XOP DOCUMENTATION

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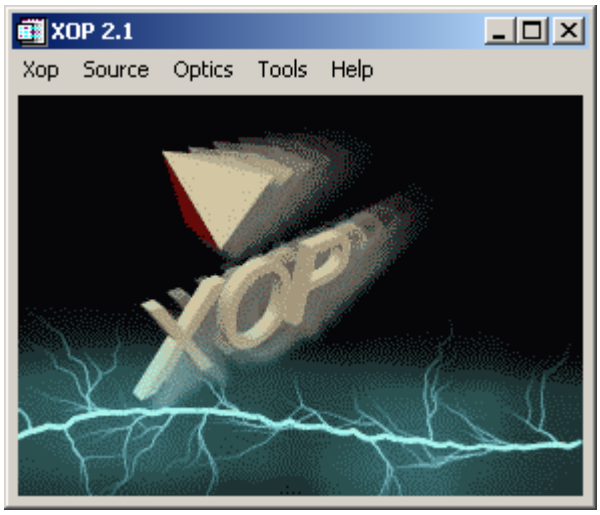
Introduction



XOP (X-ray Oriented Programs) is a widget-based driver program that is used as a common front-end interface for computer codes of interest to the synchrotron radiation community. It provides codes for :

- modelling of x-ray sources (e.g., synchrotron radiation sources, such as undulators and wigglers)
- characteristics of optical devices (mirror, filters, crystals, multilayers, etc.)
- multipurpose data visualizations and analyses

Adding external software packages (called "extensions") that are optionally installed easily expands the functionality of XOP.

Typical extensions are SHADOWVUI, a Visual User Interface for the SHADOW ray-tracing code, and XAID, a package for XAFS data analysis. The current version of XOP (v2.1) runs on most Unix, Windows and MacIntosh (OSX) platforms and is available free of charge to the scientific community.

XOP Map

- Xop
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  - Load application input file
  - Show/Edit environment
  - Quit
- Sources
  - Undulator
    - XUS (Undulator Spectrum)
    - XTC (Undulator Tunning Curves)
    - XURGENT (Undulator Radiation)
    - XYAUP (Tapered Undulators)
  - Wiggler
    - WS (Wiggler Spectrum)
    - XWIGGLER (Wiggler Radiation)
  - Bending Magnet
    - BM (Bending Magnet Radiation)
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    - Black Body (Planck distribution)
- Optics
  - DABAX: Main interface
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    - DABAX: xCrossSec (Cross section/absorption)
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    - XPOWER (Attenuation/Reflectivity in Media)
  - Crystals
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    - MAMON (Multiple beam diffraction)
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    - MLAYER (Multilayers)
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    - DABAX: xf0 (f0 scattering factor)
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XOP applications (functional sorting)

This pages helps to find the XOP applications related to a given functionality

X-ray source simulations

XOP has many tools to simulate x-ray sources. Most of them are for synchrotron radiation sources (spectral emission, angular and spatial distributions, etc.), but some other programs may also simulate the emission spectra of some x-ray tubes. Other applications may be useful for spectral calculations using some well-known typical distributions.

Bending Magnet Radiation.

Spectral flux and power for a given angular emission angle, integrated over an angle interval, and integrated over the full angle. BM

Wiggler Radiation

Two programs are available for calculating the spectral flux emitted by a wiggler:

- WS calculates the flux (and spectral power) on a (spatial or angular) aperture.
- XWIGGLER calculates the flux (and spectral power) integrated over all angles. It can deal with non-sinusoidal electron trajectories (elliptical wigglers).

Both produce the same results when a large enough aperture is chosen in WS. However, the aperture should be large enough to receive all the radiation fan, and small enough to allow accurate integration in the defined 2-dimensional integration grid. Therefore, for full emission it is recommended to use XWIGGLER for simplicity. None of these programs include the finite size and divergence of the electron beam. They cannot create power distribution maps. For these kind of calculation, it is possible to use the undulator programs using the wiggler parameters.

Undulators

The most typical calculation regarding plane and helical undulators are the spectral distributions, angular and spatial emission maps, and brightness. Two programs (XUS and XURGENT) can deal with this type of calculations, and the functionality of both overlap in more than 95%. The user can choose the one of his/her preference.

Other programs are for specific calculations. XTC computes tunning tuning curves (i.e., maximum flux and brightness for undulator gap changing in a given interval) (XTC). The code XYAUP is for tapered undulators.

Others

Two programs simulate the emission of some X-ray tubes in some particular energy intervals. They use "gold standard" experimental spectra as a starting point for an interpolation algorithm. They are XTUBE_W (Tungsten anode from 30 to 140 keV) and XTUBES (for Mo, Rh and W anodes from 18 to 42 keV).

Two other applications are for quick computation of spectral distributions following well-known laws: Maxwell distribution (thermal neutrons) and Plank distribution (thermal radiation from a black body).

X-ray optics

The applications in this group deal with calculations of the interactions of x-ray beams with optical elements or components. Typical cases are mirrors, multilayers and crystals. All these applications require the calculation of the refraction index and attenuation coefficient of the materials in use. These calculations cannot be done quickly from first principles, therefore we have compiled a data base (DABAX, DAtaBAse for X-ray applications) with the "ingredients" of these parameters. One of the advantages of DABAX is the decoupling of the data from the calculations. We can easily change the files in the database without needing to change the programs. Furthermore, we included in most programs a menu that allows the user to chose the preferred data file.

