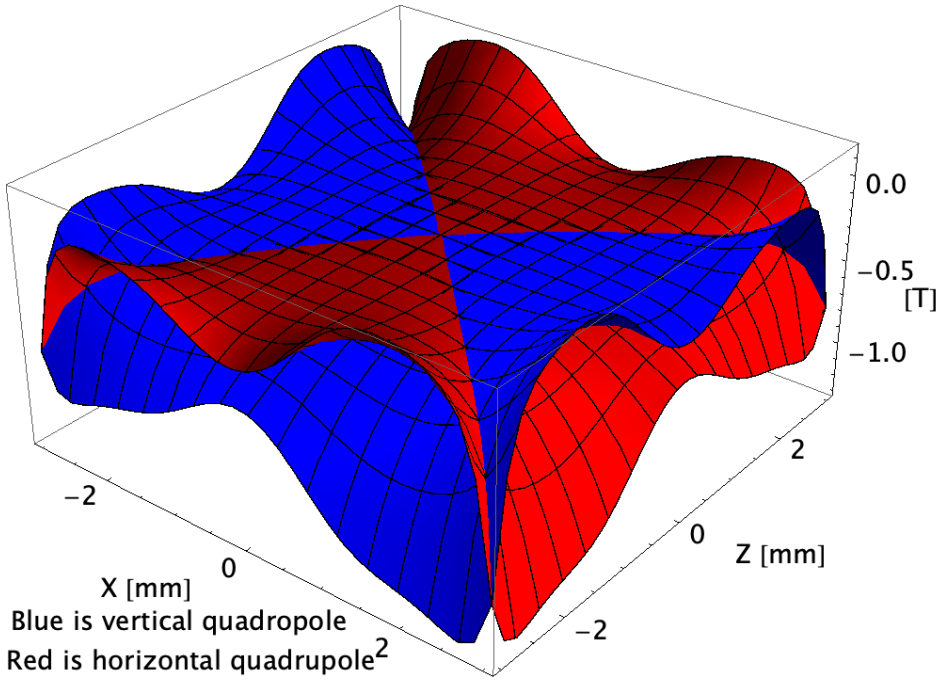
Kick map in the IP mode [μrad]



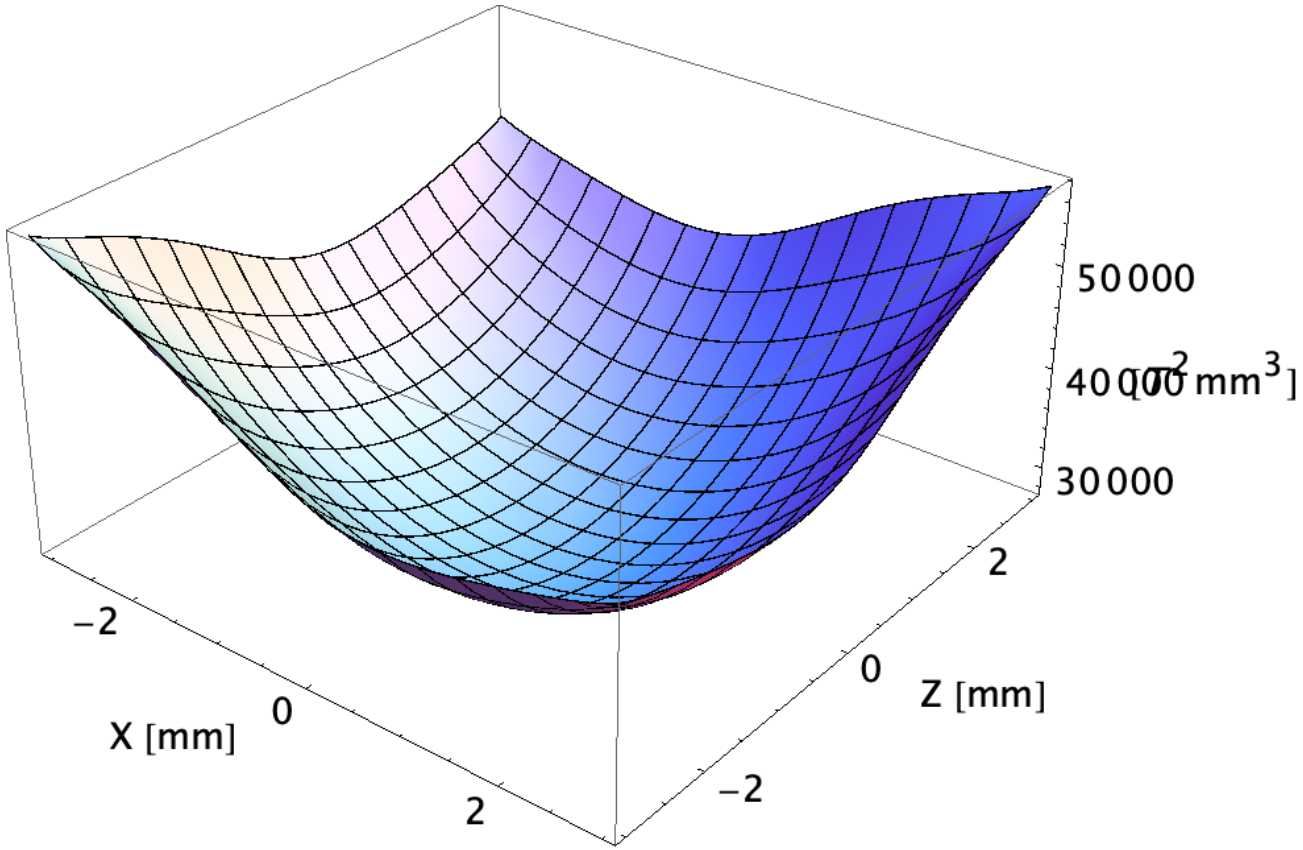


Integrated quadrupole strength map in the IP mode [T]

