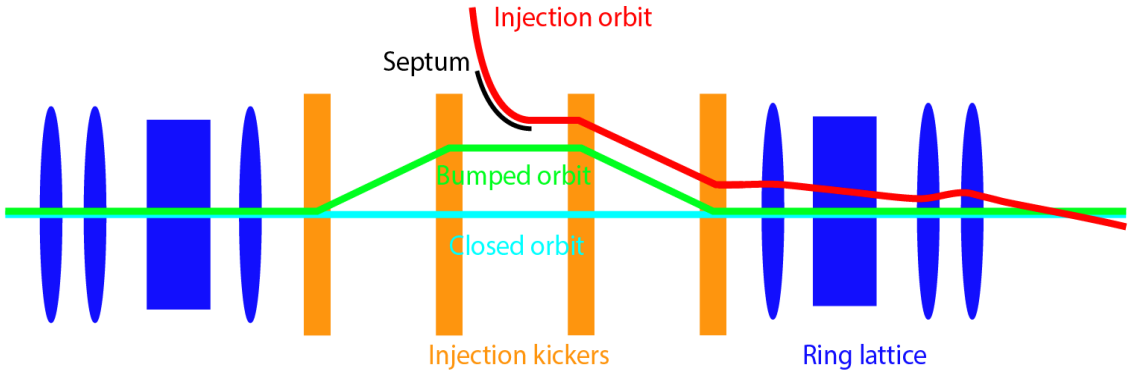
CAS – CERN ACCELERATOR SCHOOL 2017
CASE STUDY -B

DESIGN A TOP-UP INJECTION SYSTEM FOR A LIGHT SOURCE

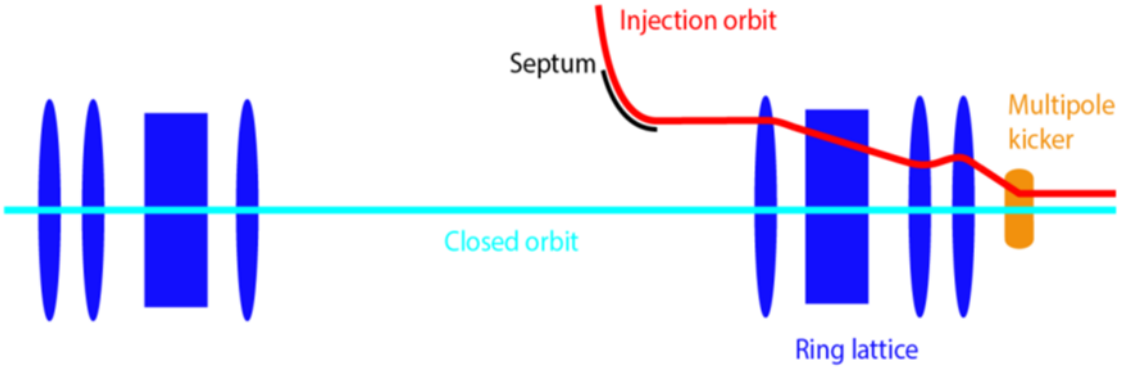
The S**C**LS

Vera Chetvertkova
Salvatore Danzeca
Janne Holma
Giulia Romagnoli
Pierre Salou
Tim Winkelmann

Multipole Kicker Injection



CONVENTIONAL INJECTION

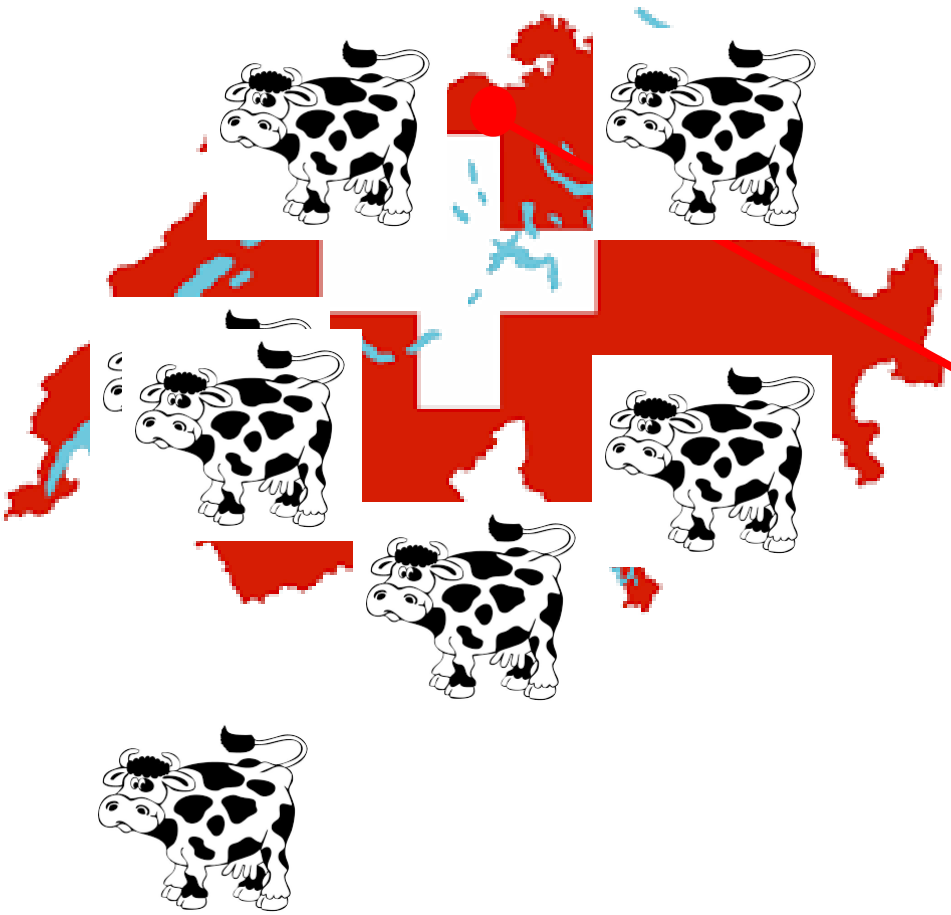


Multipole Kicker INJECTION

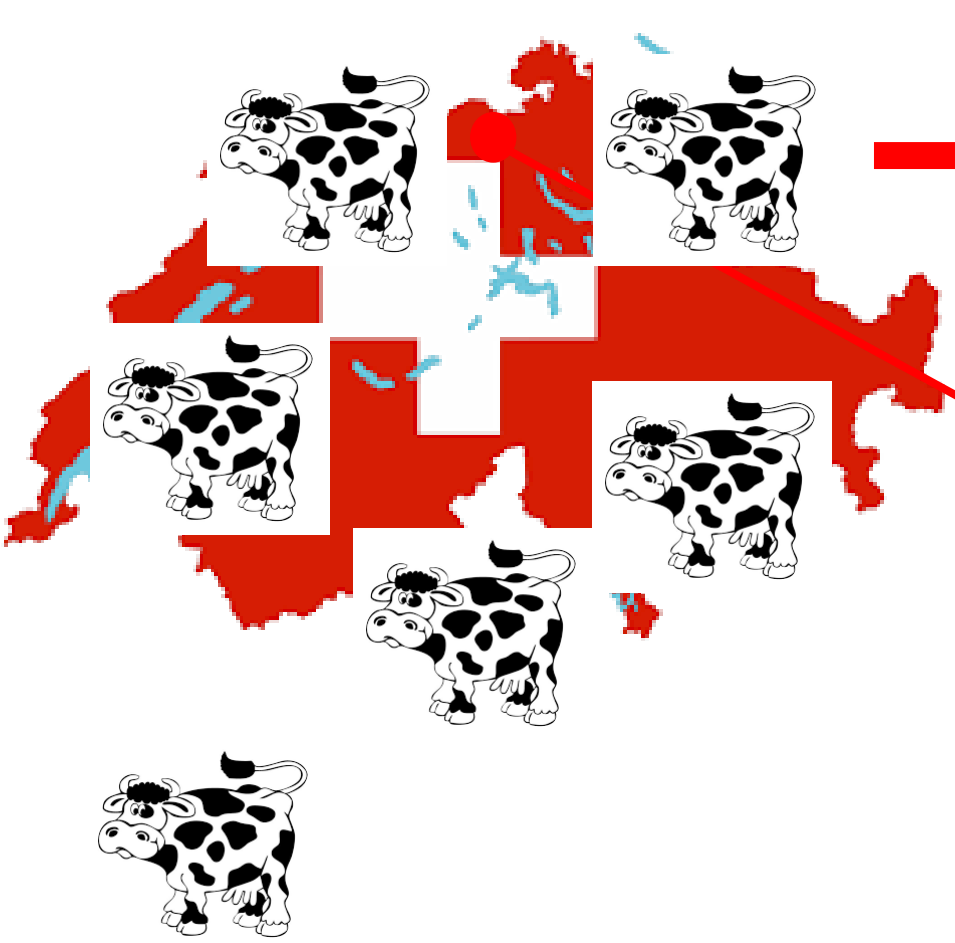
** Masamitsu Aiba, Paul Scherrer Institute
12.03.2017
CERN Accelerator School
Erice, Italy

Swiss Light Source

Swiss Light Source



Swiss Light Source



Parameter	Typical value
Circumference [m]	288
Beam energy [GeV]	2.4
Beam current [mA]	400~402
Number of bunches / beam*	390 (out of 480 rf buckets)
Hor./Ver. emittance, rms [nm]	5.5/0.01 (Energy spread ~0.1%)
Injection beam horizontal emittance [nm]	9
Beam lifetime [h]	8
Dynamic aperture [mm]	~15
Septum thickness [mm] / length [m] / field [T]	3 / 0.8 / ~0.9
Length of injection straight [m]	~10
Hor. beta function in the middle of straight section [m]	4.5
Hor./Ver. betatron tune	20.43 / 8.74

SLS top-up injection based on the conventional injection scheme.