The applications in this section are many cases redundant. The same kind of calculation (e.g., beam attenuation from materials) can be done using different programs, and the choice of one of them depends on the context of the calculations (in relation to other elements, etc.) or by user's preference.

DABAX: Main interface

This application is a font-end of the DABAX (DAtaBAse for X-ray applications) data files. It allows to inspect the data files, download new files to your local XOP installation, consult file documentation, view the numerical data and plot the data in the files. From this interface, it is possible to start applications that make some post-processing of the DABAX data to calculate different parameters of beamline components:

- DABAX: xf1f2 (f1,f2 scat fact, refraction index, reflectivity)
- DABAX: xCrossSec (Cross section/absorption)
- DABAX: xFh (Crystal Structure Factors)
- DABAX: xf0 (f0 scattering factor)

Scattering factors and related parameters

The scattering factors are used for building the refractive index of amorphous materials and the structure factor of crystalline materials.

The atomic scattering factor written as

$$f(\vec{Q},E) = f_0(\vec{Q}) + f'(E) + if''(E) \qquad (1)$$

where Q is the momentum transfer ($Q=k_f-k_i$, $|k|=2\pi/\lambda$) and E is the photon energy. In the case of elastic scattering, $Q^2=(\boldsymbol{k}_i^2-\boldsymbol{k}_f^2)=k_i^2+k_f^2-2k_ik_f=2Q^2(1-\cos 2\theta)$ $|Q|=2|k|\sin\theta=4\pi\sin\theta/\lambda$, and 2θ is the total angle of scattering of the photon (angle between k' and k).

The first term, f_0, is the non resonant scattering, and it is due to the scattering of the radiation by the electron cloud of the atom. It is proportional to the Thomson scattering (one electron). It is called *atomic form factor* or *atomic scattering factor* of the atom. The DABAX files `f0_<name>.dat` contain the elastic scattering factors

(either a tabulation or a parametrisation) data . They can be visualized using the xf0 applocation.

The second *f'* and third *f"* terms are the resonant term, also called anomalous scattering factor, even if there is nothing "anomalous" with them. They are tabulated in the f1f2_<name>.dat DABAX data files.

From the f1f2 tabulated data, one may calculate many physical quantities in the xf1f2 application for amorphous material calculations.

The photoelectric cross section is directly related to f" by

$$\sigma_{PE} = \left(2r_e\lambda\right) f'' \tag{2}$$

and the mass absorption coefficient:

$$\mu_m = 2r_e\lambda \frac{N_A}{A} f'' \tag{3}$$

where NA/A is the number of atoms per gram. The linear absorption coefficient is:

$$\mu = 2r_e\lambda\left(\rho\frac{N_A}{A}\right) f'' = \rho\mu_m \tag{4}$$

The refraction index can be written as

$$\begin{aligned} n &= 1-\delta-i\beta \\ \delta &= Kf' \\ \beta &= Kf'' \\ K &= \frac{r_e\lambda^2}{2\pi}\frac{N_A}{A}\rho \end{aligned} \tag{5}$$

and from here it is possible to compute x-ray reflectivities for mirrors using the Fresnel formulas.
The information of the nature of compounds may be needed, which is stored in the file `Compounds.dat`.

For crystalline materials, information about the crystal cell and composition and structure is taken from the files `CrystalStructures.dat` and `CrystalCell.dat`. The the structure factor of a crystal is calculated by xfH using the relationship:

$$F_{hkl} = \sum_{i\in\text{unit cell}} \left[f_0(\sin\theta/\lambda) + f'(\lambda) + if''(\lambda)\right]_i e^{i(x_i h + y_i l + z_i m)} \tag{6}$$

Cross sections and related parameters

There are several possible type of interactions between an incident x-ray beam and a target material, and the cross-section for each will be different. These individual cross-sections are known as **partial cross-sections**. These are also called interaction

channels. In the usual case that the interaction channels are independent (no interference effects between them), their overall sum is the **total cross-section**

$$\sigma_T = \sum_i \sigma_i \tag{7}$$

Considering the interaction of x-rays and atoms, there are four main interaction channels:

- Photoelectric absorption: the incident photon is absorbed by an atom, with the emission of secondary particles (photoelectron, Auger electrons or/and fluorescence x-rays).
- Coherent scattering (Rayleigh): the photon is just deflected without loosing energy (elastic scattering).
- Incoherent scattering (Compton, Raman): The photon interacts with an atomic electron exchanging energy and momentum.
- Pair production: the creation of an electron-positron pair by the photon in a nuclear field. This process can only occur if the photon energy is greater than $2mc^2$ (the rest energy of the two created particles, ~1.022 MeV), therefore it is not accessible for "typical" x-rays.

The DABAX files `CrossSec_<name>.dat` contain tabulations of one, several or all of the interactions channels. They can be visualized and compared using the xcrosssec application, which can also be used for the computation of the attenuation coefficient.

The *attenuation coefficient* μ_l (dimension L^{-1}), is relatic to the *the atomic attenuation coefficient* or interaction cross section (dimensions L^{-2}) as:

$$\mu_l = \frac{\sigma}{n} \tag{8}$$

(n is number of scatters per unit of volume)

Another non-DABAX application for cross sections is XXCOM, which uses the widely used XCOM program.

