



KNOT-APPLEアンジュレータの概念設計

CONCEPTUAL DESIGN OF KNOT-APPLE UNDULATOR

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Outline

- ◆ Motivation of consideration
- ◆ Knot-undulator to Knot-APPLE undulator
- ◆ Magnetic structures
- ◆ Expected performance
- ◆ **Summary**

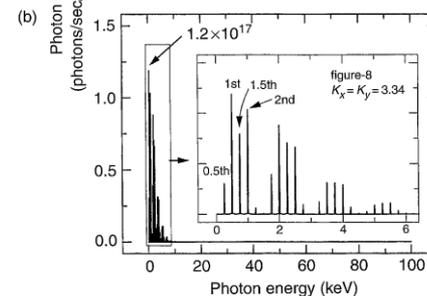
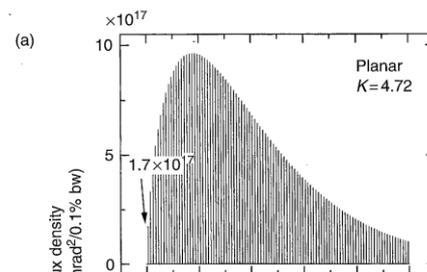
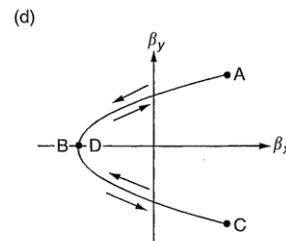
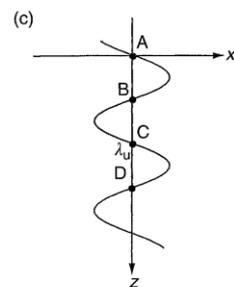
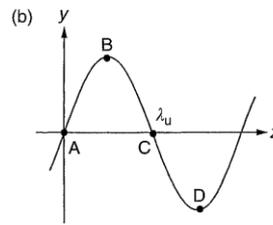
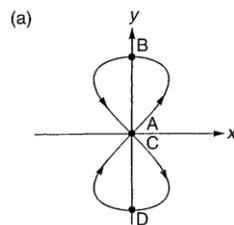
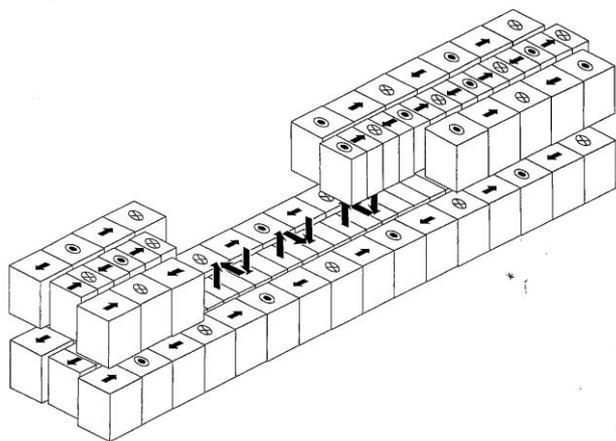


Motivation of consideration

放射光ユーザーによる“無理筋”の要求

高いエネルギーの光源リングでも
低いエネルギーの光子ビームを利用したい。

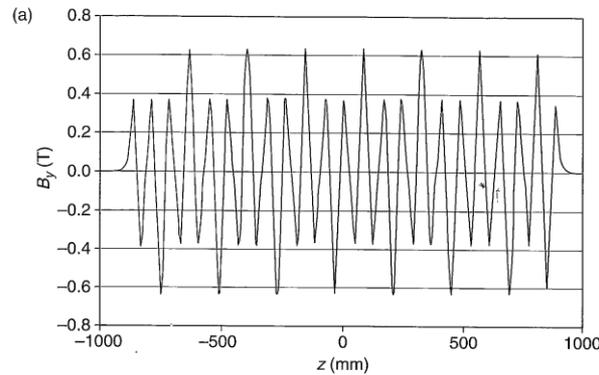
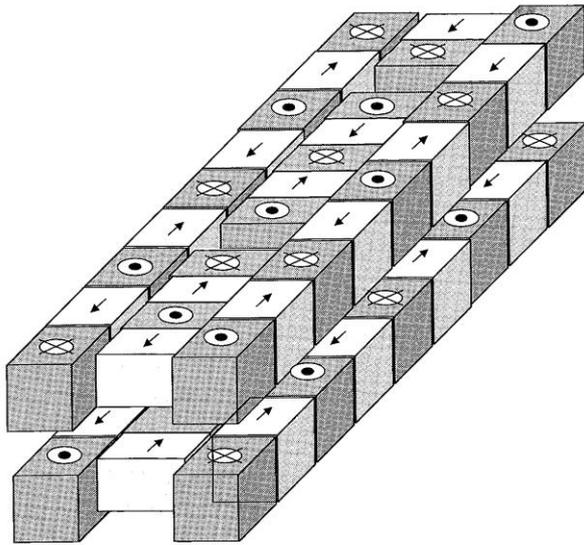
パイオニア：8 GeVリングで250 eVの光子ビーム発生を目指した
SPring-8 → Figure-8 アンジュレータ





Motivation of consideration (cont.)