CIOCCOLATE STREAM NUTS INJECTION

CIOCCOLATE STREAM NUTS INJECTION

Quad

Circulating beam

Quad

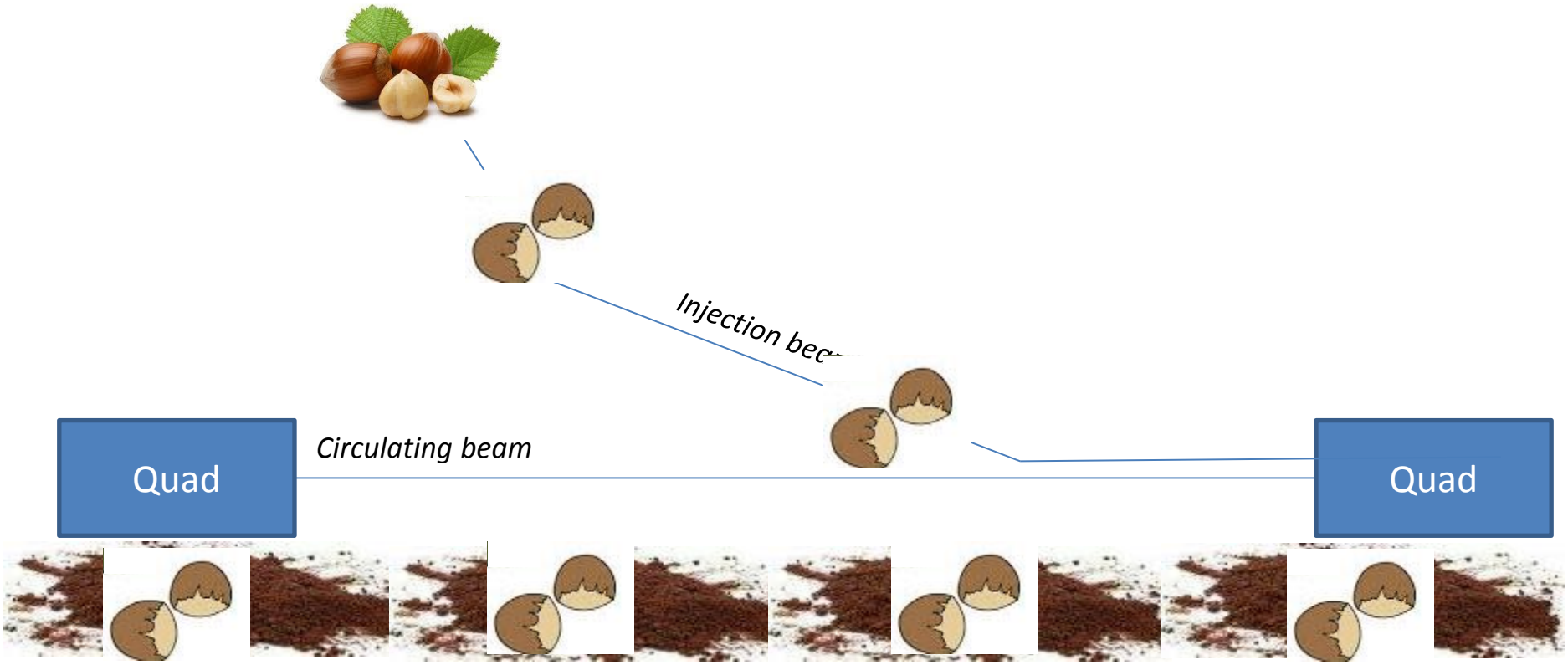
CIOCCOLATE STREAM NUTS INJECTION

Quad

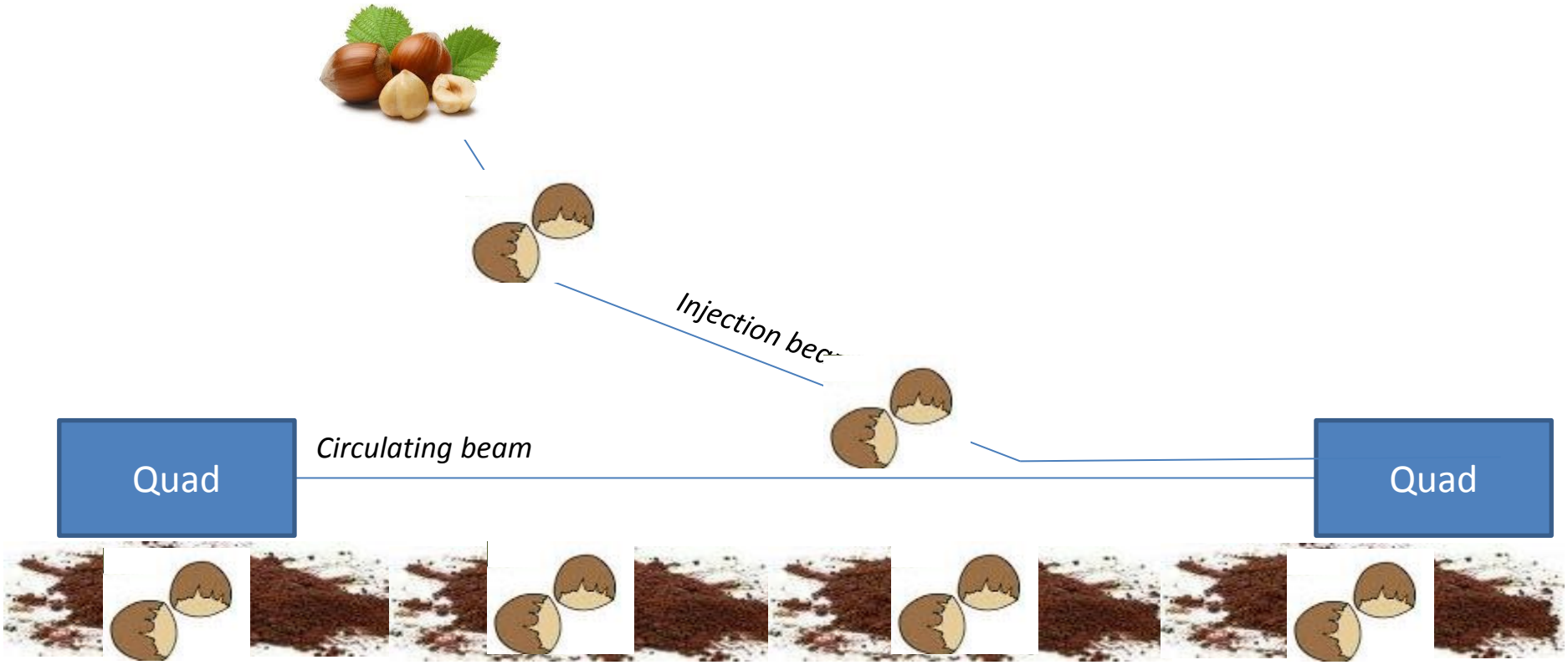
Circulating beam

Quad

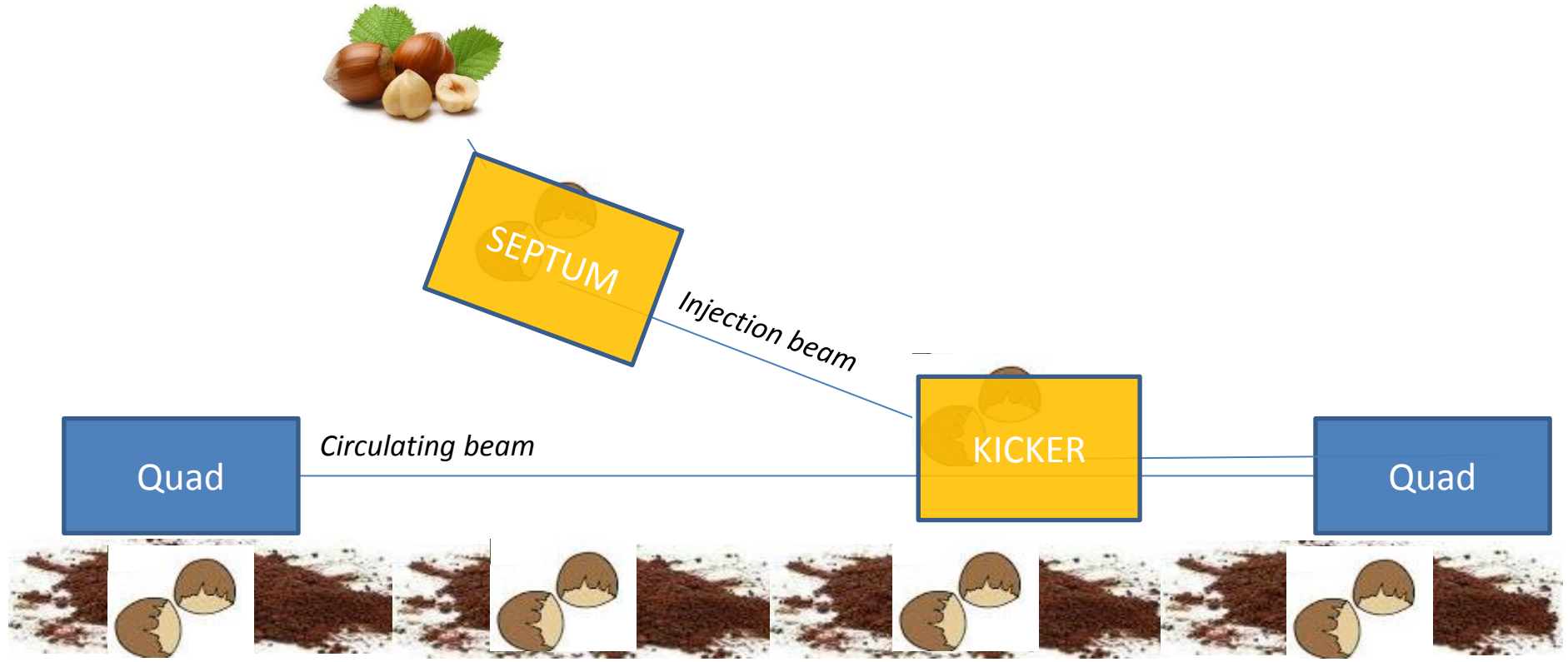
CIOCCOLATE STREAM NUTS INJECTION



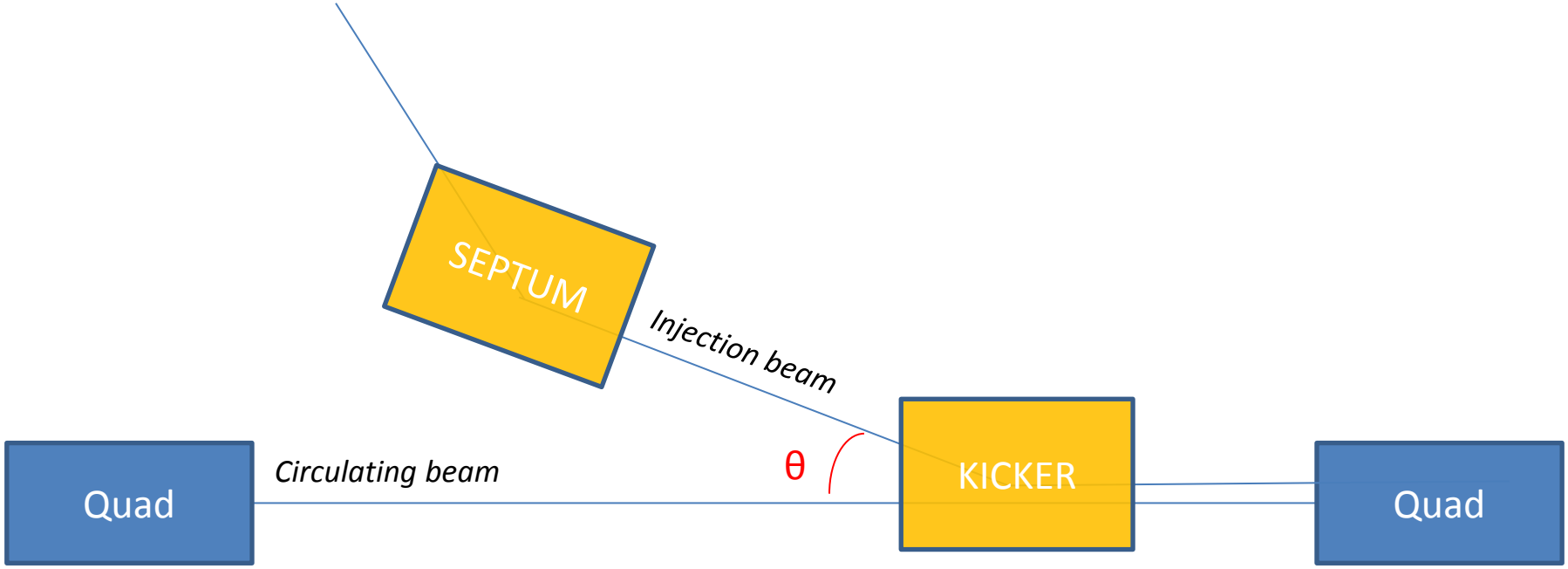
CIOCCOLATE STREAM NUTS INJECTION



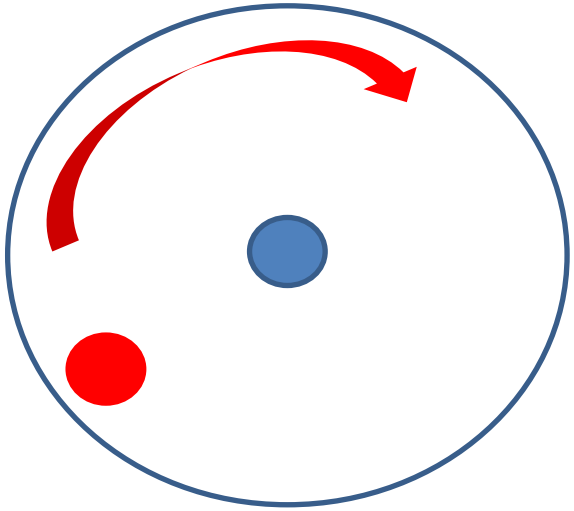
CIOCCOLATE STREAM NUTS INJECTION



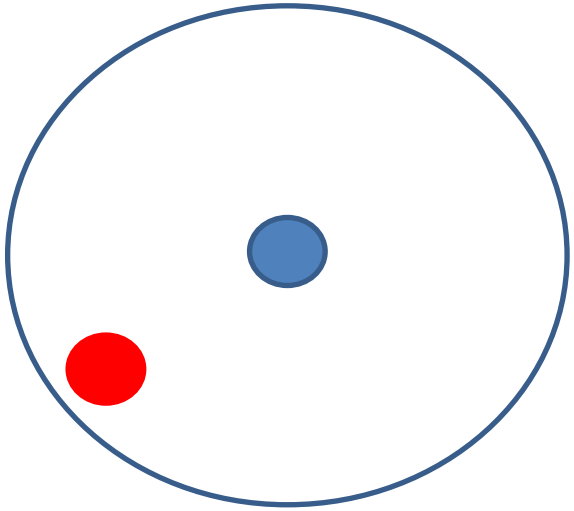
Geometry Considered

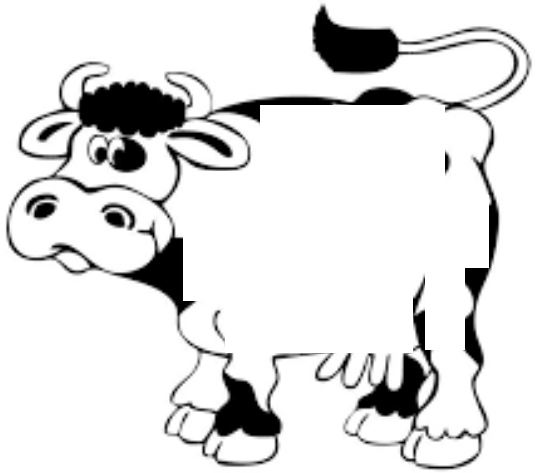


I GOAL:
INJECTED BEAM IN ACCEPTANCE !!!!

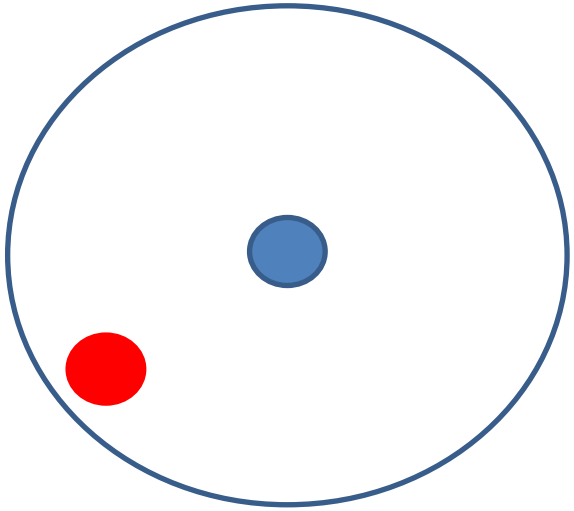


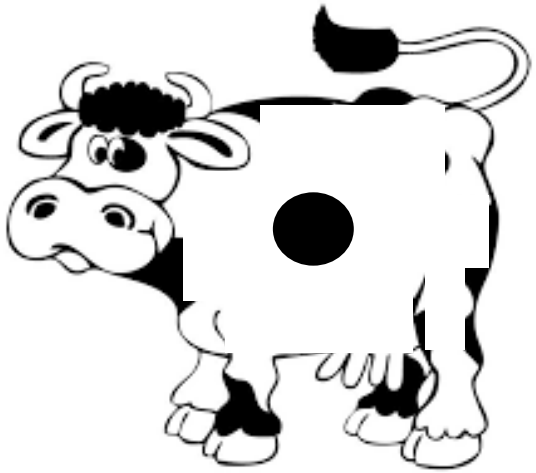
I GOAL:
INJECTED BEAM IN ACCEPTANCE !!!!



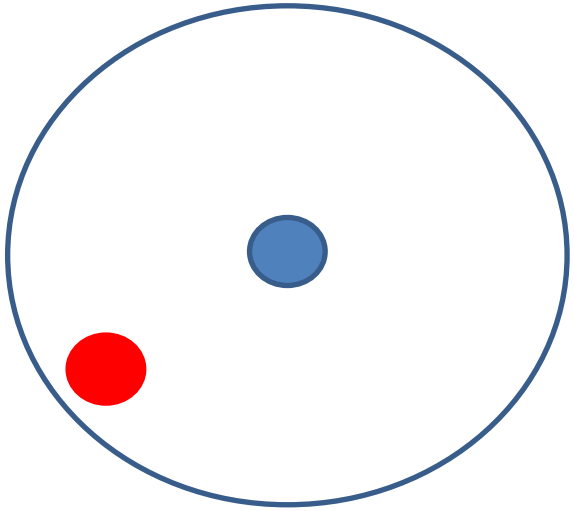


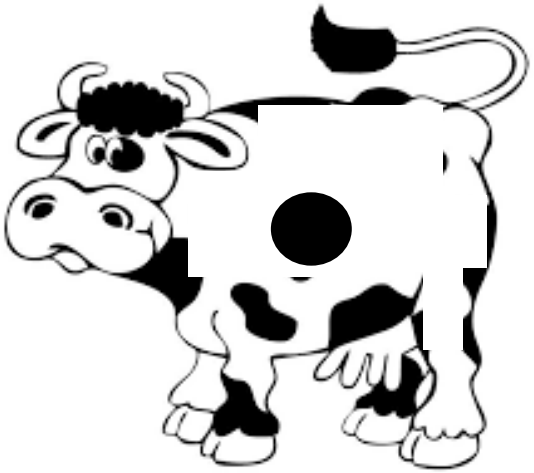
I GOAL:
INJECTED BEAM IN ACCEPTANCE !!!!



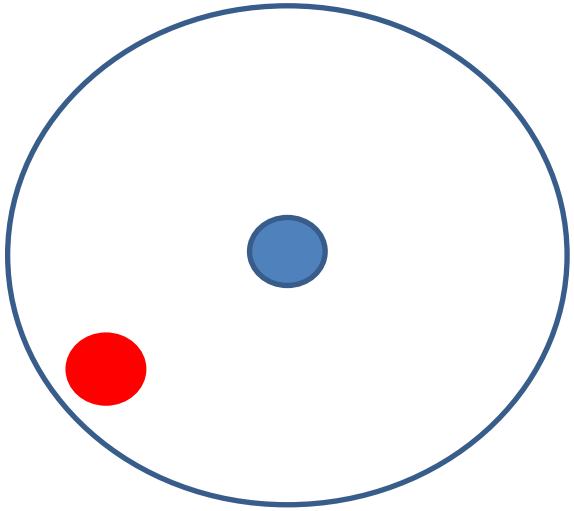


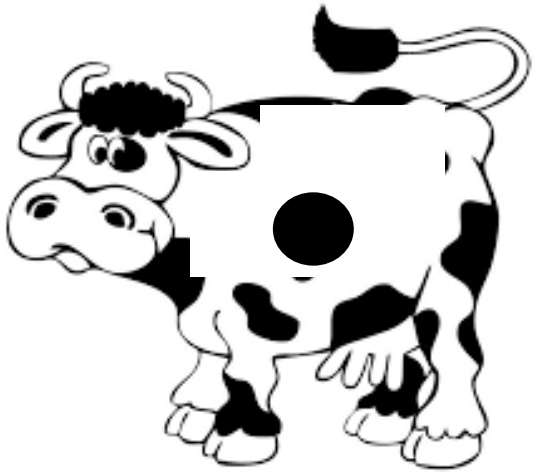
I GOAL:
INJECTED BEAM IN ACCEPTANCE !!!!



