

## AN INNOVATIVE GRAPHIC USER INTERFACE FOR PARMILA 2

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### Abstract

A new graphic user interface (GUI) has been created for the PARMILA 2 program. PARMILA 2 is an advanced version of the historical PARMILA program originally developed to design and model drift tube linear (DTL) accelerators. PARMILA 2 expands upon that capability to support the design and simulation of coupled cavity linear (CCL) accelerator structures, coupled-cavity drift tube linac (CC-DTL) structures, superconducting accelerator structures, as well as DTL structures and transport lines that can include magnetic, radiofrequency and electrostatic beam optics elements. A new software package called the Open Architecture Software Integration System, or OASIS™, has been used to develop an innovative graphic interface for the PARMILA 2 program. OASIS provides a framework for developing custom modules for the Particle Beam Optics Laboratory (PBO Lab™) software. The framework can be used to create new PBO Lab modules *without the need for writing or compiling any source code*. Tools in the OASIS software were utilized to define the GUI features of the new PARMILA 2 module. Existing PARMILA 2 executables, including Parmila.exe, Lingraf.exe and readdst.exe, have been linked to GUI commands utilizing other tools within the OASIS framework. This paper presents an overview of the new PARMILA 2 module and illustrates some of the GUI features.

### INTRODUCTION

PARMILA (Phase and Radial Motion in Ion Linear Accelerators) is a well established computer code [1] used for the design and simulation of proton (and heavier particle) linear accelerators. The program has a long history and the version 2 developed at the Los Alamos National Laboratory includes design capabilities for drift tube linacs (DTLs), coupled cavity linacs (CCLs), coupled cavity drift tube linacs (CCDTLs) and several types of superconducting linac structures [2, 3]. One challenge to users of PARMILA has been acquiring a good knowledge of the detailed input file format required by the program. The development of an intuitive, easy-to-use graphic interface for PARMILA 2, as an Application Module of the Particle Beam Optics Laboratory (PBO Lab), directly addresses that challenge.

PBO Lab is a modular suite of commercial software applications which has Application Modules that support a variety of particle beam optics programs and other accelerator-related codes [4]. Each optics program Application Module incorporates a specific particle beam

optics modeling or simulation program. Available modules include TRANSPORT [5], TURTLE [6], MARYLIE [7], TRACE 3-D [8] and DECAY-TURTLE [6]. Other modules are also available, including an Optimization Module utilizing the NPSOL [9] and MINOS [10] nonlinear constrained optimization programs, and specialized modules for modeling electrostatic elements [11] and traveling wave accelerator components [12]. PBO Lab provides a common graphic user interface (GUI) for constructing and editing iconic object-based computer models of accelerators and beamlines. The common GUI for optics programs in PBO Lab simplifies the task of carrying out calculations for a given beamline. PBO Lab assures that the input files for every optics program represent the same beamline, and PBO Lab will automatically display graphical results that may otherwise require post-processors. Users do not need to construct input files in the format required by a specific program -- PBO Lab takes care of all the needed bookkeeping, and the object model automatically creates the necessary input files following simple menu commands issued by a user.

### PBO LAB PARMILA-2 MODULE

The requirements to develop a workable GUI for PARMILA were outlined some years ago [13] and a prototype concept was described at the 1994 Linac Conference [14]. For a variety of reasons, further progress was limited until a new approach for creating optics code GUIs for PBO Lab became available. The new approach was provided by the Open Architecture Software Integration System, or OASIS. Developed under the auspices of the U. S. DOE Small Business Innovation Research (SBIR) program, OASIS [15] provides the type of reusable framework required for rapidly creating PBO Lab Application Modules without the need to write any new source code, for either the GUI (PBO Lab) or the associated physics code (e.g. PARMILA). In brief, OASIS is a new PBO Lab Module that is used to create additional PBO Lab Modules, where the GUI and related object model themselves provide the creative framework.

The document (or start up) window for the PARMILA-2 Module is basically the same as that for any other PBO Lab Module. Figure 1 illustrates an example document window which has an iconic description of a drift tube linac (DTL) model displayed. The DTL model was created by using the "drag and drop" construction kit of the PBO Lab software. Several custom features of the PARMILA-2 Module are pointed out in Figure 1.