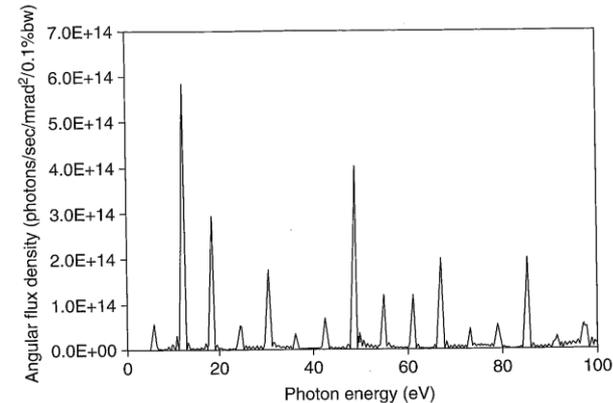
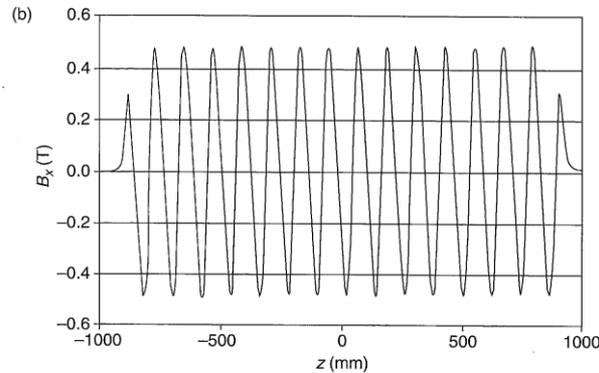
Figure-8アンジュレータと同様、ビーム軸上のパワーを低減できる
新奇アンジュレータのアイデア \rightarrow PERA



$$B_x = -B_{x0} \sin(2\pi z / \lambda_x)$$

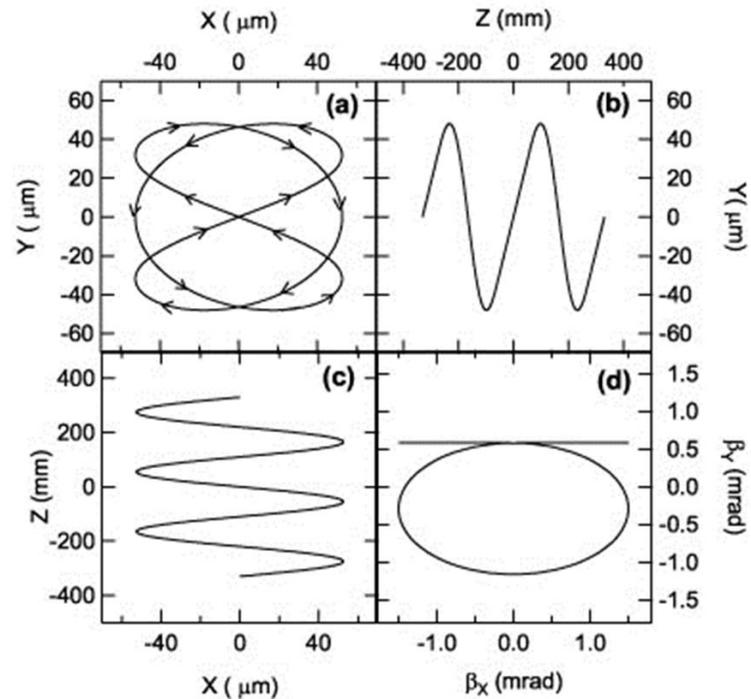
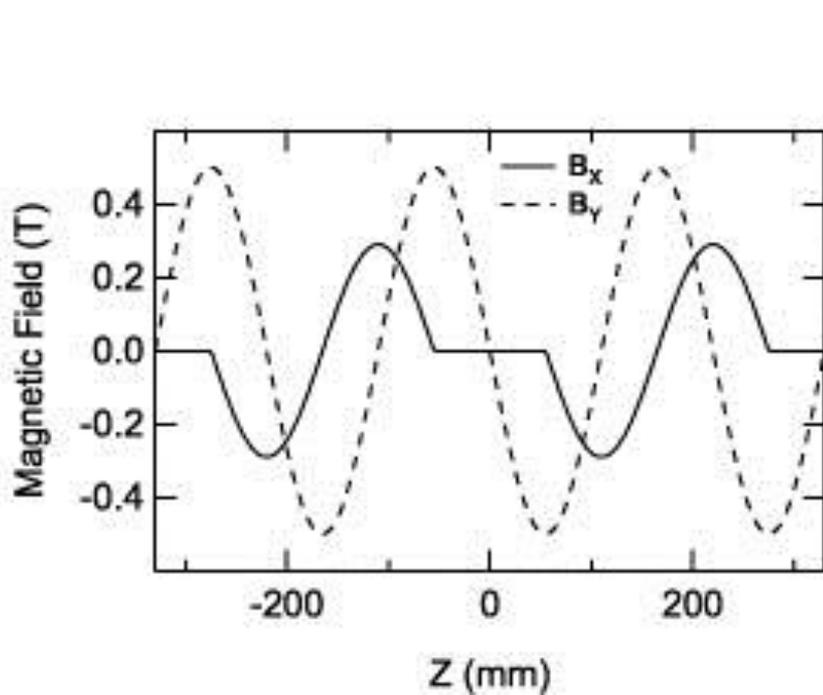
$$B_y = B_{y0} \left\{ \frac{1}{2} \cos(2\pi z / \lambda_{y1}) + \frac{3}{2} \cos(2\pi z / \lambda_{y2}) \right\}$$

Here, $\lambda_{y1} = 2\lambda_x$ and $\lambda_{y2} = 2\lambda_x/3$.



Motivation of consideration (cont.)

Figure-8アンジュレータと同様、ビーム軸上のパワーを低減できる
新奇アンジュレータのアイデア → Knotアンジュレータ





Motivation of consideration (cont.)