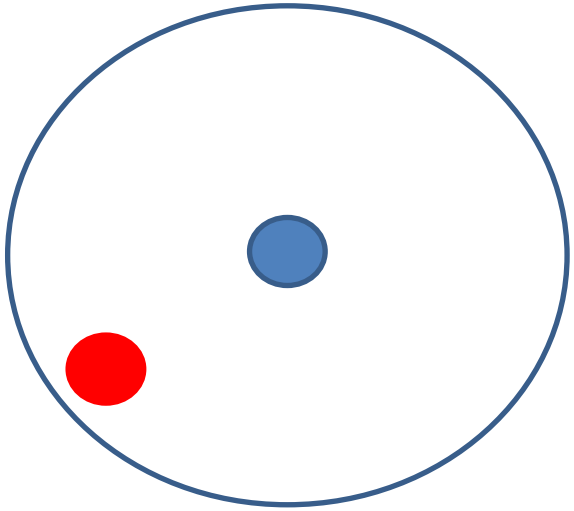


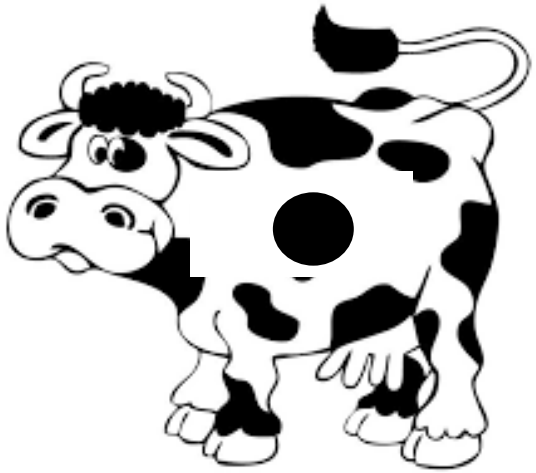
I GOAL:
INJECTED BEAM IN ACCEPTANCE !!!!



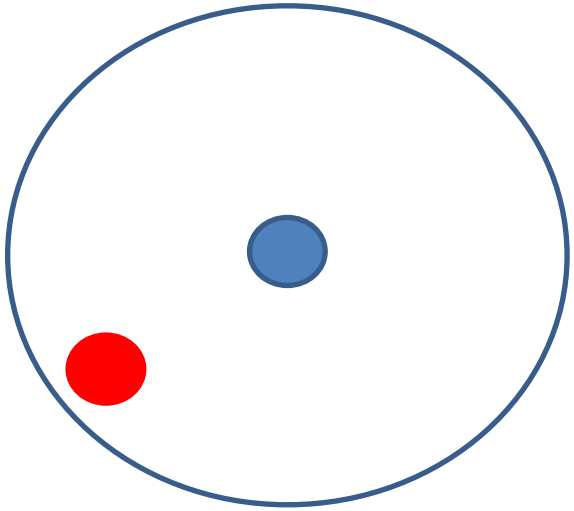


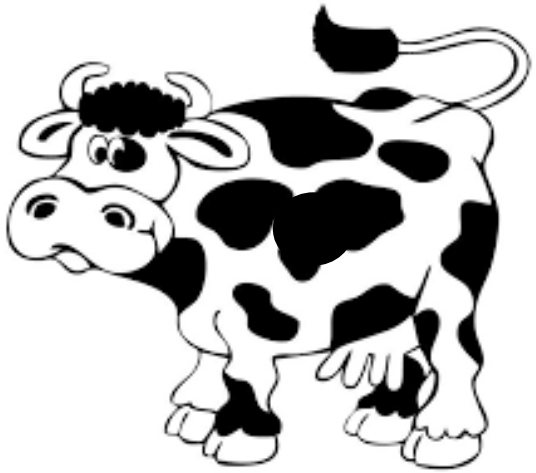
I GOAL:
INJECTED BEAM IN ACCEPTANCE !!!!

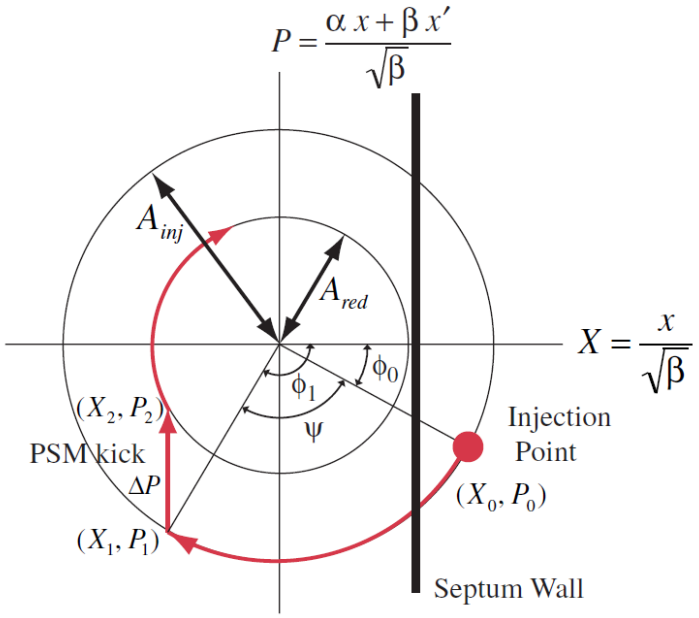


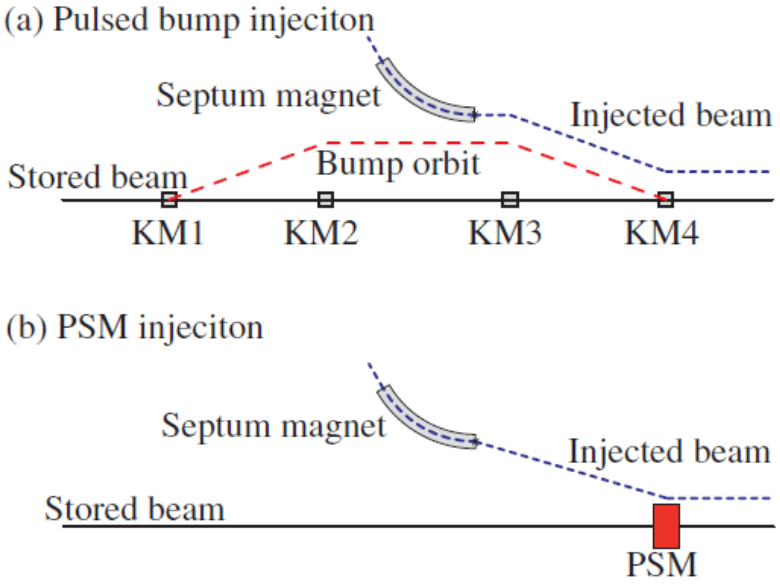


I GOAL:
INJECTED BEAM IN ACCEPTANCE !!!!









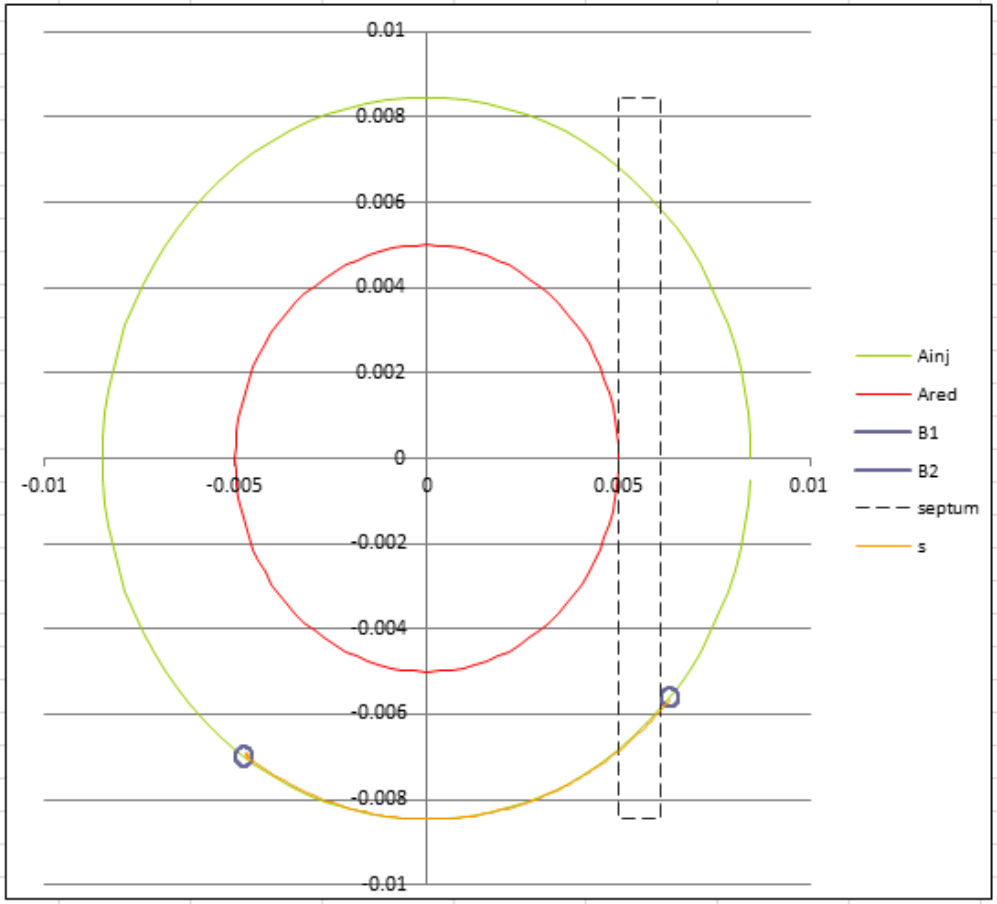
Beam injection with a pulsed sextupole magnet in an electron storage ring

Hiroyuki Takaki and Norio Nakamura
Institute for Solid State Physics, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8581, Japan

Yukinori Kobayashi, Kentaro Harada, Tsukasa Miyajima, Akira Ueda, Shinya Nagahashi, Miho Shimada, Takashi Obina, and Tohru Honda
Photon Factory, High Energy Accelerator Research Organization, 1-1 Oho, Tsukuba, Ibaraki 305-0801, Japan
(Received 8 February 2009; published 24 February 2010)

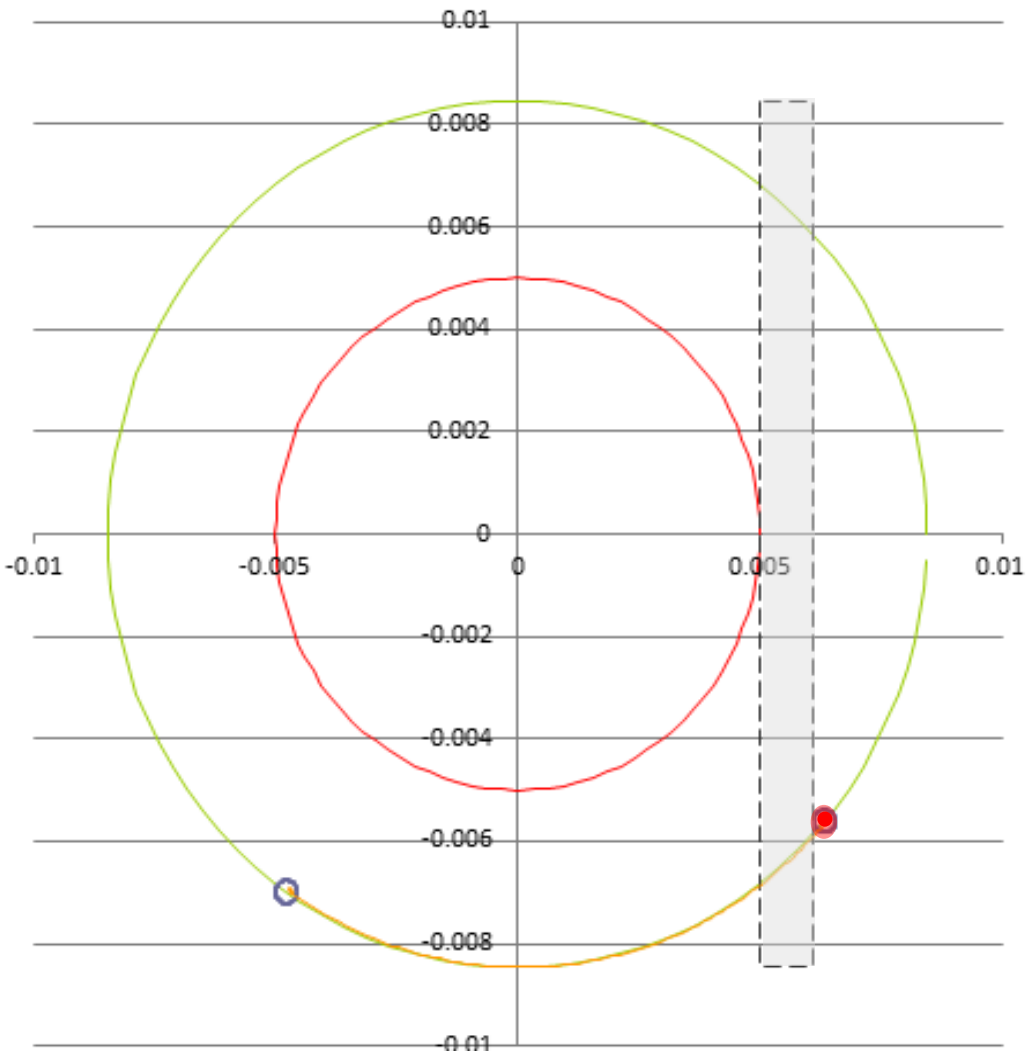
EXCEL PARAMETRIC **TOOL**

	A	B
1	s1 (m)	-3.5
2	s2 (m)	4.5
3	Epsilon (m)	5.00E-09
4	N	10
5	Dyn Ap (m)	1.50E-02
6	septum thicK. (m	3.00E-03
7	beta 0 (m)	4.5
8	ds (m)	1.00E-03
9		
10	beta1	7.2222222
11	beta2	9
12	alpha1	0.7777778
13	alpha2	-1
14	Ared	5.00E-03
15	xs	3.00E-03
16	Xs	1.12E-03
17	sqrt(NE)	0.0002236
18	X1	6.34E-03
19	X2	-4.78E-03
20	x1	1.70E-02
21	x2	-1.43E-02
22	x'	-0.0039209
23	P1	-0.0056061
24	P2	-0.0069863
25	Ainj	0.008463
26	lenght	-5
27	th	-0.0025996
28	beamonquad	-0.1364243



MERCI PIERRE!!!!

