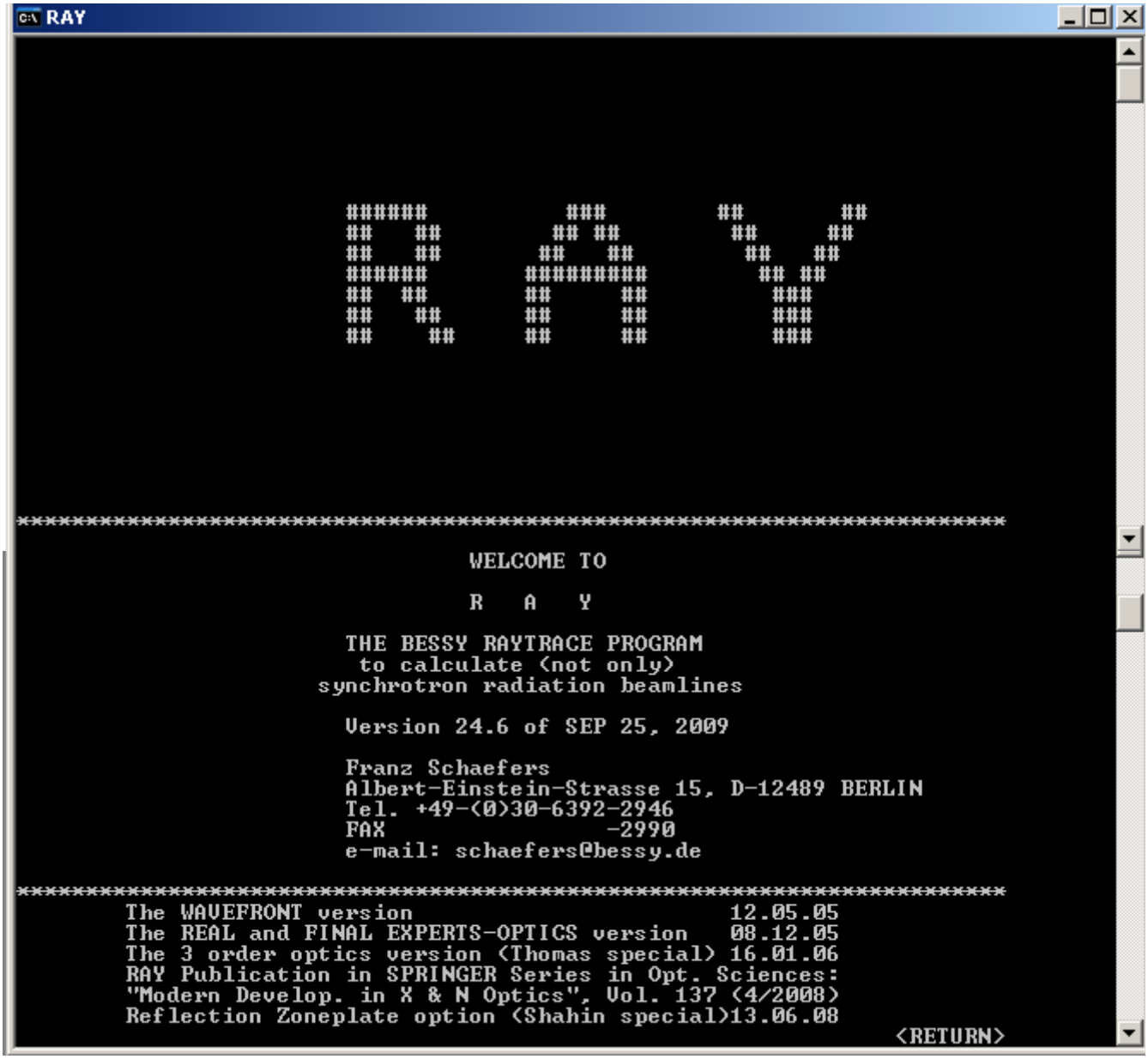
HELMHOLTZ ZENTRUM BERLIN für Materialien und Energie

