HELMHOLTZ ZENTRUM BERLIN
für Materialien und Energie

WAVE
A General Purpose Code for Synchrotron Radiation

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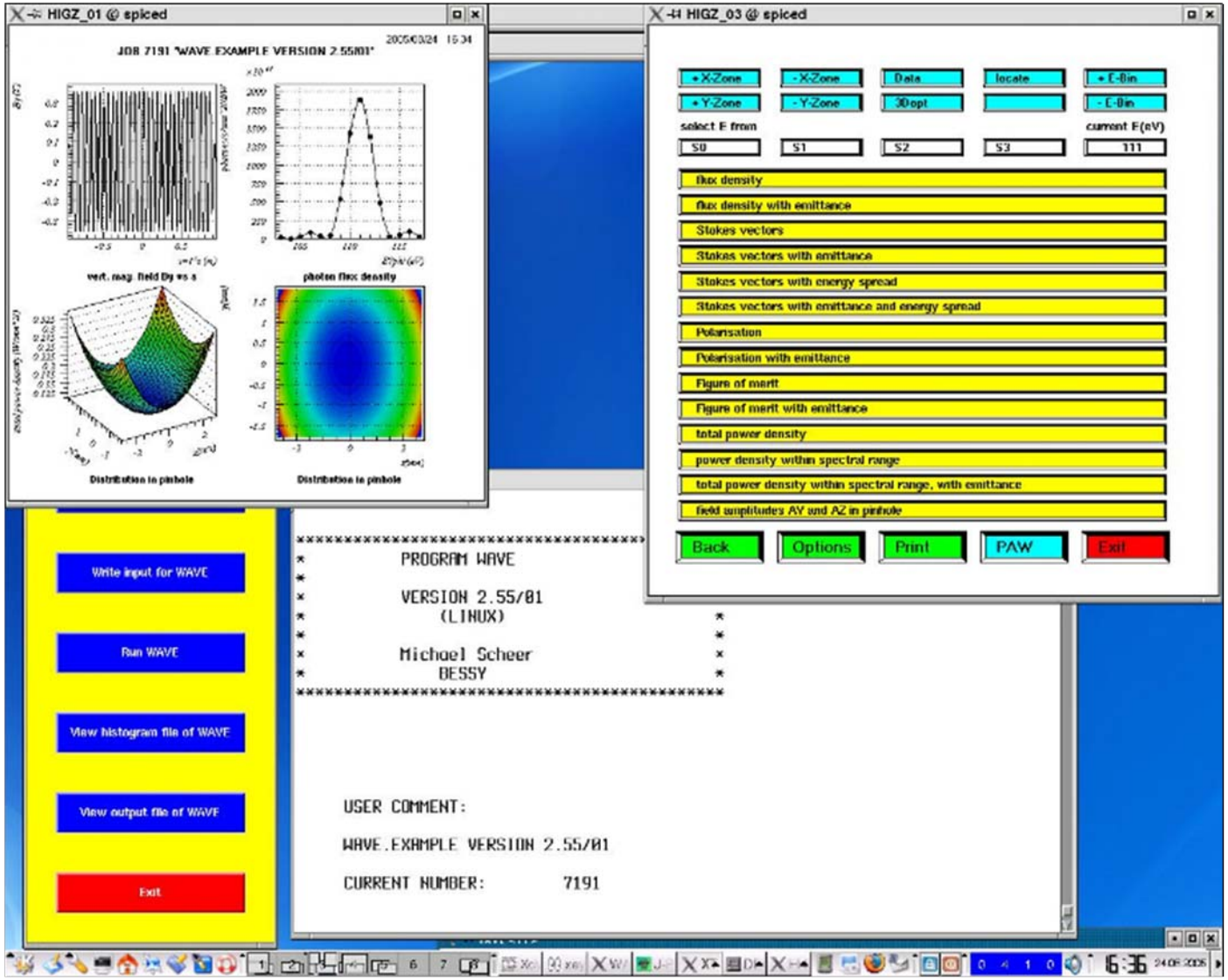
Graphical User Interface



WAVE is controlled by input files to be run in batch mode

GUI:

To handle files and visualize results

Based on Perl-Tk and PAW

Main Features

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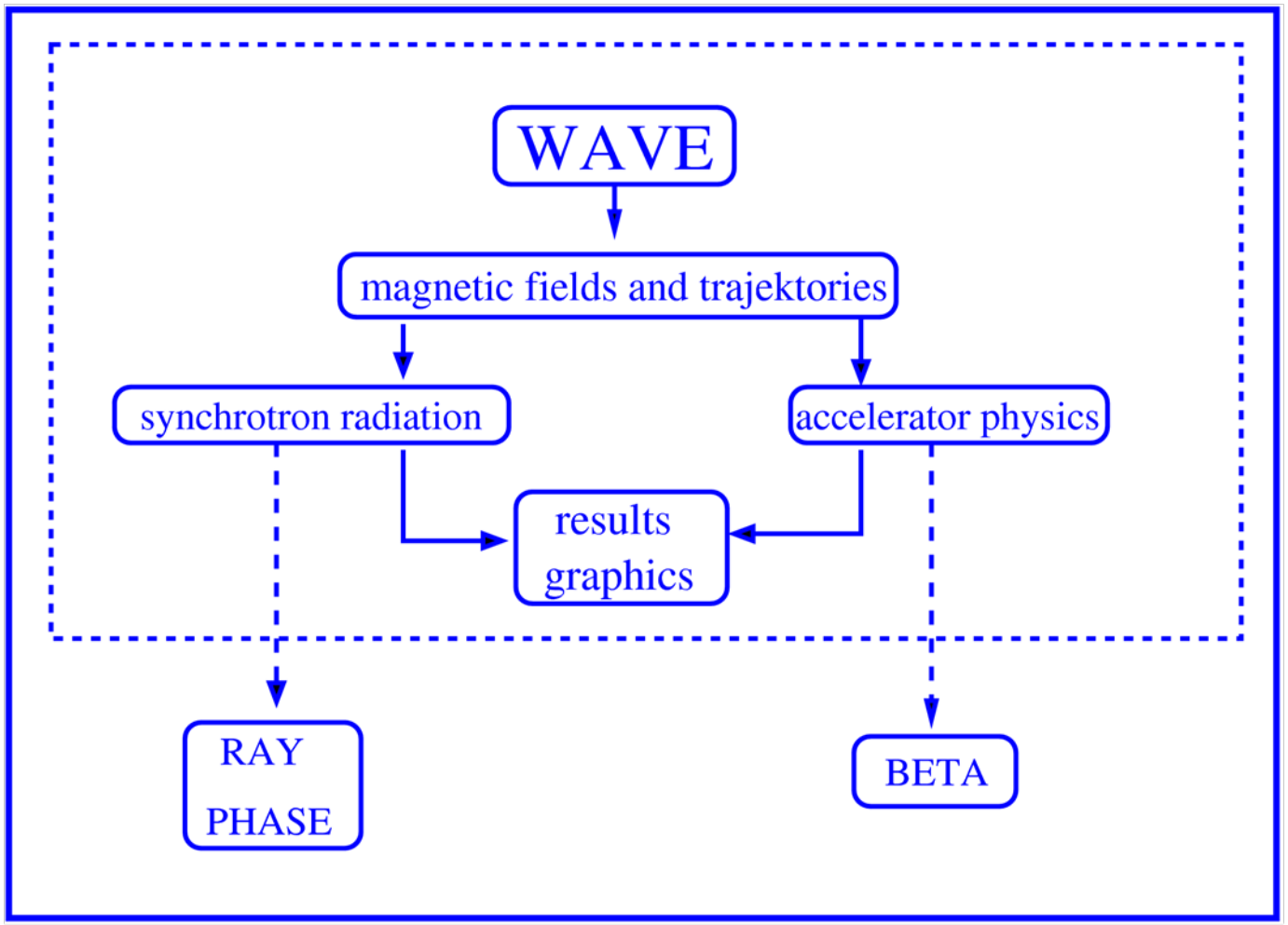
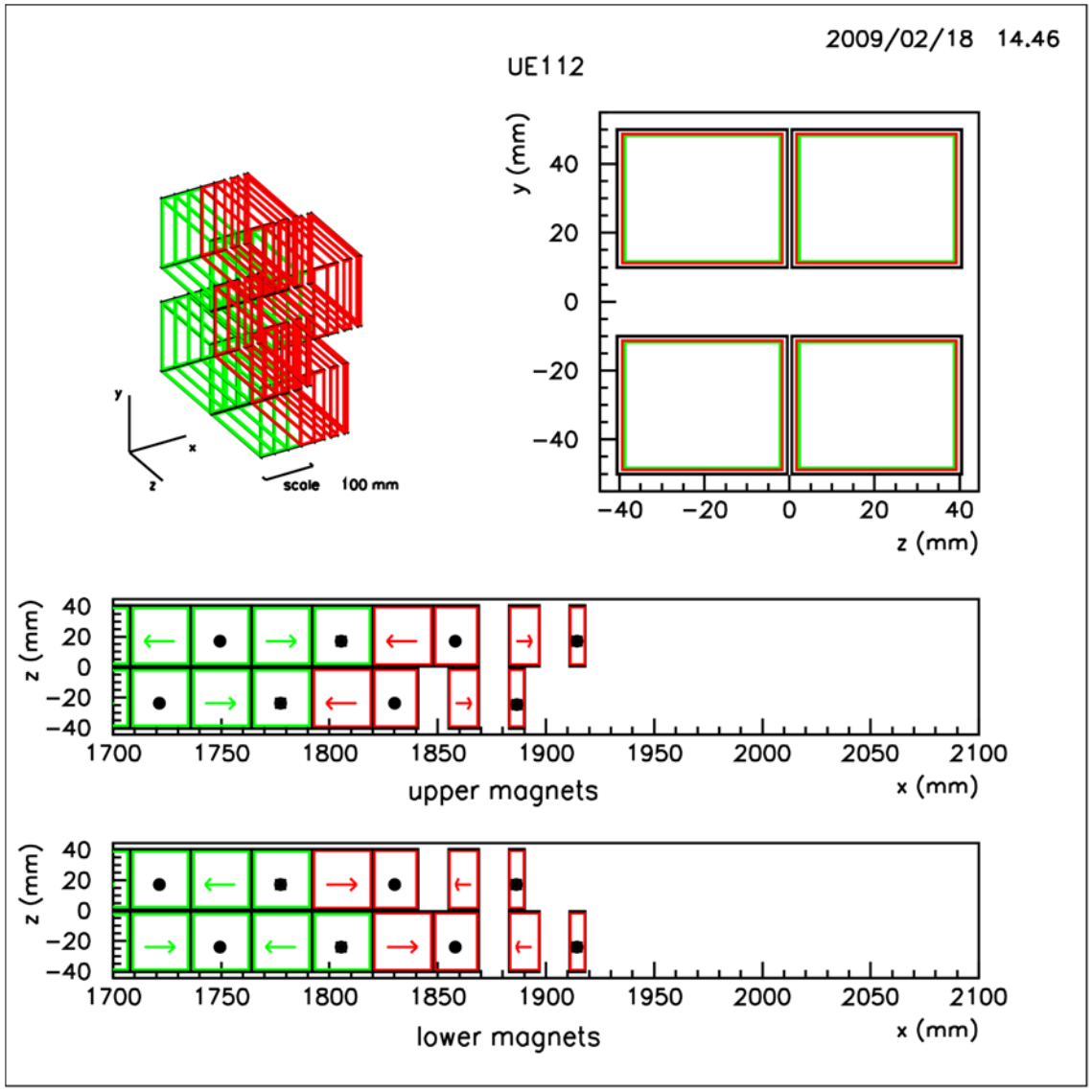
- Magnetic fields
- Synchrotron radiation
- Accelerator physics of insertion devices
- Interfaces for RAY, PHASE and BETA
- Runs on various platforms