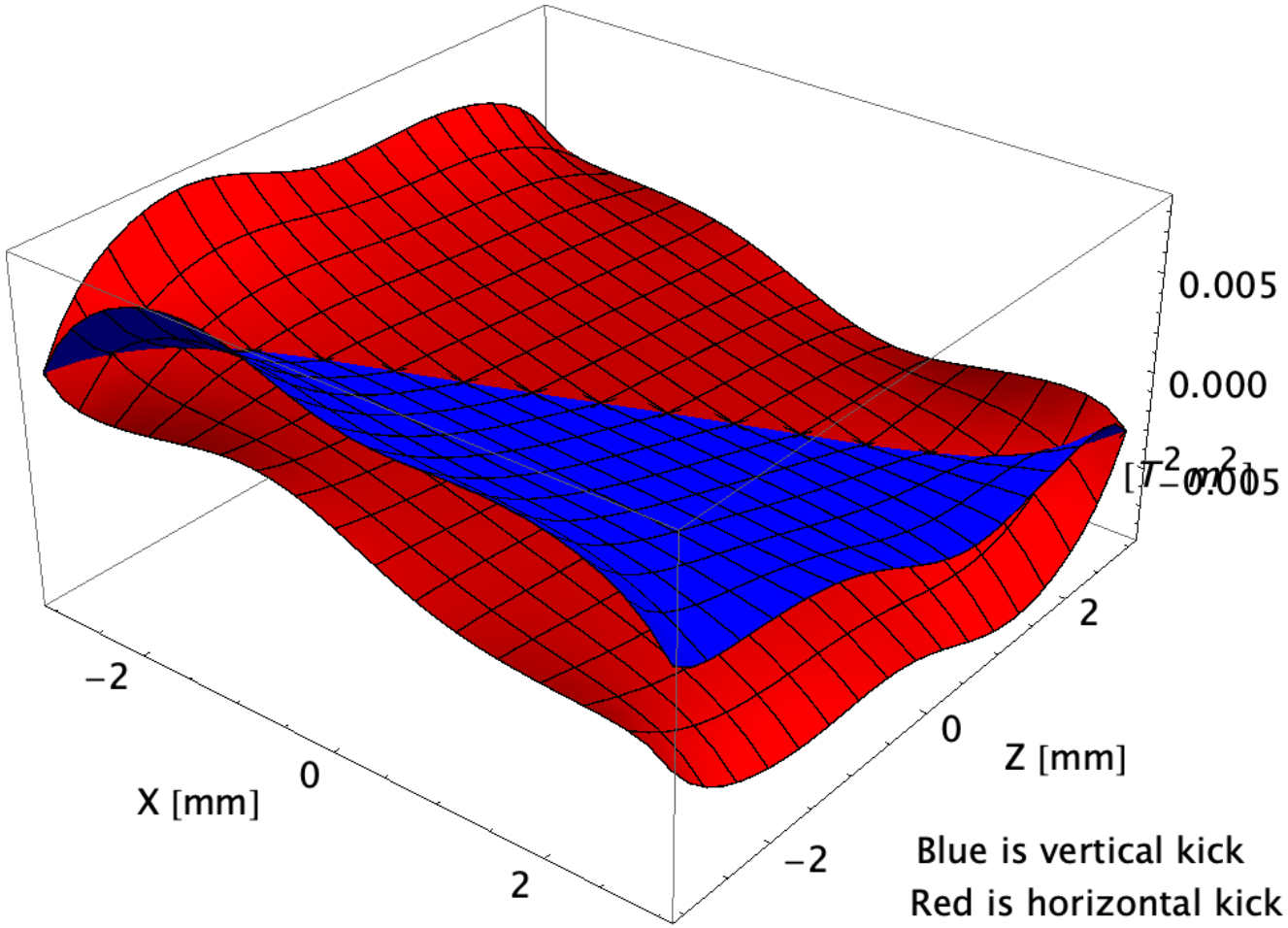




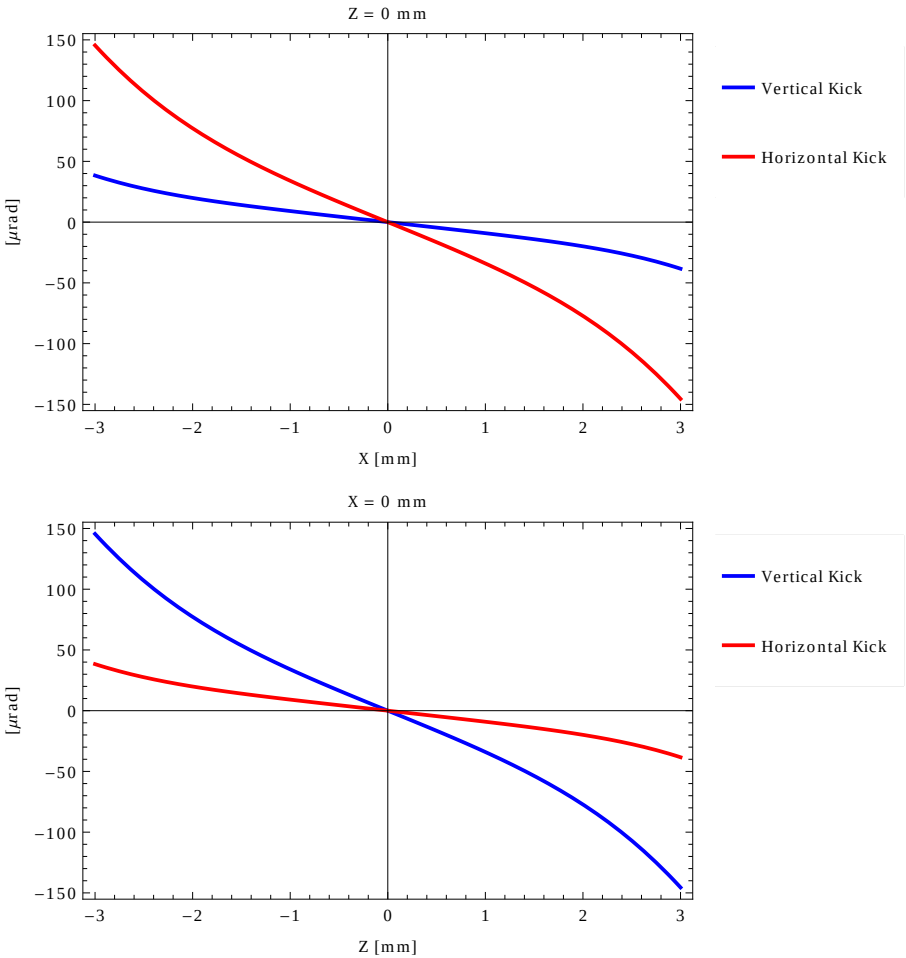
Focusing potential in the IPN mode