# RAY - getting started



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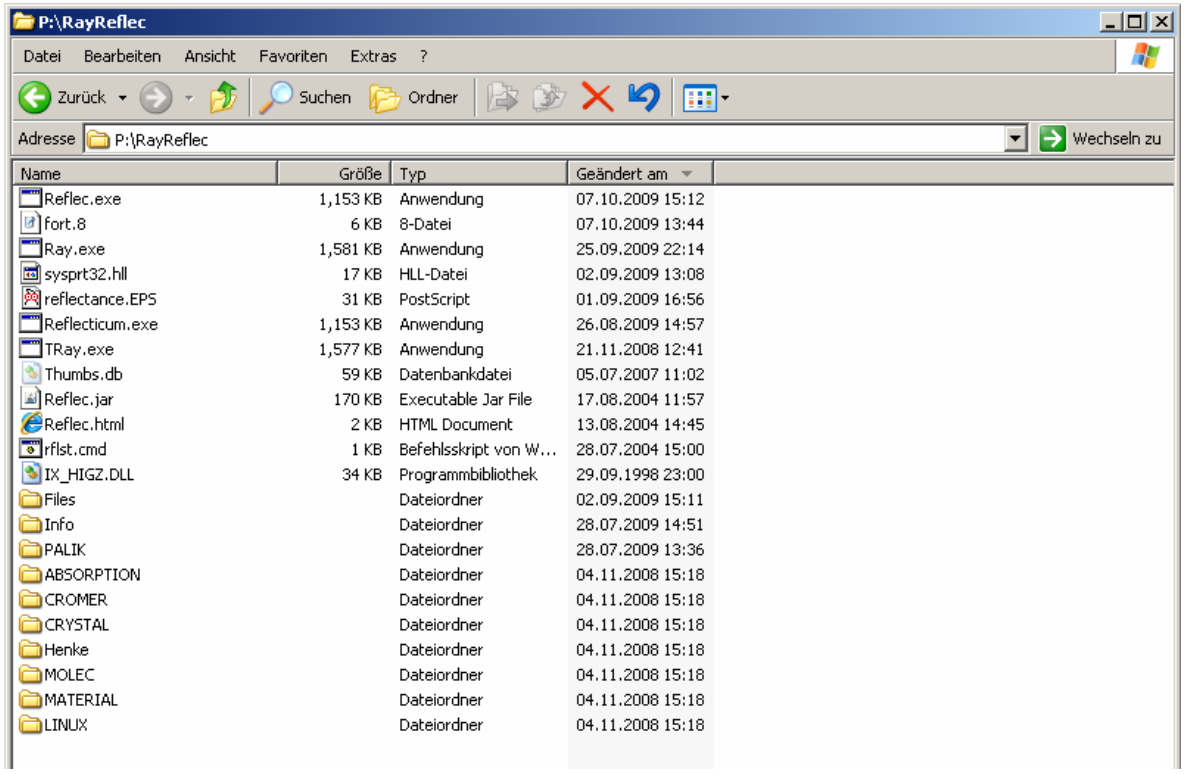
# RAY, REFLEC - getting started

Welcome to RAY and REFLEC, the BESSY programs to calculate (not only Synchrotron Radiation beamlines and VUV/X-ray optical elements).
This manual is supposed to give a brief *technical* assistance to get started. For a deeper insight into the physics, optics and geometry I refer to the references given at the end. These publications are included in the ZIP-file under <**INFO**>.
The file <**RAY.ZIP>** can be downloaded from my webmail account:

http://webmail.bessy.de/~schaefers@bessy.de/RAY.ZIP

After unzipping a directory RAYREFLEC with the following structure has been created:




| Name | Größe | Typ | Geändert am |
|---|---|---|---|
| Reflec.exe | 1,153 KB | Anwendung | 07.10.2009 15:12 |
| fort.8 | 6 KB | 8-Datei | 07.10.2009 13:44 |
| Ray.exe | 1,581 KB | Anwendung | 25.09.2009 22:14 |
| sysprt32.hll | 17 KB | HLL-Datei | 02.09.2009 13:08 |
| reflectance.EPS | 31 KB | PostScript | 01.09.2009 16:56 |
| Reflecticum.exe | 1,153 KB | Anwendung | 26.08.2009 14:57 |
| TRay.exe | 1,577 KB | Anwendung | 21.11.2008 12:41 |
| Thumbs.db | 59 KB | Datenbankdatei | 05.07.2007 11:02 |
| Reflec.jar | 170 KB | Executable Jar File | 17.08.2004 11:57 |
| Reflec.html | 2 KB | HTML Document | 13.08.2004 14:45 |
| rflst.cmd | 1 KB | Befehlsskript von W... | 28.07.2004 15:00 |
| IX_HIGZ.DLL | 34 KB | Programmbibliothek | 29.09.1998 23:00 |
| Files | | Dateiordner | 02.09.2009 15:11 |
| Info | | Dateiordner | 28.07.2009 14:51 |
| PALIK | | Dateiordner | 28.07.2009 13:36 |
| ABSORPTION | | Dateiordner | 04.11.2008 15:18 |
| CROMER | | Dateiordner | 04.11.2008 15:18 |
| CRYSTAL | | Dateiordner | 04.11.2008 15:18 |
| Henke | | Dateiordner | 04.11.2008 15:18 |
| MOLEC | | Dateiordner | 04.11.2008 15:18 |
| MATERIAL | | Dateiordner | 04.11.2008 15:18 |
| LINUX | | Dateiordner | 04.11.2008 15:18 |

Here you will find the DOS-programs <**RAY.EXE**> and <**REFLEC.EXE**>. By double-clicking on one of these the program is started in a DOS-box under Windows (tested up to Windows-VISTA).
The subdirectories contain the various optical constants data bases, the directory <FILES> the parameter-files and data-files.

**Both RAY and REFLEC programs are very curious! You will be asked many questions! Most of them are self-explaning. And you will be helped by additional explanations in cases of unclear or complicated questions, e.g. Stokes-formalism or azimuthal angle definitions.**

**Don‘t give up! All this is necessary to perform a raytrace simulation.**

**RAY has no Graphical User Interface, but all questions are answered by default. So you cannot do wrong.**
**And believe me, without GUI it is much quicker to handle and much more easy to get it run!**
**The keyboard-input is one-directional - from source to focus, as in real life.**
**First, there will be a question about**

**<How many RAYS to be calculated ?>  [ 20000 ] :**

**(maximum: 100 million), questions to describe the light source**

**<Specify the SOURCE>  [ DI ] :**
**…**
**the optical elements (up to ten)**

**<Specify the 1. OPTICAL ELEMENT>  [TO] :**
**…**
**wheather you want to search for the focus position**

**<Display BEAM WIDTH (find FOCUS position)?>  [N] :**

**and about the image planes (number and distance) at the end of your optical setup.**
**Once your optical setup is fully described (for the default beamline with one optical element 40 (!) questions have to be answered), you may store these parameters to make it easier the next time. If you have made a typing error or a wrong input, there are options of jumping back after input of source and/or mirror parameters:**

**<OPT. ELT. PARAMETERS O.K. (Y/N)>  [YES] :**

**To start, you might just go through all the questions (withour reading them), confirm all answers by the <RETURN>**

**button, and after one minute or so you are about to start your first beamline calculation by confirming:**

**<START CALCULATIONS ?>  (Y/N/E_xit)  [YES] :**

**This initiates a test-run with a few rays to set the dimensions of all arrays and buffers, which are displayed immediately after finish, and then finally:**

**<START WITH RAYTRACING ?> (Y/N/E_xit) [YES] :**

**Then, a couple of seconds later, after having calculated 20.000 rays you may display the focal properties by answering the question:**