Main Structure



- Planar and helical wigglers and undulators as analytical models of permanent magnet structures
- Tapers and field errors of insertion devices
- Dipoles, quadrupoles, sextupoles with fringe fields
- In- and output of magnetic fields maps or tables
- Maxwell-conform parametrization and interpolation of magnetic fields

Magnetic fields

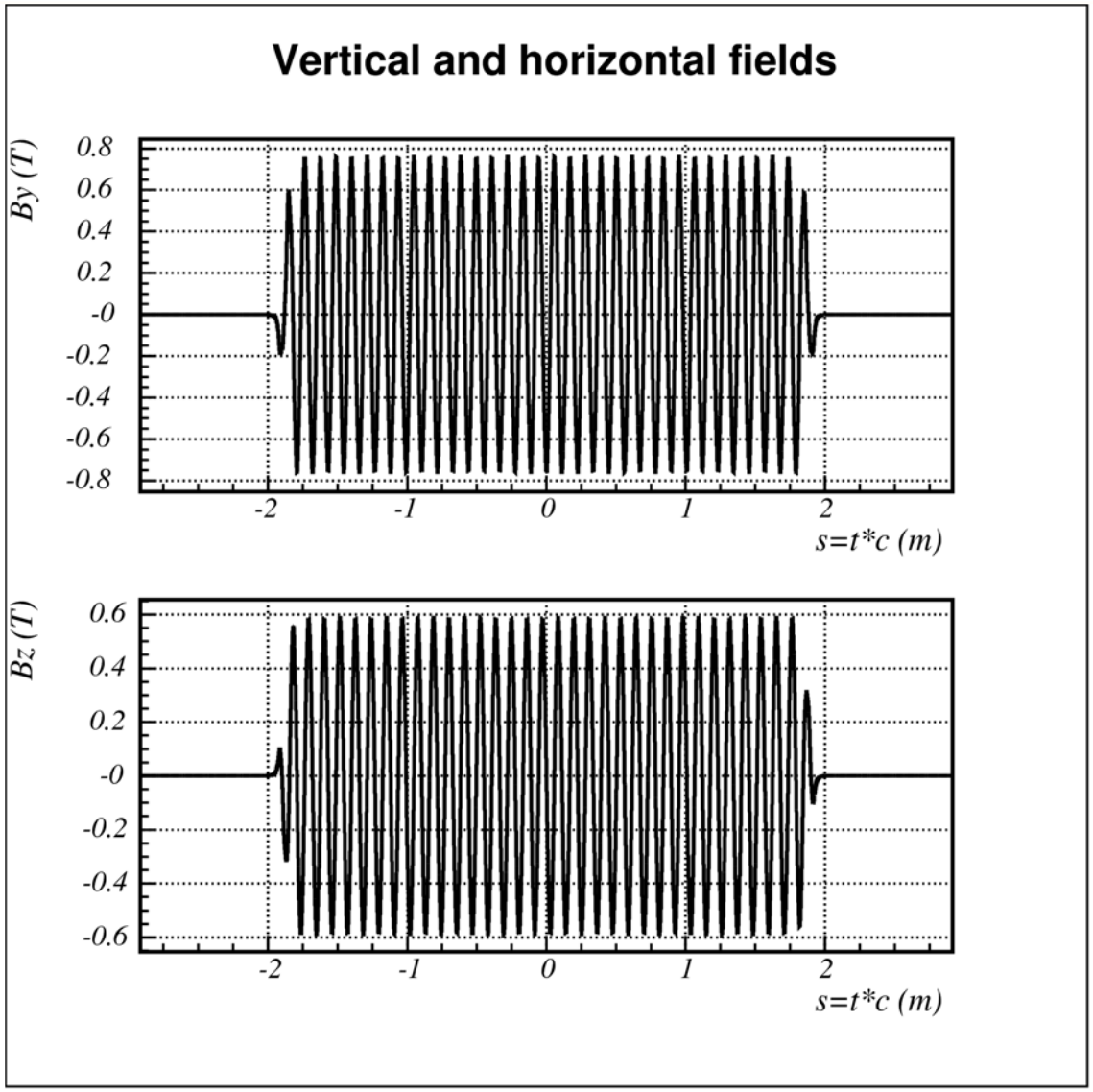


REC model of UE112

endpole configuration

parallel shift

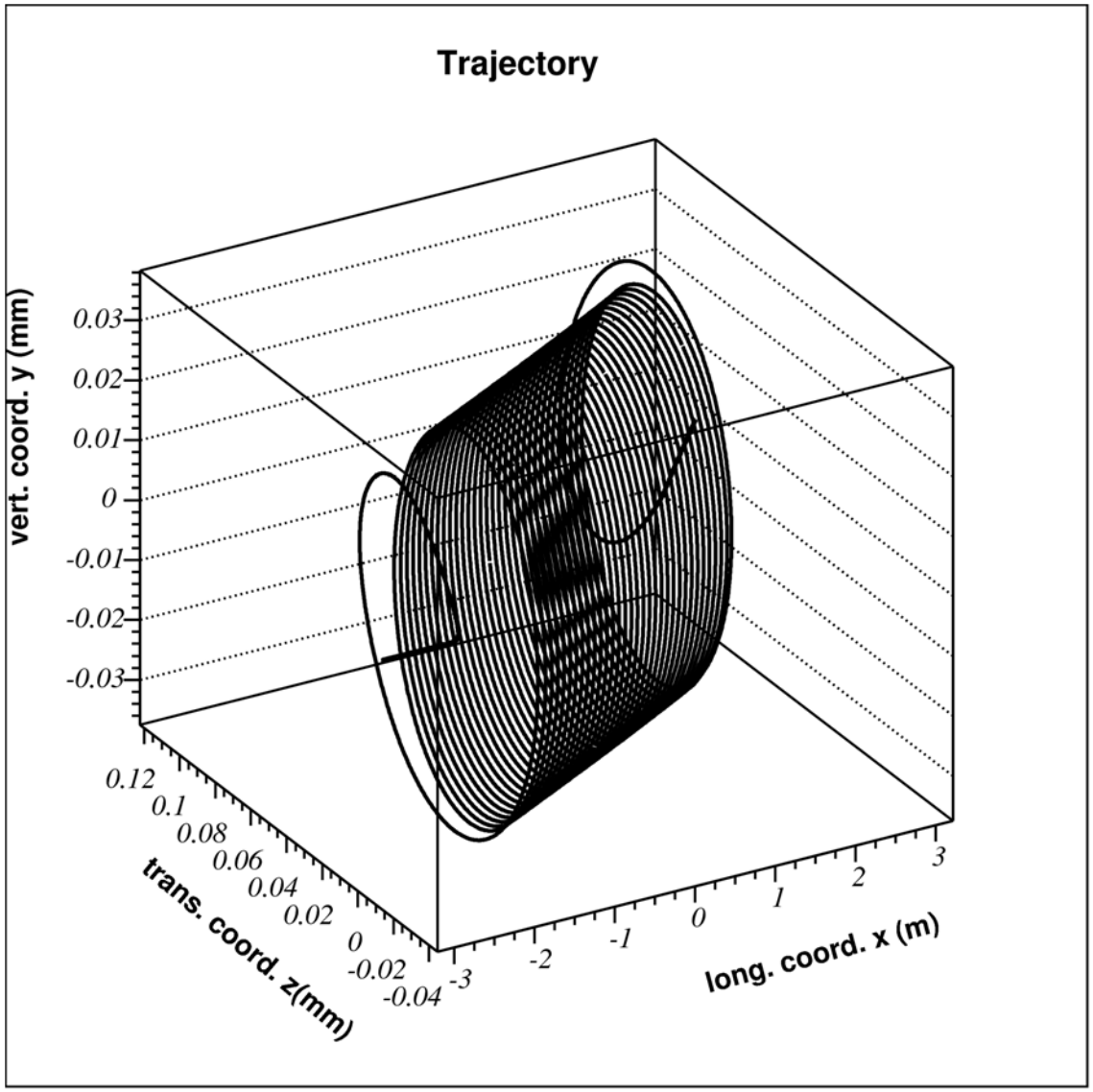
