Novel beam-profile light monitors

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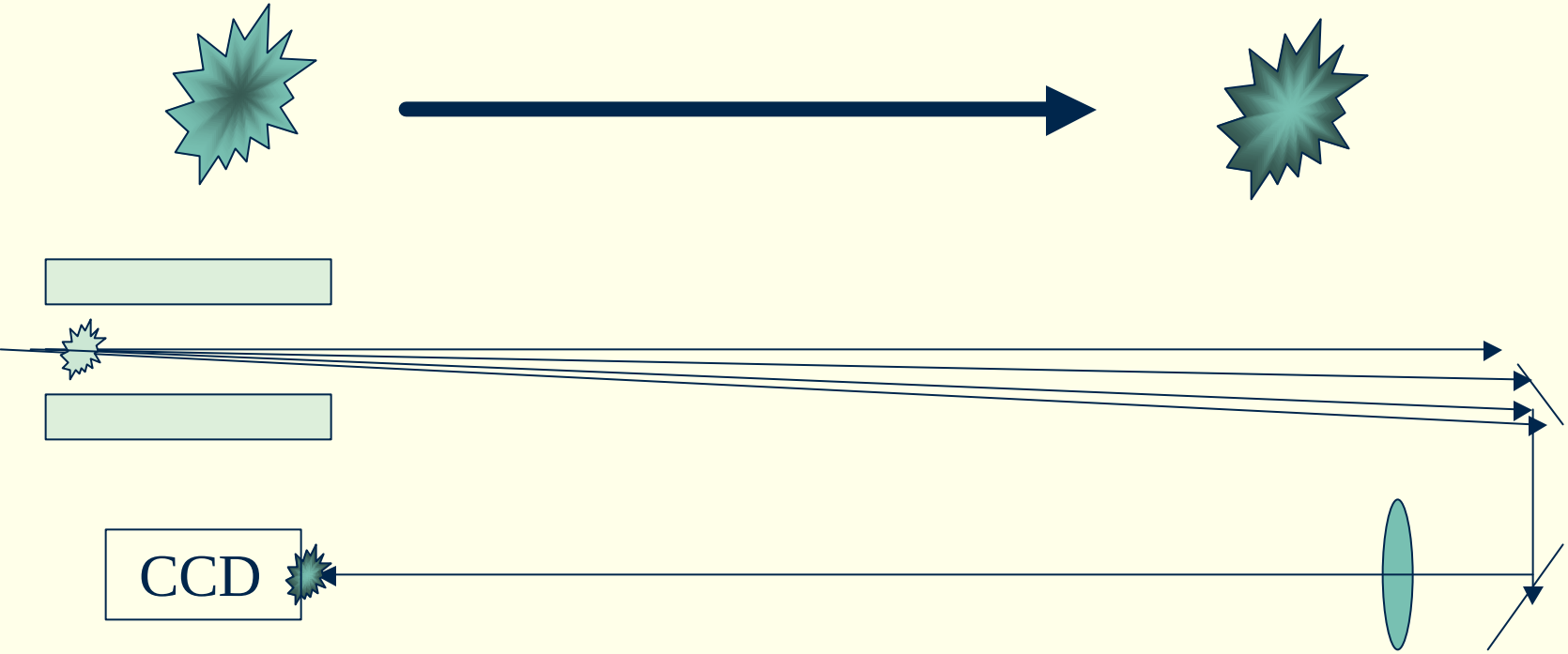
Outline

- ***m*-Wiggler for beam-profile monitor**
  - Non-linear intensity map
  - Large dynamic range
- Test at RHIC
- LHC -> shorter wavelength-> better resolution