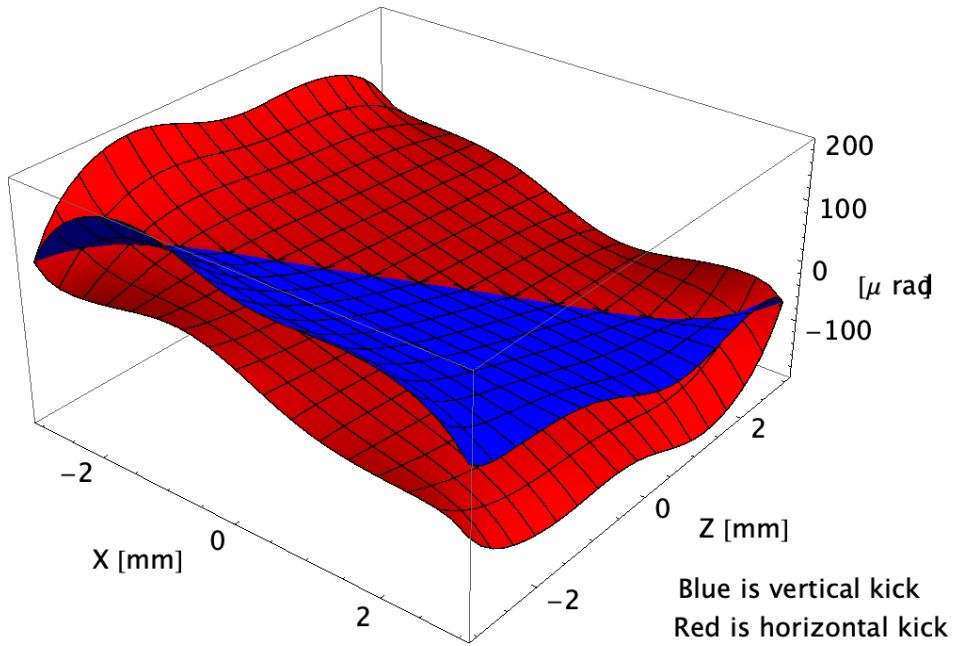


Kick map for the IPN mode used for tracking [T^2m^2]