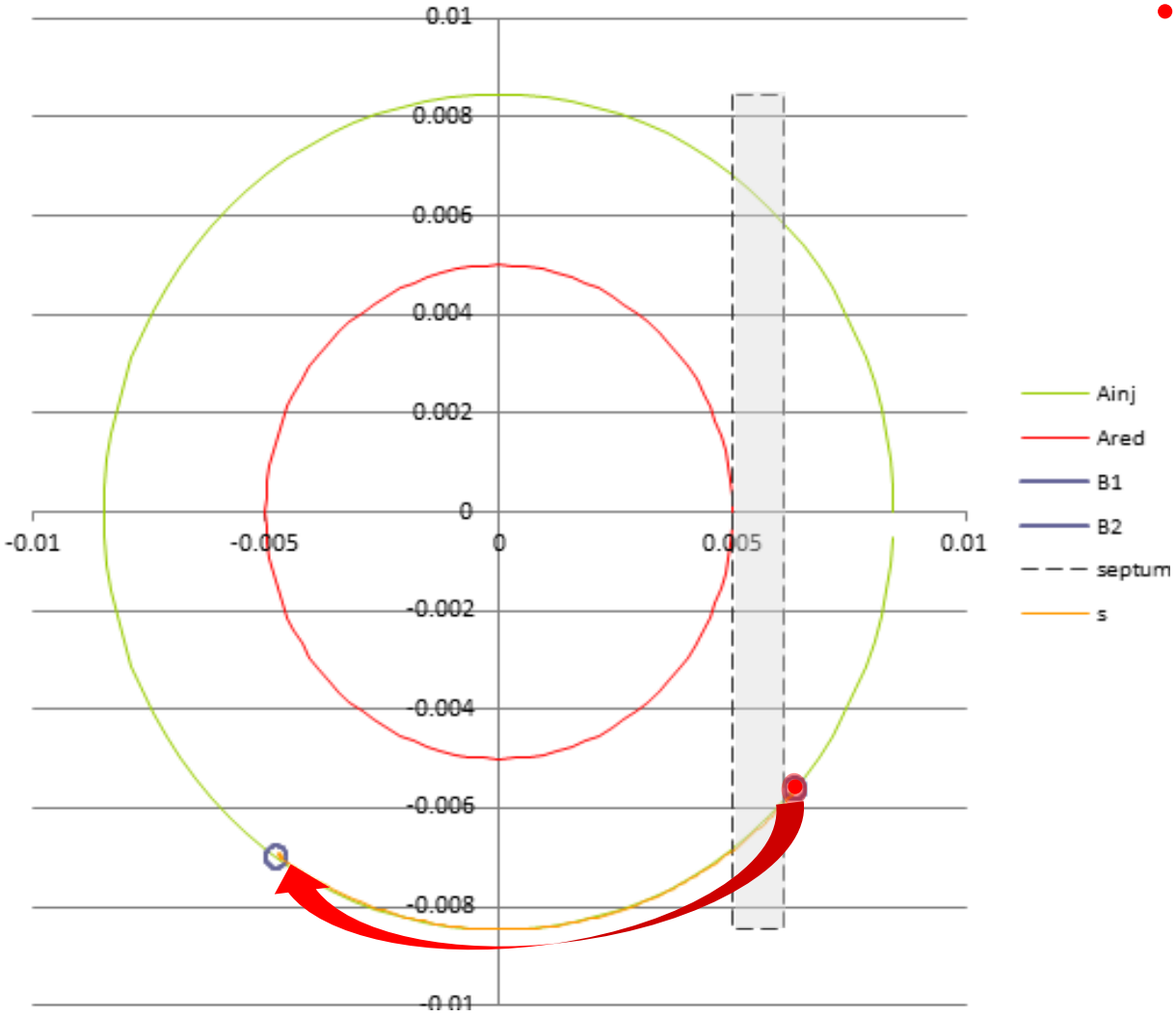
Parametric Calculation



- *Injected beam with emittance*

Septum thickness

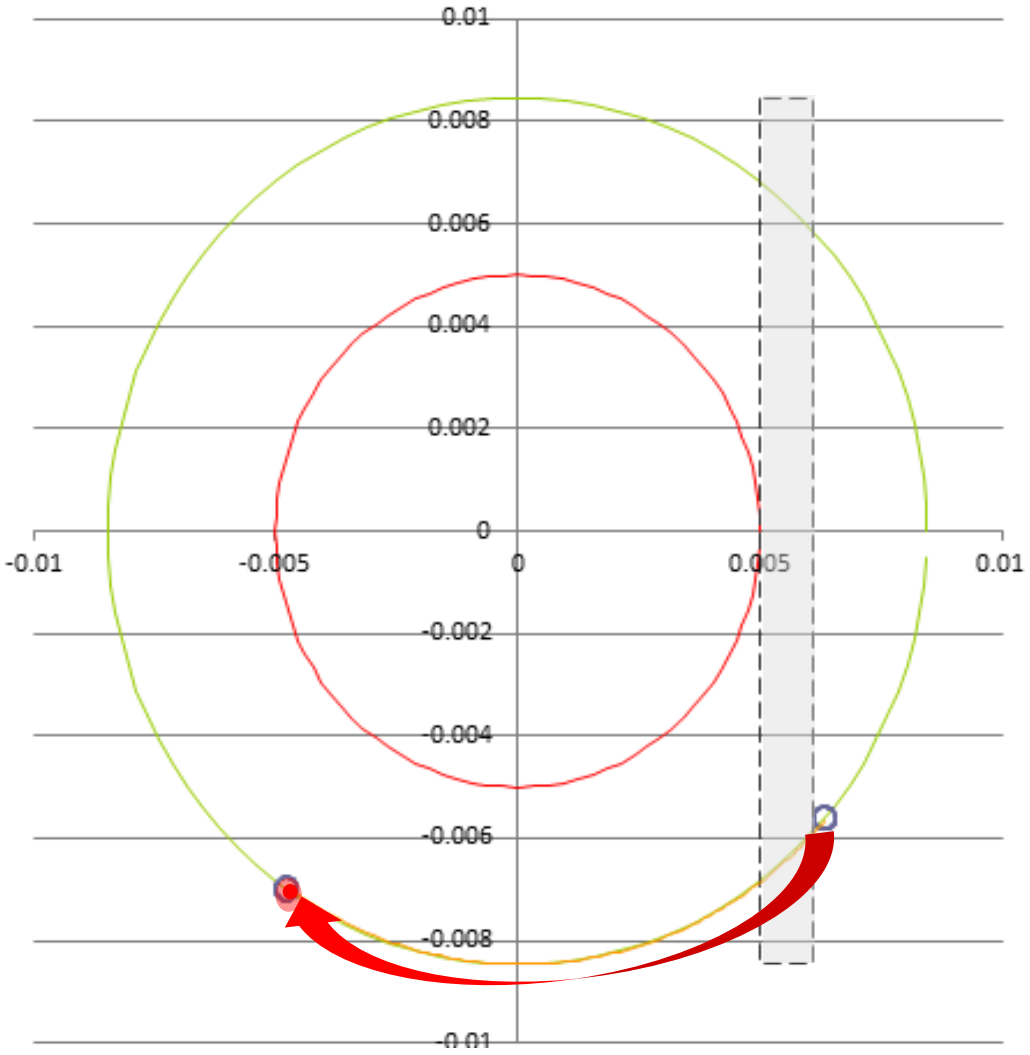
Parametric Calculation



- *Injected beam with emittance*

Septum thickness

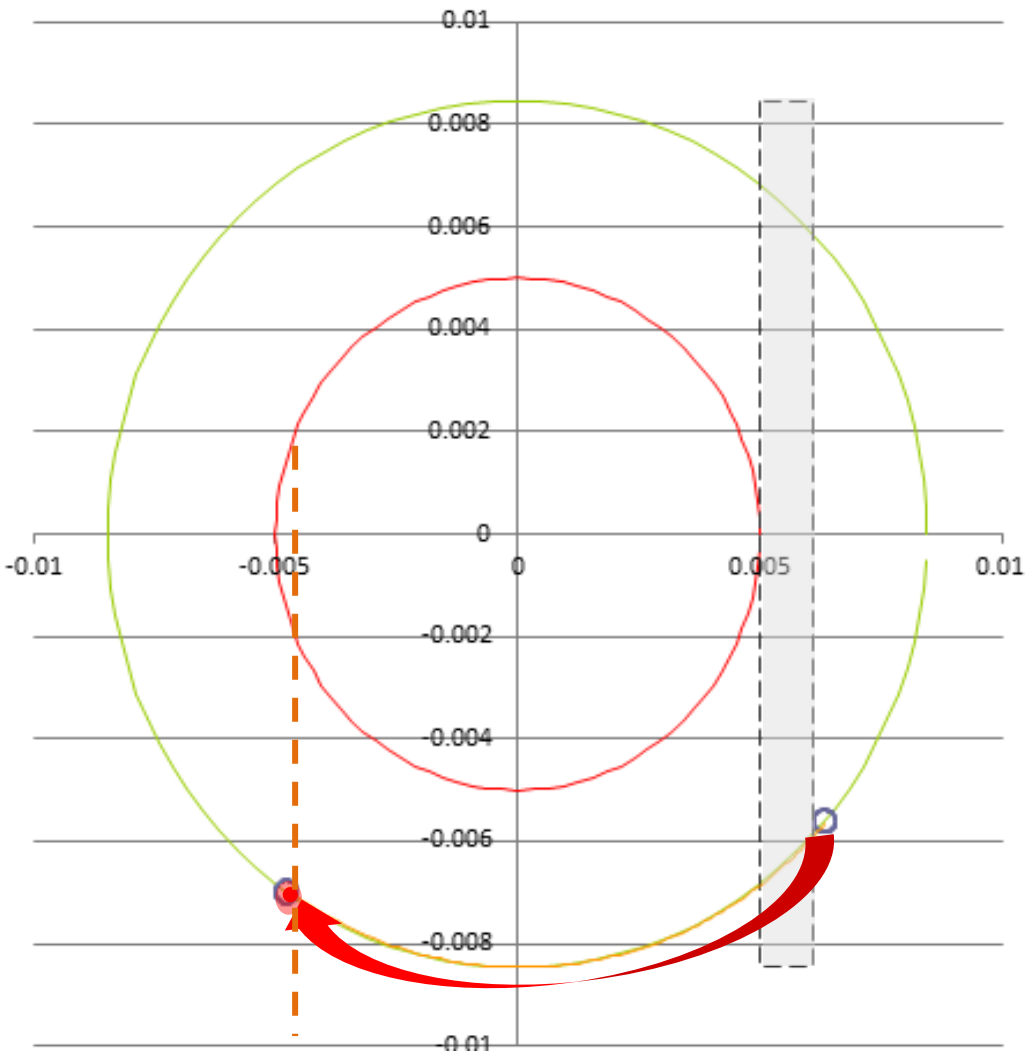
Parametric Calculation



- *Injected beam with emittance*

Septum thickness

Parametric Calculation

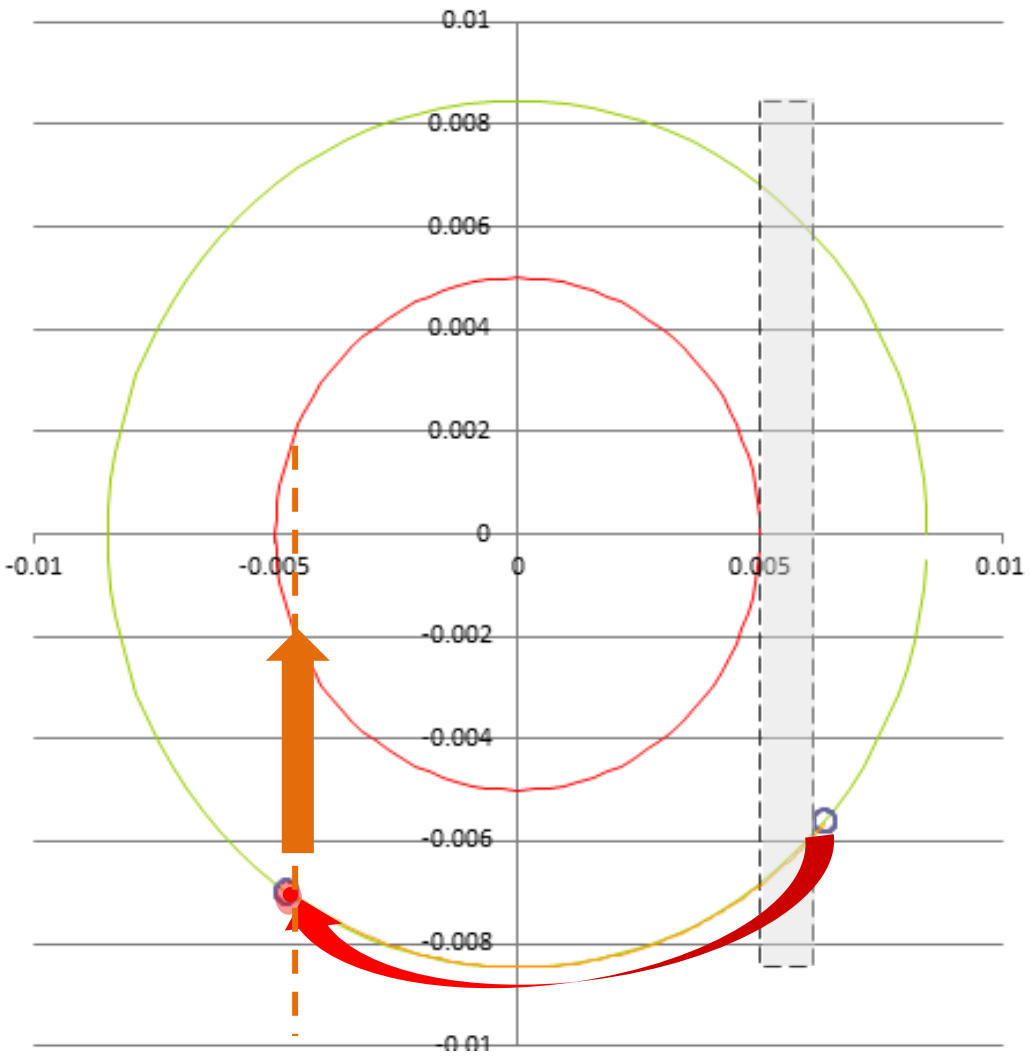


- *Injected beam with emittance*

Septum thickness

Position KICKER

Parametric Calculation