Magnetic field



Elliptical Undulator
UE112

shift = λ/4

Magnetic fields



Elliptical Undulator
UE112

shift = λ/4

Synchrotron radiation

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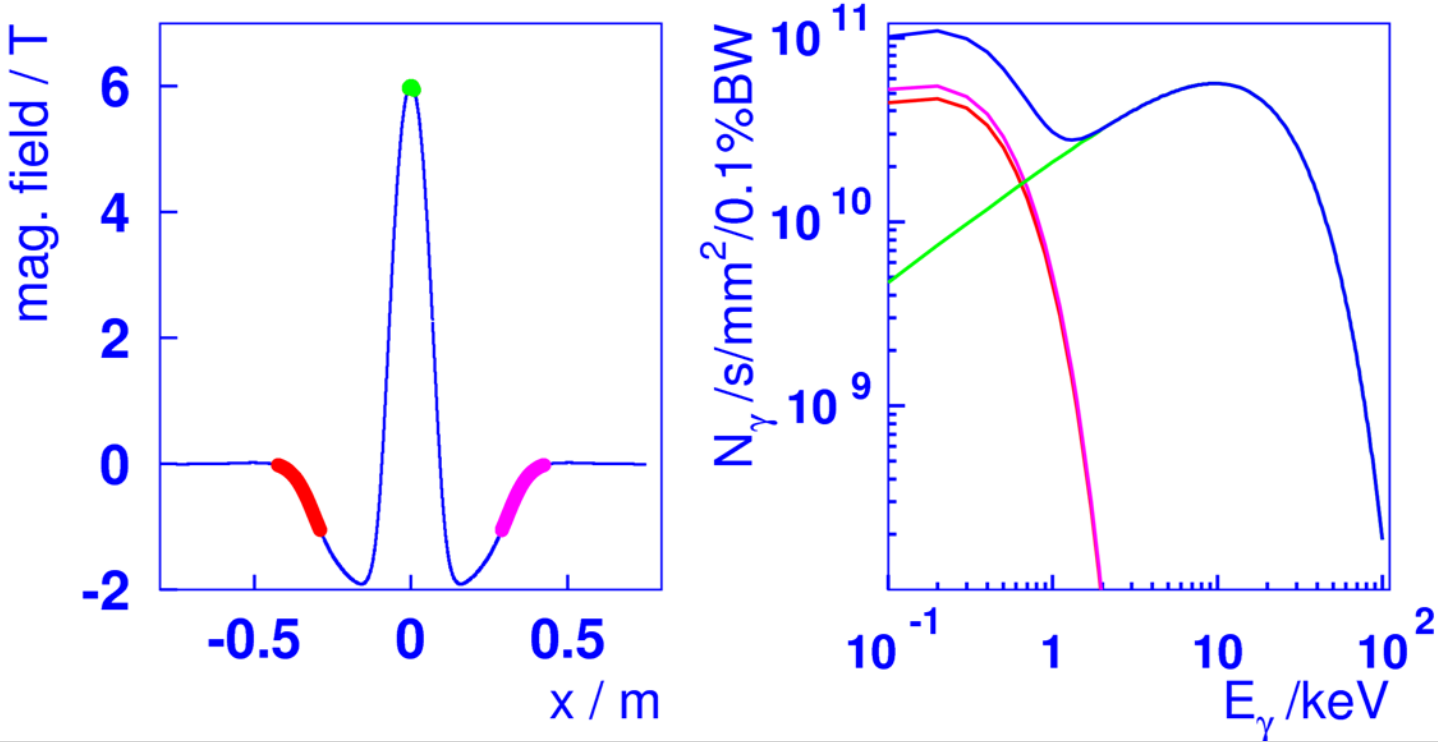
1. Track particle and find sources
2. Calculate radiation coherently for each source
3. Sum up contribution of sources incoherently
4. Apply filters, emittance folding, e-spread folding etc.
5. Integration of flux and power distributions over pinhole