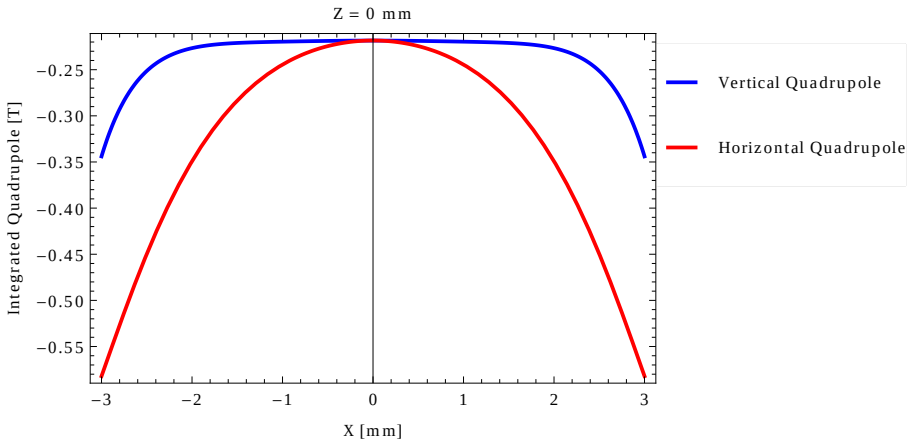


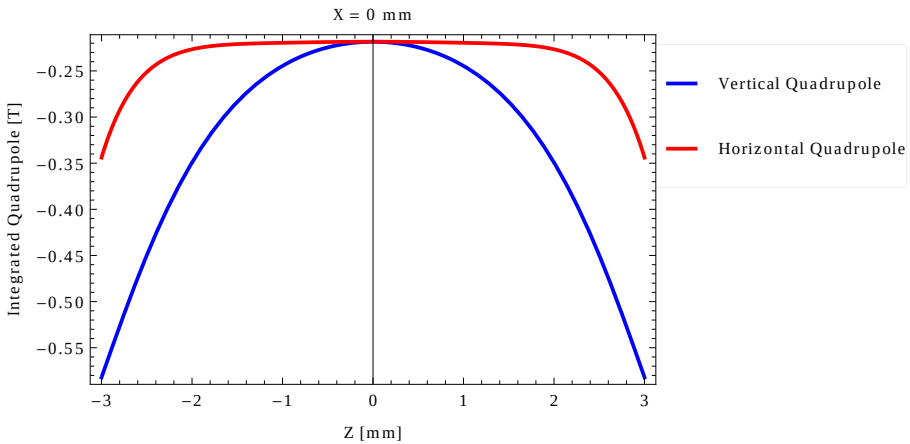
Kick map in the IPN mode [μrad]