最近のさらにアップグレードした“無理筋”要求

偏光可変かつ全ての偏光状態で軸上放射パワーが小さい放射光が
欲しい。

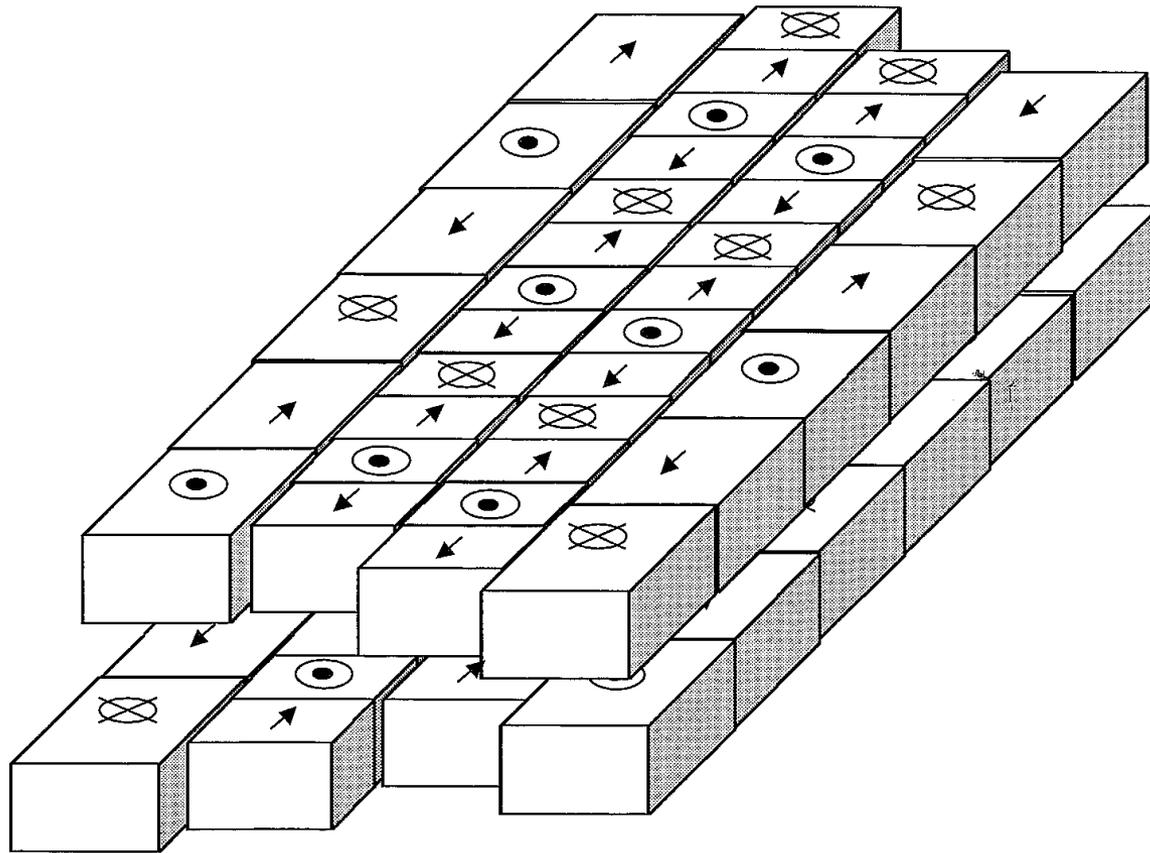
7-70 eV photon beam from 3.5 GeV ring at SSRF by Shan Qiao