Field, sources, and spectral flux of a super-conducting WLS

Evaluate integral numerically for steps of trajectory

$$\int_0^{\Delta T} \frac{1}{R(t)} \frac{\vec{n}(t) \times [(\vec{n}(t) - \vec{\beta}(t)) \times \dot{\vec{\beta}}(t)]}{(1 - \vec{\beta}(t)\vec{n}(t))^2} e^{i\omega(t+R(t)/c)}\, dt$$

For each integration step:

ω - independent part is treated as constant
phase is expanded to first order

For infrared radiation, velocity term can also be calculated

Formula of Schwinger as alternative for wiggler mode:

Field strength of source point is calculated from trajectory according to position of observer

Results of both methods agree to 10^{-5} for a constant dipole field

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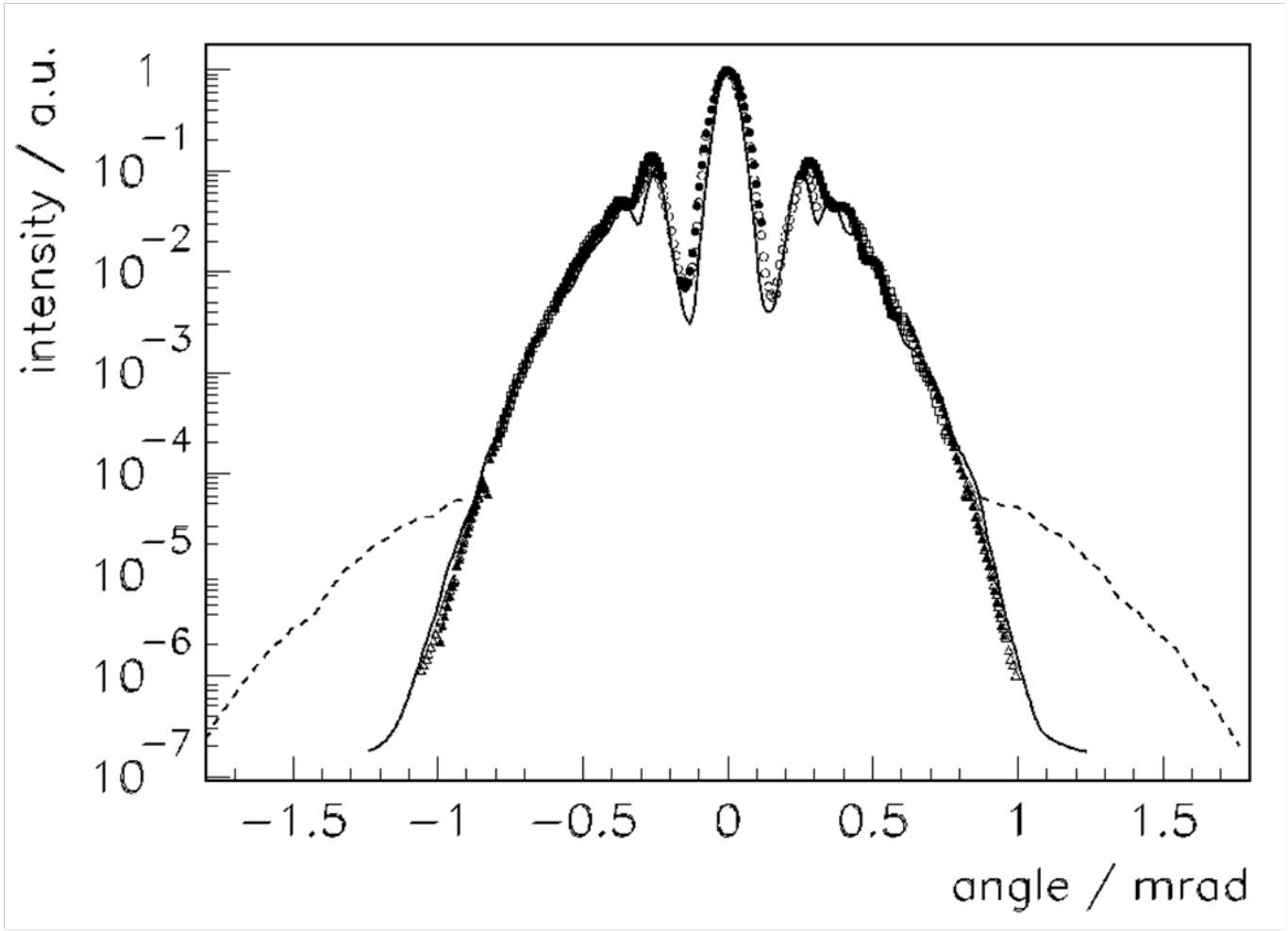
Horizontal distribution of synchrotron radiation of the UE56