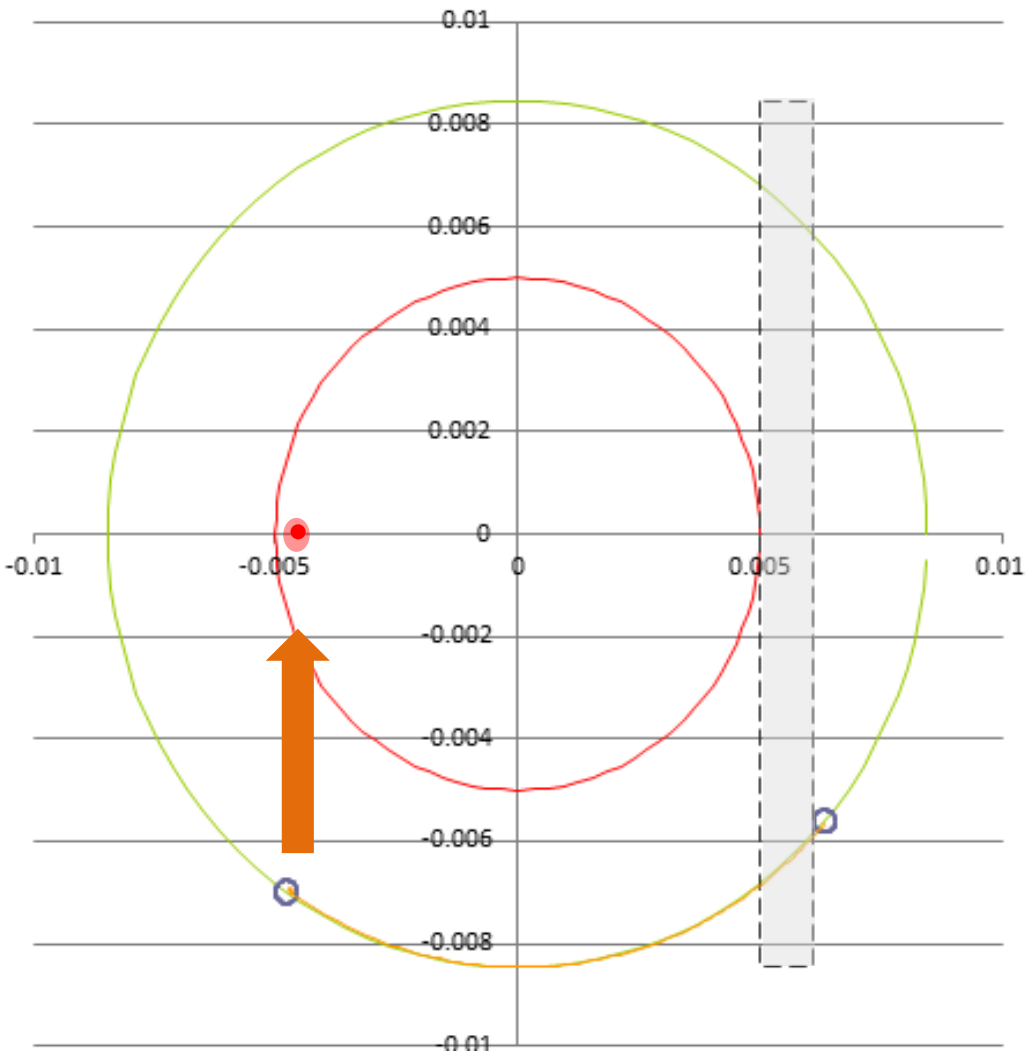
- *Injected beam with emittance*

Septum thickness

Position KICKER

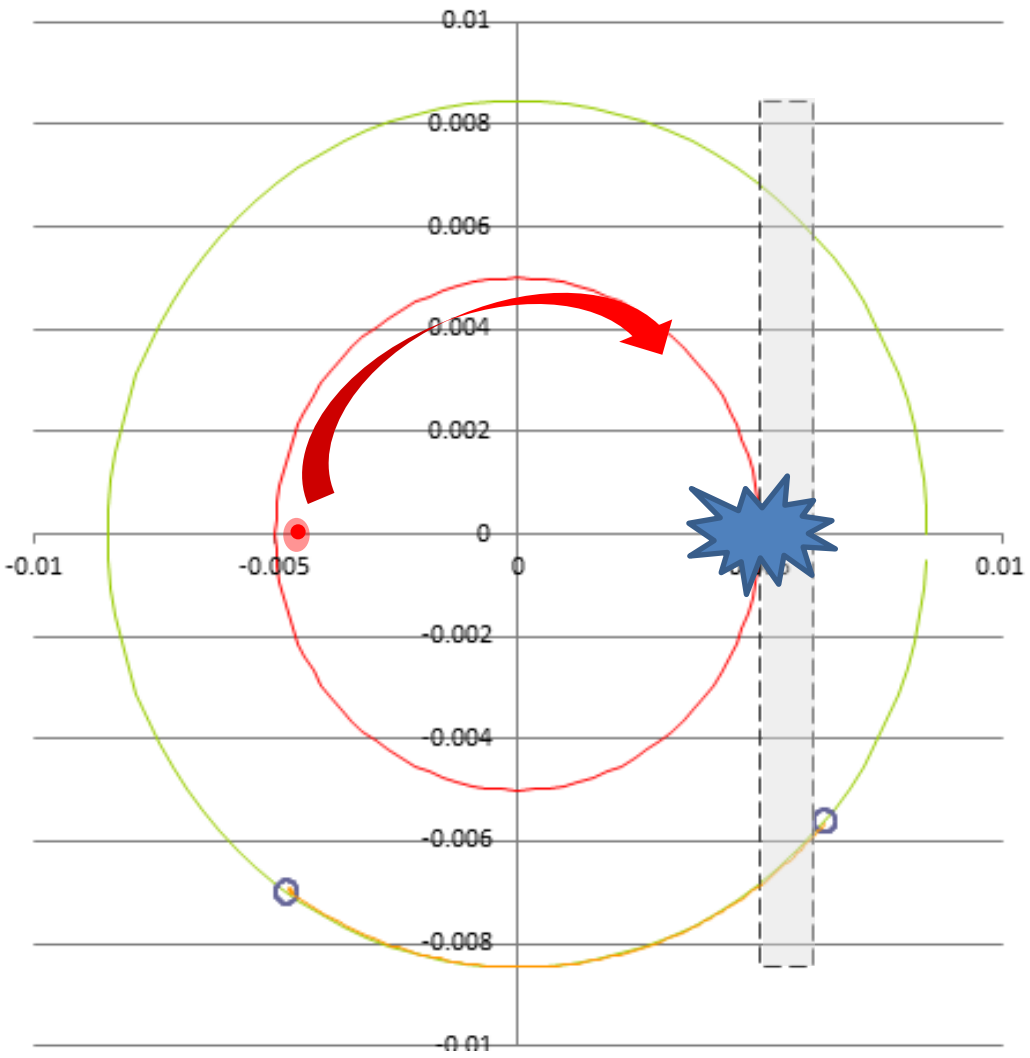
KICKER ANGLE

Parametric Calculation



- *Injected beam with emittance*
- *Septum thickness*
- *Position KICKER*
- *KICKER ANGLE*

Parametric Calculation



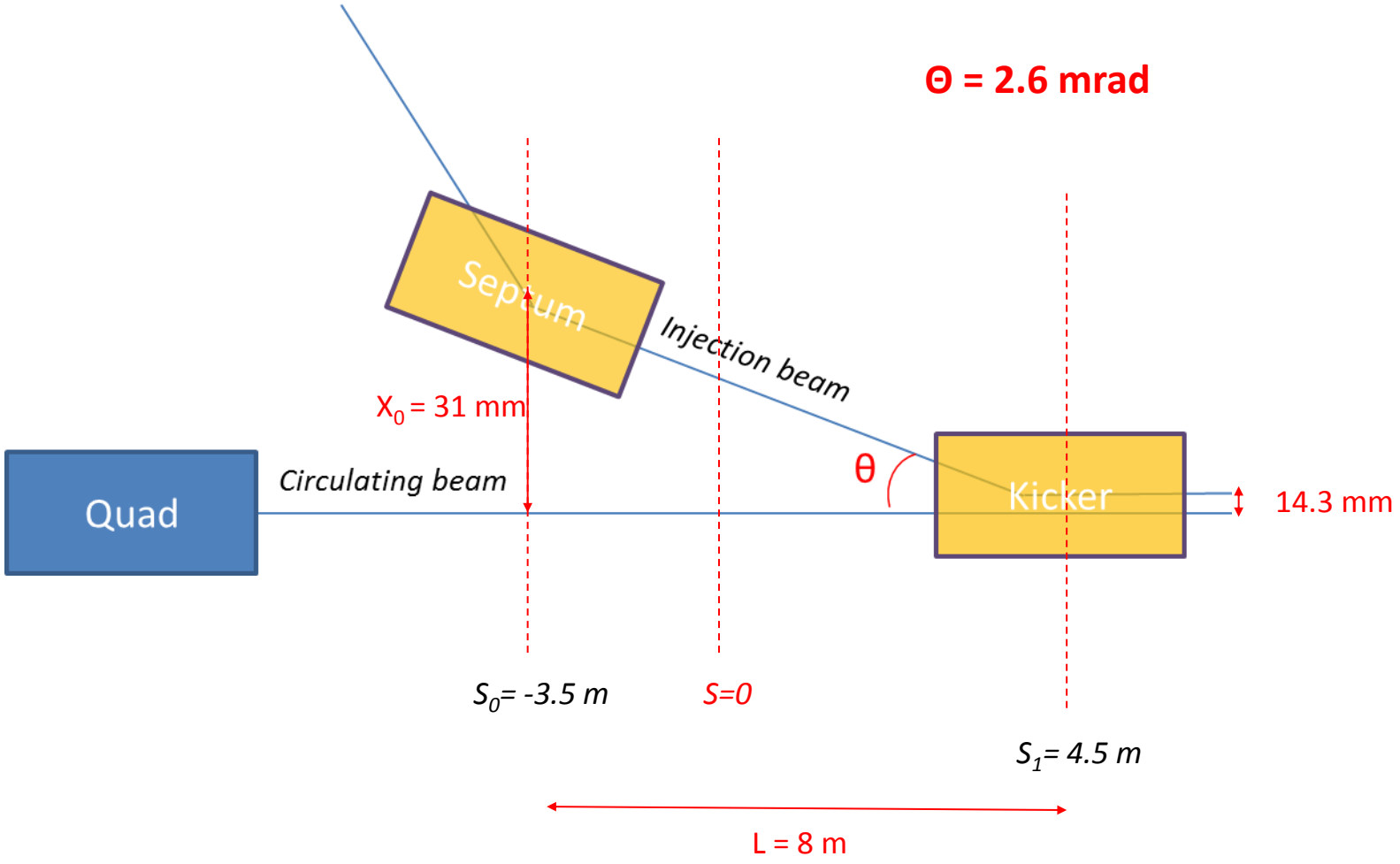
- *Injected beam with emittance*

Septum thickness

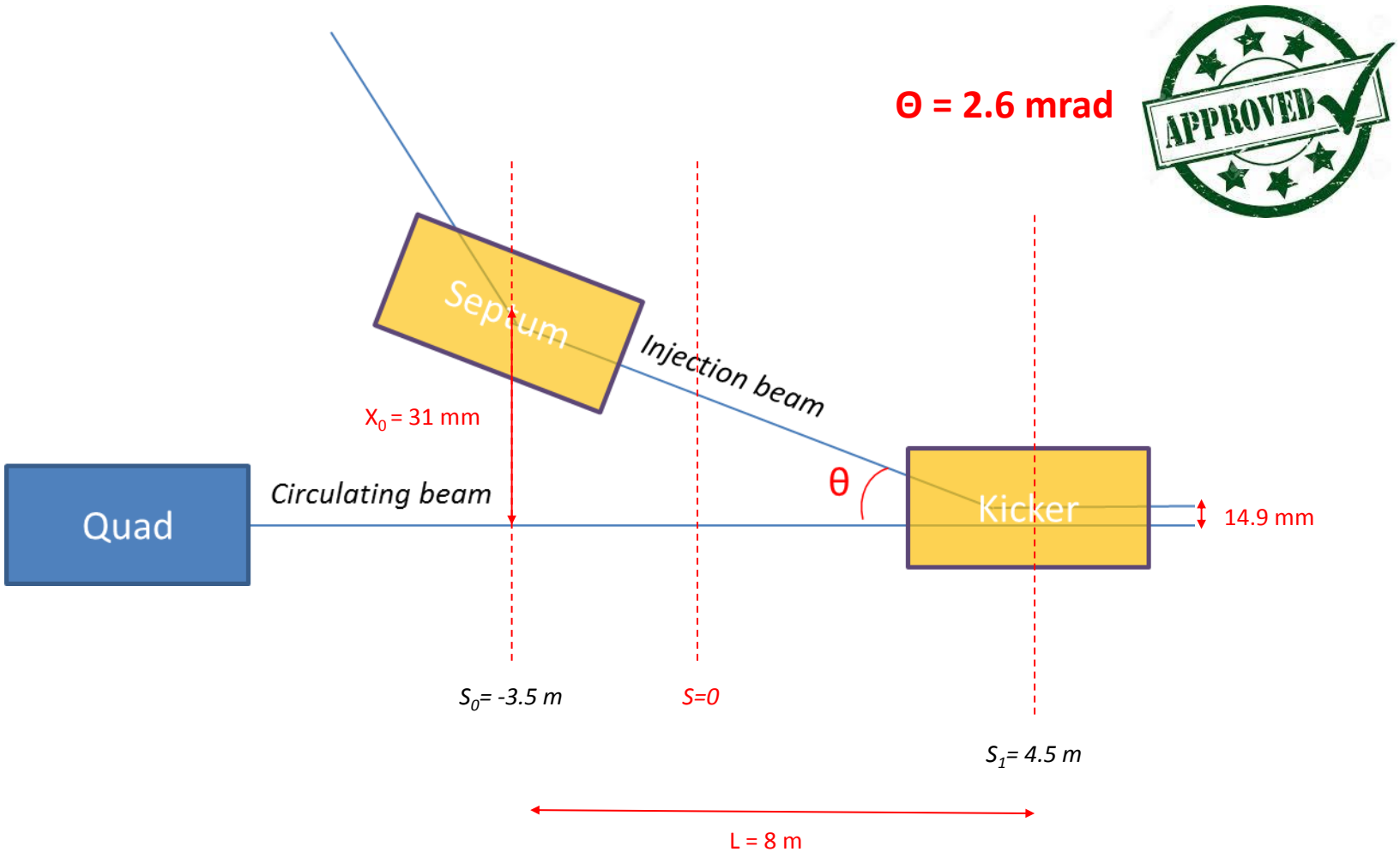
Position KICKER

KICKER ANGLE

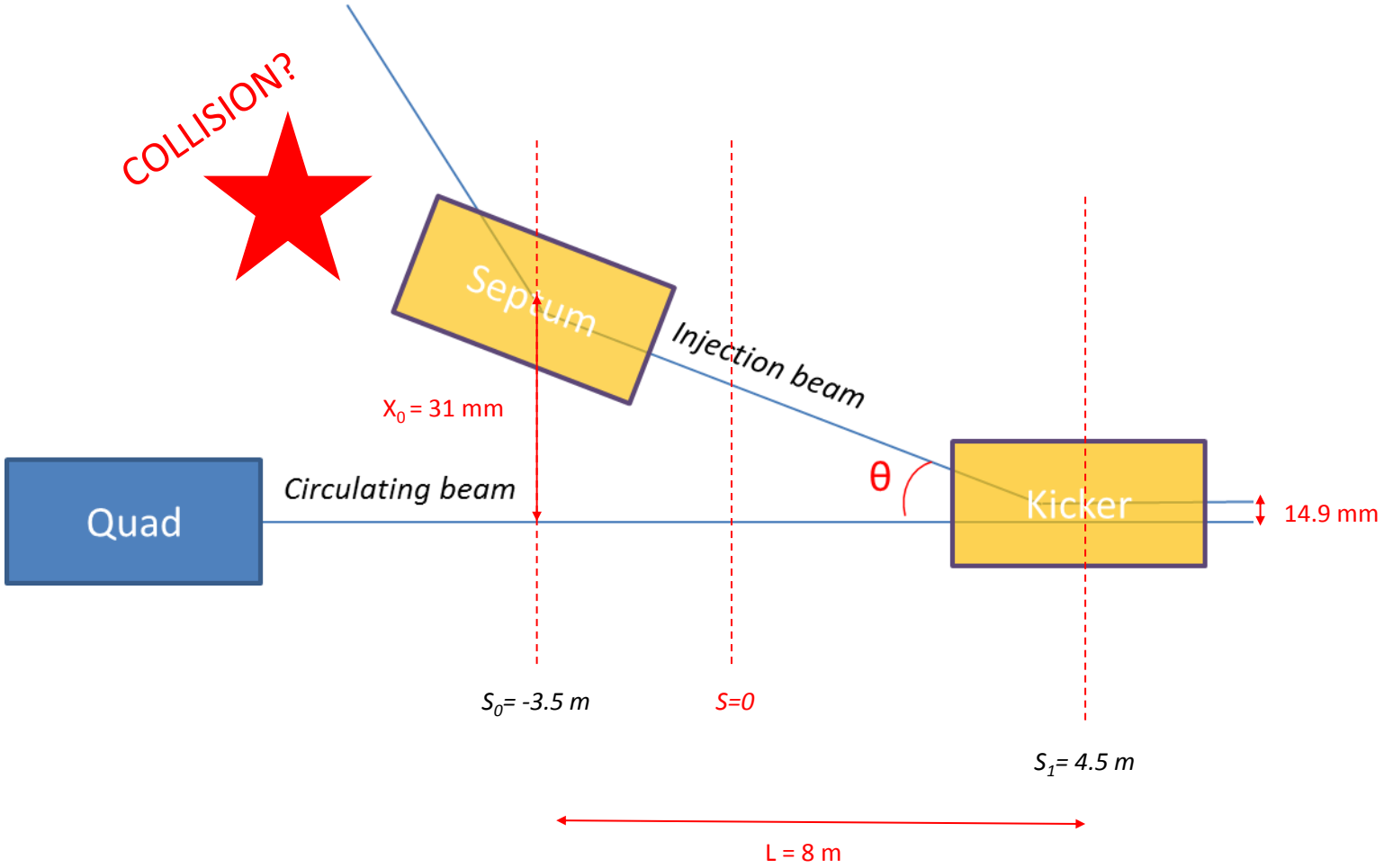
II GOAL:
AVOID COLLISION !!!!


