To those who have your own PC:

Please access the URL below, download and install SPECTRA before the lecture starts. If you have any problem, please let me know.

http://radiant.harima.riken.go.jp/spectra/index.html

SPECTRA- a synchrotron radiation calculation code 25733

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Welcome to the SPECTRA home page!

2014/08/19: Version 10.0.1 has been released.

What is SPECTRA?

SPECTRA is an applicaltion software to calculate optical properties of synchrtron radiation emitted from bending magnets, wigglers (conventional and elliptical) and undulators (conventional, helical, elliptical and figure-8). Calculations of radiation from an arbitrary magnetic field distribution is also available. Parameters on the electron beam and the source can be editted completely on graphica user interfaces (GUIs) and it is possible to show the calculation result graphically. The energy spectrum and radiation power after transmitting various filters and convolution of detector's resolution are also available.

Supported Operating Systems

The graphical part of SPECTRA is writtend in the C++ language with wxWidgets GUI tool kit and OpenGL graphic library. Thanks to portability of these libraries, SPECTRA will run on most available operating systems such as Microsoft Windows, Mac OS X, Linux, and most unix-like operating systems.

Important Notes on Brilliance Calculation

In version 10.0, rigorous estimation of brilliance based on the Wigner function method has become available (Phys. Rev. ST-AB, 17 (2014) 060702), in contrast to that based on the traditional way by the Gaussian approximation. Although the brilliance estimation by the Gaussian approximation is still available for campatiblity with the older versions, it is referred to as GA.Brilliance (Gausss-Approximated) and is distinguished from the rigorous estimation.

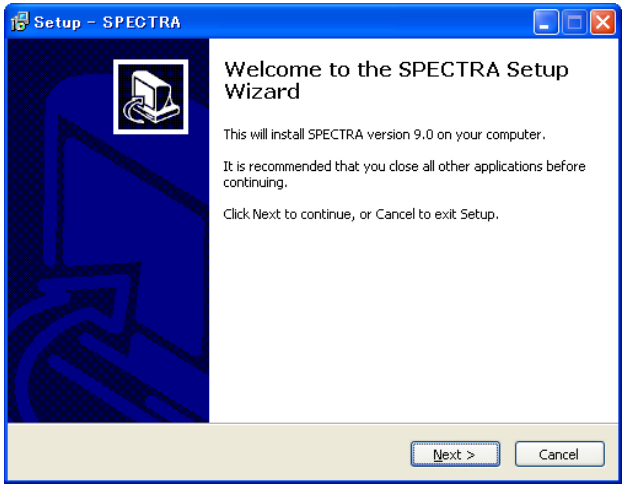
Functions supported

At present, the main functions supported in SPECTRA are as follows:

- Energy spectra of the brilliance, flux density, partial flux after passing through a slit, and total flux
- Spatial dependence of the flux and power densities
- Beam size, angular divergence, coherent flux as a function of the gap and K value
- The peak brilliance, flux, and radiatino power as a function of the gap and K value
- Radiation power after passing through a filter composed of varisou material
- Far-field approximation for fast evaluation of radiation
- More precise estimation of radiation in the near-field zone

GUI for Pre and Postprocessor

SPECTRA is equipped with a full graphical user interface to help the user to input and edit parameters necessary for SR calculation, and to visualize the results of calculation. Examples of the preprocessors are shown below.



Introduction to SPECTRA

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What is SPECTRA?