APPLE-8 or Knot-APPLE



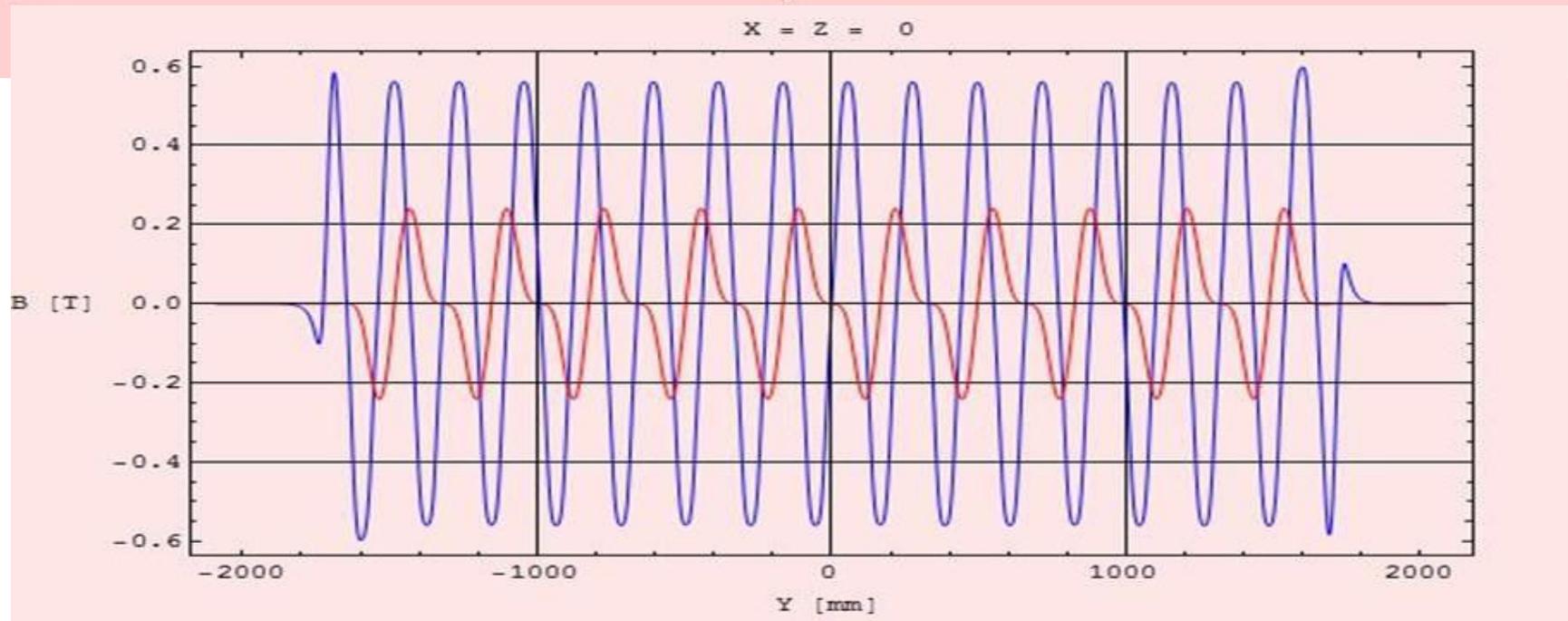
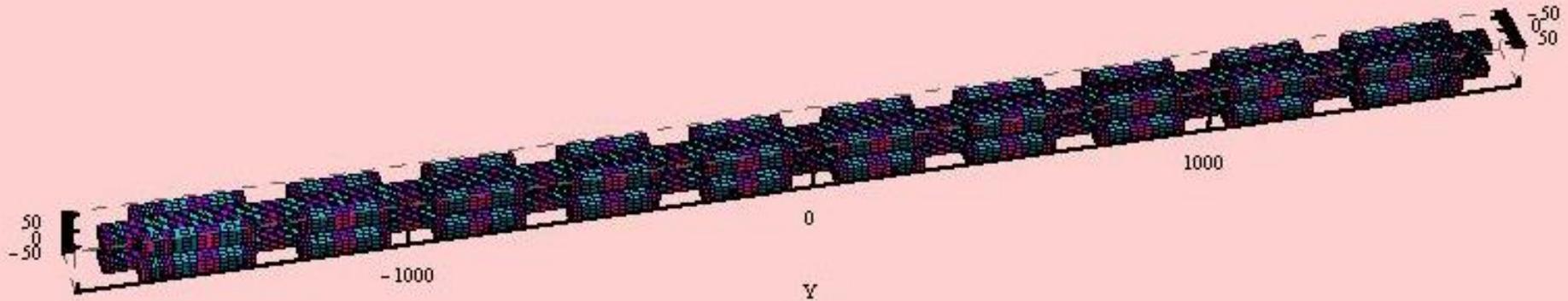
APPLE-8 undulator





Knot-undulator to Knot-APPLE undulator

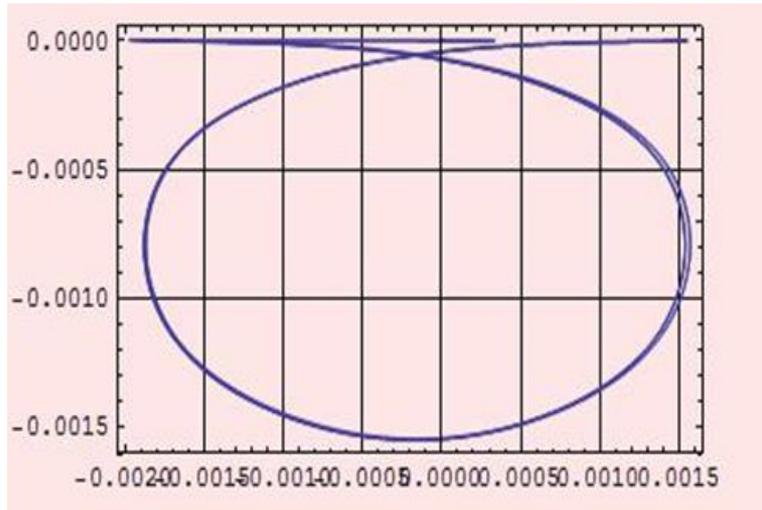
gap=40 mm, $\lambda_v=220$ mm, $\lambda_h=330$ mm



