

# MAPA: IMPLEMENTATION OF STANDARD INTERCHANGE FORMAT AND USE OF ANALYZING LATTICES

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*Abstract*

MAPA (Modular Accelerator Physics Analysis) is an object oriented application for accelerator design and analysis with a Motif based graphical user interface. MAPA has been ported to AIX, Linux, HP/UX, Solaris and IRIX. MAPA provides an intuitive environment for accelerator study and design. The user can bring up windows for fully nonlinear analysis of accelerator lattices in any number of dimensions. The current analysis methods of Lifetime plots and Surfaces of Sections have been used to analyze the improved lattice design of Wan, Cary and Shasharina (this conference). MAPA can now read and write Standard Interchange Format (MAD) accelerator description files and it has a general graphical user interface for adding, changing and deleting elements. consistency checks prevents deletion of used elements and creation of recursive beamlines. Plans include development of a richer set of modeling tools and the ability to invoke existing modeling codes through the MAPA interface.

## 1 MAPA AS A FRAMEWORK FOR STUDYING DYNAMIC SYSTEMS AND ACCELERATORS

MAPA was created in such a way, that many dynamical systems can be studied within it with the use of the same graphical user interface. In order to hook up a system to the code, users have to inherit it from *System-Map* tree class hierarchy and represent its attributes as parameters, options and strings. Each system should be provided with the method `int Advance(double* p)` which describes the way the *d*-dimensional array of coordinates changes in one step of time. MAPA has many systems included already (non-linear maps, toroidal magnetic systems for plasma confinement and accelerators).

On the Fig. 1, we showed a typical view of the GUI. The upper left window has two systems, one of which is an accelerator (empty beamline by default). By clicking on the button, the user chooses the system, and brings the system control window (upper right on Fig. 1). This window has several menus for invoking methods for the system control and graphical analysis. Thus, the window for changing parameters can be brought up for dynamical changes of the system.

A special button in Menu allows reading description files, after which an corresponding accelerator is instantiated. We provided MAPA with parsers for reading both from the MAPA-native and SIF (MAD) format. This implies that the set of accelerator elements of MAPA is full enough: has all elements currently in use in MAD.

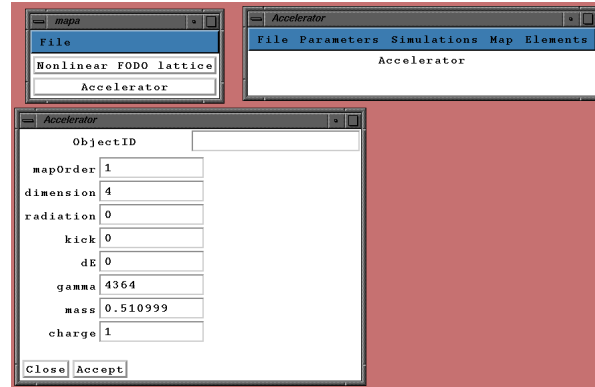


Fig. 1 A typical view of MAPA GUI: a window for choosing the system, control window and window for changing parameters.

## 2 GRAPHICAL ANALYSIS OF ACCELERATOR

MAPA has a rich set of graphical methods for analysis of accelerators. By invoking the menus described above, a user can bring up surfaces of sections (Fig. 2), which have means for starting orbits from clicks, or by choosing initial conditions in the slots, erasing orbits, zoom-in and out, and change the order the axis to see orbits in configuration space.

A special window can be brought up for dynamical changes of the beamline: adding, removing and changing the elements (Fig. 3).

Another powerful means for the accelerator study is a Lifetime plot (see Fig. 4, where different color indicate different confining properties of phase space locations).

Finally, MAPA can perform simulations relevant to the system, like Monte Carlo simulations (Fig. 5). As always, parameters of the calculations can be changed interactively and dynamically.