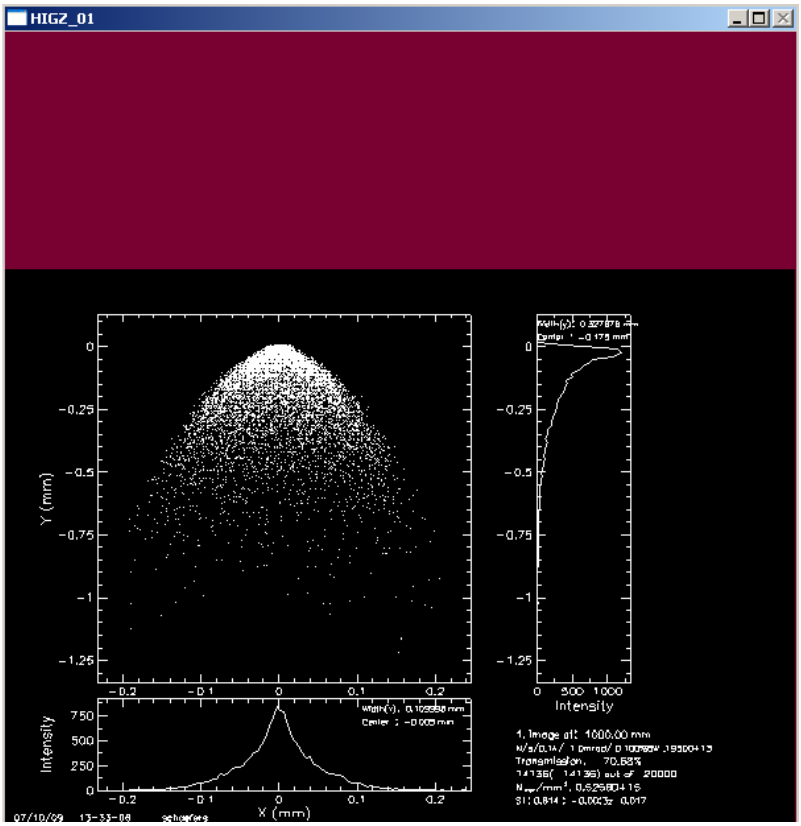
**<Display 1. image plane ?> [N] : yes**

**and the next one:**

**<Display point diagram (footprint) ?> [N] : yes**

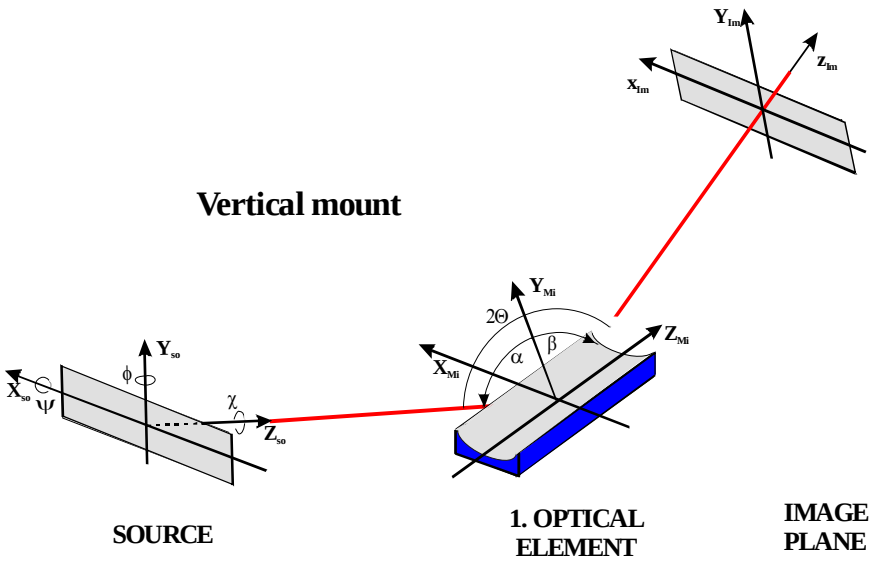
**with <yes> or <y>**

**Then the following picture should appear in a separate window on your monitor:**




This is the spot pattern, the geometric distribution of the rays at the focal position of the beamline you have calculated!

Obviously you have calculated a TO_roidal mirror placed after a bending magnet (DI_pole) source in grazing incidence geometry (vertical mount, s-polarisation geometry) with a demagnification of 10:1.




Of course you may rescale the figure, plot or store it, display a couple of additional information about angular distribution of rays, energy distribution for dispersive mounts, and the time behaviour <pathlength difference> (with respect to the central ray), store all calculated data as ASCII-table values. You may jump back to start of display by

<Repeat graphics> (Y/N/E_xit) ? [ NO ] :

to display another parameter which you might have forgotten. By default <[ NO ]> you would go back to the start of the program, to modify or optimise a certain beamline parameter, or to calculate your next beamline.

All this which you have done so far may not be *your* beamline, but you are free to change everything during the next run!