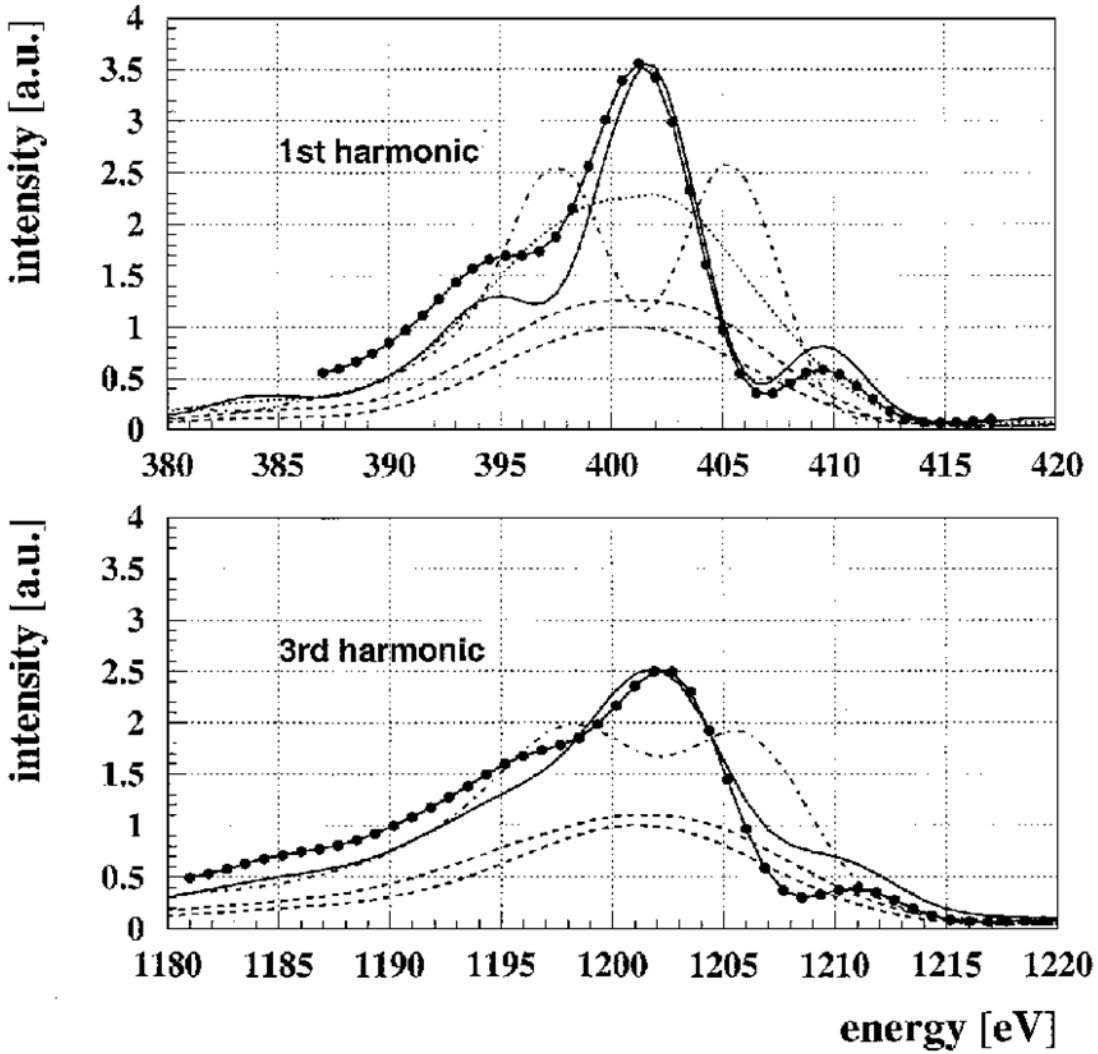
Comparison of measurements and WAVE calculations