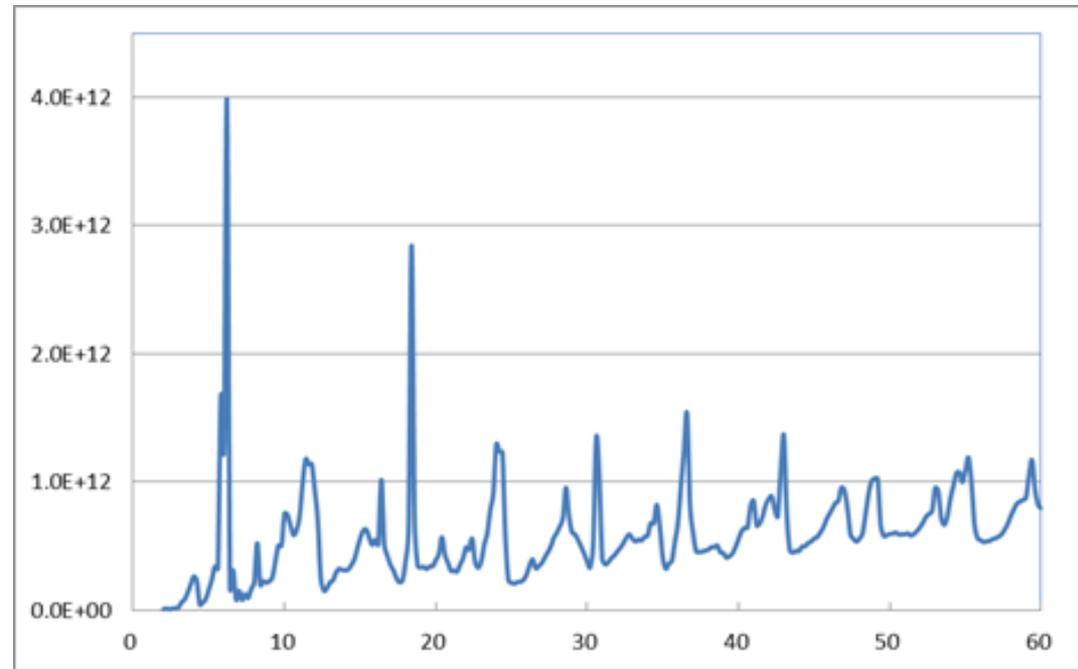


Knot-Undulator

SSRF: $E=3.5$ GeV, $I=200$ mA, $\varepsilon_0=11.2$ nrad



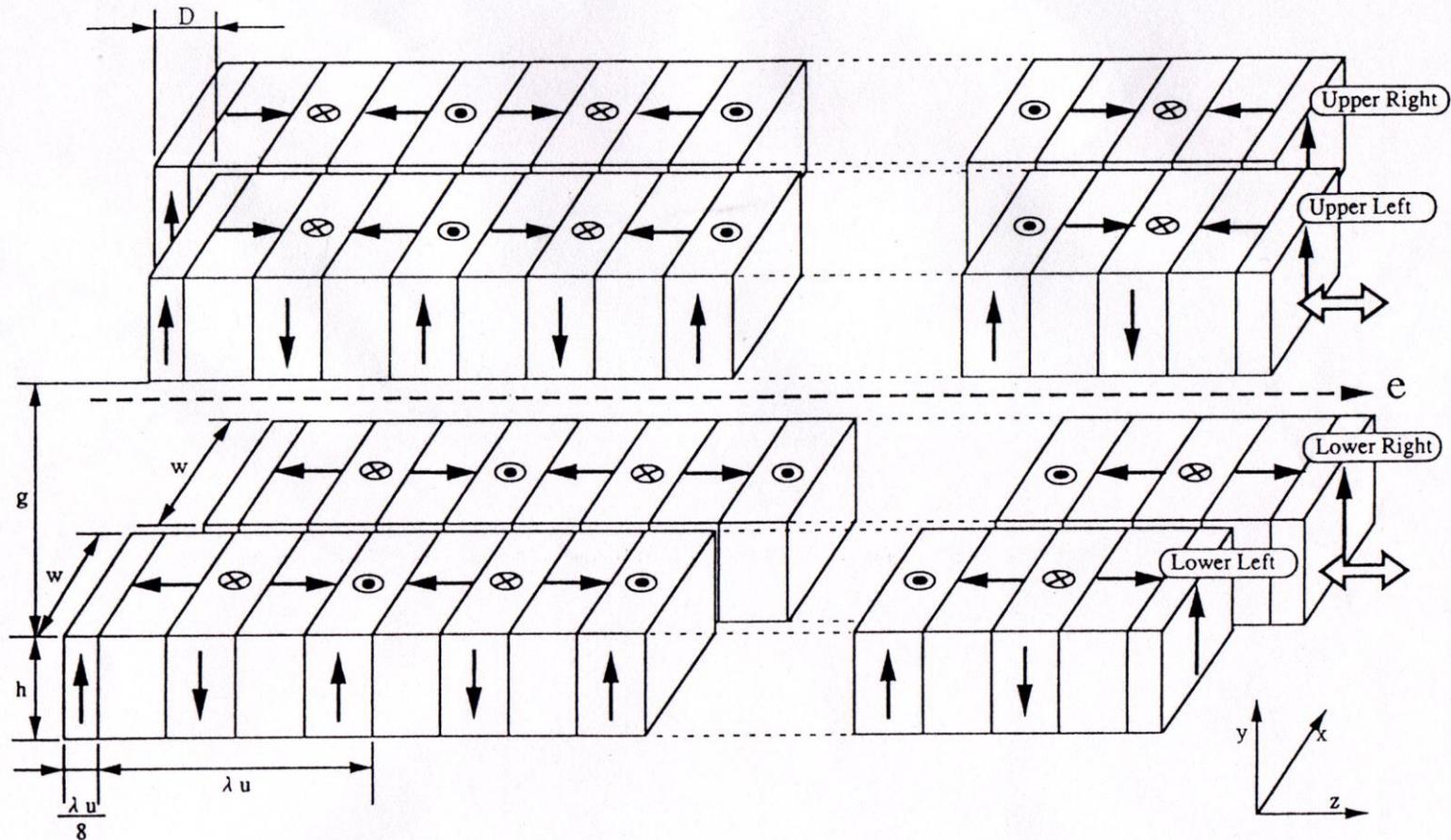
kick angle



PL \geq 99%

spatial flux density

APPLE-II型アンジュレータ



Schematic view of the magnetic structure for generating variably polarized undulator radiation. $D = \lambda_u/4$.