Attenuators

Attenuations (often also called *filters*) are material plates inserted in the beam with the aim of reducing its intensity. As attenuation coefficient is energy-dependent, the attenuation effect is energy-dependent, thus it modifies the spectral distribution of the x-ray beam.

Attenuation coefficients can be calculated from tabulated cross sections using the xcrosssec and xxcom programs. Although xf1f2 also calculates the (photoelectric) attenuation coefficient, is not recommended to use it for attenuation calculations as it ignores inelastic scattering which may be crucial for high photon energies and low atomic number elements.
The intensity I of an x-ray beam after been travelled in a material of plate of thickness t is given by the well-known exponential law:

$$I(t) = I_0 e^{-\mu_l t} \tag{9}$$

where I_0 is the incoming intensity. The application xpower uses this formula to calculate the effect of up to five optical elements (attenuators and mirrors) placed in an x-ray beam. Their effect is computes as a function of the x-ray energy.

Mirrors

The reflectivity of a thick reflecting surface (mirror) is computed using the Fresnel formulas. They require to know the refractive index, which is obtained from DABAX data files. Again, reflectivity is energy dependent, because of the dependence of the refractive index on photon-energy. Two applications can be used:

- xf1f2: Calculates the reflectivity of mirrors versus photon-energy, incidence angle or both.
- xpower. Calculates the reflectivity of mirrors versus photon energy. It may apply this reflectivity to a source spectrum and combine it with attenuators and a monochromator.

Crystals

Crystals are used for x-ray monochromators. Almost all x-ray monochromators in synchrotron beamlines use perfect crystals like silicon or germanium. For describing the crystal diffraction by perfect crystals, the dynamical theory of diffraction should be used. Several calculation algorithms are implemented in XOP crystal application to deal with different kind of crystals:

- Flat perfect crystals diffraction profiles, like Si, Ge or diamond can be calculated using the xcrystal code. It can calculate angular scans for a given photon energy, or energy scans for a given incident angle. Any crystal structure may be used (definition parameters are in DABAX files `CrystalStructure.dat` and `CrystalCell.dat`). It includes a simple model for the temperature factor.
- An alternative non-DABAX program for flat crystal diffraction profiles is xinpro. However, we recommend the use of xcrystal
- Mosaic crystal reflectivity can be computed using xcrystal
- The diffraction profiles of curved crystals is in general different from the flat ones. Several models are available in the xcrystal_bent program:
    - Multilamelar model, useful for computing diffraction profiles of curved crystal in Bragg geometry
    - Penning-Polder model, for crystals in Laue geometry.
    - Takagi-Taupin. This model is in experimental status so results should be taken with extreme prudence. It is recommended not to use it if the user is not familiar with the theory

A program for displaying multiple reflections and calculate unweganregun patterns is mamon. It is valid for cubic lattices only and uses a simplified model (no dynamical theory) for line intensities.

Multilayers and others

We included in XOP a basic program for multilayer calculations: mlayer. It can calculate the multilayer (periodic and graded) reflectivity versus photon energy (for a constant incidence angle) or versus incidence angle (for constant energy). This program is limited because it can only deal with elements (not compounds) and it does not take into account the effect of the roughness at the interfaces. Users interested in more sophisticated multilayer modeling and fit with experimental data can use the IMD code, available as an XOP extension.

A program for calculating the focusing effect of Compound refractive lenses using a simplified ray-tracing models is also available: crl

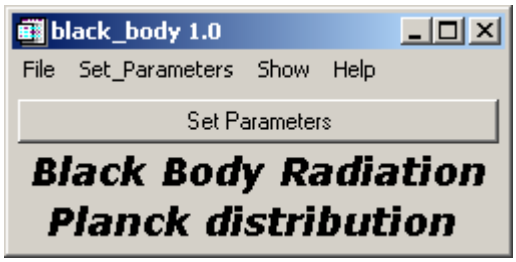
Tools

A number of tools are available from the XOP and TOOLS menus in the main XOP windows.

- Load files
  - Xop->Load extension: for loading an installing XOP extension
  - Xop->Load application input file: loads an XOP's application input file (usually `*.xop`) and starts the corresponding application.
- XOP appearence/environment:
  - Xop->Show/Edit environment: editor for environment variables used by XOP
  - Tools->Change Widget Fonts
  - Tools->Change Working Directory
  - Tools->Change Color Table
  - Tools->Set default color table
- Utilities
  - Tools->Xplot (plotting tool): XY-data analysis and visualization
  - Tools->Display File: very simple file viewer and editor.
  - Tools->IDL file editor: another very simple editor.
  - Tools->Calculator
  - Tools->XOP Macro: edits and runs XOP macros (scripts in IDL syntax with limited functionality).

XOP applications (alphabetical sorting)

BLACK_BODY



Function

To calculate the spectra (spectral power and brightness) of a black body emitter as a function of the photon energy. It can be used as a first approximation for an x-ray plasma source. The output spectra can be saved to files (using `File->write files for Xop/Optics`) for being used by xpower.