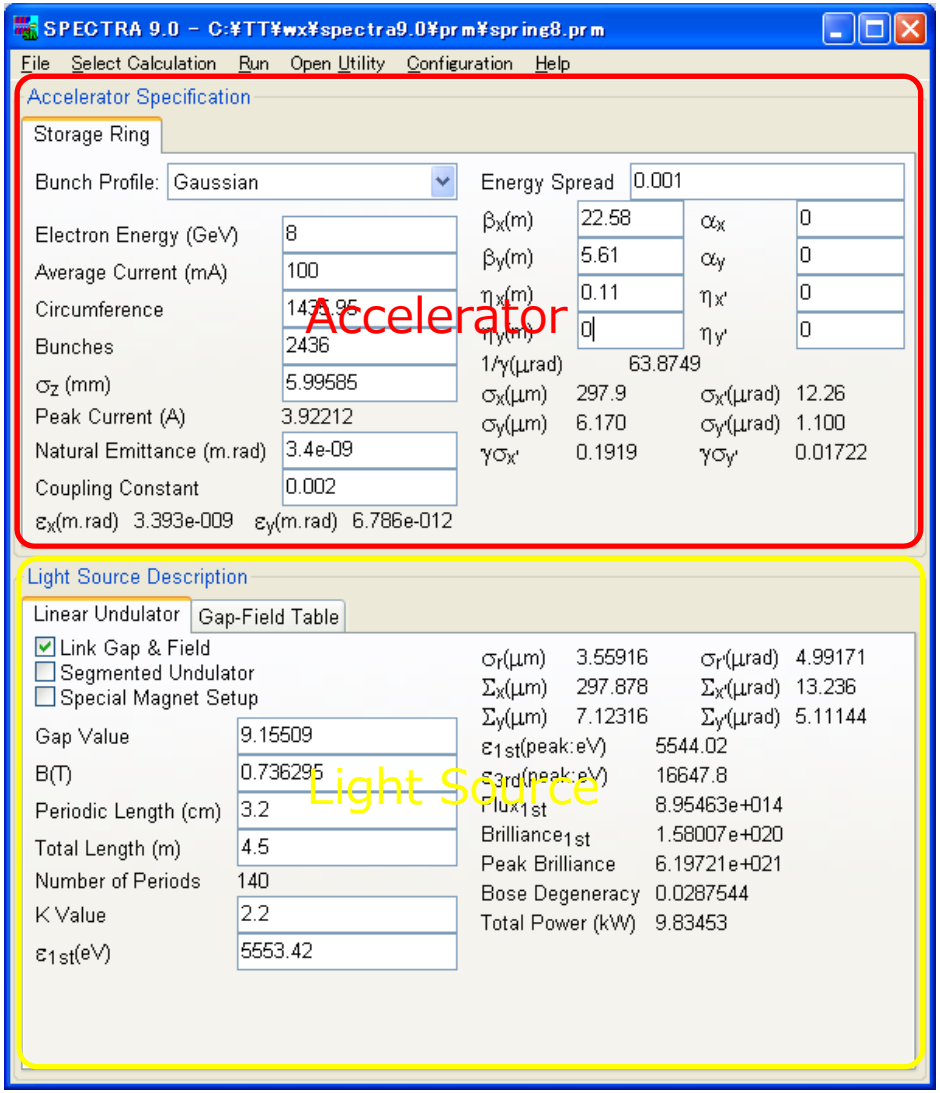
- Quantitative evaluation of SR is necessary to design optical elements in the beamline, analyze the experimental data, etc.
- This requires not only expertise on SR but also numerical implementation to take into account the e-beam effects.
- SPECTRA is computer software to help the SR users to accurately evaluate the optical characteristics of SR from various sources.

Functions Supported

- Spectrum of photon flux (density)
- Spatial profile of photon flux and radiation power
- K-value dependence of photon flux and radiation power
- Degree of polarization (Stokes parameters)
- Brilliance curve
- Filtering
- Coherent radiation
- Fully graphical pre- and post-processor
- ……

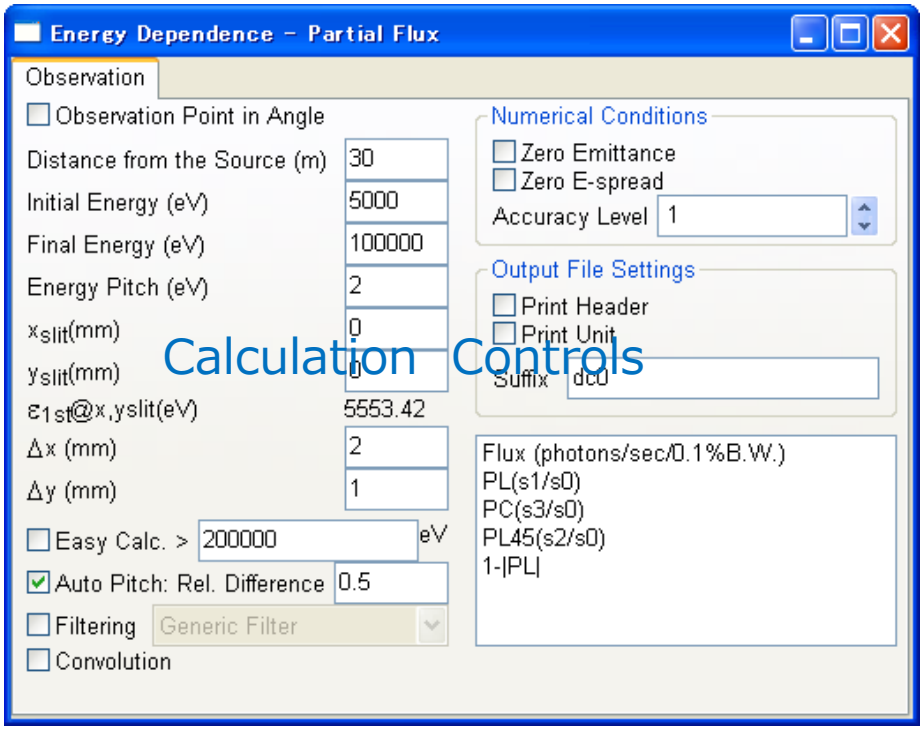
General Instruction (1)

1. After starting the program, open a parameter file or run [File]-[Create New].
2. GUI panels pop up to show the parameters defining the accelerator and light source.
3. Edit the parameters related to the accelerator and light source.
4. Save the parameter file if necessary.