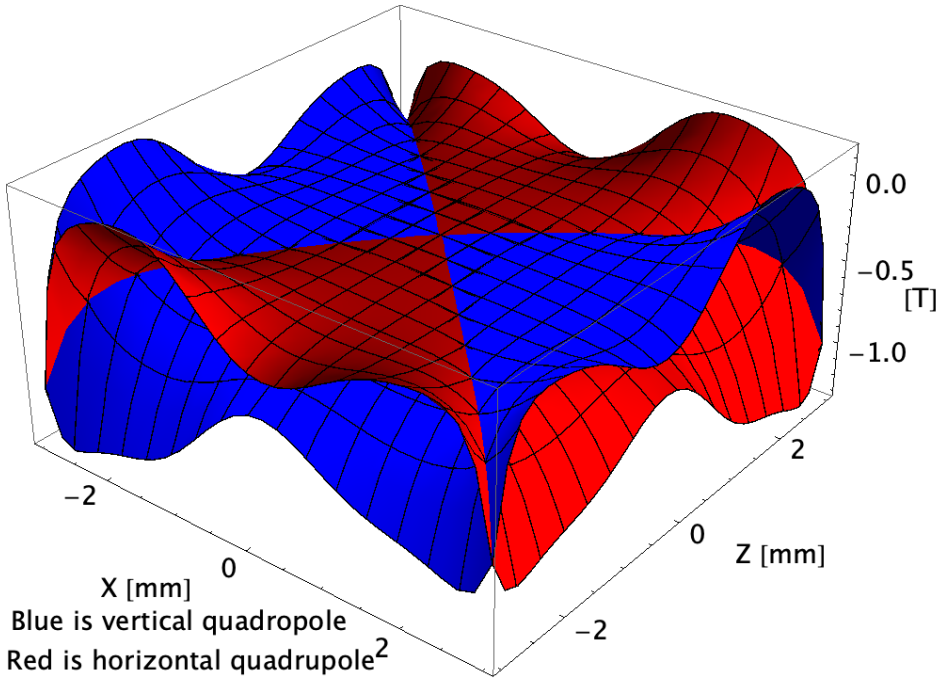




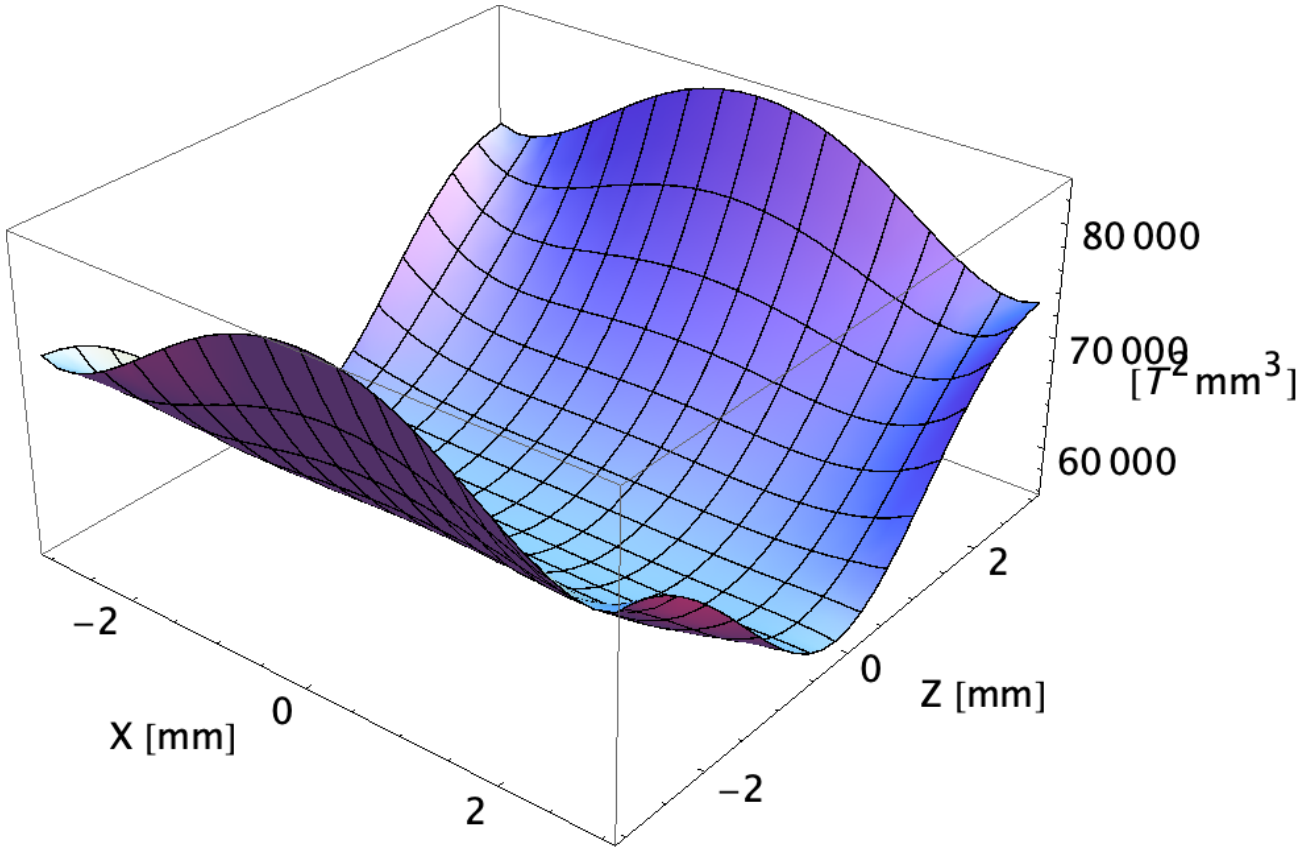
Integrated quadrupole strength map in the IPN mode [T]