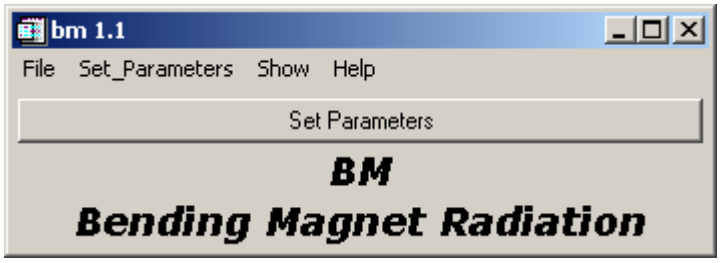
Documentation:

- application doc
- input parameters

Technical aspects

- The interface is created using the automatic application generator xop_ifc
- Reference: David Attwood *Soft X-rays and extreme ultraviolet radiation. Principles and applications* Cambridge University Press, 2000, Pags. 242-246

BM



Function

To calculate synchrotron radiation distributions for bending magnets. It can calculate Flux and Power spectra as a function of photon energy or/and angle. It can be used for power calculations. The output can be written to files that will be later be used by xpower.

Produced results:

- Plot energy spectra
- Plot angular distribution (all wavelengths)
- Plot angular distribution (one wavelength)
- Plot (angular,energy) distribution
- View numerical values

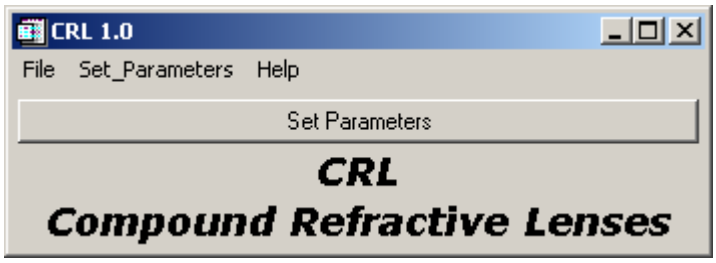
Documentation:

- application doc
- input parameters

Technical aspects

- The interface is created using the automatic application generator xop_ifc
- Numerical calculations are done using the IDL functions:
  - sync_ene.pro
  - sync_ang.pro
  - sync_f.pro
  - sync_hi.pro
  - sync_g1.pro
  -
- Limitations: Emittance effects (electron beam size and divergences) are not included.

CRL



Function

To calculate the parameters of Compound Refractive Lenses (CRL).

Two kind of calculations are allowed:

1. main parameters (focal distances, gain, acceptance, etc.) (calculated using Refs. 1 & 2)
2. Pseudo-Ray-Tracing to compute the beam profile at the image plane and the phase-space plot. (calculated using Ref. 2, formulas 9 and 32 for cylindrical and parabolic lenses, respectively).

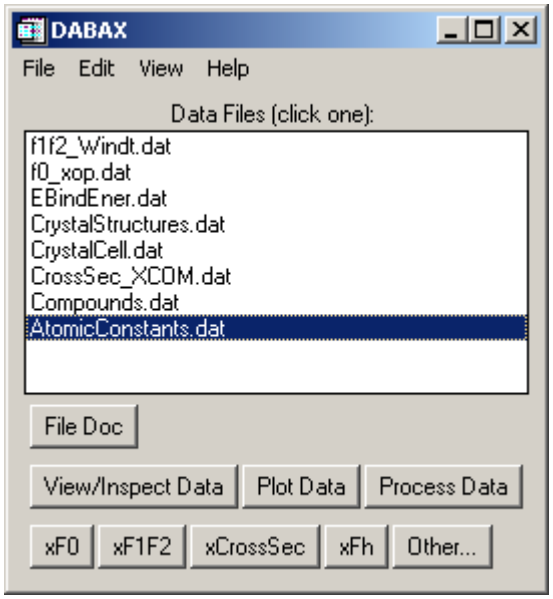
Documentation:

- application doc
- input parameters

Technical aspects

- Numerical calculations are done using the IDL functions crl_calc_rt
- References:
  - Snigirev, V. Kohn, I. Snigireva, A. Souvorov and B. Lengeler: "Focusing High Energy X-rays by Compound Refractive Lenses", Applied Optics 37 (1998) pp. 653-662)
  - P. Elleaume: Nucl. Instrum. and Meth. in Phys. Research A 412 (1998) pp. 483-506

DABAX



Function

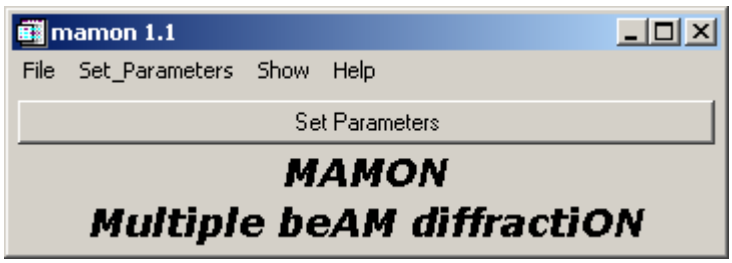
This application is a font-end of the DABAX (DAtaBAse for X-ray applications) data files. It allows to inspect the data files, download new files to your local XOP installation, consult file documentation, view the numerical data and plot the data in the files. From this interface, it is possible to start applications that make some post-processing of the DABAX data to calculate different parameters of beamline components:

- DABAX: xf1f2 (f1,f2 scat fact, refraction index, reflectivity)
- DABAX: xCrossSec (Cross section/absorption)
- DABAX: xFh (Crystal Structure Factors)
- DABAX: xf0 (f0 scattering factor)

Documentation:

- application doc

MAMON



Function

to calculate the Umweganregung peak location plot (the diffracted wavelength lambda vs. the azimutal angle angle Psi) for a given primary reflection in perfect cubic crystals.

