IMAGIC
Basics

A Brief Introduction
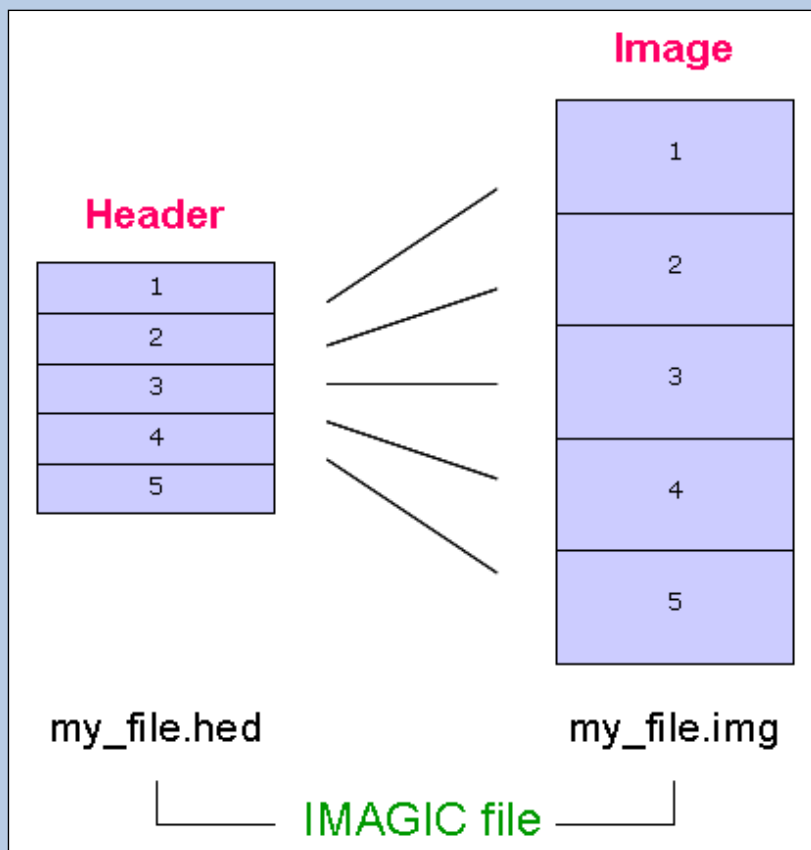
IMAGIC - Package

IMAGIC is a tool case of commands and procedures for image analysis and 3-D reconstruction. Although it was developed in the field of (cryo) electron microscopy it can be used in many other fields of image and data processing.

IMAGIC - Files

An "**IMAGIC** image file" consists of a header file (extension: hed) and the image density file extension: img):

the **IMAGIC** image file contains the actual image density values, while the header file contains information about the images ("meta data") as a set of records that can be accessed through different labels. For example:

IMN	image location number (1,2,3,...)
IXLP	number of lines per image
IYLP	number of pixels per line
IZLP	number of sections if input is a 3-D volume
REF	multi-reference number
CLASSNO	class number
ALPHA	Euler alpha angle
BETA	Euler beta angle
GAMMA	Euler gamma angle

etc.

An additional PLT text file can be associated to an **IMAGIC** image file to store further meta-data like:

coordinates of particles
contour of masks
image numbers
Euler angles
graphics (curves)
etc.

The PLT file may contain a maximum of five numerical values per line, separated by blanks (or by commas).

A few other **IMAGIC** text (ASCII) files may be generated during processing:

CLS files are classification files containing classes and their members
LIS files contain information printed during execution of a program
LOG files contain output of programs when running as batch job (script)
DAT files contain data for various purposes
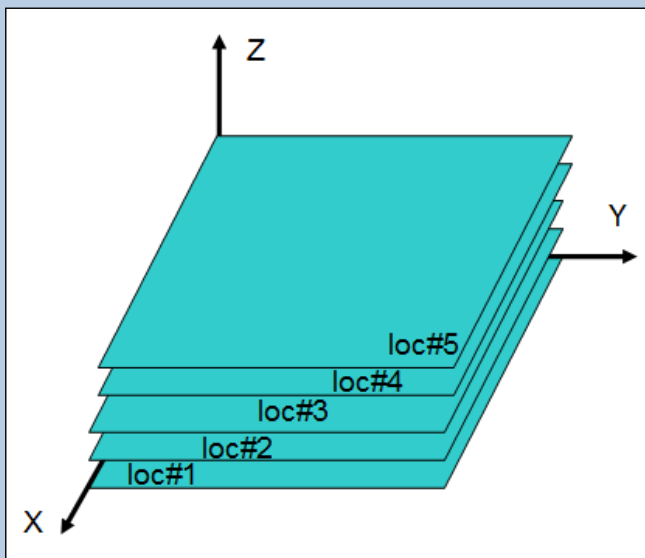DFF (default) files) are used to store your last answers