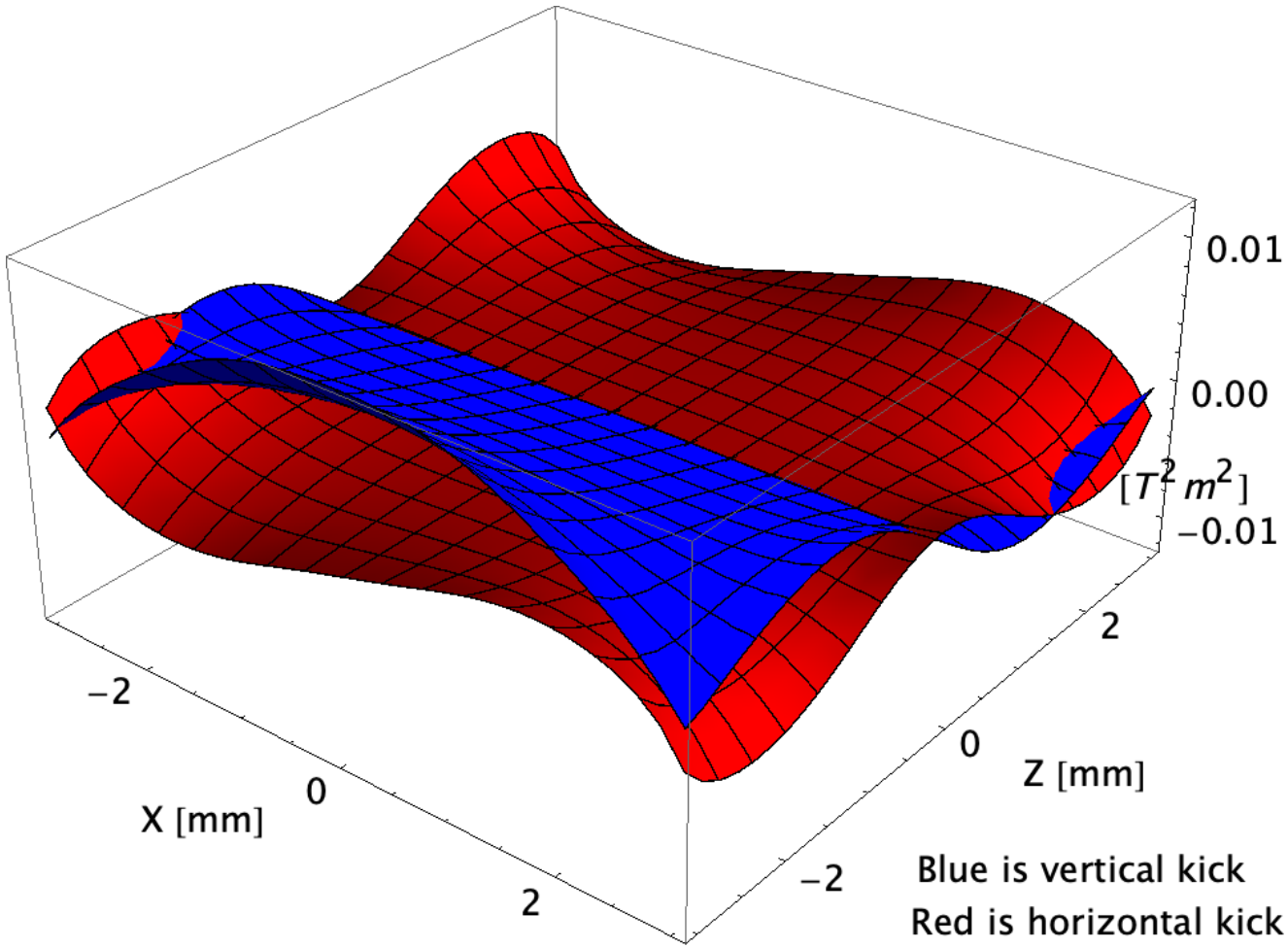




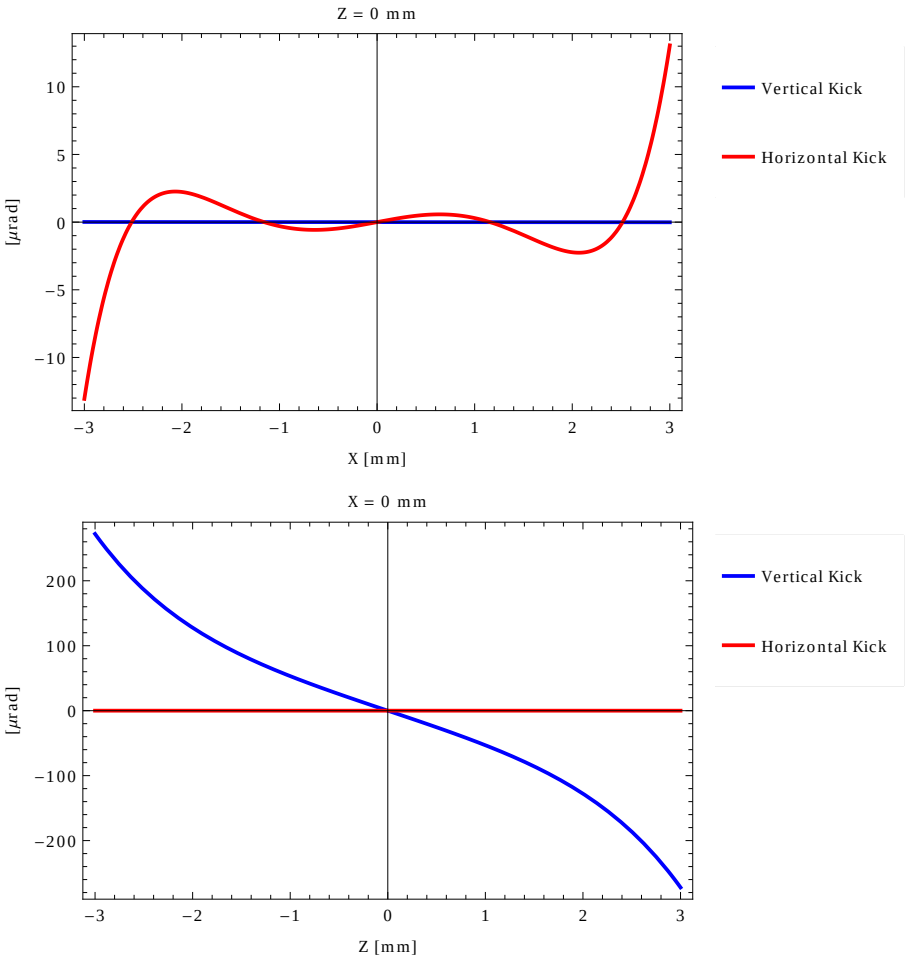
Focusing potential in the VP mode

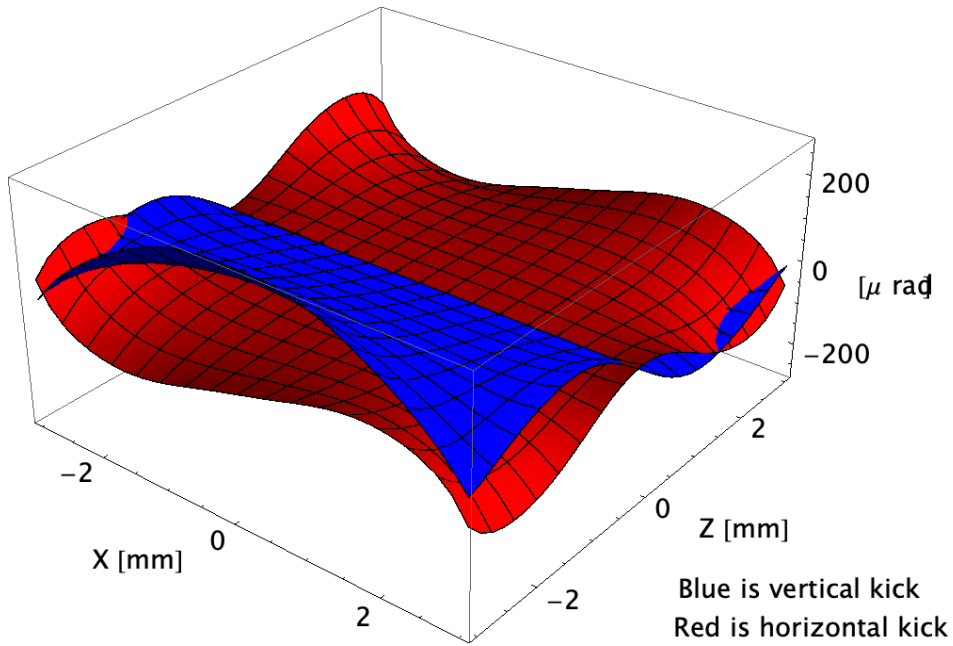