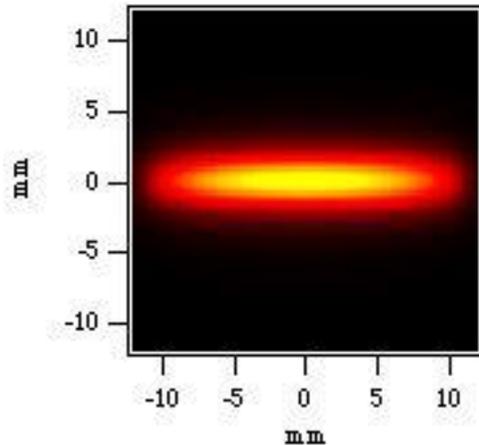


Radiation from APPLE II undulators

Advantage: High flexibility

Various polarization states:

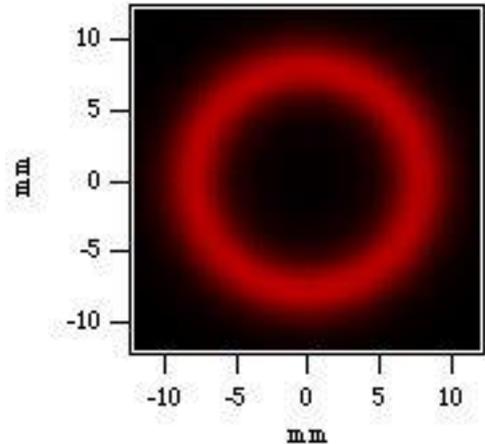
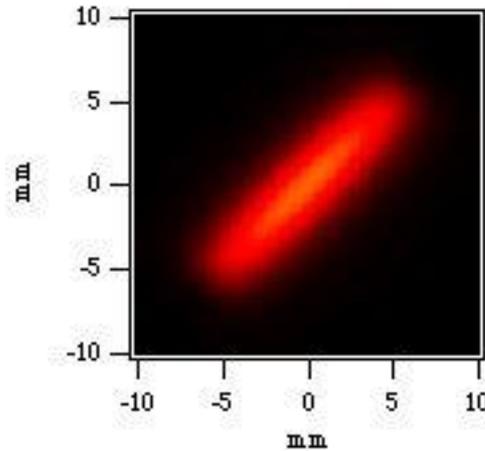
- elliptic
- linear inclined



horizontal



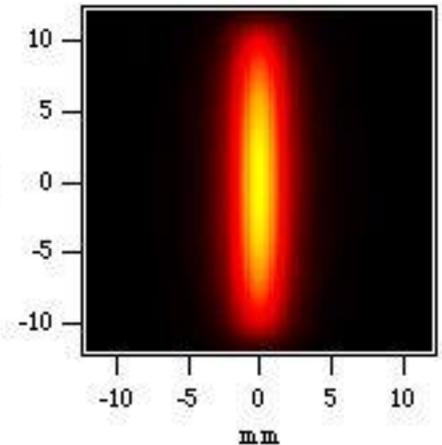
Linear inclined



Circular



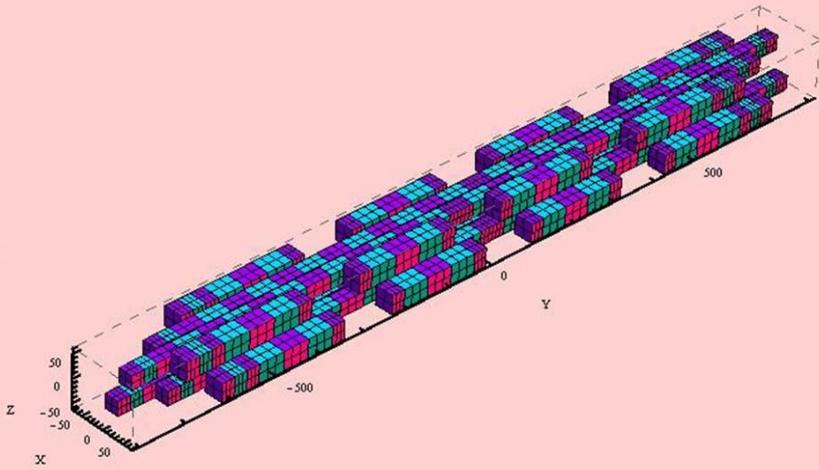
ID: ESRF-HU88 gap 16 mm,
power density @ 30m