$$l_{opt} = \frac{1}{2g^2} l_w (1 + g^2 q^2 + a_w^2 \downarrow_0)$$

Wiggler field

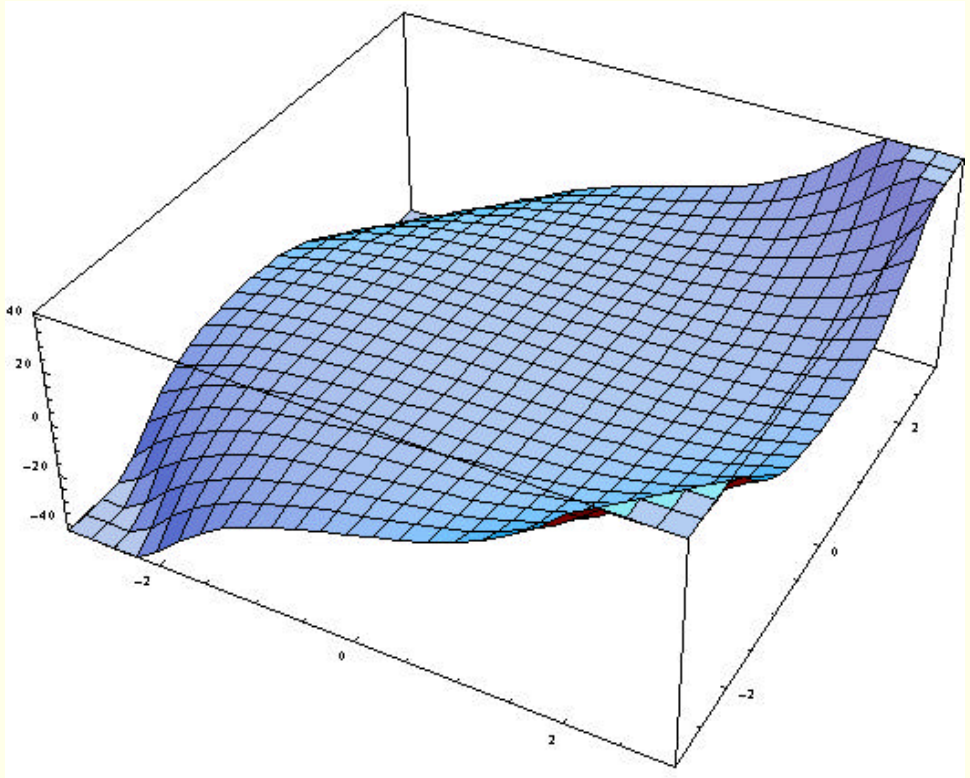
- ***m*-Wiggler - conventional - falls too fast**

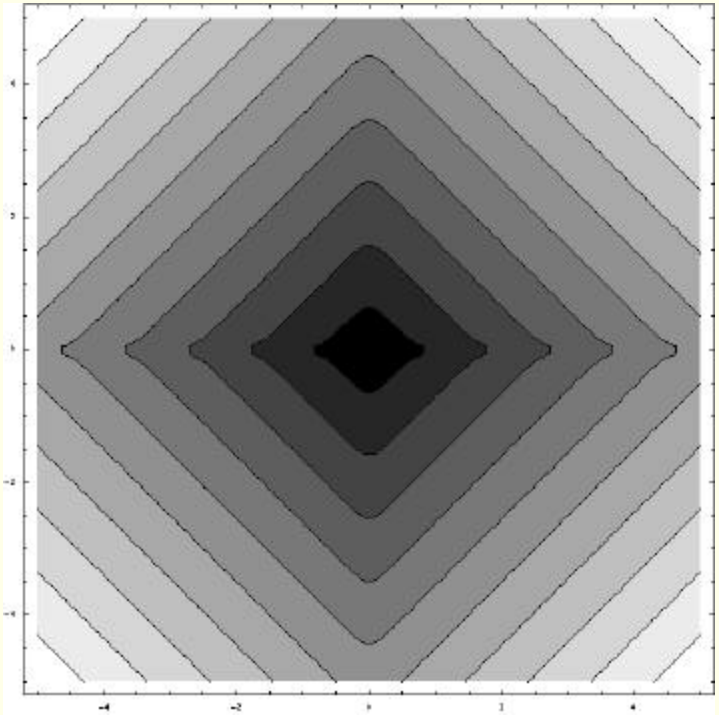
$$B_y = B_o \cdot \sin k_w z \cdot \cosh k_w y;\ k_w = \frac{2p}{l_w}$$

