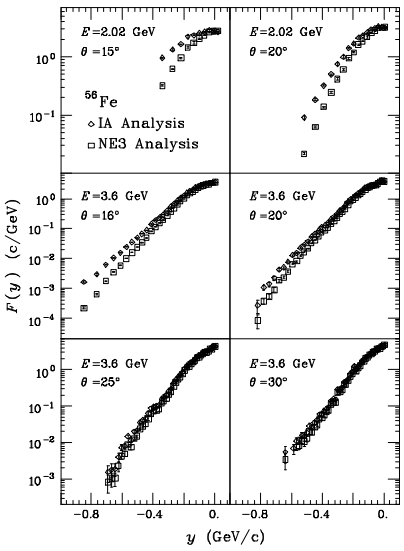
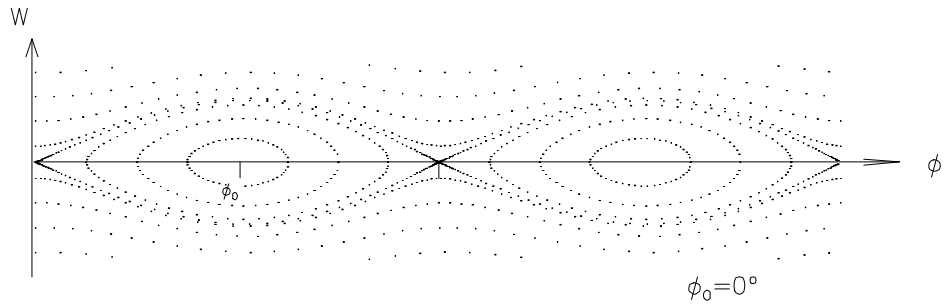
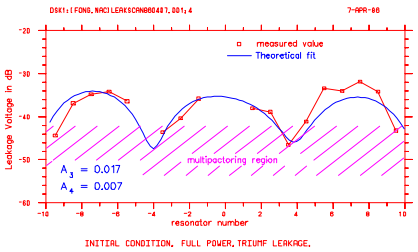
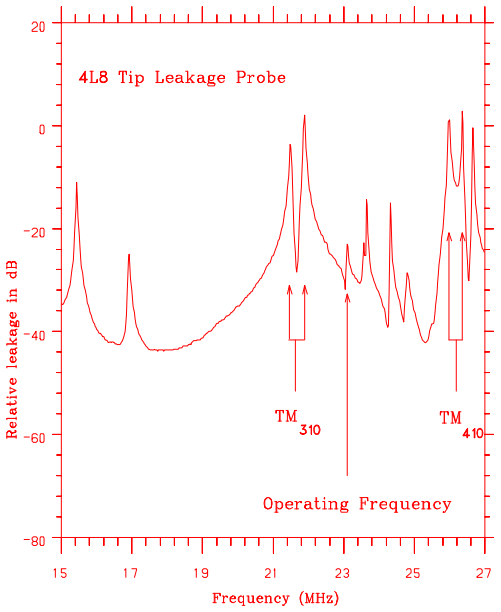
PHYSICA 1.00

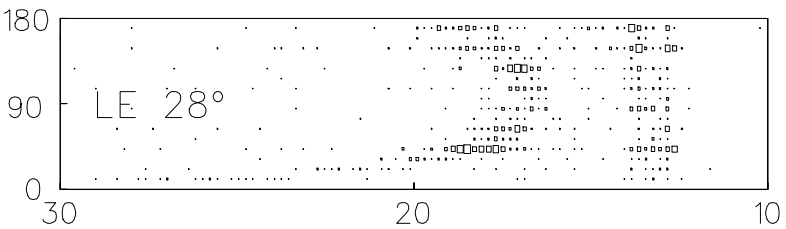
Mathematical Analysis and Data Visualization Software











$$\vec{E}(x,y) = \sum_{i=3,4} \frac{\varepsilon\omega^2 \vec{\mathfrak{E}}_i(x,y)}{\omega^2 - \omega_i^2} \iint (\vec{E}_U + \vec{E}_L).\vec{\mathfrak{E}}^*_i(x',y')dx'dy'$$

- **The Product** – Software which frees you from the tedious chore of writing specialized analysis/graphics programs and 'reinventing the wheel'. Explore your data graphically and analyze it with sophisticated mathematical functions and operations. Customize the program to suit your needs.

- **The Advantages** – Quickly identify trends and features in your data. Access your data, no matter what the format. Speed comparable to FORTRAN. Use PHYSICA's high level interpretive programming language to write your own proceedures, or let PHYSICA write them for you while you interactively explore the possibilities. PHYSICA allows for full operating system access as well as dynamic loading of your own routines.

- **Reliability** – The software has over 30 man-years of development at TRIUMF (Canada's National Meson Facility) with prototypes used at nearly every high-energy physics laboratory in the world. The software has been tested and utilized in 'real life' science/engineering applications.

- **The Users** – Scientists, engineers, researchers and analysts who explore, analyze or visualize data.

- **Using PHYSICA** – Users enter commands interactively for quick analysis and visualization of data. Users execute proceedures for more repetitive tasks. Develop complete applications in a fraction of the time compared to FORTRAN or 'c'.

- **The Environments** – DEC and Silicon Graphics workstations, and multi-user systems running ULTRIX, VMS, or OpenVMS. A large number of terminal types and graphics hardcopy devices are supported, including PostScript, HPGL, Tektronix, etc.

- **The Applications** – PHYSICA is the choice for data analysis and visualization applications. Examples include high-energy physics research, chemical engineering, electrical engineering, medical research, materials research, financial analysis, wood technology, pulp and paper research, agricultural research, and others.