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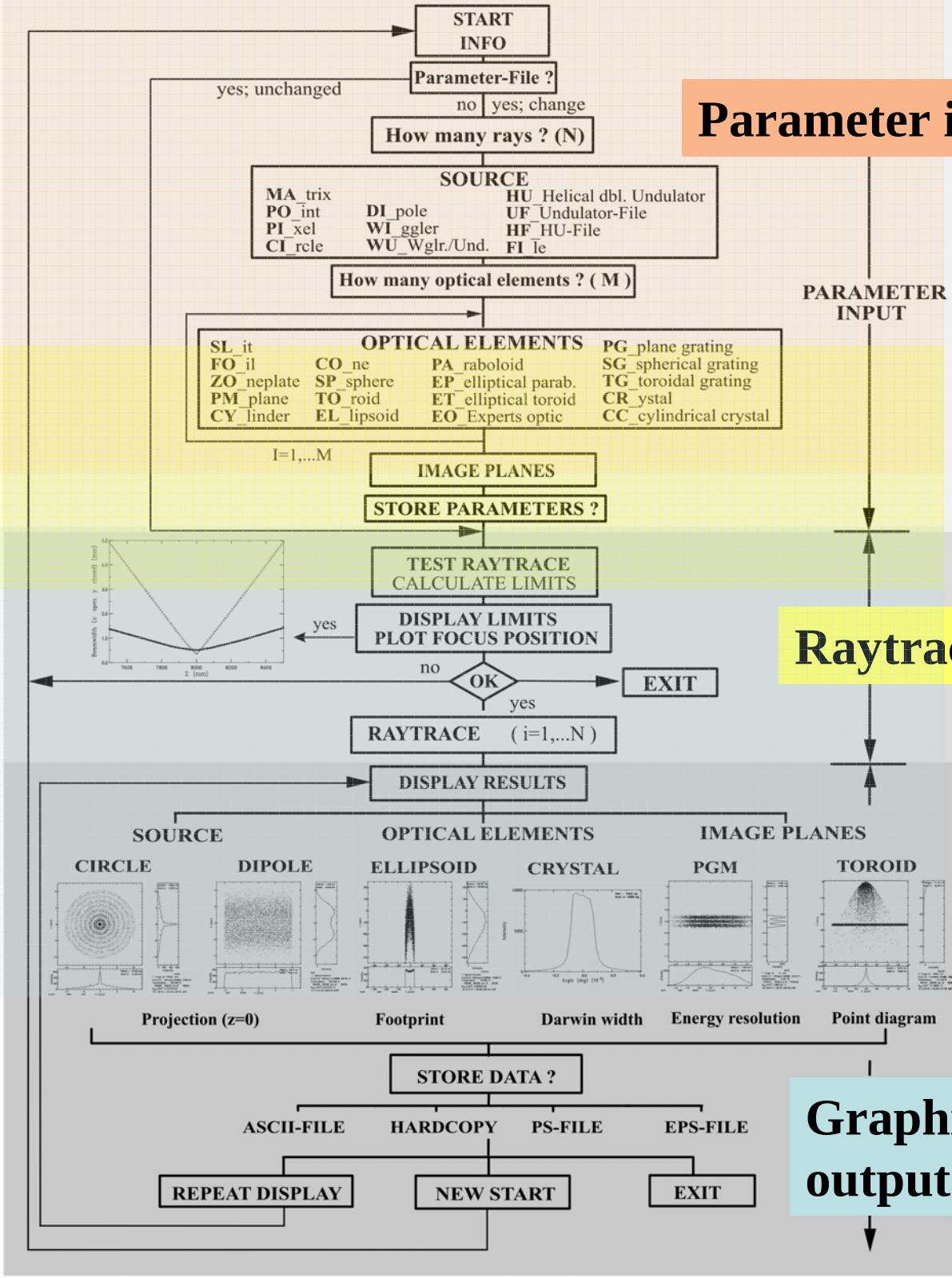
# FLOW CHART OF RAY