Θ = 2.6 mrad
Septum
Injection beam
X0 = 31 mm
Quad
Circulating beam
θ
Kicker
14.3 mm
S0= -3.5 m
S=0
S1= 4.5 m
L = 8 m

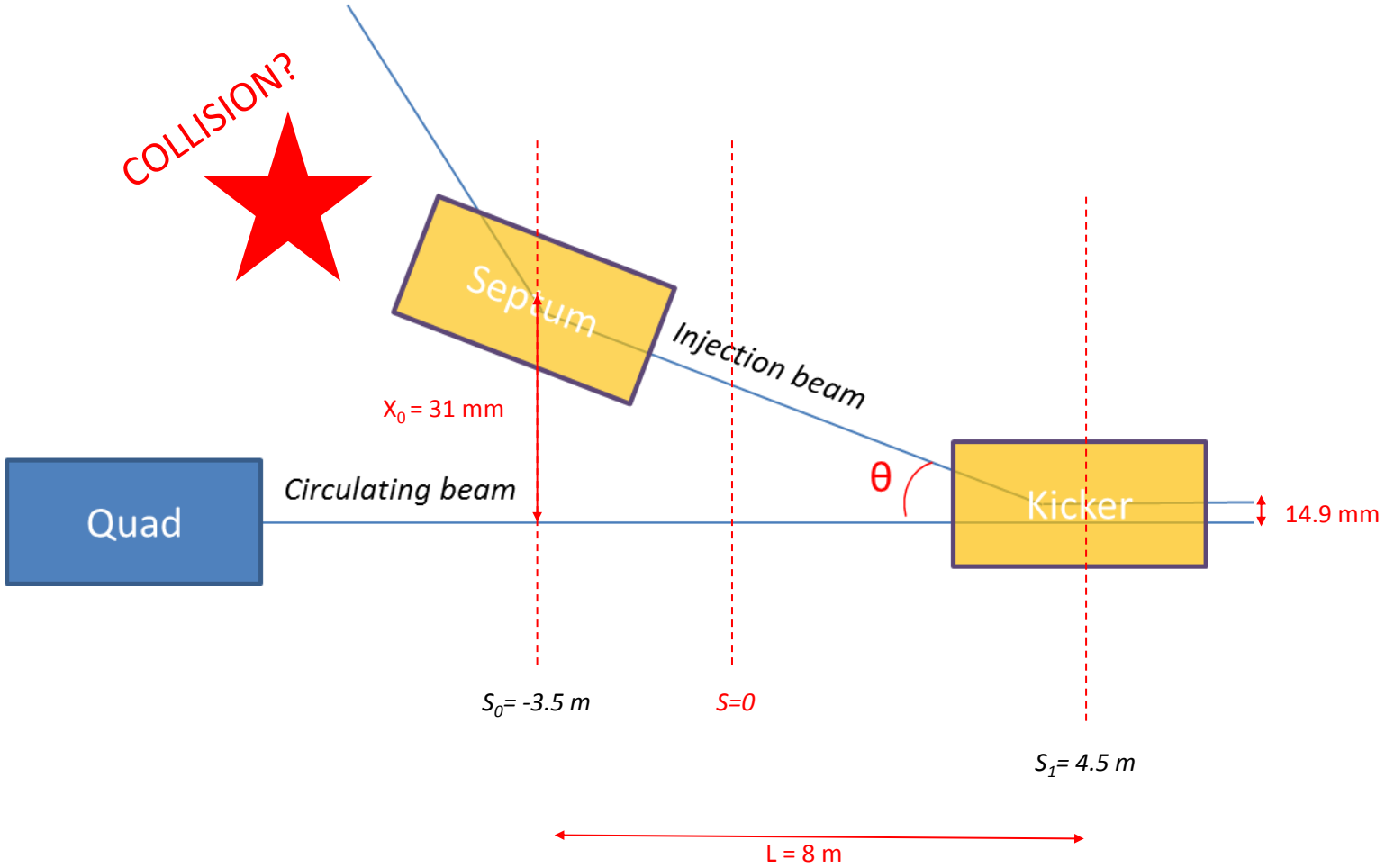
Septum Strenght



Septum Strenght



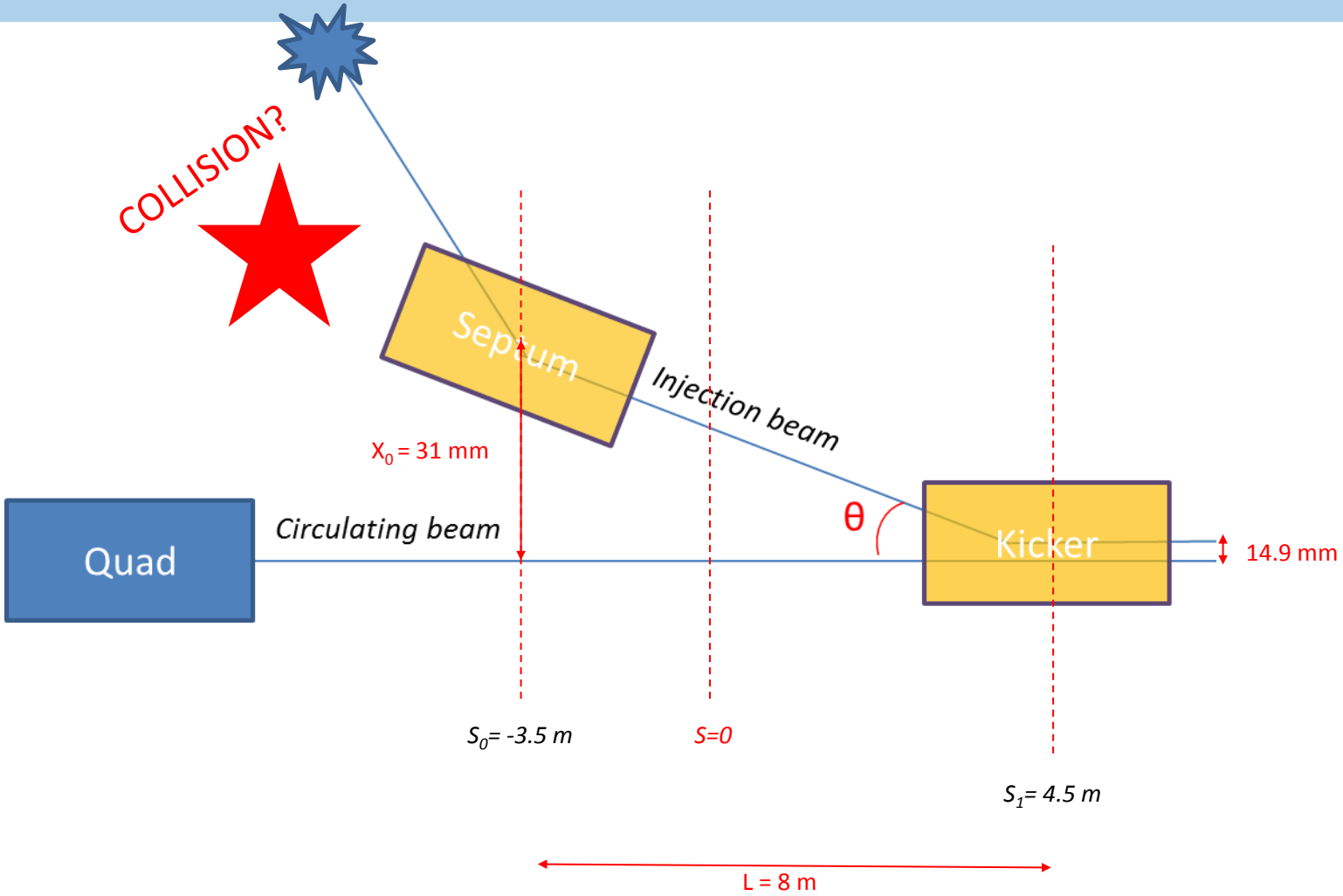
Septum Strenght



Septum lenght = 0.8 m
Septum field = 0.9 T
Septum Thickness = 3 mm

→ Septum Angle= 5.2 ° →

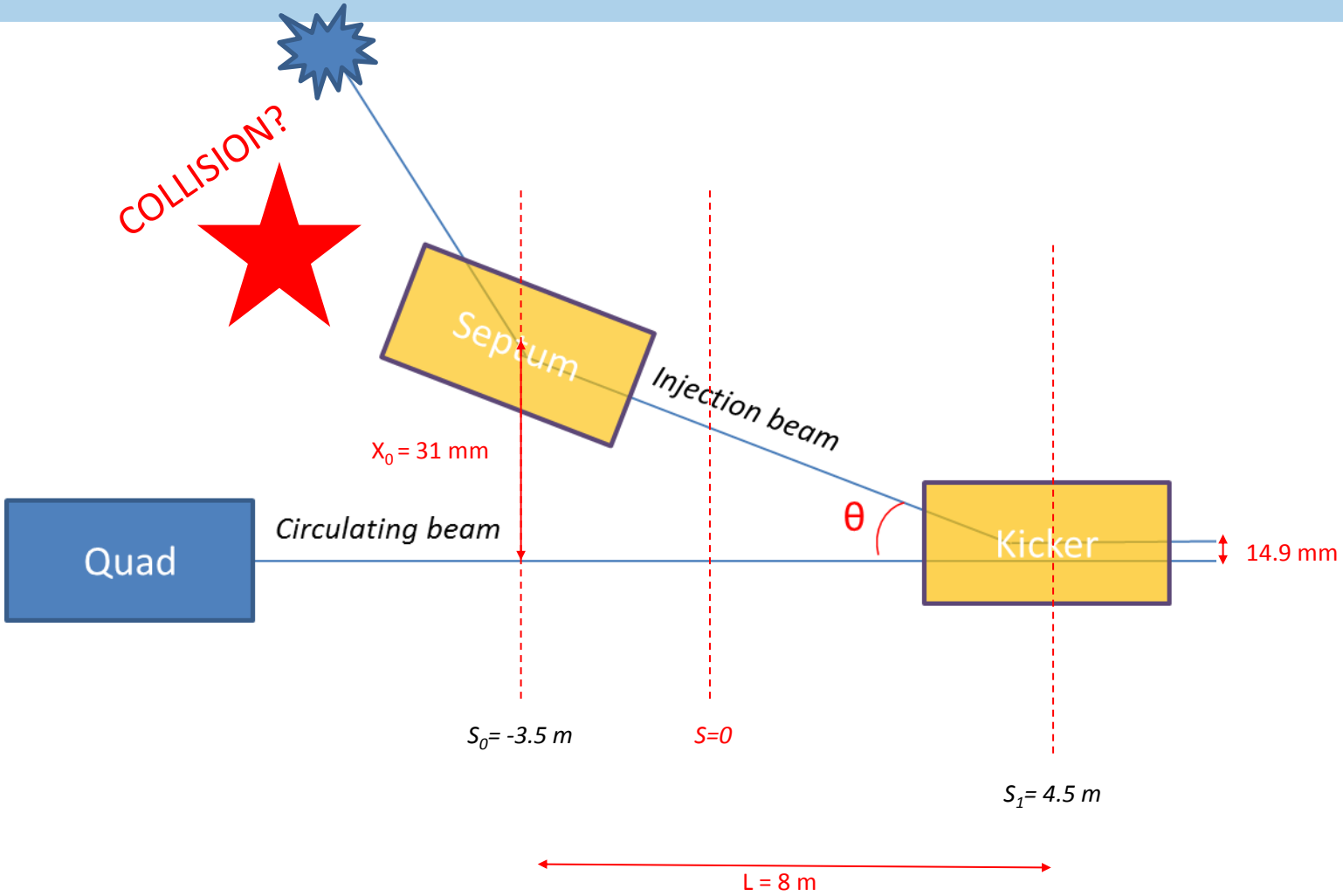
Septum Strenght



Septum lenght = 0.8 m
Septum field = 0.9 T
Septum Thickness = 3 mm

→ Septum Angle= 5.2 ° →

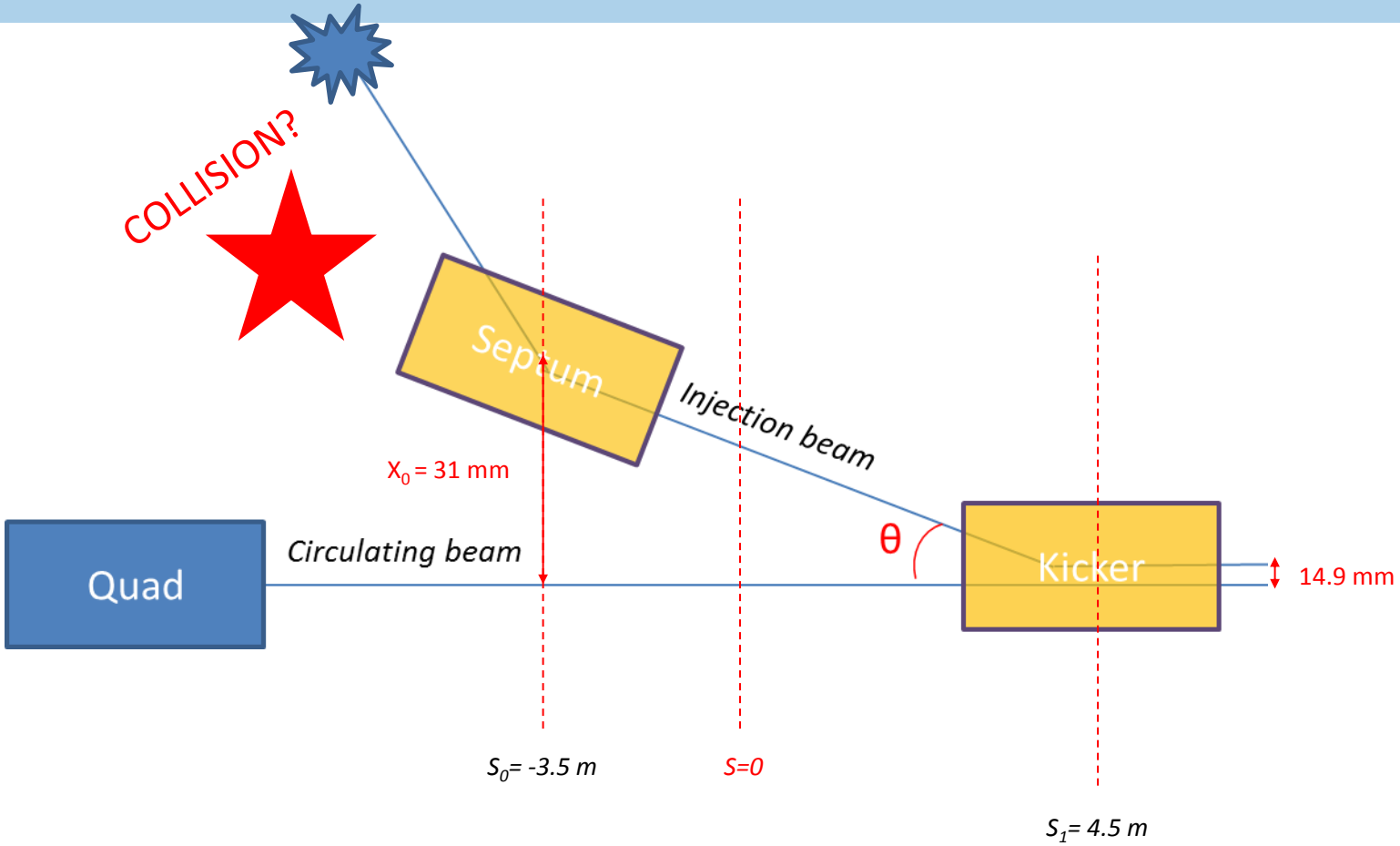
Septum Strenght



Septum lenght = 0.8 m
Septum field = 0.9 T
Septum Thickness = 3 mm

→ Septum Angle= 5.2 ° →

Max beam height = 29 cm



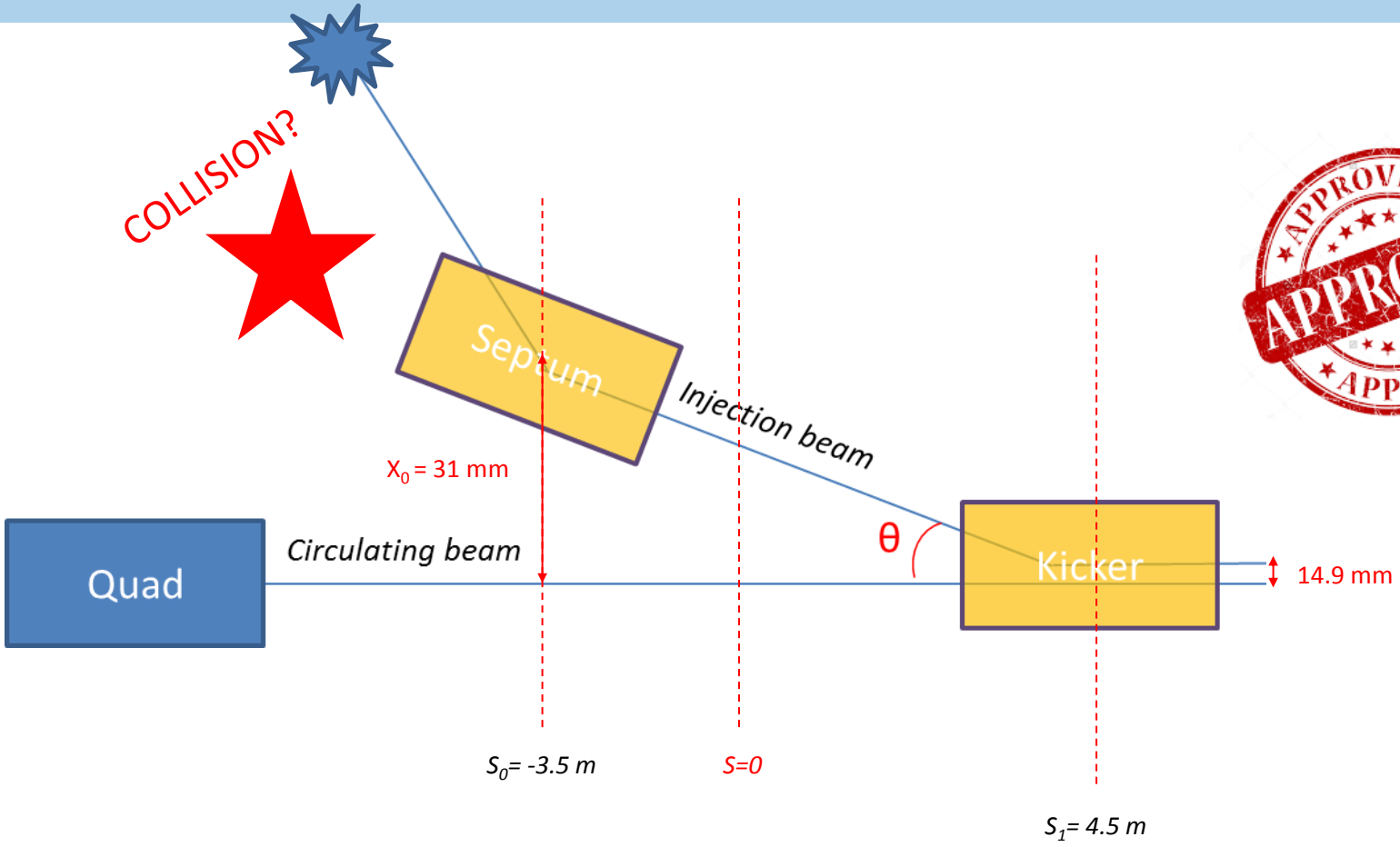
QUAD DIAMETER = 40 cm