IMAGIC - Coordinate System

The **IMAGIC** coordinate system is a right-handed system with its (1,1) origin in the top-left corner of the image. The length of the lines (number of rows/columns) is NY and the number of lines is NX:
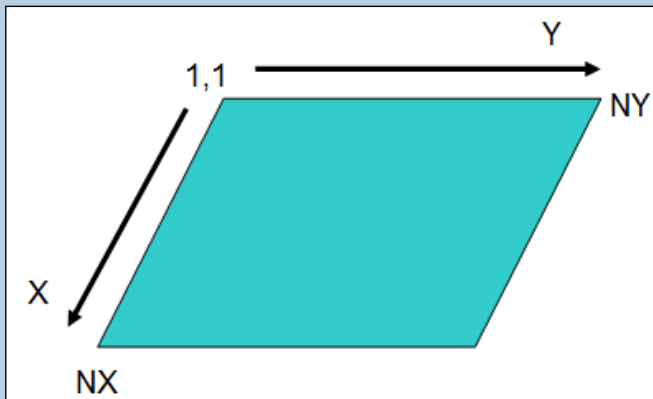
The **IMAGIC** coordinates for a 3-D volume are the following:

Note that Z = X x Y as required for a right-handed co-ordinate system.

IMAGIC - Euler Angles

IMAGIC 3-D orientations are defined by three Euler angles Alpha, Beta and Gamma.

From the perspective of an external viewer (like every **IMAGIC** image used/created in commands ANGULAR-RECONSTITUTION, THREED-SURFACE, THREED-FORWARD, etc.) the Euler angles are defined as follows:
The first rotation is a rotation around the Z-axis by GAMMA, followed by a rotation BETA around the new Y-axis and a rotation ALPHA around the new Z-axis .
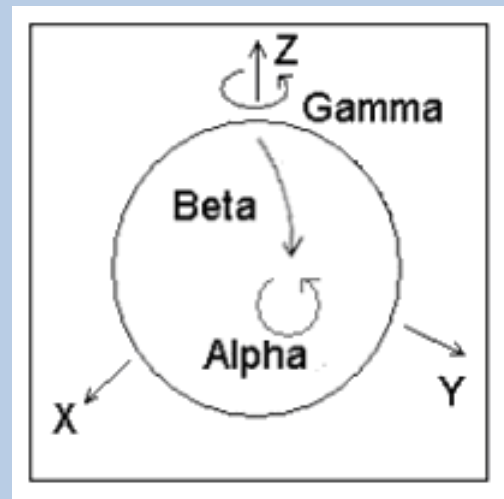
But normally a user does not think in this way but tries to imagine how the particle would look like "in his hands":
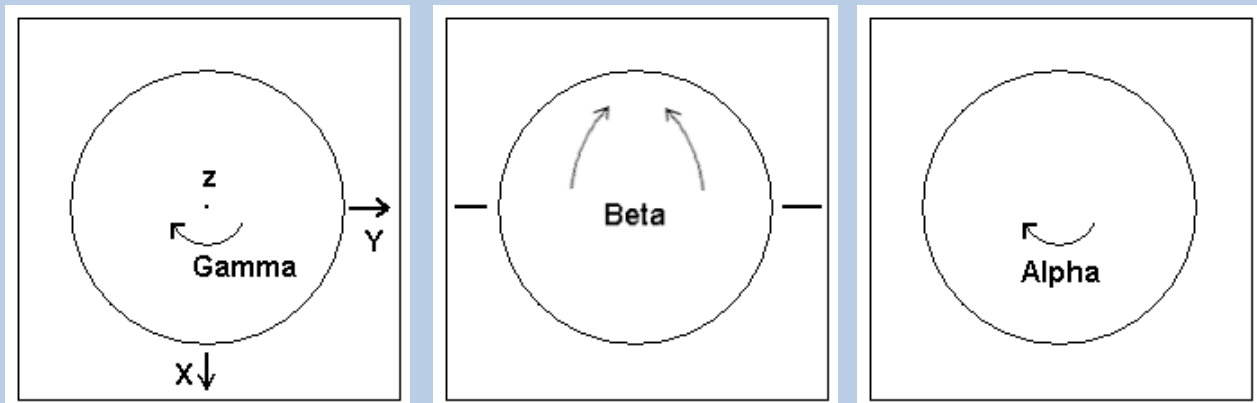
1> Look at the particle along the Z-axis ("north pole")
2> Rotate the particle clockwise by Gamma
3> Rotate the particle into the plane clockwise by Beta
4> Rotate the particle clockwise by Alpha

