

The LHC main rings consist of two intersecting rings, LHC1 and LHC2. Due to historical reasons and the use of “lens style” modeling, accelerator physicist have never represented the common region of the ring with a “proper” object oriented approach. Although LHC1 and LHC2 share magnets, traditional tracking codes such as the code MAD-X of CERN, represented these common magnets as different objects on the computer. Special purpose programming was written to insure that these magnets would share common settings in both rings.

While such hacks were indeed done correctly in the code MAD-X of CERN, Etienne Forest of KEK (Japan) and Frank Schmidt of CERN decided to include in MAD-X a library called PTC (Polymorphic Tracking code), which permits a more realistic representation of complex accelerators. In particular, common magnets are not cloned, but exist individually in computer memory as they do in a real accelerator.

To check the correctness of this approach in the case of complex ring topologies, it has been necessary to visualize simple orbits of the accelerator on the screen. The GINO library of Bradly Associates, particularly GINOMENU STUDIO, has allowed us to create the necessary interface with our existing libraries, namely PTC and MAD-X. Indeed our GINOMENU project contains in excess of 440 widgets. This was extremely tedious to program direct without GINOMENU STUDIO.

In addition, our GINO program has been used in connection with the Japan Proton Accelerator Research Project Complex (J-PARC) by Dr. Alexander Molodjontsev of KEK. It has been used, in connection with MAD-X and ORBIT (an code from Oak Ridge National Laboratory, USA) in the study of space charge effects at J-PARC. Finally it has been used with PTC in the design of FFAGs, particularly by Dr. Dejan Trbojevic of Brokhaven National Laboratory.

The BMP file shows a screen shot of a few windows opened by PTC. In particular, the window called “Layout” displays one of the intersecting region of LHC1 and LHC2. The light blue curve (LHC1) and the red curve (LHC2) are actual trajectories computed with MAD-X/PTC and displayed by a GINO based program.

It should be pointed out that one is only looking at a tiny fraction of the machine. Over 26,000 objects are in memory during that run owing to the gargantuan dimensions of LHC. Many things can be plotted including “phase space” plots and also plots of the optical functions describing the elementary properties of the LHC. For example, in the figure dispersion.bmp, we show the “dispersion” of LHC1 in red and that of LHC2 in white. Again, we repeat that this is done for a true model of the machine containing “unique” objects in the common areas. To our knowledge, this is a feature unique to PTC in accelerator physics.