Septum lenght = 0.8 m
Septum field = 0.9 T
Septum Thickness = 3 mm

→ Septum Angle= 5.2 ° →

Max beam position = 29 cm

Septum Strenght



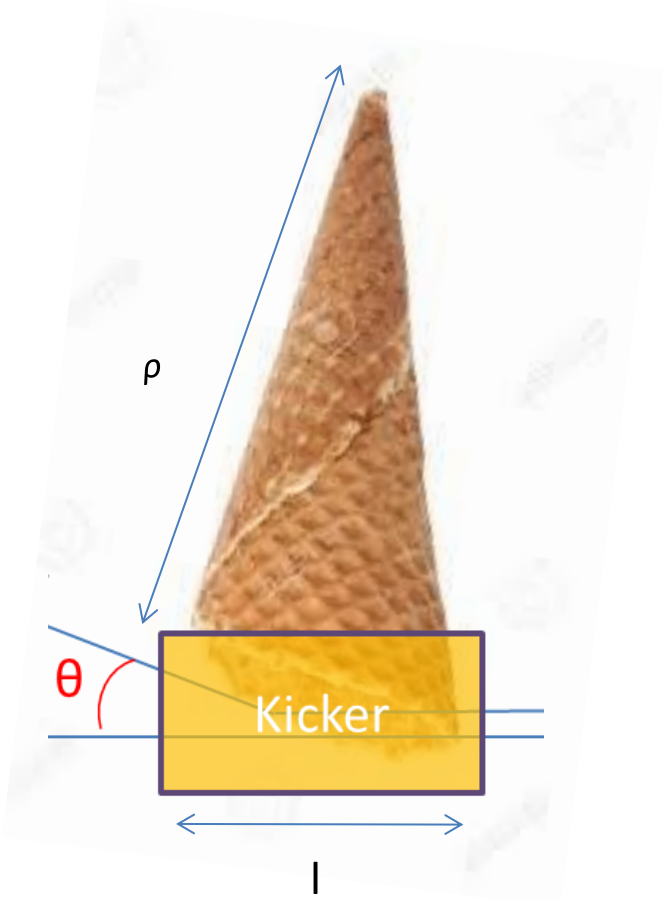
L = 8 m

QUAD DIAMETER = 40 cm

Septum lenght = 0.8 m
Septum field = 0.9 T
Septum Thickness = 3 mm

→ Septum Angle= 5.2 ° →

Max beam height = 29 cm



$B'' = K_2 B \rho / l$ $K_2 = 25\ m^{-2}$

$B = 0.1$ T magnetic field

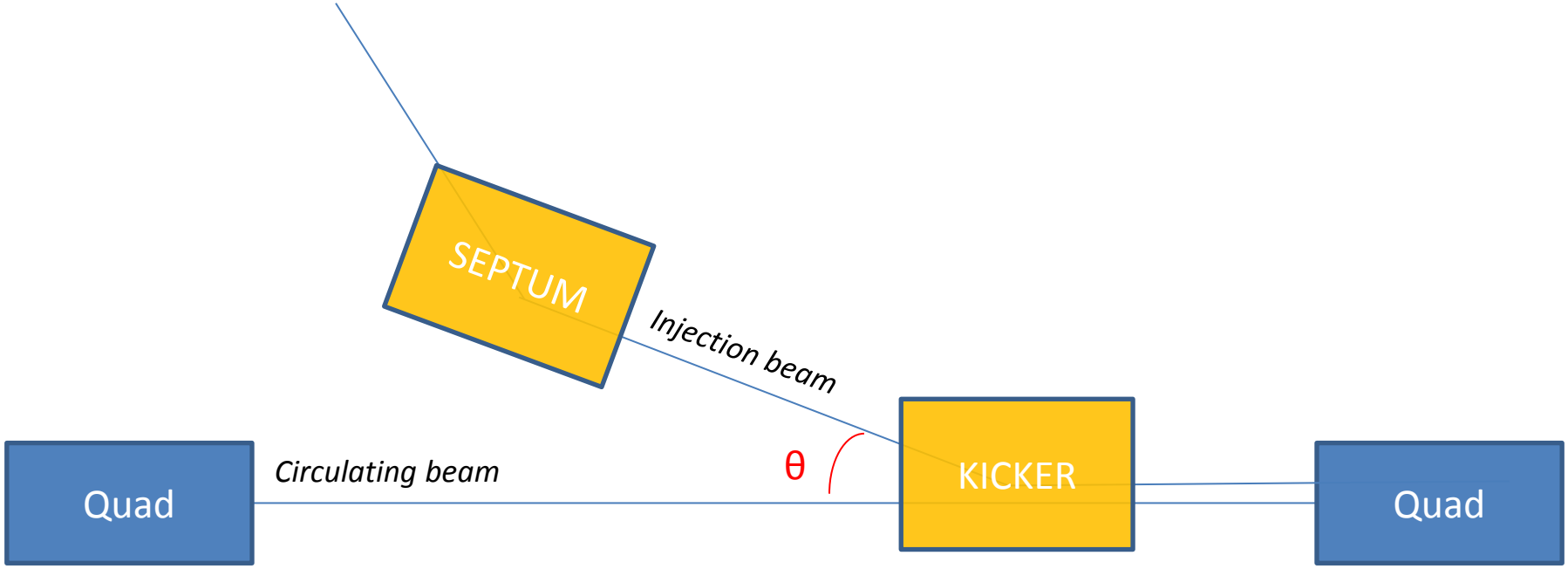
$P = c B \rho$ (P of the circulating beam 2.4 GeV)

$\rho = P / c B = 80$ m

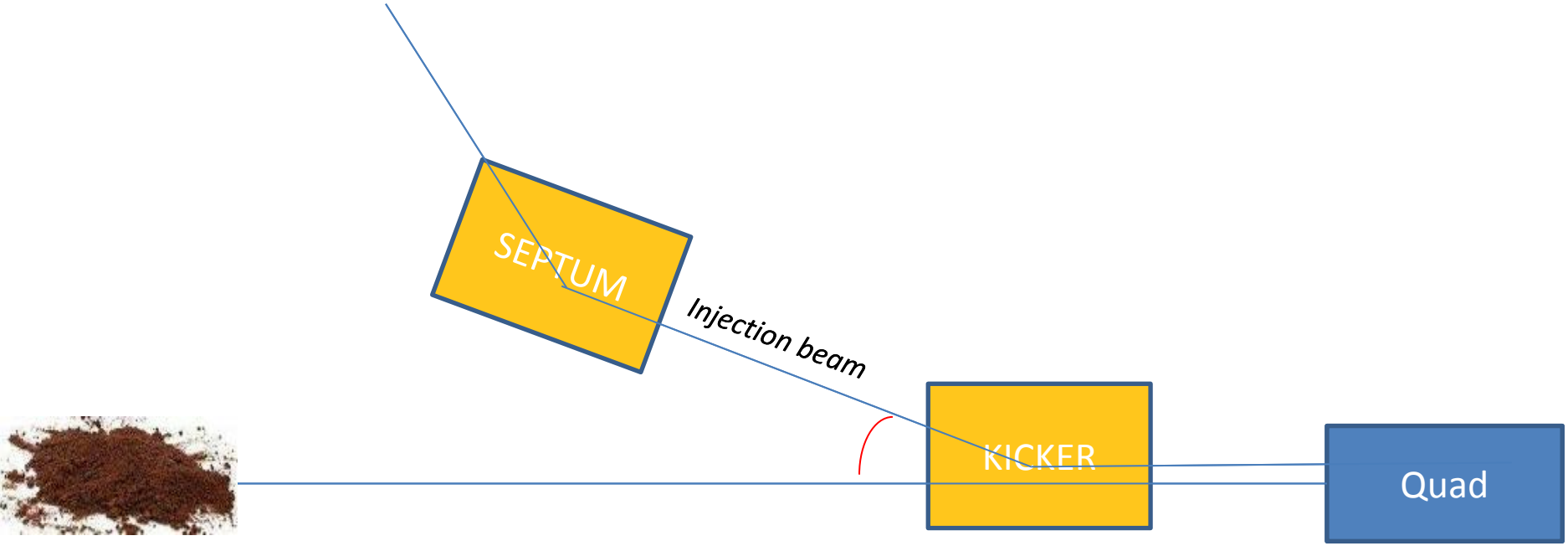
$l = 0.2$ m length of the magnet

$B'' = K_2 B \rho / l = 1000\ T/m^2$ sextupole field strength

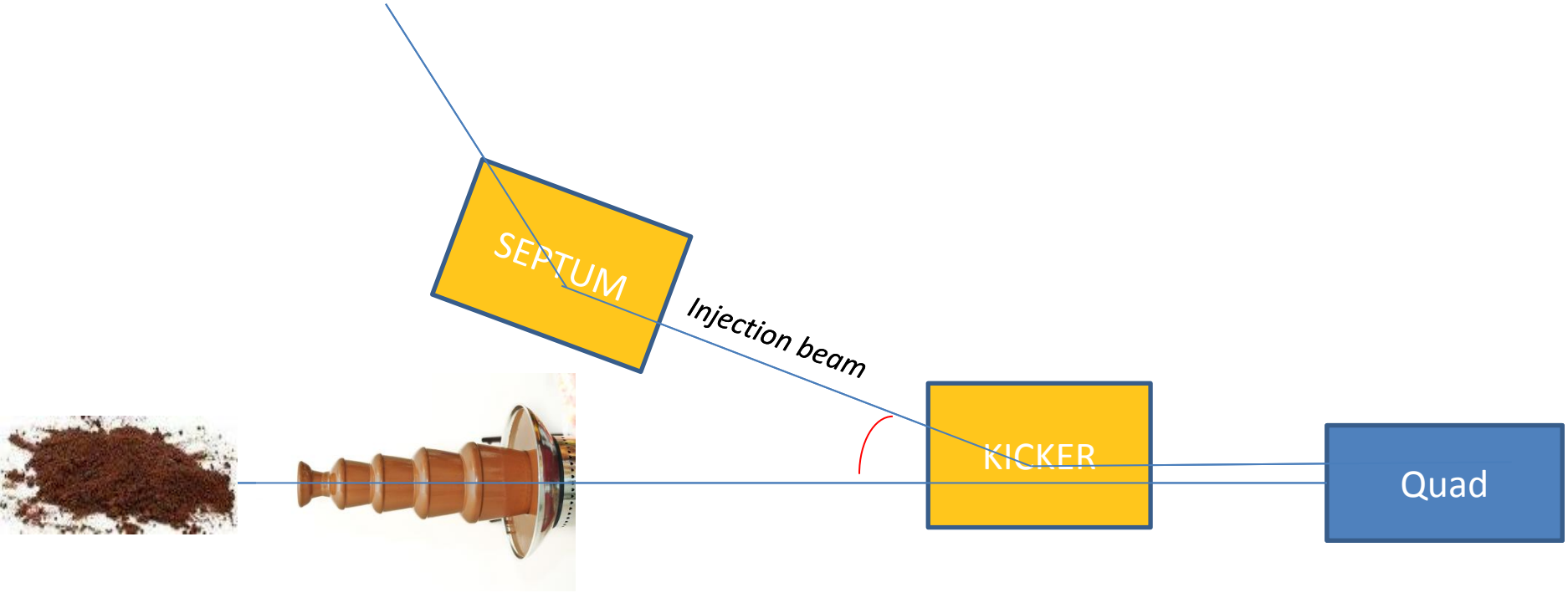
NEW SLS INJECTION FOR…..