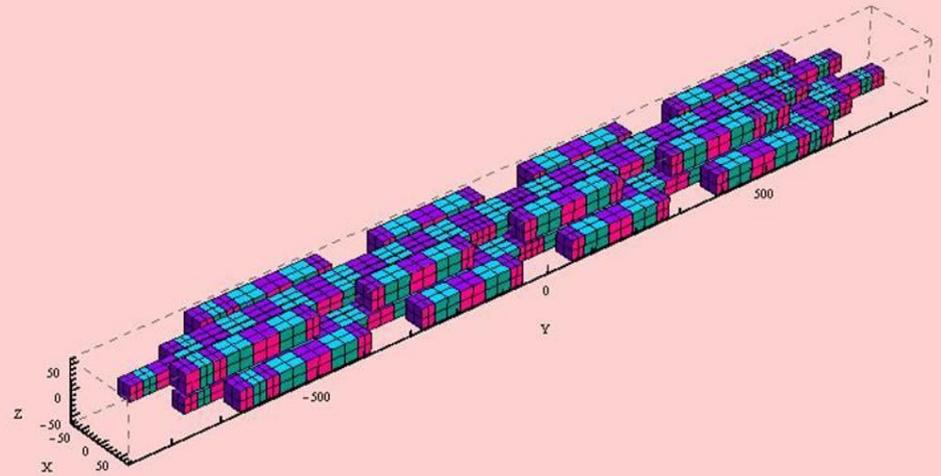
Vertical



Knot-APPLE



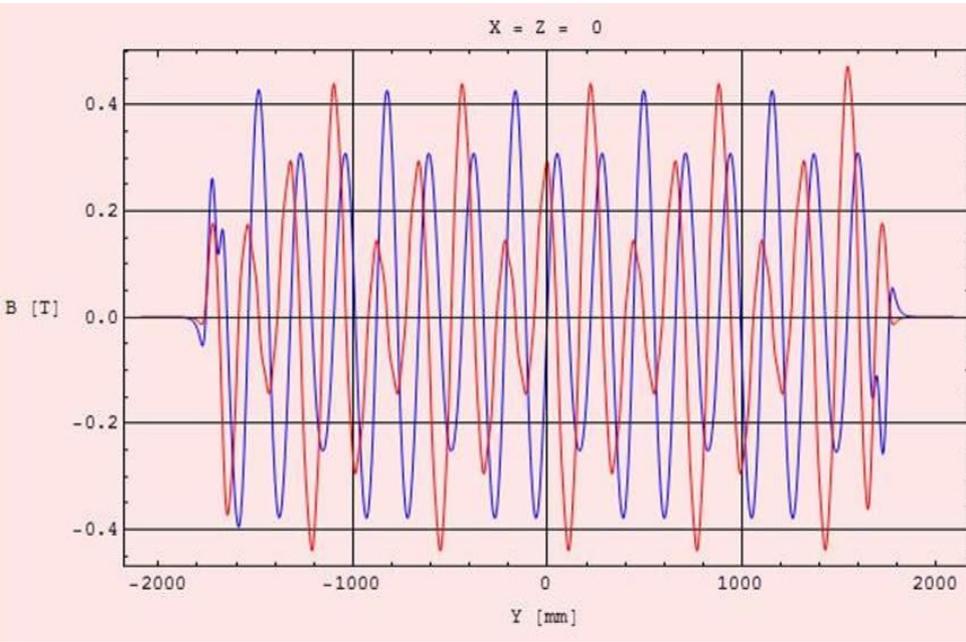
$D=65$ mm, parallel



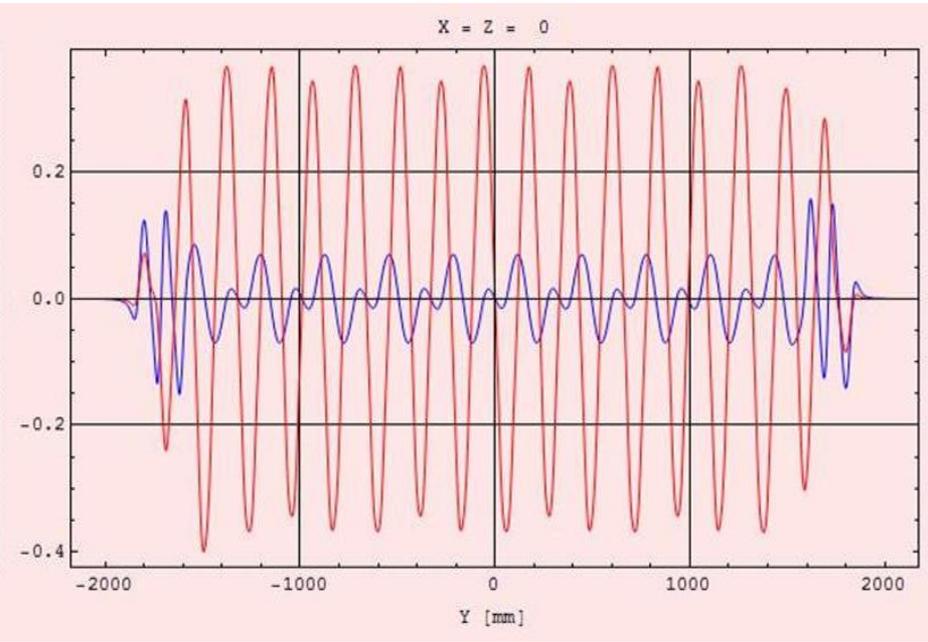
$D=110$ mm, antiparallel



Knot-APPLE field



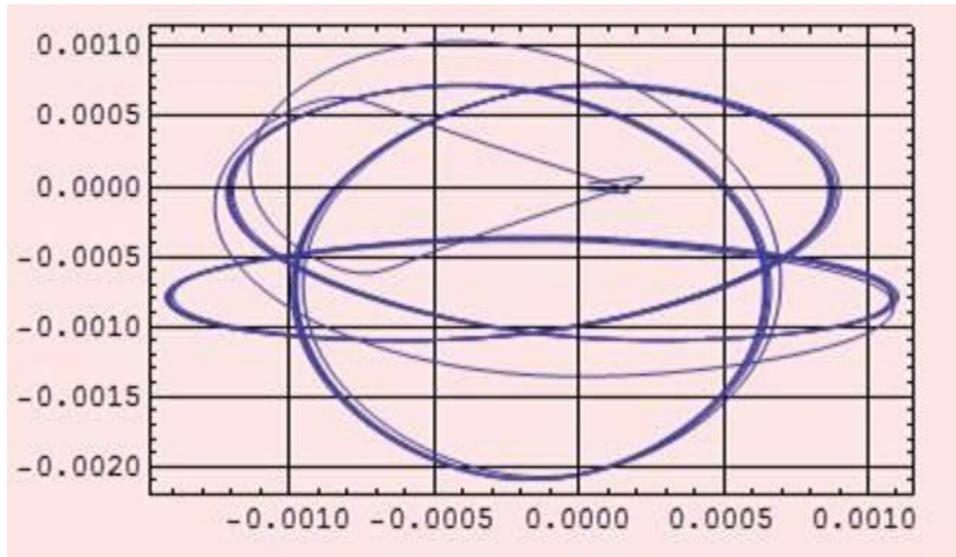
$D=65$ mm, parallel



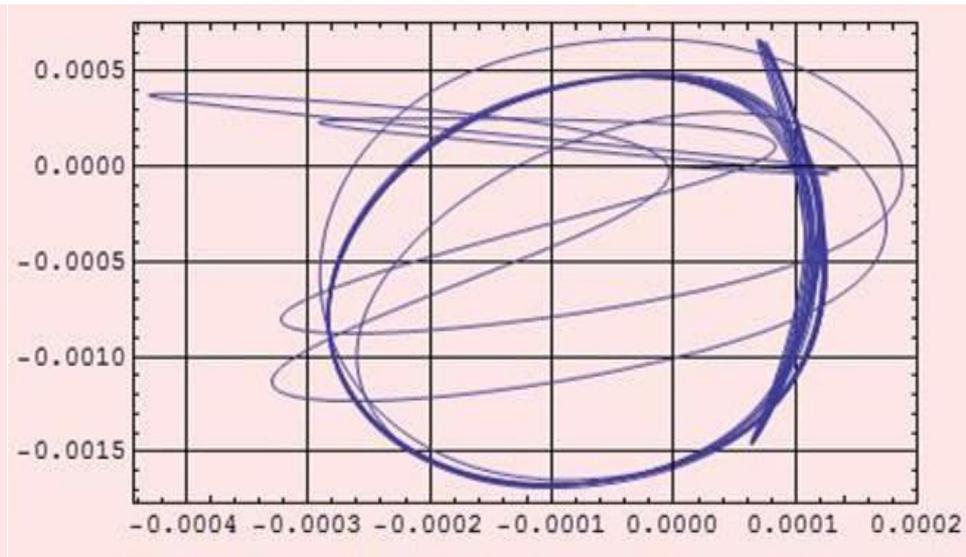
$D=110$ mm, antiparallel



Knot-APPLE : kick angle



$D=65$ mm, parallel
circular

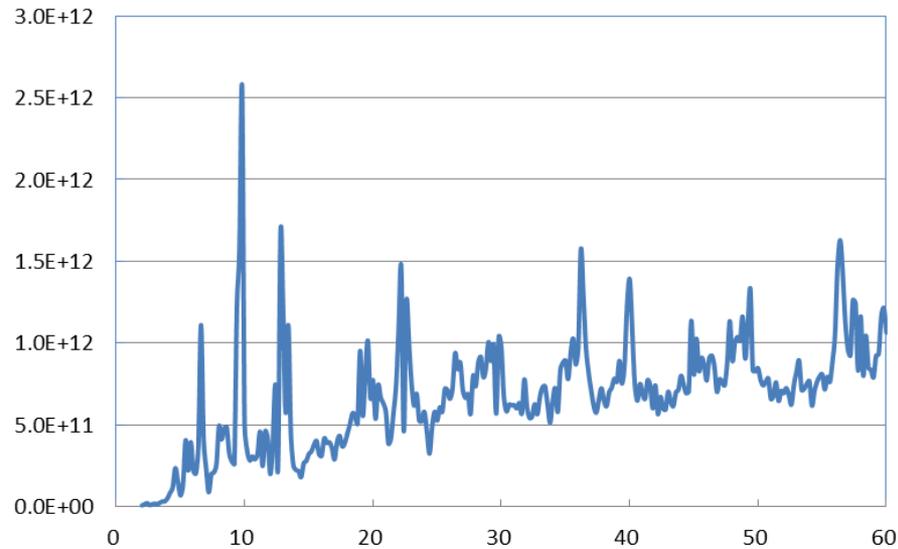