- ***m*-Wiggler - unconventional**

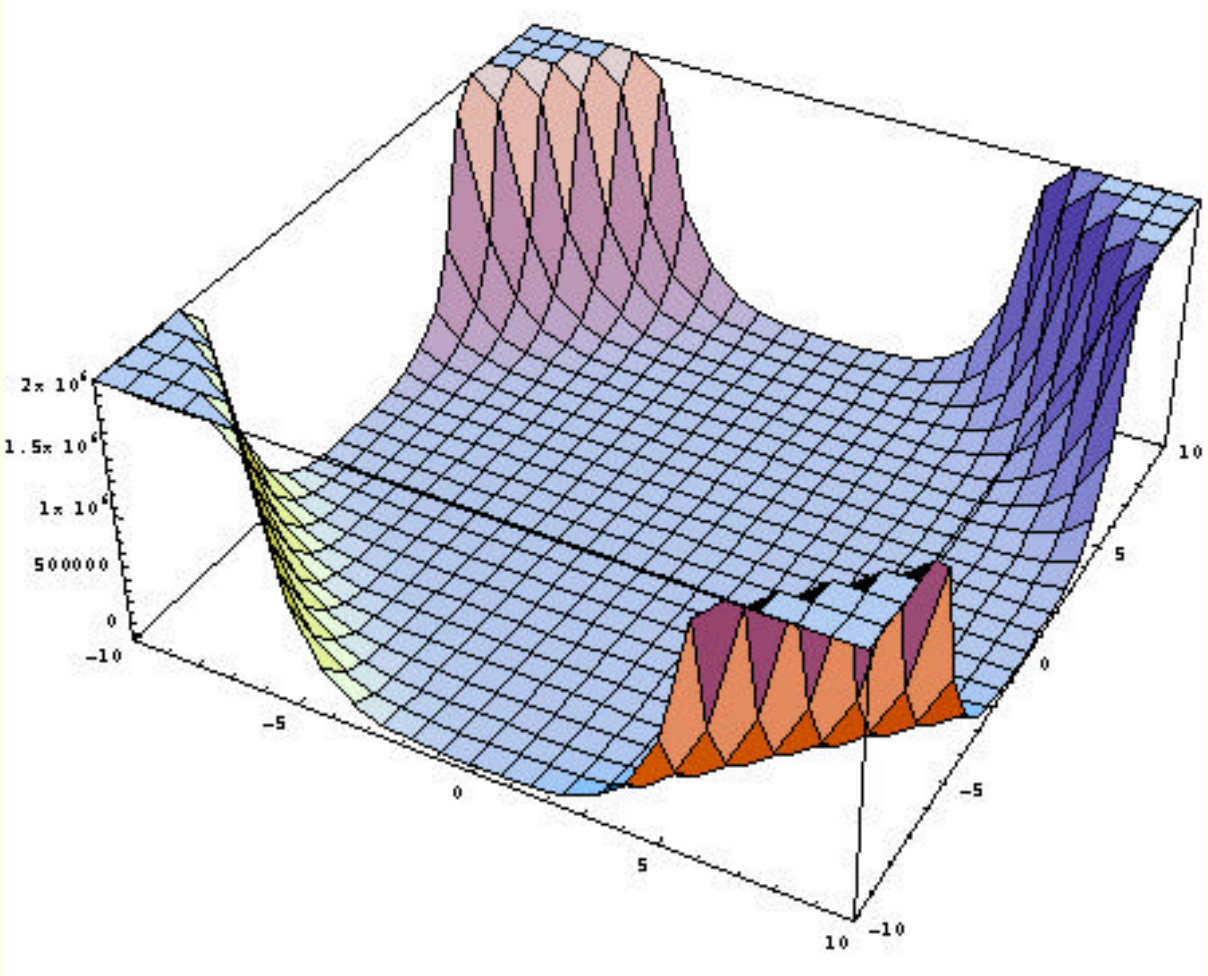
$$B_y = B_o \cdot \sin k_w z \cdot \cosh \frac{k_w y}{\sqrt{2}} \cdot \cosh \frac{k_w x}{\sqrt{2}}$$

Wiggler with enhanced field





Magnetic Potential Profile



Intensity field

- ***m-Wiggler - unconventional***

$$I \propto N_w \cdot B_y^{\,2}$$

$$I = I_o \cdot \cosh^2 \frac{k_w y}{\sqrt{2}} \cdot \cosh^2 \frac{k_w x}{\sqrt{2}} \cdot r(x,y)$$

$$k_w |x, y| >> 1$$

$$I \approx I_o \cdot \exp\left(\sqrt{2} k_w |y|\right) \cdot \exp\left(\sqrt{2} k_w |x|\right) \cdot r(x,y)$$