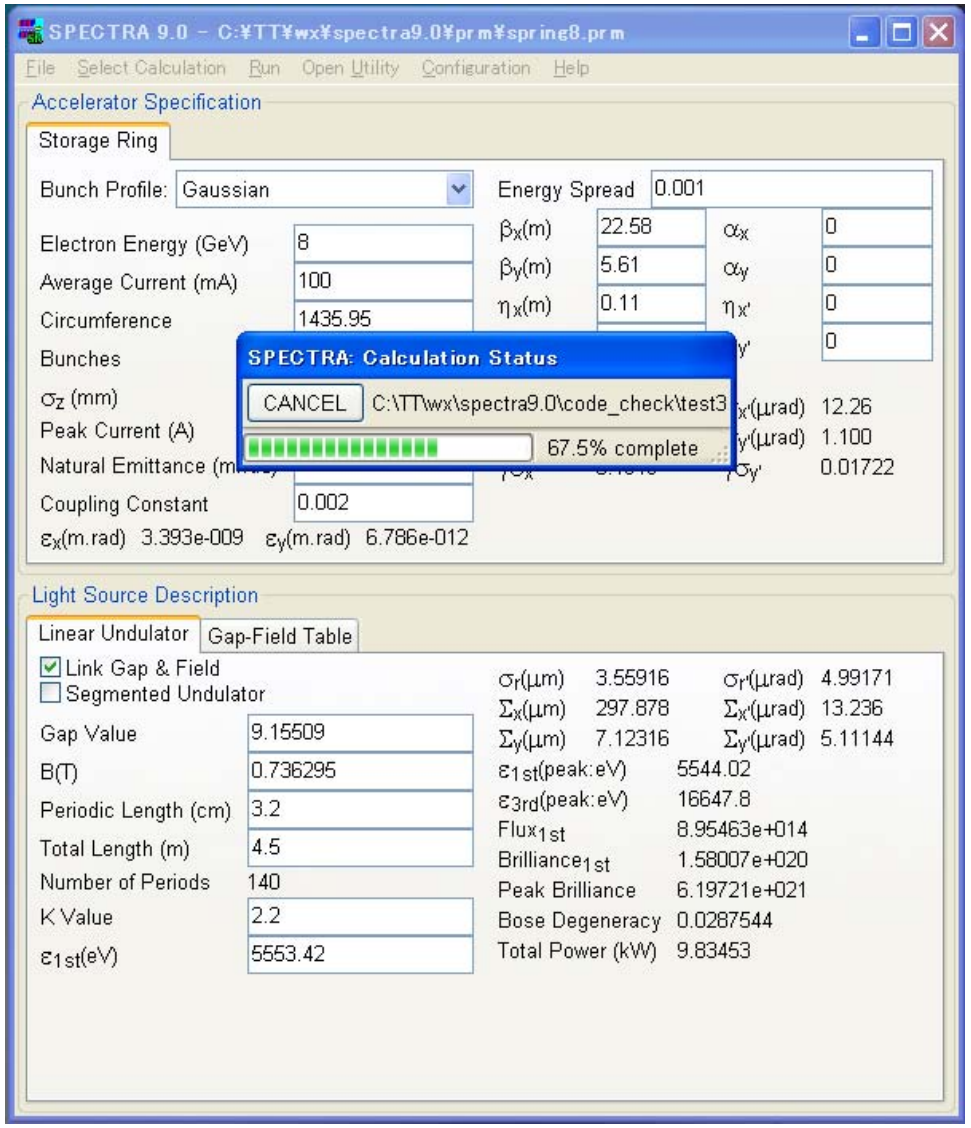
General Instruction (2)

5. Select the type of calculation (dependency and main item) from submenus of [Select Calculation].
6. Edit the parameters related to calculation controls.