Marker: Measurement

Solid line: WAVE

Dashed line: Slicing signal

Coupled Undulators UE56



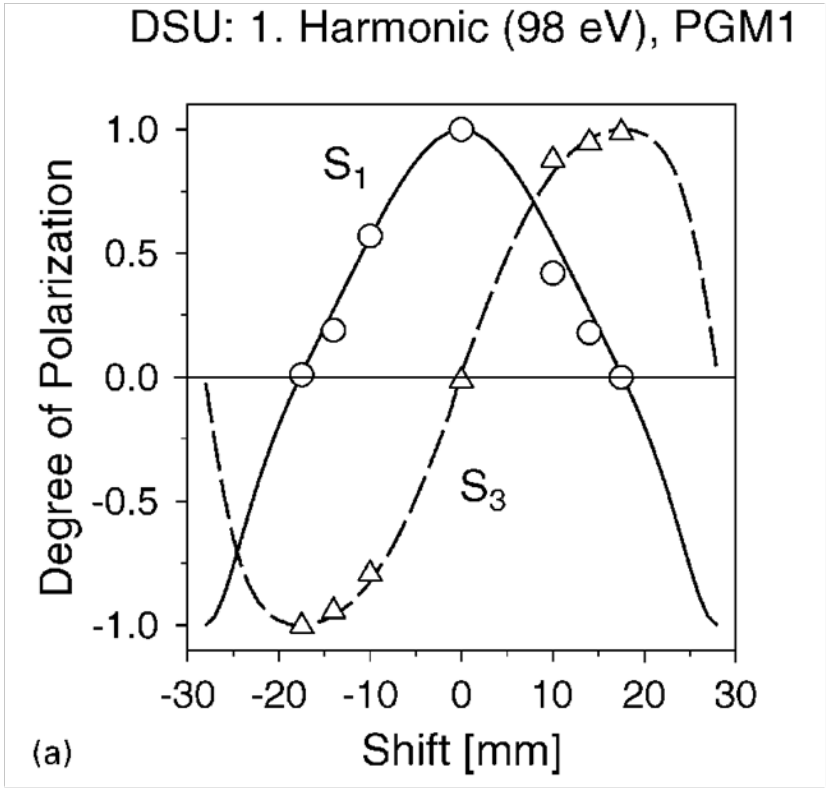
Interference of two coupled UE56

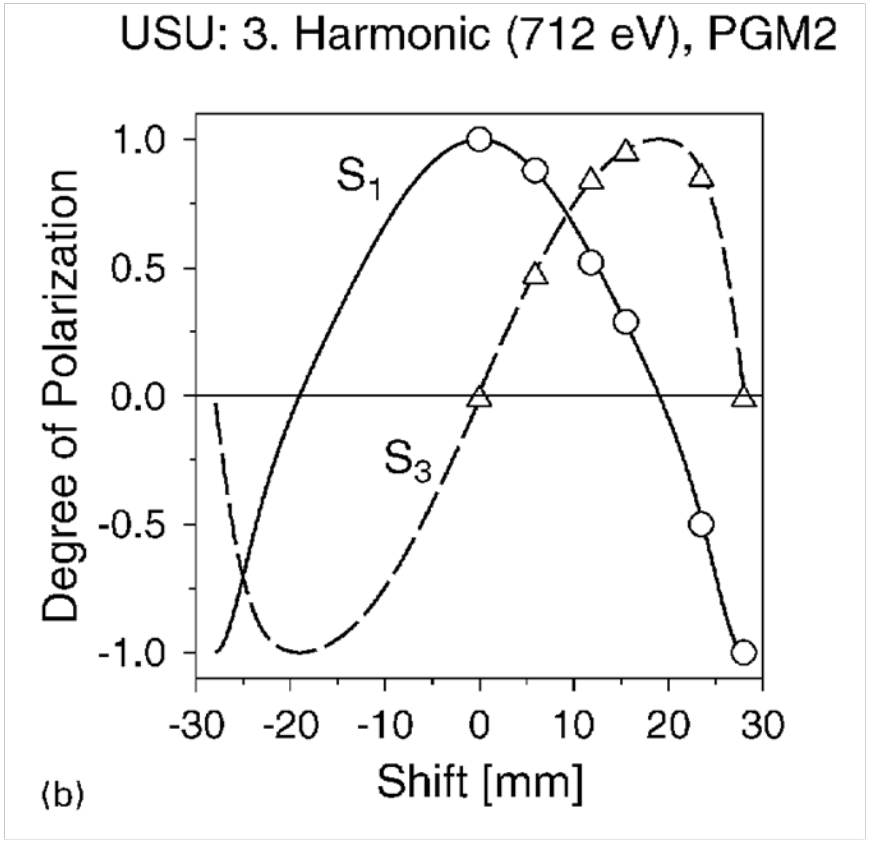
Solid line:
Constructive interference

Marker:
WAVE calculations
Magnets are modeled by current sheets

Dashed and dotted line:
Destructive interference, contribution of each UE56 and incoherent sum