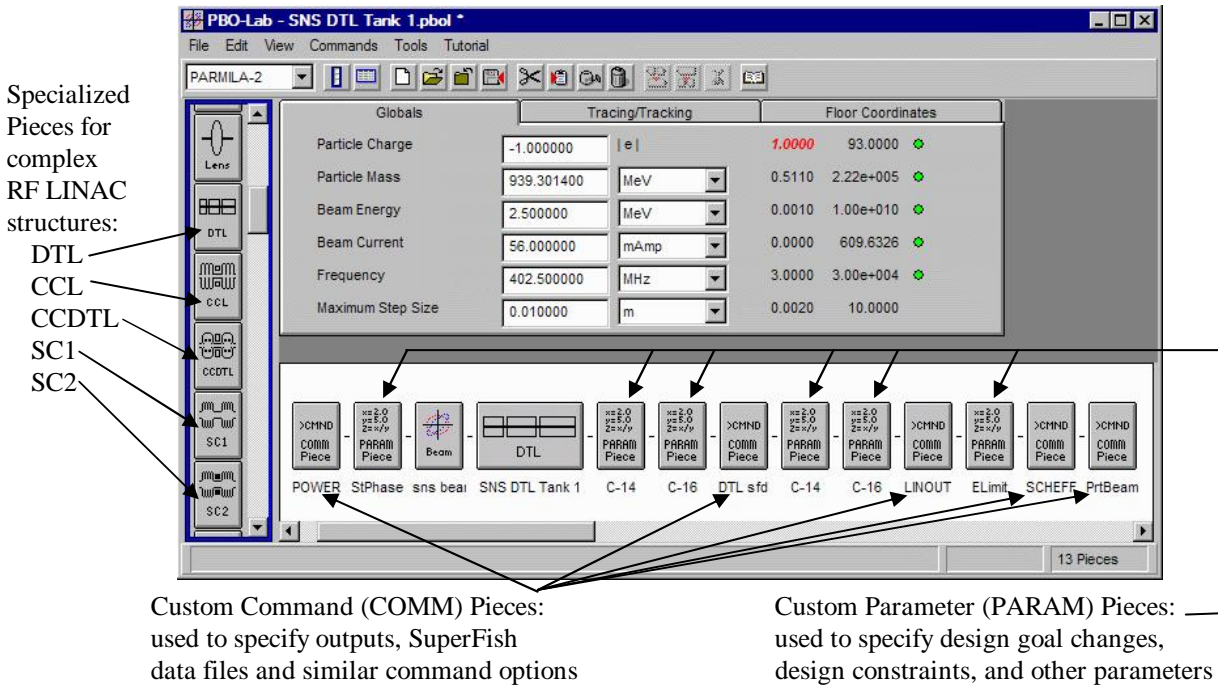


Figure 1: The standard PBO Lab Document Window is used for the PARMILA-2 Module. This example shows a beamline model for a single-tank drift tube linac (DTL) accelerator.

Figure 1 shows a number of icons representing new PBO Lab Pieces created for the PARMILA Module. The new Pieces are of three types: Palette Pieces, Command (COMM) Pieces and Parameter (PARAM) Pieces. Each of the newly created Pieces corresponds to specific lines in a PARMILA 2 input file [3]. Table 1 summarizes most of the new Pieces. The entries listed for the COMM and PARAM Pieces give the corresponding PARMILA keywords implemented for those Piece types.

The PBO Lab data input windows (Piece Windows) provide a complete description of the command or parameter that will be utilized -- not just the keyword. It is beyond the scope of this paper to describe the implementation in detail here, but an example illustrates how this assists users. Figure 1 illustrates the use of several PARMILA "Change" types. These are identified by the Piece comments "C-14" and "C-16" which appear as labels below the corresponding PARAM Pieces.

In constructing a PARMILA-2 beamline, a scrolling list window is used to select Pieces that contain Change types. Figure 2 shows the list window for the PARMILA-2 Parameter Pieces. All PARAM Pieces are given brief word descriptions. Figure 2 illustrates the selection "m. Ramp Quads w Energy" which corresponds to Change type 14, discussed in the PARMILA 2 documentation in subsection "m" of the Change section. Similarly, the item "o. Gradient of First DTL Quad" corresponds to Change type 16. A Change type PARAM Piece, that is selected and created using the "Create Piece" button shown in Figure 2, will have a default label (e.g. "C-12") which identifies the Change type that will appear in the PARMILA 2 input file (e.g. "CHANGE 12"). Users need not look up any Change type code, or the format for a Change type, in order to implement a specific type of Change. Users simply select from the descriptions appearing in the PARMILA-2 Parameter Piece list window (Figure 2).

Table 1: Examples of custom PBO Lab Pieces developed for the PARMILA 2 Module using the OASIS framework. PARMILA 2 keywords implemented through COMM and PARAM Pieces are listed under the respective columns.

Palette Pieces	Command (COMM) Pieces	Parameter (PARAM) Pieces
DTL, CCL	SCHEFF, LINOUT, POWER,	Change Types (20+ Pieces)
CC-DTL	PrtBeam, SFDATA, TRANSPORT,	ExQ Types (7+ Pieces)
SC1, SC2	Quad OPTIONS, MPOLES, ...	Elimit, StartPhase, ErrorSeed, ...

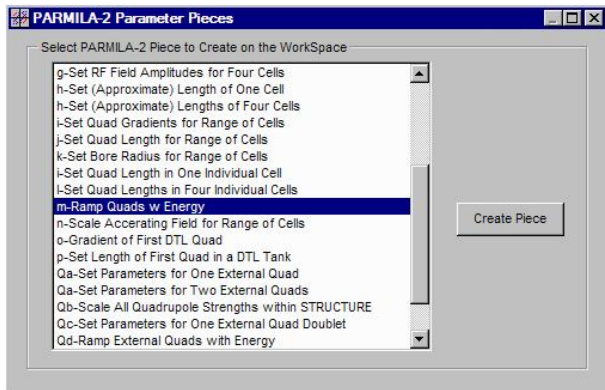


Figure 2. Scrolling list window used for selecting and creating PARMILA-2 Parameter Pieces.

Other custom Command and Parameter Pieces developed for the PARMILA-2 Module provide simple text descriptions of their function. The corresponding Piece Windows likewise provide descriptive information useful for specifying any needed input parameters. The format and syntax for each line in the PARMILA 2 input file is automatically handled by the PARMILA-2 Module.

Standard transport elements supported by PARMILA 2 (i.e. drifts, quadrupoles, bends, etc.) are implemented using the standard PBO Lab Pieces for those elements, requiring no additional objects in the PBO Lab object model. In a few cases, additional parameters have been added to the standard Pieces in order to support specific PARMILA capabilities, such as specifying the number of times space charge forces are computed in a drift element.

The PARMILA program can be used in a design mode or a simulation mode, and the new Module has been developed to support both modes. Location specific commands and parameters are set up using the custom created Command and Parameter Pieces.

## SUMMARY

An innovative GUI has been developed for the PARMILA 2 accelerator design code, implemented as an Application Module for the Particle Beam Optics Laboratory. This new PBO Lab PARMILA-2 Module was created using the Open Architecture Software Integration System.

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