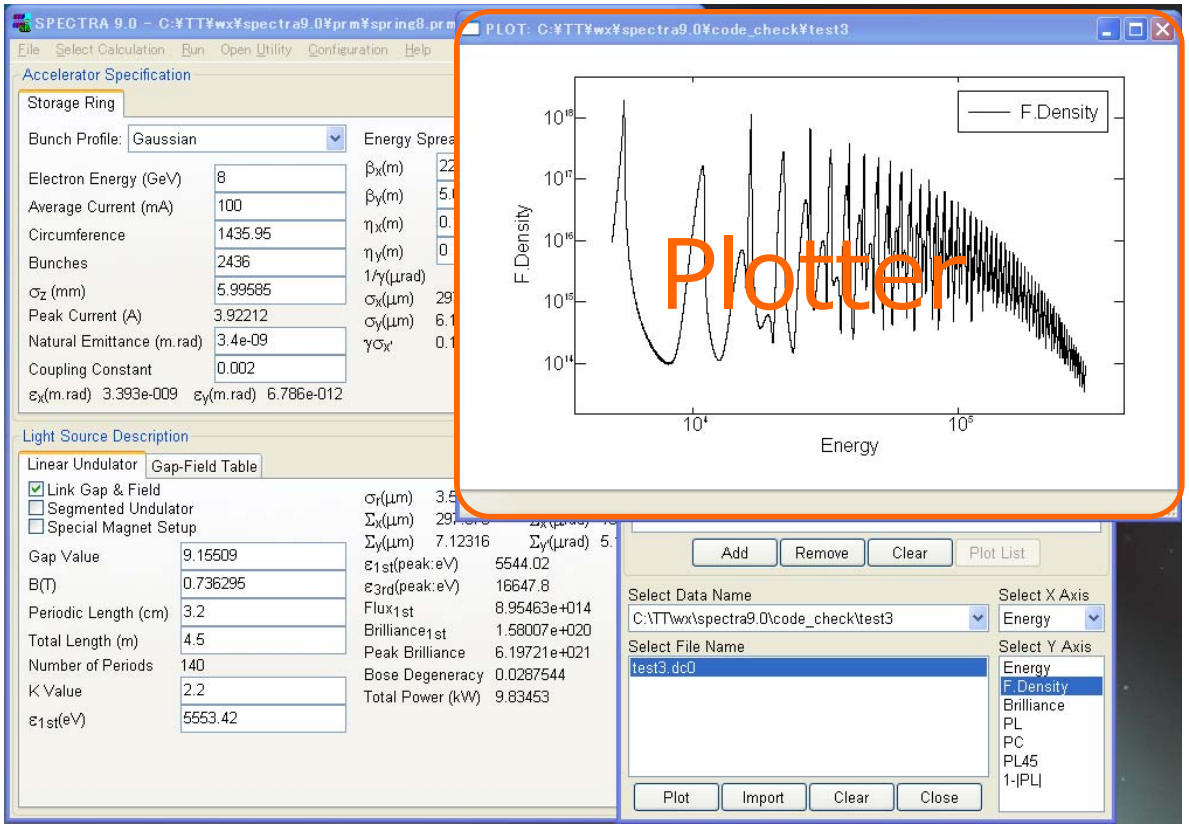
General Instruction (3)

7. After specifying all the parameters and selecting options, run [Run]-[Start Calculation] command to start a calculation.
8. Input a file name to save the calculation results in the dialog box.
9. A progress bar pops up to indicate the status of the calculation.



General Instruction (4)

10. The calculation results are saved in a file with the name you specified and a suffix specific to the calculation type.
11. To verify the calculation results graphically, select the data name and items to be plotted, then click “Plot”.



TUTORIAL

I. Spectrum
II. Modifying the Conditions
III. Spatial Profile
IV. Brilliance Curve
V. Scanning a Parameter
VI. Any Other?

I. Spectrum

- Calculate the partial flux of SR passing through a rectangular slit.
- The output file of SPECTRA is an easy-to-read text file. Open it with a text editor to check the contents.
- Create a plot to visualize the output data.

II. Modifying the Conditions

- Change the width or height of the slit to see how it broadens the spectral profile.
- Change the position of the slit to see how it changes the spectral profile.
- If you find any peculiar profile, increase the accuracy level.
- Learn how to create a “calculation process” to do successive calculations.
- Learn how to create a “multiplot” to compare more than one calculation results.

III. Spatial Profile

- Calculate the angular profile of the photon flux density.
- Change the photon energy to be fixed to see how the profile changes according to “detuning” (energy shift).

IV. K Dependence

- Calculate the flux and power as a function of the K value. This corresponds to the undulator gap motion.
- Learn the difference between “Fixed” energy and “Peak” energy.
- Add a spectrum plot to clarify the meaning of “Peak” energy calculation.

V. Scanning a Parameter

- “Scanning a parameter” is an option to specify more than one calculations with a specific parameter being changed.
- All the calculations are processed in sequence.
- An animation can be created by a post processor.

VI. Any Other Examples?

Now, let me know your requests on SR computation.

Documentation

- PDF-formatted instruction manual (spectra_reference.pdf) is placed in “[SPECTRA]/help” directory.
- HTML-formatted help files are also available, which can be viewed by running the [Help]-[Help] command.