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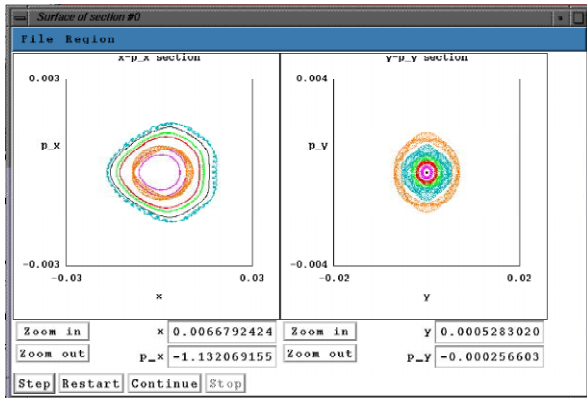


Fig. 2 Surfaces of section for ALS (Lawrence Berkeley Lab).

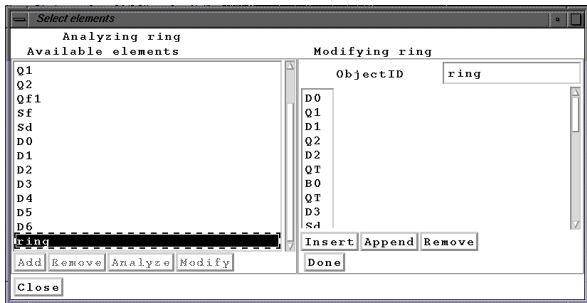


Fig. 3 A window for changing the beamline.

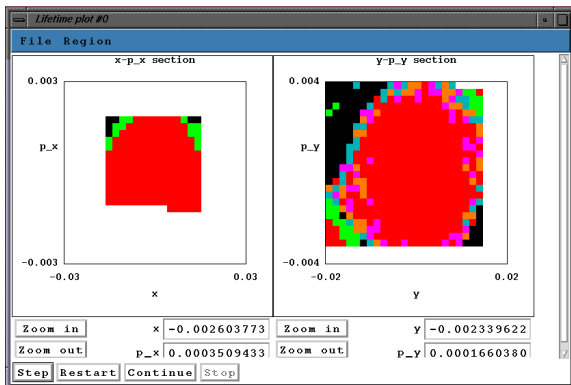


Fig. 4 Lifetime plots.

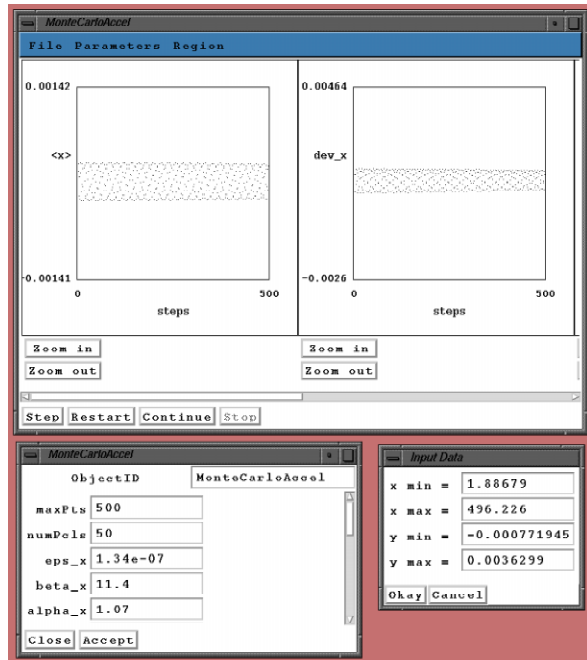


Fig. 5 Monte Carlo simulation for ALS.

### 3 SPECIAL FEATURE OF MAPA AND FUTURE PLANS

MAPA is a framework for studying dynamical systems. It is specially well suited for studying accelerators. All parameters of accelerator can be changed dynamically through a user friendly graphical interface. Several dynamical systems can be instantiated simultaneously for the ease of comparison. MAPA has a rich set of graphical analysis means. MAPA is easily extended and portable across many platforms. MAPA reads and writes MAD files.

Plans are at work to invoke Differential Algebra methods for rapid tracking and non-linear map analysis. Fitting facility will also be included soon.