$D=110$ mm, antiparallel
vertical linear



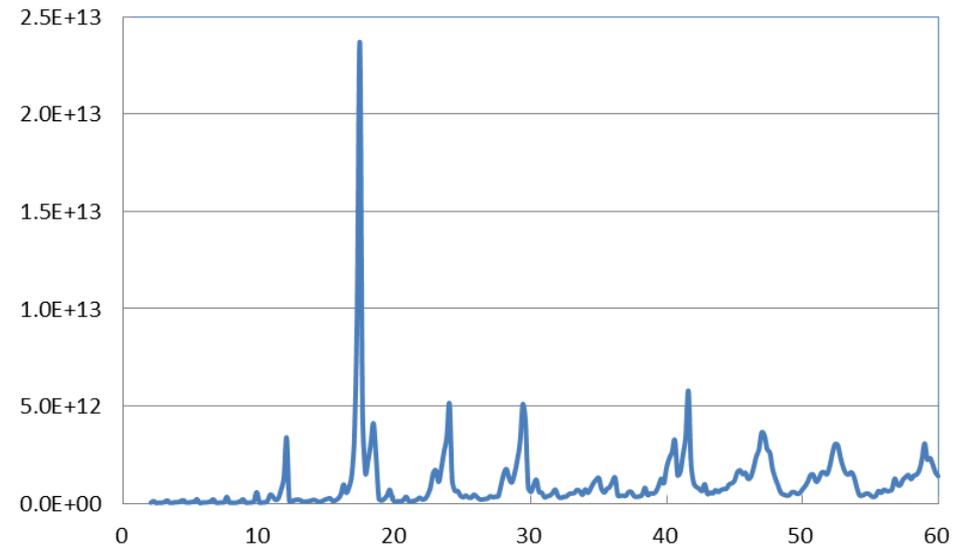
Knot-APPLE : SFD

$P_c \approx 90\%$



$D=65$ mm, parallel
circular

$P_L \approx 97\%$



$D=110$ mm, antiparallel
vertical linear



まとめ

世界で現在稼働中の、あるいはこれから建設されるであろう中エネルギーの高輝度光源リングで、真空紫外線域や低エネルギー軟X線を利用する放射光ユーザーを想定して、軸上放射パワーが小さくかつ偏光可変の挿入光源Knot-APPLEアンジュレータを提唱した。

3 GeVクラスの光源リングで、光子エネルギー10 eV程度の光を発生するには、周期長の長い($\lambda_u > 200$ mm)アンジュレータを大きな K 値(~ 10)で使用する必要があり、本アイデアが有用であると考えられる。