Summary of PHYSICA 1.0 Features

Data Reduction & Analysis

- User defined variables (scalars, vectors, matrices, tensors, character strings, arrays of character strings)
- Full indexing on variables
- Vectors may be specified as a list or a range
- Boolean operators ($<$, $>$, &, etc.)
- Array operators (inner/outer product, matrix transpose, etc.)
- Over 180 built-in functions including:
  scalar type (Bessel, Clebsch-Gordan, etc.);
  array type (Σ, Π, loop, where, etc.);
  character type (case, date/time, etc.)
- Eight user functions and eight user subroutines loaded at run time via shareable image
- Dynamic loading during execution of a user written function or subroutine
- Mathematical/character expressions may appear in any suitable command parameter
- Indices allowed on mathematical expressions
- Use character variables to substitute for complicated expression substrings
- Differentiate/Integrate an arbitrary expression
- Interpolate 1-D or 2-D data using various methods (linear, Lagrange, weighted splines under tension, Fritsch-Carlson)
- Smooth data using various methods (weighted splines under tension, Savitzky-Golay filters)
- Convolution and deconvolution of data
- Integral transforms of arbitrary expressions
- Fast Fourier Transforms and Inverse FFT's
- Reorganize data (sort, step, roll, wrap, etc.)
- Weighted (re-)binning of 1-D or 2-D data into automatic or user defined bins (specified by centres or edges)
- Multiple real roots of an expression
- Recursive and non-recursive digital filters
- Manual or automatic determination of data extrema using graphics cursor
- Fit data with an arbitrary, non-linear, expression involving up to 25 parameters
- Ellipse fitting
- Calculation of parameters for least-squares fit using adjustable parameters

Data Input/Output

- Display the history of variables
- Read data from binary or ASCII files by formats or column numbers
- Output data to binary or ASCII files by formats or in columns
- Dynamic allocation of arrays
- Digitize data from a displayed plot or from a digitizing pad

PHYSICA's Built-In Language

- Macro capability with up to 20 nesting levels and with parameter passing
- Macro library of 'super' commands
- Nested looping, branching and conditional statements in macros
- Display messages, prompt for user input from within a macro
- Return to keyboard from within a macro, and later resume macro execution
- Create a macro interactively

2-D Plotting

- Customized 2-D line graphs, scatter plots, horizontal or vertical bar charts, each with a large variety of type styles and fonts of any size and color
- Customized or automatic legends
- Multiple axes with arbitrary axis positioning
- Fill the area between data curves or individual histogram bars with dot or hatching patterns (automatic or user defined)
- Logarithmic axes, to any base, including e
- Axis scaling can be automatic or user set (including commensurate axes)
- Labels can optionally follow the curves on rescaling a graph
- Many plotting symbols (18 special ones or use any keyboard character), with control over size, colour and angle.
- Complete control over axis appearance (short/long tic mark length and angle, seperation between tic marks and axis labels, axis angle, length and location, axis labels size, colour, font, number of digits, etc.

3-D Display

- Contour plots: polar coordinates, colour, legend, area/volume tabulations, control over contour label size, colour, seperation, etc.
- Density plots: polar coordinates, derivatives, random point type, box type, colour filled regions, dithering patterns with automatic or user defined patterns, diffusion type, profiles, legend, area/volume tabulations, etc.
- 3-D Surface plots with hidden line: either 'lego' type or smooth type
- Pie charts, filled and/or exploded wedges

General Graphics Utilities

- Unlimited text capabilities for titles, labels, and annotations
- User control of pen plotter speed and pen assignments
- Multiple graphics windows
- Any number of charts of any mixed type on a single picture
- High quality display on a wide variety of graphics devices, including:
  X windows, VT640, REGIS terminals,
  PT100G, CIT-467, Tektronix 41xx/42xx,
  PostScript, HI/HP/Roland plotters,
  LN03+, HPlaserJets, GKS metafiles, etc.
- More than 40 graphics fonts
- Entry of lines, arcs and text with dynamic adjustment of position, size, font, justification
- Modification of colour, size, position, font, and other attributes of drawing elements
- Modification and deletion functions can operate on selected elements or on entire areas of the drawing
- Area fill functions for arcs and polygons

Integration with EDGR

- Merging of one image into another, by overlaying or by scaling into a specified area
- Extraction of a portion of an image into a new drawing file
- Composition of several images on a single page by 'tiling'
- Multi-frame facility for sequential archiving of images
- Translation, scaling, rotation and duplication of drawing elements
- Support of dashed line types and variable line thickness
- Circles, ellipses, and arcs can be specified in a variety of ways
- Zoom and pan functions allow variable magnification and display region
- Separate main and zoom windows under X, with editing in either window
- Layer facility allows selective editing and overlaying of drawing elements
- Import function reads and converts Tektronix output from other packages
- Import Autocad plot files (with colour)
- Grid overlay with variable origin and spacing. Independent 'snap' grid for automatic placement of digitized points
- Standard function keys for distance and angle measurement, reference points, markers, grid snap, numerical coordinate entry
- Survey function for export of numerical coordinates to other programs
- The graphics editor library provides a family of subroutines that enable users to generate drawing files from their own programs. Thus, the graphic images produced by programs can be captured and stored in a device-independent way. The resulting drawing files have the same structure as those created by the graphics editor itself, and can be edited and processed in the same ways.

Other Features

- Comprehensive on-line documentation: instant help for any command, or interactive browsing through help library
- Keyword searching
- Save/Restore an entire session, including graphics
- A journal file of all command input and message output
- Create your own commands by aliasing
- Automatic prompting for missing or incorrect command parameters
- Disable/Enable features
- Asynchronous error trap handling
- Access to the operating system
- Dynamic and static input line recall buffers with read/write capability
- Dual level built in calculator
- To come: point and click interface option for Xwindow applications