Kick map for the VP mode used for tracking [T^2m^2]

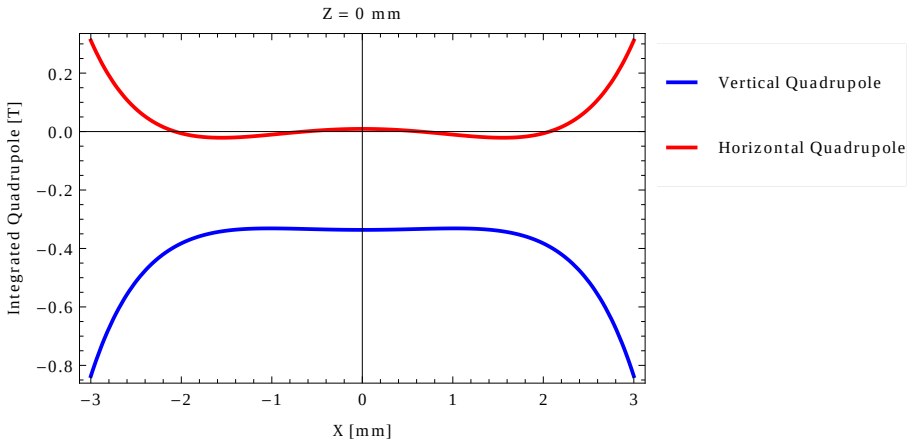


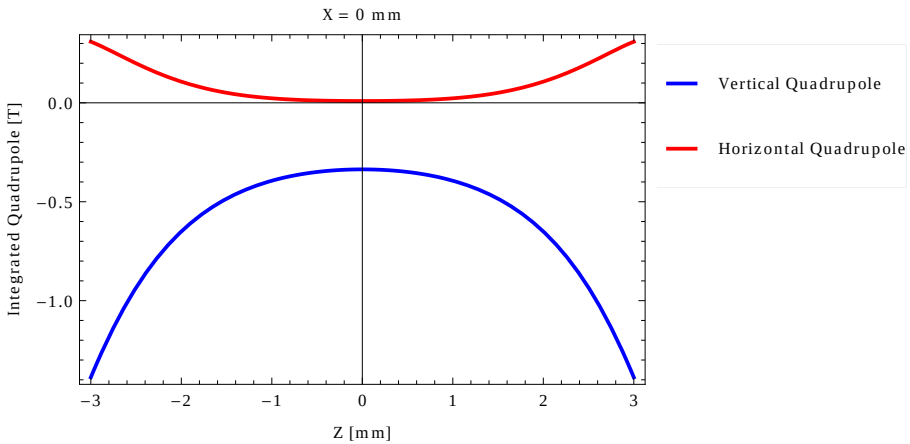
Kick map in the VP mode [μrad]