Produced results:

- Spaghetti plot (wavelengh versus Psi for all reflections in the defined interval)
- Unweganregun plot: the intensity plot versus Psi for a given wavelenth.

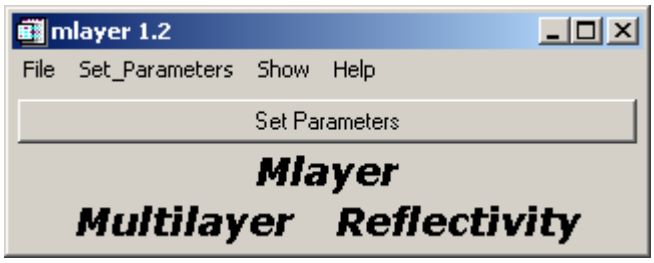
Documentation:

- application doc
- input parameters

Technical aspects

- The interface is created using the automatic application generator xop_ifc.pro
- Numerical calculations are done using an external C program.
- Limitations:
  - Only cubic crystal structures allowed
  - Intensity model very simple:
    - The formula is not valid for perfect crystals, only for powders
    - The total intensity must be the sum of the primary reflection plus the intensity of the so-called operative reflections plus the contribution of the cooperative ones.
    - Anomalous scattering factors are not considered.

MLAYER



Function

To calculate to calculate multilayer reflectivities as a function of either the photon energy or incident angle.

Documentation:

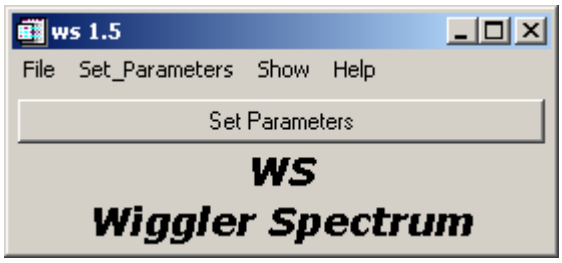
- application doc
- input parameters

Technical aspects

- The interface is created using the automatic application generator xop_ifc.pro
- Scattering factors are precomputed using DABAX "default" `f1f2_<name>.dat` file:
- Limitations:
  - it can only deal with elements (not compounds)
  - it does not take into account the effect of the roughness at the interfaces.

Users interested in more sophisticated multilayer modeling and fit with experimental data can use the IMD code, available as an XOP extension.

WS



Function

To calculate the spectral flux (in an aperture) and brightness of a wiggler insertion device.

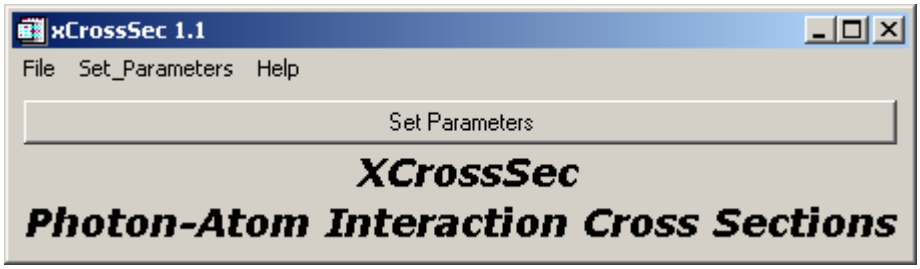
Documentation:

- application doc
- input parameters

Technical aspects

- The interface is created using the automatic application generator xop_ifc.pro
- Numerical calculations are done using a Fortran code ws
- Limitations:
    - Emittance effects (electron beam size and divergences) are not included.

XCROSSSEC



Function

to calculate to calculate Photon-Atom Cross Sections, Mass Absorption Coefficients and liner absorption coefficients for elements, compounds and mixtures. It users data from DABAX.

Documentation:

- application doc
- input parameters

XCRYSTAL

Function

To calculate to calculate diffraction profiles of perfect and mosaic crystals. It allows Bragg and Laue geometries and (in the case of perfect crystals) diffracted and transmitted intensity calculations. The diffracted intensity can be calculated as a function of either rock angle or photon energy.

It uses the DABAX database to define the crystal structure and to retrieve the scattering factors to build the crystal structure factors.

Documentation:

- application doc
- input parameters

Technical aspects

- Numerical calculations are done using the Fortran code diff_pat.f

XCRYSTAL_BENT

<Window Picture>

Function

Calculate the diffraction profiles of curved crystals. Several theoretical models are available in the xcrystal_bent program:

- Multilamelar model, useful for computing diffraction profiles of curved crystal in Bragg geometry
- Penning-Polder model, for crystals in Laue geometry.
- Takagi-Taupin. This model is in experimental status so results should be taken with extreme prudence. It is recommended not to use it if the user is not familiar with the theory
    -

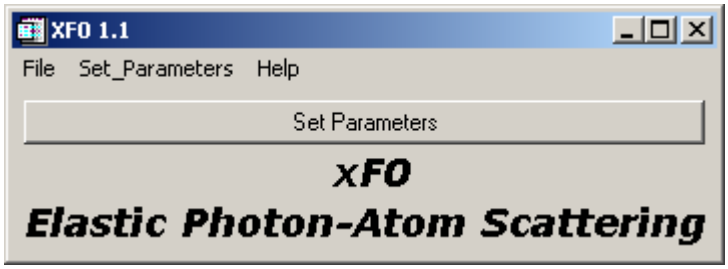
Documentation:

- application doc
- input parameters

Technical aspects

- Numerical calculations are done using the Fortran codes crystal_ml, crystal_za, crystal_pp and crystal_tt:

XF0



Function

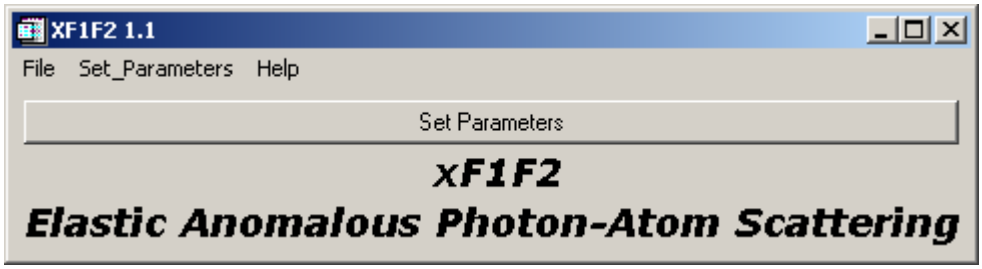
calculate the elastic photon-atom scattering function versus x=sin(theta/2)/lambda.

It uses the DABAX data.

Documentation:

- application doc
- input parameters

XF1F2



Function

To calculate o calculate elastic anomalous photon-atom scattering, and their derived parameters:

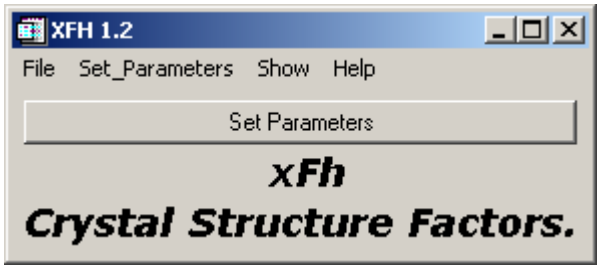
- refraction index
- photoelectric absorption
- mirror reflectivity

It uses DABAX data.

Documentation:

- application doc
- input parameters

XFH



Function

To calculate the structure factor of a crystal, and its energy dependence.

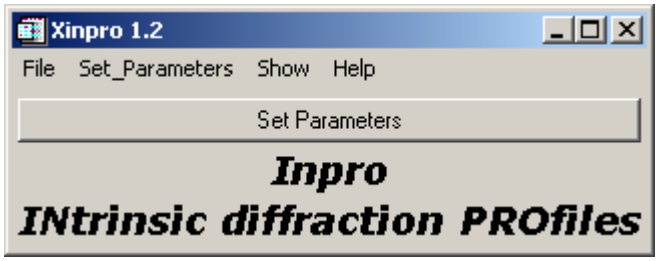
Documentation:

- application doc
- input parameters

Technical aspects

- A model for the thermal parameter is calculated using debyewaller.pro

XINPRO



Function

calculate perfect crystal reflectivity. xinpro calculates the diffracted and transmitted profiles in reflection (Bragg) and transmission (Laue) geometries for plane perfect crystals.

NOTE: This is an standalone program developed at the ESRF optics group. XOP developers recommend to use xcrystal, as it has a wider functionality and uses DABAX files.

Documentation:

- application doc
- input parameters

Technical aspects

- Bugs:
  - The Debye-Waller model diverges for zero Kelvin.

XOP_ENVIRONMENT

Function

It starts a text editor that allows to view and change the XOP environment variables.

XOP_IFC

Function

This is a tool for creating application interfaces in XOP. It is used for the applications with a simple input and output. Calculations may be done directly in the script file or using external compiled programs.

Documentation:

- application doc

Technical aspects

- Requires a script file (<appl>.ifc) with the interface definitions sitting in the ifc directory of the XOP installation.

XOP_MACRO

Function

This is a very simple environment to edit and run "XOP macros".

An XOP macro is a bunch of IDL instructions that are executed. It cannot be pre-compiled. Lines are executed one by one. However, a mechanism has been defined for creating IF or FOR blocks. These blocks are compacted into a single IDL command line before being executed. The "compacted" code can be previewed by clicking on the "Compact" button.

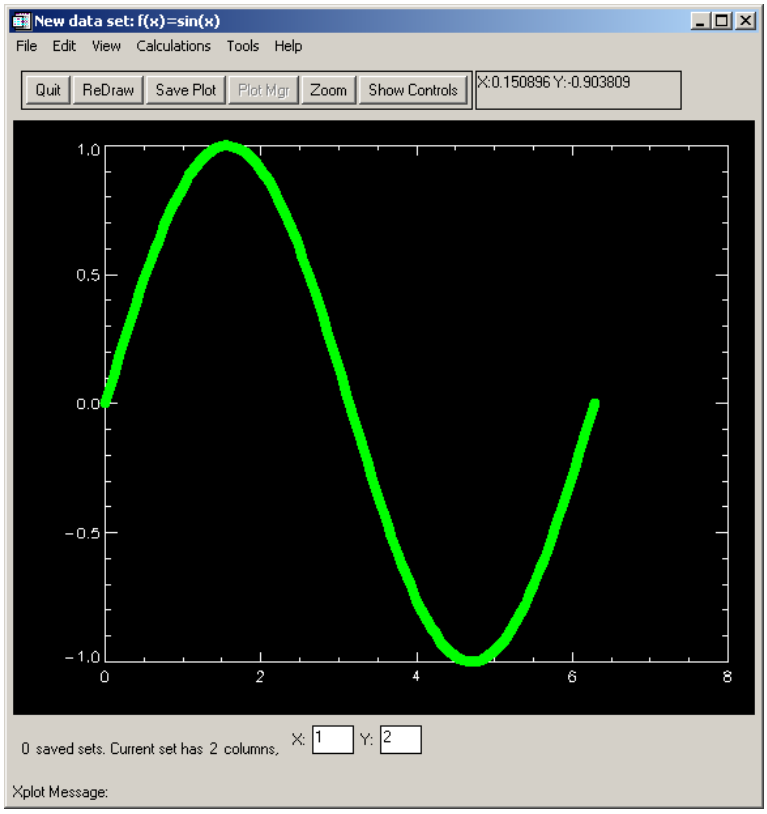
Documentation:

- application doc

Technical aspects

- Limitations:
  - No IDL compilation "on the fly" allowed using XOP with embedded IDL
  - Macros are very difficult to debug.
- Bugs:
  - There are sometimes internal conflicts with the variables producing unexpected results.

XPLOT

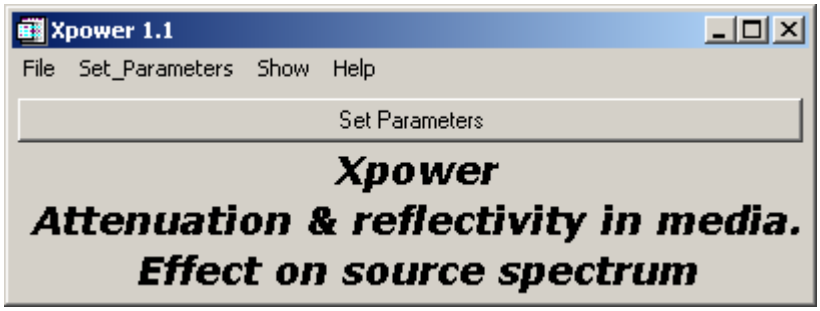


Function

XPLOT is a general package for creating X-Y plots that also allows for sophisticated data visualization, processing, manipulation and analysis.

Documentation [application manual] [on-line use]

XPOWER



Function

calculate the transmission in terms of flux or spectral power as a function of photon energy for a set of up to five attenuators and mirrors.
The integral of the spectral power gives the total power of the beam. Therefore this application can be used for calculating the power absorbed and/or transmitted by the optical elements.

Produced results:

- Local transmission and absorption of individual optical elements
- Apply the transmitivity/reflectivity of elements on the source spectrum (cumulated properties).

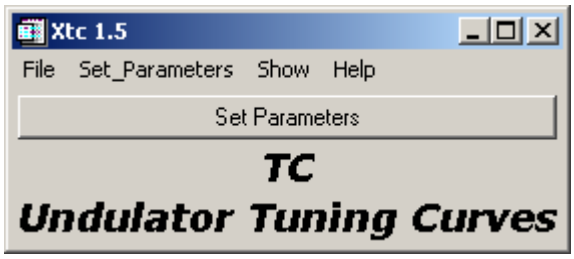
Documentation:

- application doc
- input parameters

Technical aspects

- Limitations:
  - The calculations made by xpower concern only intensities. Therefore, all effects related to the beam divergence, size, etc. are neglected. In other words, it performs calculations in a one-dimensional phase space (intensity). For more accurate calculation, a multidimensional phase space has to be taken into account. For that, a full ray-tracing can be done using the ShadowVUI extension.

XTC



Function

calculate on-axis brilliance tuning curves for an ideal undulator insertion device (regular planar device or a helical device).

The effect of the particle beam emittance and the beam energy spread is taken into account.

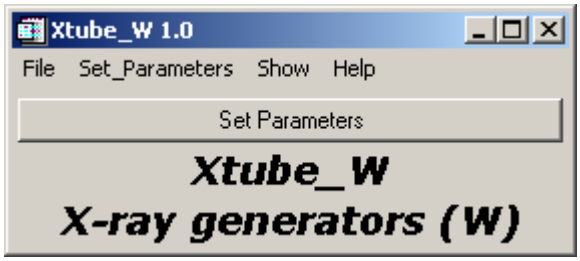
Documentation:

- application doc
- input parameters
- tc doc

Technical aspects

- Calculations are done using a Fortran program tc.f
- Limitations:
  - The program uses the Bessel function approximation which is valid for an ideal device, e.g., no magnetic field errors.
  - Electron energy spread is not taken into account (for the moment).

XTUBE_W



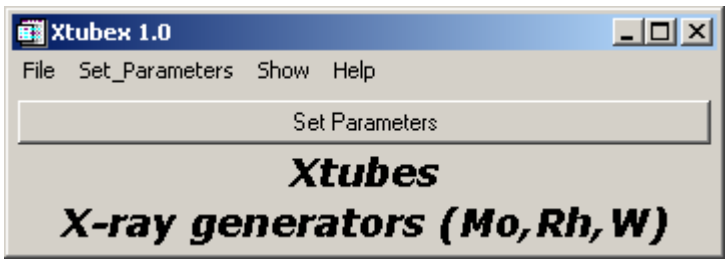
Function

To calculate the spectrum of a tungsten x-ray tube for voltages in the 30-140 kV interval.