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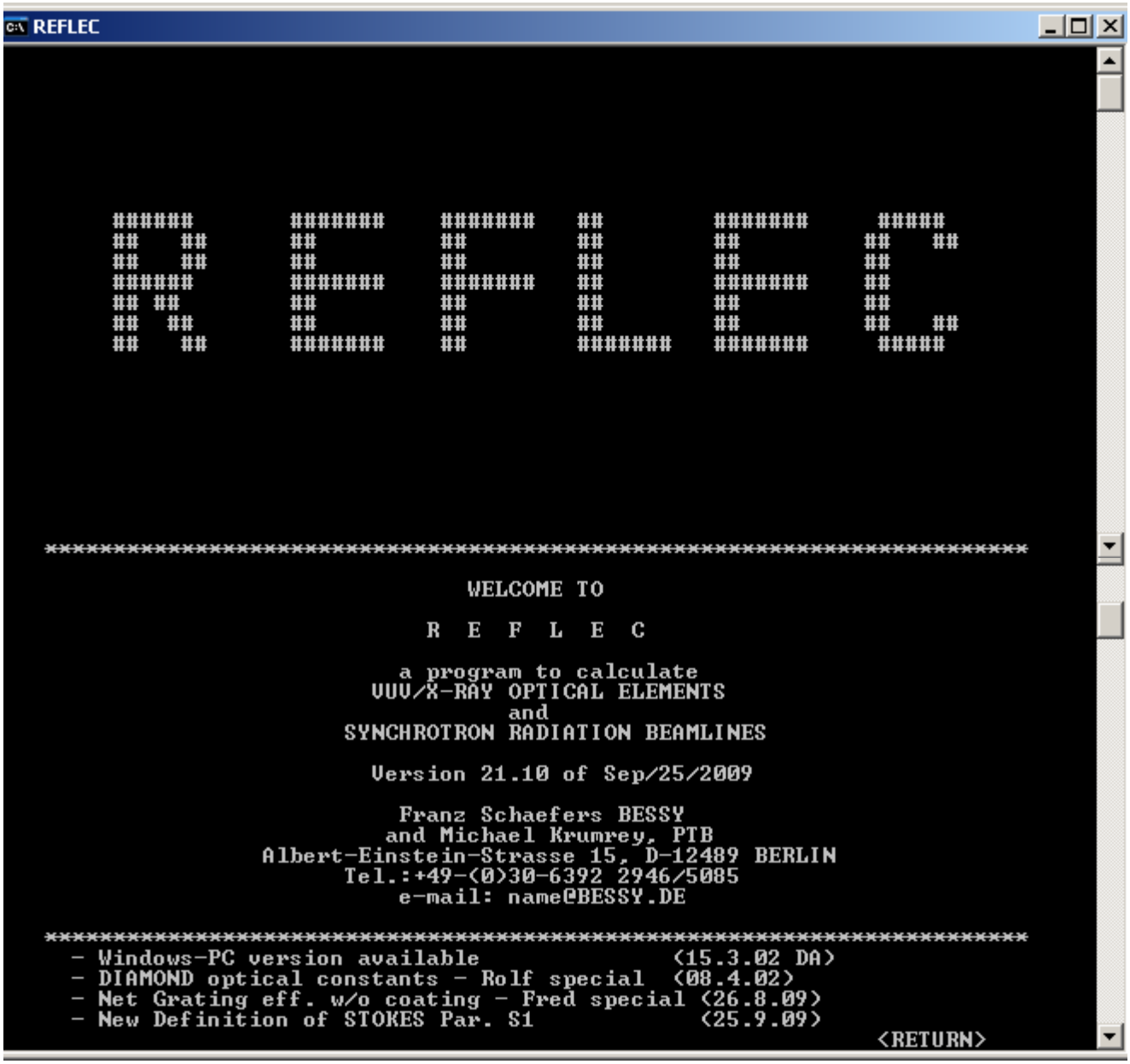
# REFLEC - getting started