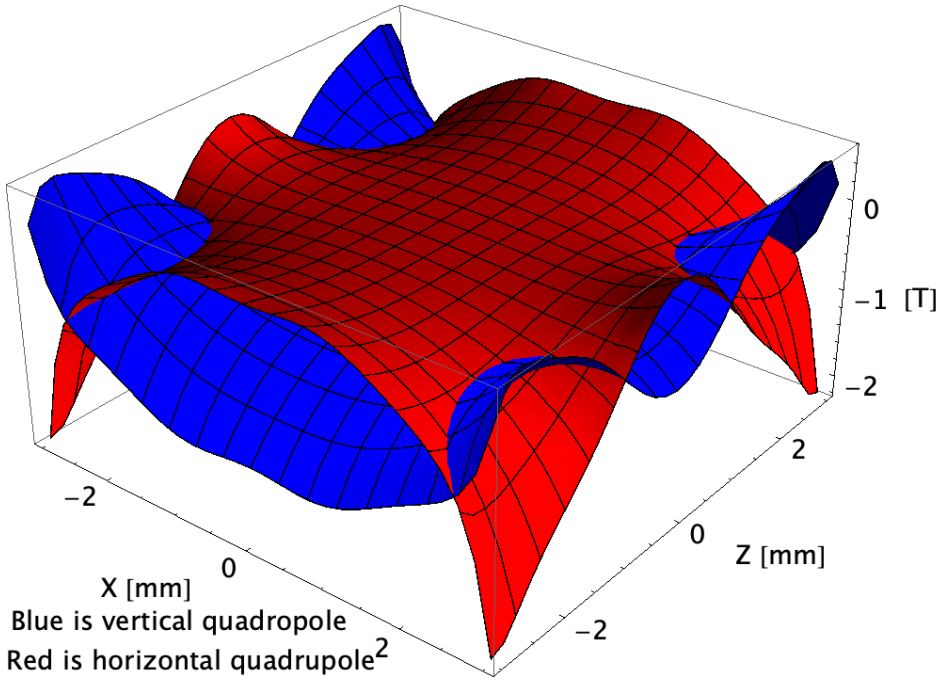




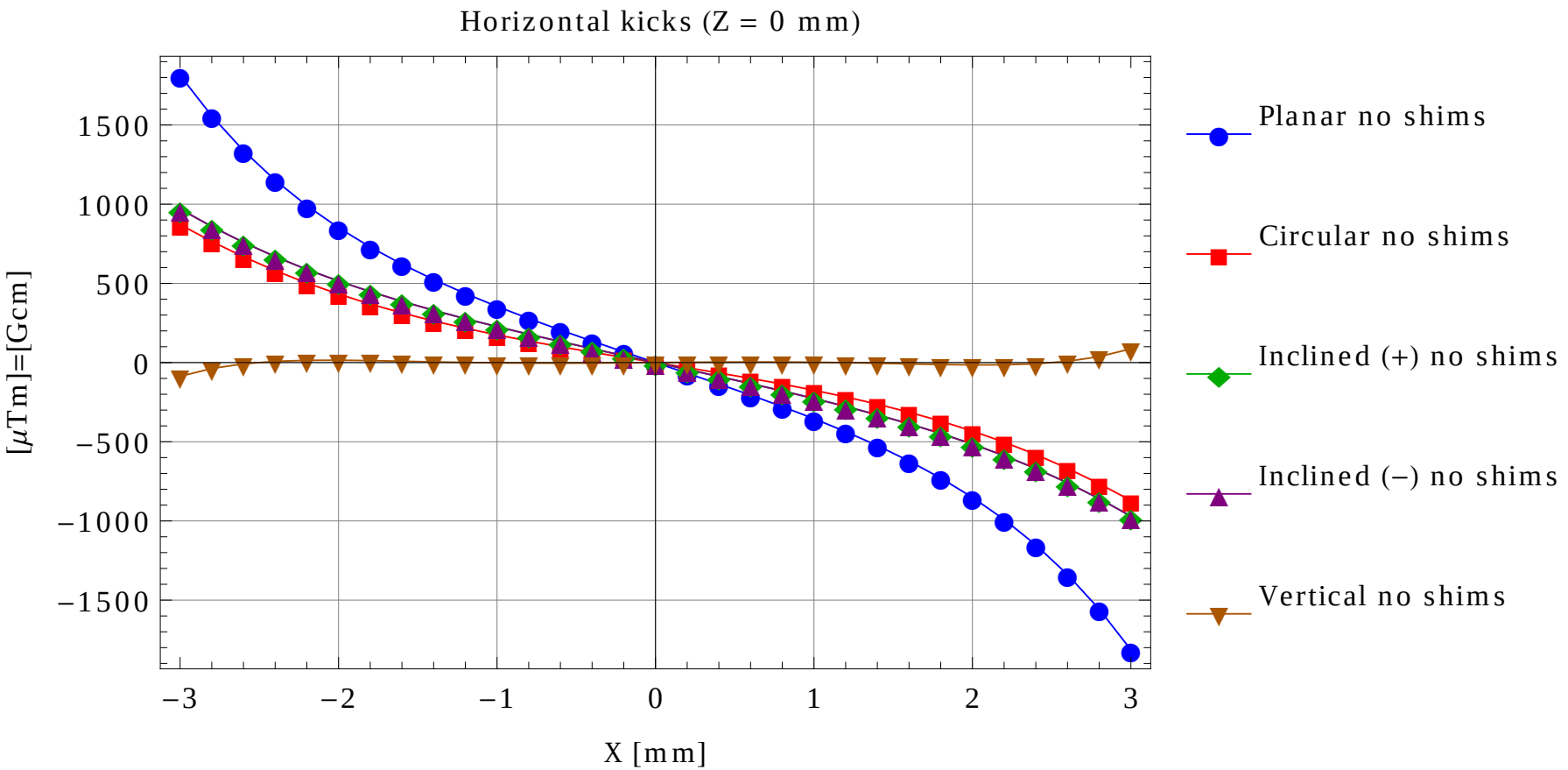
Integrated quadrupole strength map in the VP mode [T]







Horizontal kick from the X-type



Vertical kick from the X-type