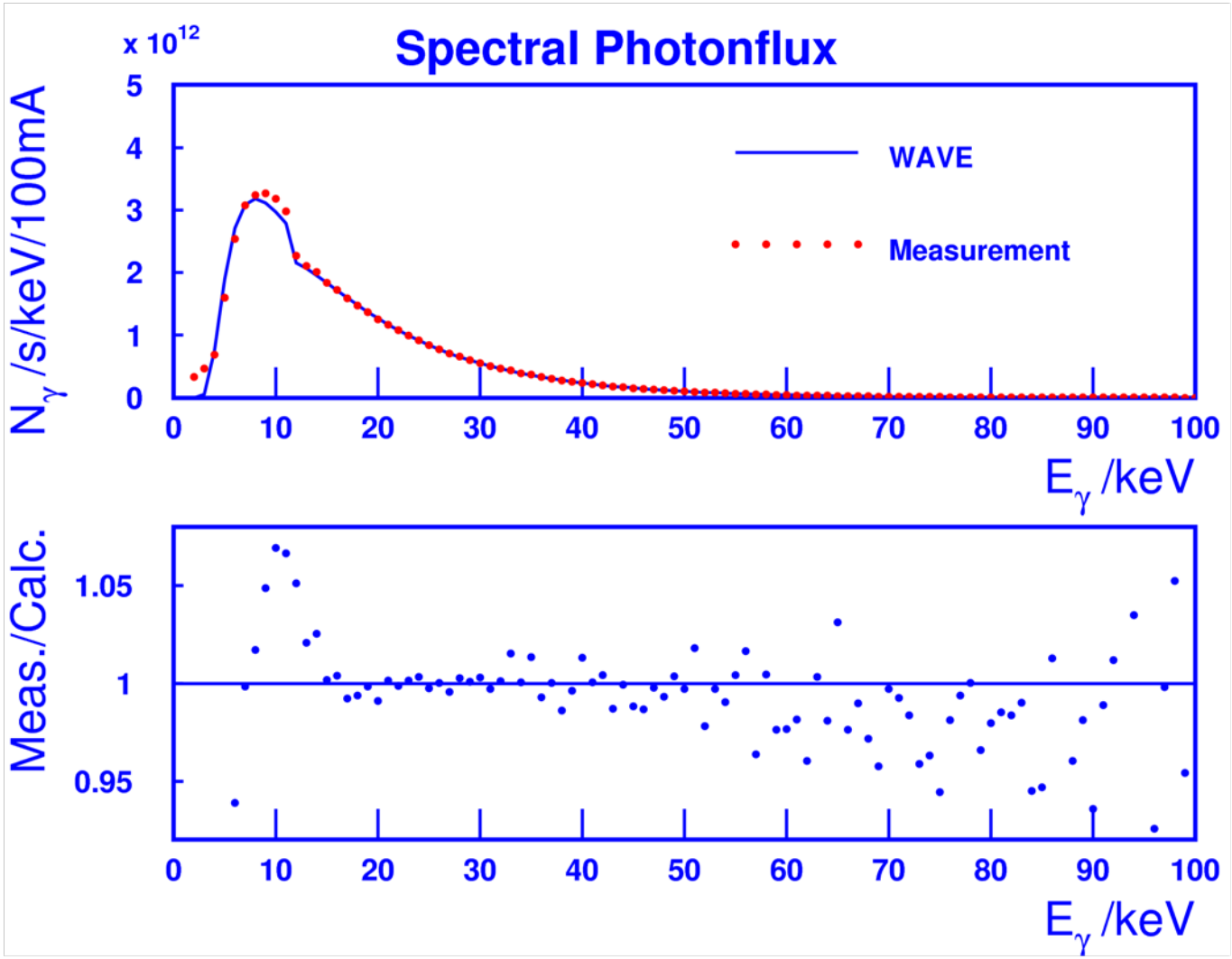
Polarization of Double Undulator UE56





Markers: Measurements Lines: WAVE calculations

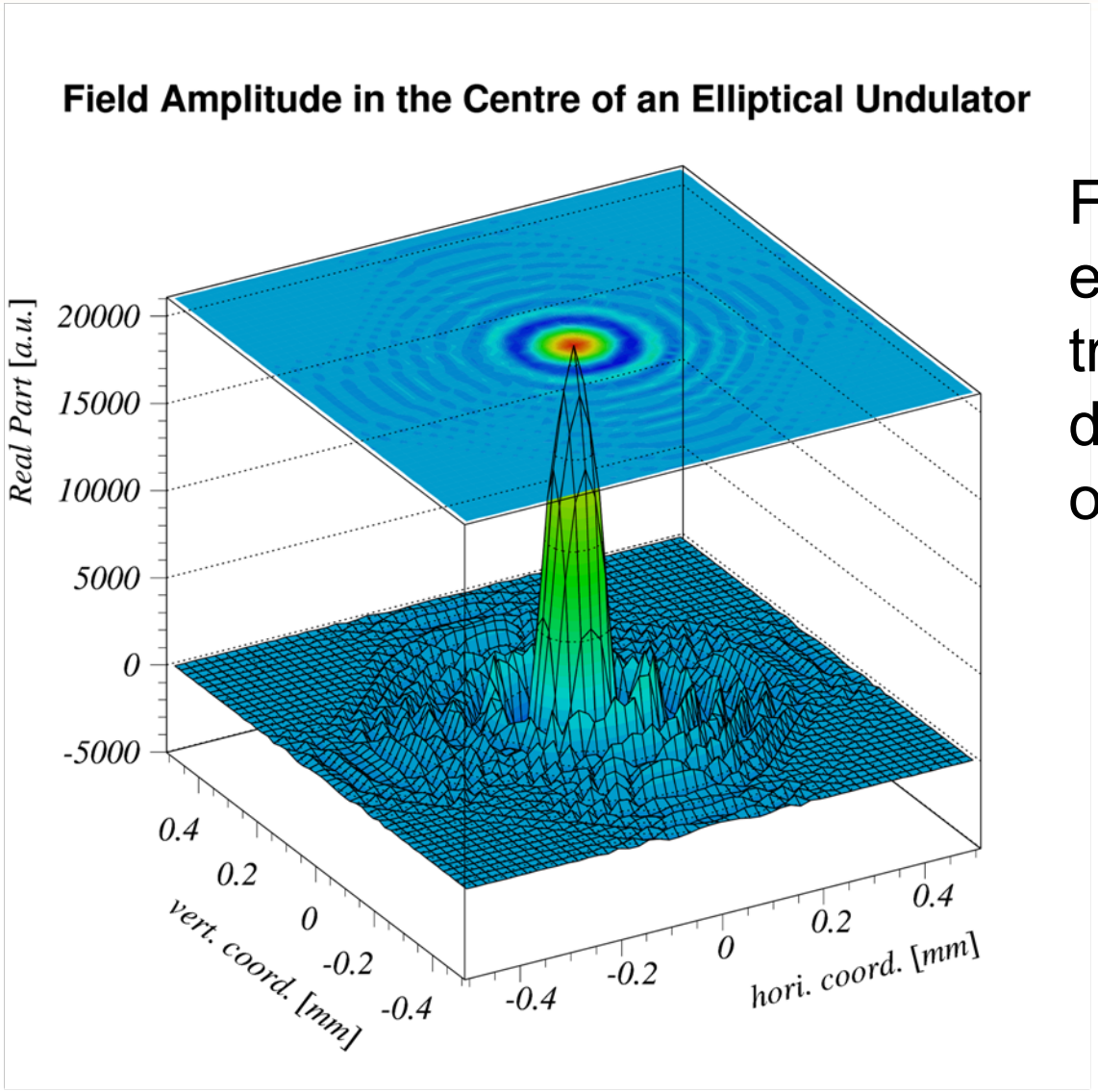
Superconducting Wavelength Shifter



Calculation and Measurement of absolute photon flux of a 6T-WLS

Ratio of measurement and calculation

Radiation Field



Field amplitude of an elliptical undulator, transformed from 10m down-stream to the center of the device