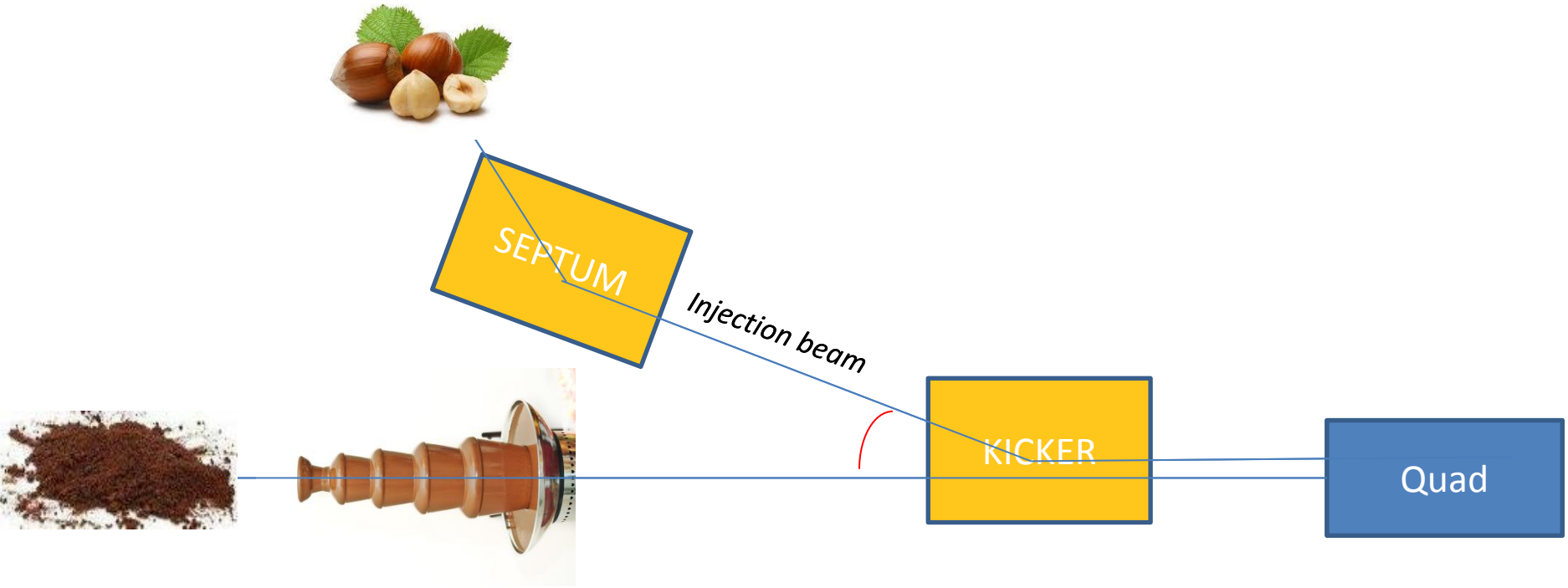
NEW SLS INJECTION FOR…..



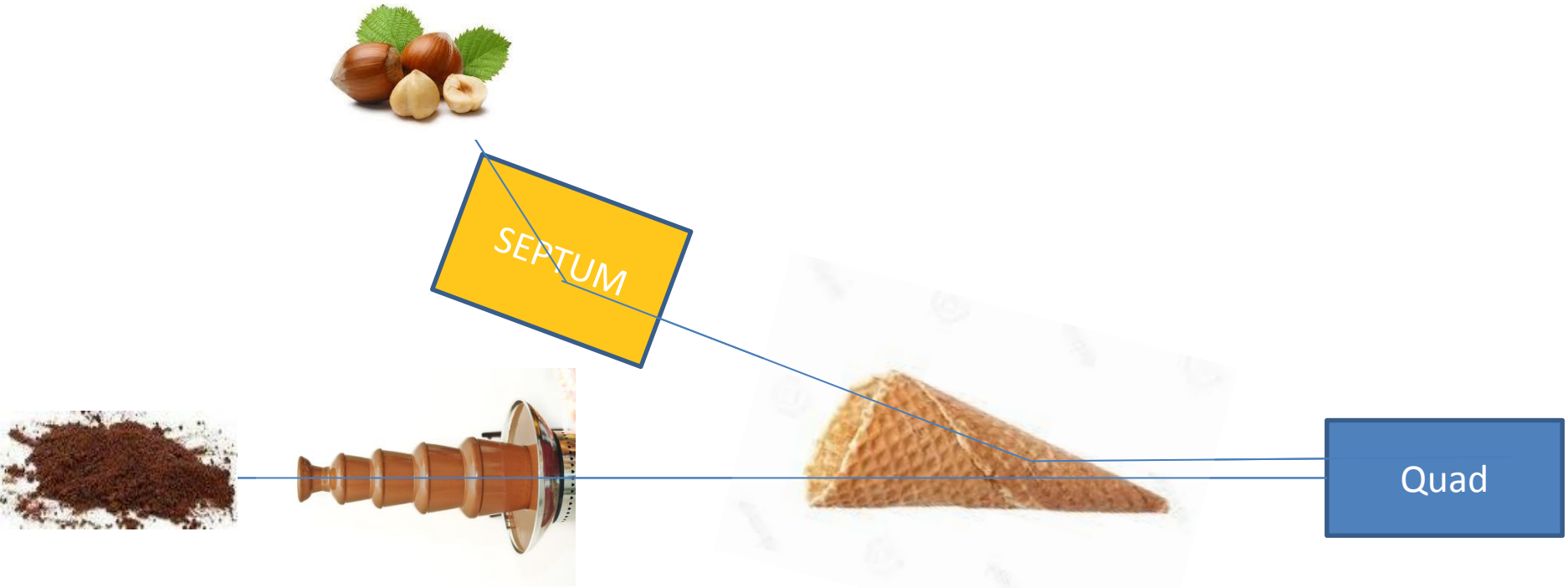
NEW SLS INJECTION FOR…..



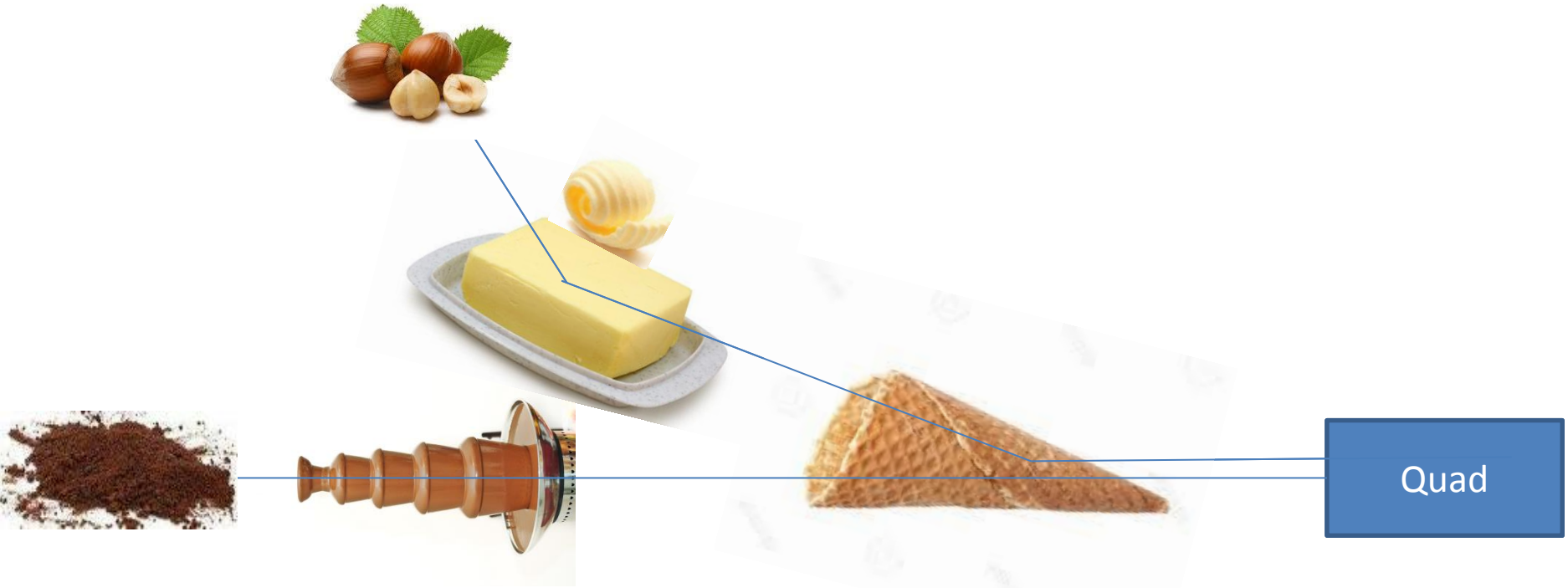
NEW SLS INJECTION FOR…..

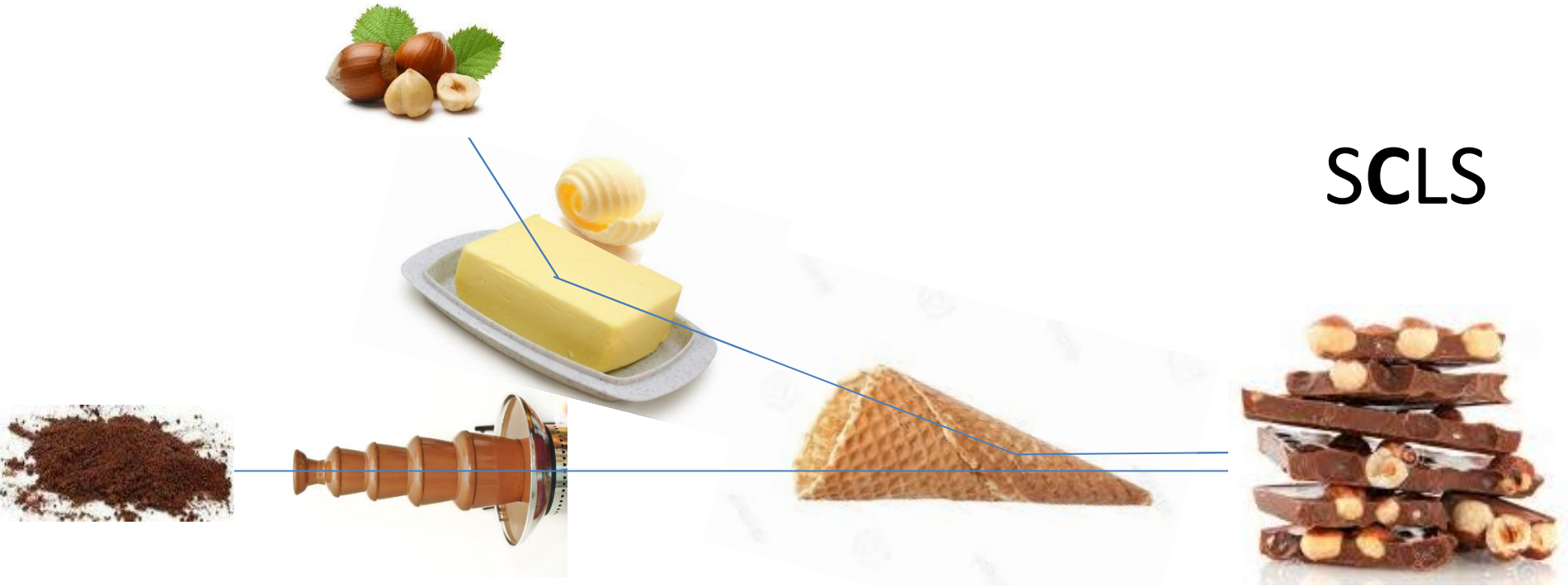


NEW SLS INJECTION FOR…..

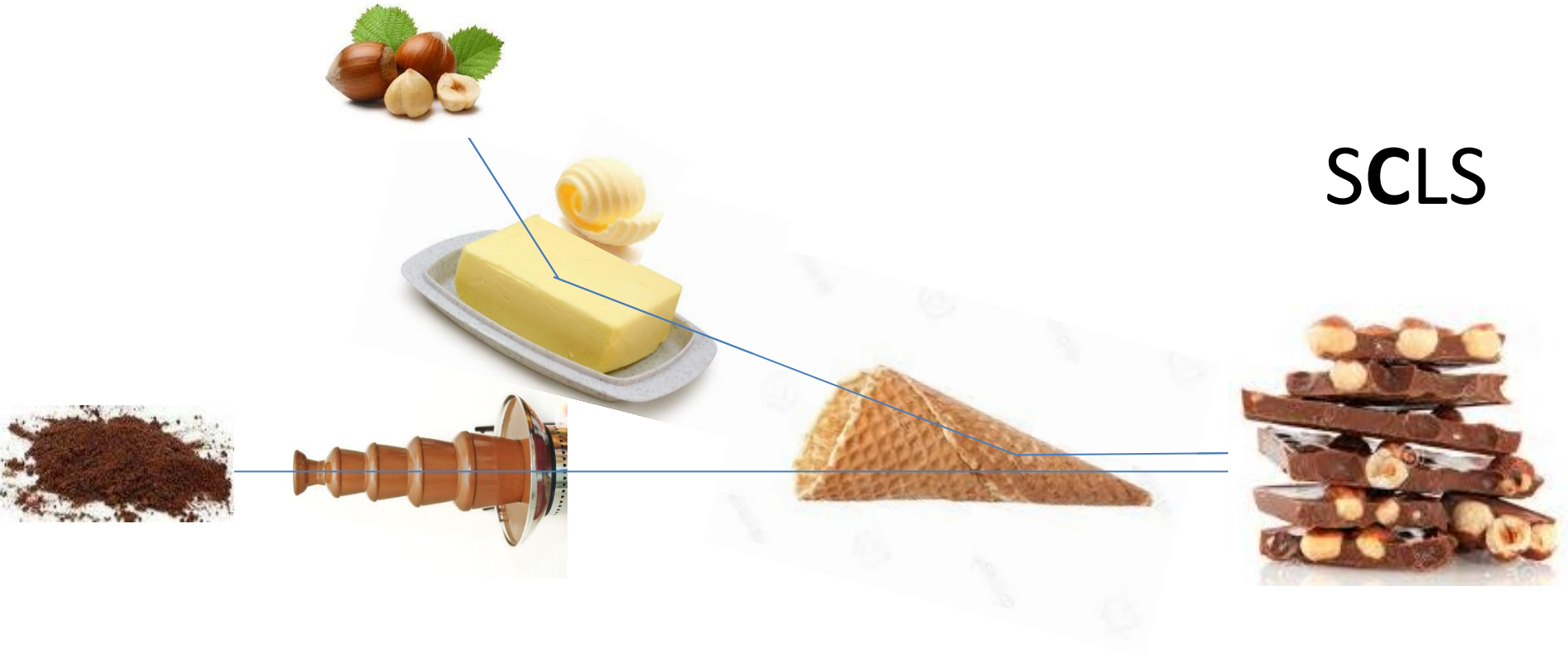


NEW SLS INJECTION FOR…..





SCLS



Swiss **Ciocc** Light Source!

THANK YOU!!!!