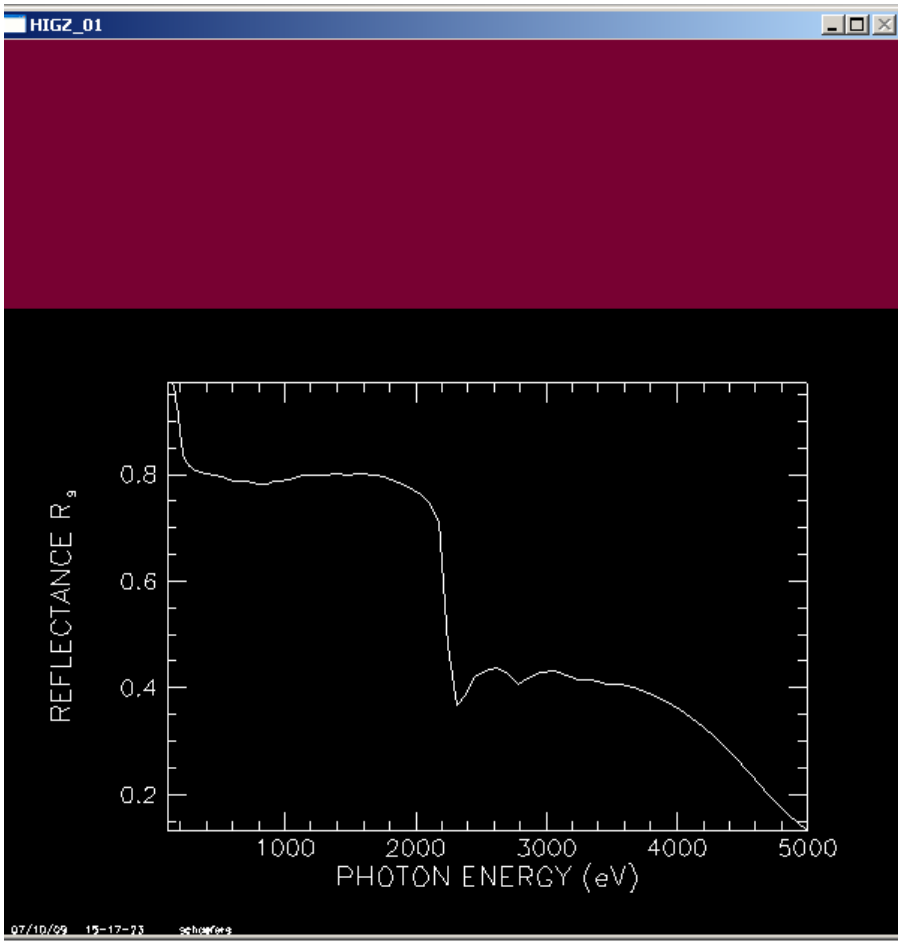


**RAY is a raytrace program, primarily taking care about geometric optics, while REFLEC is a program incorporating Schwinger- and Fresnel equations including Stokes formalism to calculate optical parameters of bending-magnet synchrotron radiation sources, mirrors, gratings, crystals, foils etc. as function of incidence angle or photon energy.**

**The programs are similar, they share common source code.**
**REFLEC has no Graphical User Interface GUI, but all questions are answered by default. So you cannot do wrong.**
**And believe me, without GUI it is much quicker to handle and more easy to get it run!**

**So, also REFLEC is quite curious. But it is even easier to start with than RAY.**

**After answering 22 questions (answers are by default) by pushing the <RETURN> button you will get this picture in a separate window:**



**This is obviously the s-reflectivity of a Au-coated (monolayer) mirror at 1 degree grazing incidence in the energy range from 100 eV to 5000 eV.**

**This may not be of any interest to you, but you may change all the parameters of the element, the element itself, and also the display parameters.**

**So, for instance, since 10 elements can be calculated and displayed simultaneously in one graph, it is very simple to get an overview about different mirror coatings, or the dependence of reflectivity from the incidence angle, or the comparison between s- and p-polarisation.**

**References:**

***1.*** ***RAY - THE BESSY RAYTRACE PROGRAM***
**F. Schäfers, In: Springer Series in Modern Optical Sciences: Modern Developments in X-Ray and Neutron Optics, eds. A. Erko, M. Idir, Th. Krist, A.G. Michette, Springer Berlin/Heidelberg, Vol. 137, 9-41 (2008)**

***2.*** ***REFLEC - A program to calculate VUV and soft x-ray optical elements and synchrotron radiation beamlines***
**F. Schäfers, M. Krumrey, Technischer Bericht, BESSY TB 201, 1-17 (1996)**

***3.*** ***RAY - the BESSY raytrace program to calculate synchrotron radiation beamlines***
**F. Schäfers, Technischer Bericht, BESSY TB 202, 1-37 (1996)**

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