RI HIC prototype

m-Wiggler 3D wiggler

Constansts		
e	**1.60219E-19**	**C**
$m_e c^2$	5.10999E+05	eV
$m_e c^2$	0.51100	MeV
$m_p c^2$	9.38272E+08	eV
$m_p c^2$	0.93827	GeV
$m_{Au} c^2$	1.8484E+11	eV
$m_{Au} c^2$	184.83958	GeV
r_e	2.8179E-13	cm
r_p	1.5347E-16	cm
r_{Au+}	4.8620E-15	cm
c	2.99792E+10	cm/sec
s_{Th}	**1.98034E-28**	**cm^2**
a	**7.29735E-03**	
$Z*m_e/A*m_p$	**2.18400E-04**	***4.76984E-08***
$Z^2*m_e/A*m_p$	**1.72536E-02**	***2.97686E-04***

$^{197}Au^{79+}$

Number of bunches	6.0000E+01
Ni (# of ions per bunch)	1.0000E+09
Z	**79.0000**
A	**197.0000**
Z^2/A	*31.68*
r_{Au+}/r_e	*1.7254E-02*
m_e/m_p	5.4462E-04
Z/A	4.0102E-01
k factor	*2.1840E-04*
1.7254E-02	

Revolution frequency

γ	1.08000E+02		**Circumfeence**	**3833.845**	**m**
β	9.99957E-01	4.28679E-05		3.83E+05	cm
v	2.99780E+10	cm/sec	fo	7.8193E+04	Hz
λ	1.00000E-04	cm	fb	4.6916E+06	Hz
l **cut-off**	**1000.00**	**nm**	Ni/sec	4.6916E+15	i/sec
b_x	**30.00**	**m**	Length	3.0000E-01	m
$\varepsilon_{x\ 95\%\ norm}$	3.00E-05	m rad	coeff	2.2925E-02	
σ_x	1.18E-03	m	Cut-off wl	7.5000E-01	λ [μm]
12 σ_x	14.14	mm			
$B_{pole\text{-}tips}$	7.00	kGs			

$\lambda_{w,\ mm}$	λ [μm]	**Bw**	Max angle	Kwe	Nw
10	4.28669E-01	**2.61441E-02**	8.01662E-03	2.44186E–03	3.0000E+01
11	4.71536E-01	**4.62849E-02**	7.11546E-03	4.75531E–03	2.7273E+01
12	5.14403E-01	**7.44998E-02**	6.26627E-03	8.34994E–03	2.5000E+01
13	5.57270E-01	**1.11445E-01**	5.44525E-03	1.35316E–02	2.3077E+01
14	6.00137E-01	**1.57385E-01**	4.62698E-03	2.05797E–02	2.1429E+01
15	6.43004E-01	**2.12256E-01**	3.77705E-03	2.97370E–02	2.0000E+01
16	6.85871E-01	**2.75733E-01**	2.83127E-03	4.12056E–02	1.8750E+01
17	7.28738E-01	**3.47306E-01**	1.58159E-03	5.51452E–02	1.7647E+01
18	7.71605E-01	**4.26335E-01**		7.16754E–02	1.6667E+01
19	8.14472E-01	**5.12106E-01**		9.08784E–02	1.5789E+01
20	8.57339E-01	**6.03867E-01**		1.12802E–01	1.5000E+01

$\lambda_{w,\ mm}$	Flux per e-	Flux per Ag++	**Flux total**	ρ	**Visible**	
10	4.1009E-06	1.22E-09	**5.73E+06**	0.57	**0.45**	2.55E+06
11	1.4138E-05	4.21E-09	**1.97E+07**	0.63	**0.40**	7.92E+06
12	3.9960E-05	1.19E-08	**5.58E+07**	0.69	**0.35**	1.98E+07
13	9.6871E-05	2.88E-08	**1.35E+08**	0.74	**0.30**	4.10E+07
14	2.0806E-04	6.19E-08	**2.91E+08**	0.80	**0.25**	7.20E+07
15	4.0545E-04	1.21E-07	**5.66E+08**	0.86	**0.19**	1.06E+08
16	7.2984E-04	2.17E-07	**1.02E+09**	0.91	**0.12**	1.20E+08
17	1.2303E-03	3.66E-07	**1.72E+09**	0.97	**0.04**	7.10E+07
18	1.9629E-03	5.84E-07	**2.74E+09**	1.00	**0.00**	0.00E+00
19	2.9895E-03	8.90E-07	**4.18E+09**	1.00	**0.00**	0.00E+00
20	4.3757E-03	1.30E-06	**6.11E+09**	1.00	**0.00**	0.00E+00

Note: with a conventional wiggler flux of visible photons is dramatically lower by 3-to-6 orders of magnitude

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.