Documentation:

- application doc
- input parameters

XTUBES



Function

To calculate the spectum of an X-ray tube with Mo, Rh or W target in the energy range 18-40 keV

Documentation:

- application doc
- input parameters

Technical aspects

- Bugs:
  - See a comment on units in [application doc]

XURGENT

Function

calculate the spectral distributions, angular and spatial emission maps, and brightness for plane and helical undulators.

Documentation:

- application doc
- input parameters
- doc on Urgent

Technical aspects

- Limitations:
  - Electron energy spread is not taken into account.

XUS

Function

calculate the spectral distributions, angular and spatial emission maps, and brightness for plane and helical undulators.

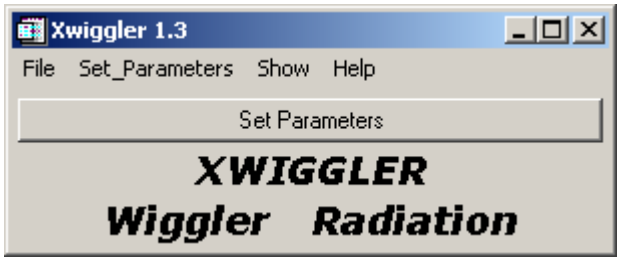
Documentation:

- application doc
- input parameters
- us doc

Technical aspects

- Limitations:
  - Electron energy spread is not taken into account (for the moment).

XWIGGLER



Function

To calculate the full emission (flux and spectral power) of a plane (conventional or elliptical) wiggler.

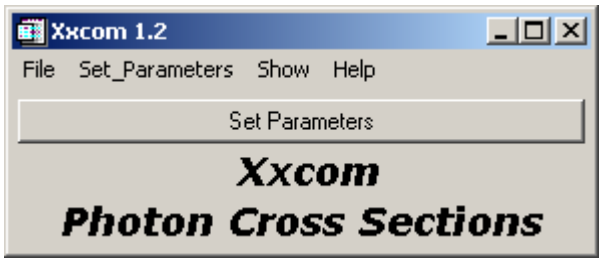
Documentation:

- application doc
- input parameters

Technical aspects

- Numerical calculations are done using the IDL functions:
  - wiggler_spectrum.pro and wiggler_nphoton.pro
  - synchrotron radiation functions in sync_ene.pro, sync_f.pro, sync_g1.pro and sync_hi.pro
- Limitations:
  - Emittance effects (electron beam size and divergences) are not included.

XXCOM



Function

calculate and displays photon-atom cross sections.

It interfaces XCOM, a computer program and data base to calculate photon cross sections for scattering, photoelectric absorption and pair production, as well as attenuation coefficients, in any element, compound or mixture, at energies from 1keV to 100GeV

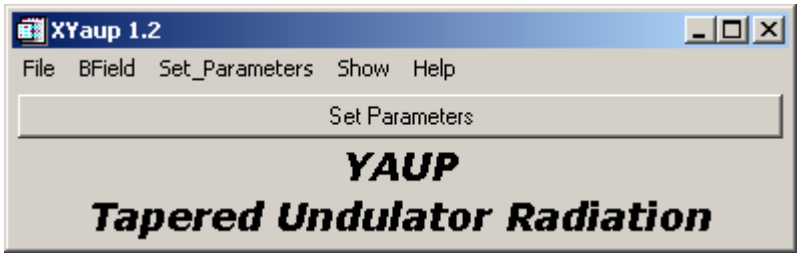
Documentation:

- application doc
- input parameters
- xcom doc

Technical aspects

- Reference:
  XCOM: Photon Cross Sections on a Personal Computer, M. J. Berger and J. H. Hubbell, Center for Radiation Research, National Bureau of Standards, Gaithersburg, MD 20899
- A web interface of these data is available at NIST: http://physics.nist.gov/PhysRefData/Xcom/Text/XCOM.html

XYAUP



Function

calculate spectra of a tapered undulator insertion devices.

Documentation:

- application doc
- input parameters
- yaup doc

Technical aspects

- Reference:
  B. I. Boyanov, G. Bunker, J. M. Lee, and T. I. Morrison *Numerical Modeling of Tapered Undulators*, Nucl. Instr. Meth. A339, 596-603, 1994

XOP extensions

"XOP extension" is a software package which is not part of the XOP standard distribution, but it can be installed optionally and run under the XOP interface.

For a complete list of available extensions, functionality, download and installation procedures see the XOP web page.

Access to documentation:

For accessing the documentation below, the corresponding package has to be installed in your system:

SHADOWVUI: Visual User Interface for the SHADOW ray tracing package

IMD - specular and non-specular (diffuse) optical functions of an arbitrary multilayer structure (D. Windt)

TOPO (D. Windt)

NOP - Thermal neutrons optics

XAID - XAFS data analysis tools

INES - Inelastic scattering

MIAM: is an image processing software targeted for x-ray microscopy applications. Its aim is to group in a graphical interface common processing sequences and apply them to bunches of x-ray images

XOP WEB LINKS

Nota: In order to access these links, your computer needs to access the internet.

- www server: http://www.esrf.fr/computing/scientific/xop/
- ftp server www server: http://ftp.esrf.fr/pub/scisoft/xop/