Note that the important angles to define a 3-D orientation are Beta and Gamma. Alpha is only the final in-plane rotation.

IMAGIC - Command Parameters

IMAGIC first asks for all file names and parameters needed before any calculation is started. Every question also has an associated help, which can be accessed by "?".

IMAGIC command questions will often suggest values. When a command is started the first time in the current working directory this is the programmer's suggestion.

IMAGIC remembers the last values you have entered for a specific command. These values (stored in the DFF files) become the default values the next time the command is started in that working directory. In general, if you do not know how to answer a question, the default values serve as an intelligent first guess.

IMAGIC - MPI Parallel Processing

In **IMAGIC** MPI refers to parallel processing. If your notebook computer (or any other type of computer) has multiple cores commands which are using parallel processing will ask you if you want to run the command in parallel or not. In the beginning always first run on a single core (non-parallel mode) which will give you more feedback (answer NO). Later when using many images your answer may be YES. Note that the number of processors to be used should be at least the number of nodes PLUS 1.

There three ways on how to work with **IMAGIC**:

IMAGIC in a terminal window (line-by-line mode)
IMAGIC within a specific IMAGIC GUI program
IMAGIC within IMAGIC GISP (a single particles analysis GUI workflow)

IMAGIC - Terminal Mode

IMAGIC can be started in one (or more) terminal/command window(s) of your computer. The commands are interactive and are followed by specific questions which are asked line-by-line.

```
my_notebook> imagic

IMAGIC-COMMAND:
```

You can get the associated help for each question by typing a '?':

```
Image dimensions X,Y              : ?

  The (INTEGER) dimensions of the images are defined as:

  X : number of lines in the image
  Y : number of pixels in a line
```

The suggested values (programmer or your last choice) appear in brackets.

```
Image dimensions X,Y [512,512]    :
```

If an **IMAGIC** command can run in parallel you are asked the following:

```
Use MPI parallelisation [YES]                    : yes
Number of processors to be used                  : 3
```

Refer to manual "Hands-On – Playing with IMAGIC – Terminal Window ".

IMAGIC - guiIMAGIC

guiIMAGIC is a GUI oriented program to run the IMAGIC commands in a GUI oriented design.
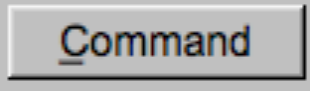
You can call **guiIMAGIC** directly in your computer. You can also start **guiIMAGIC** as a command from **IMAGIC** in terminal mode which has the advantage that you don't have to specify the working directory on the "Start page" of **guiIMAGIC** because **guiIMAGIC** will automatically use the working directory of the terminal windows.

```
my_notebook> imagic

IMAGIC-COMMAND: guiIMAGIC
```

IMAGIC - with IMAGIC GUI Programs

Within the specific **IMAGIC** GUI programs (like **guiCNORM**, **guiCTF**, etc.) you can always run any IMAGIC command in a GUI oriented design.

In the toolbar of each of these specific **IMAGIC** GUI programs you will find a "Command" button.
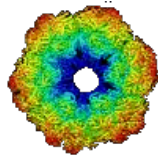
Command

Clicking this "Command" button you will get a new page with a list of buttons to run any **IMAGIC** command you want to work with.

Refer to the manual of the related **IMAGIC** GUI program to get further help.

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Feedback / Error hints

We intensively tested **IMAGIC** / the **IMAGIC** GUI programs and tried to find all possible errors and inconsistencies. But you may still find some problems.

We are happy to get feed-back. Please send your comments, error hints etc. to

imagic@ImageScience.de

THANK YOU VERY MUCH.

Image Science

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