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THE REVIEW-OF-PARTICLE-PROPERTIES SYSTEM

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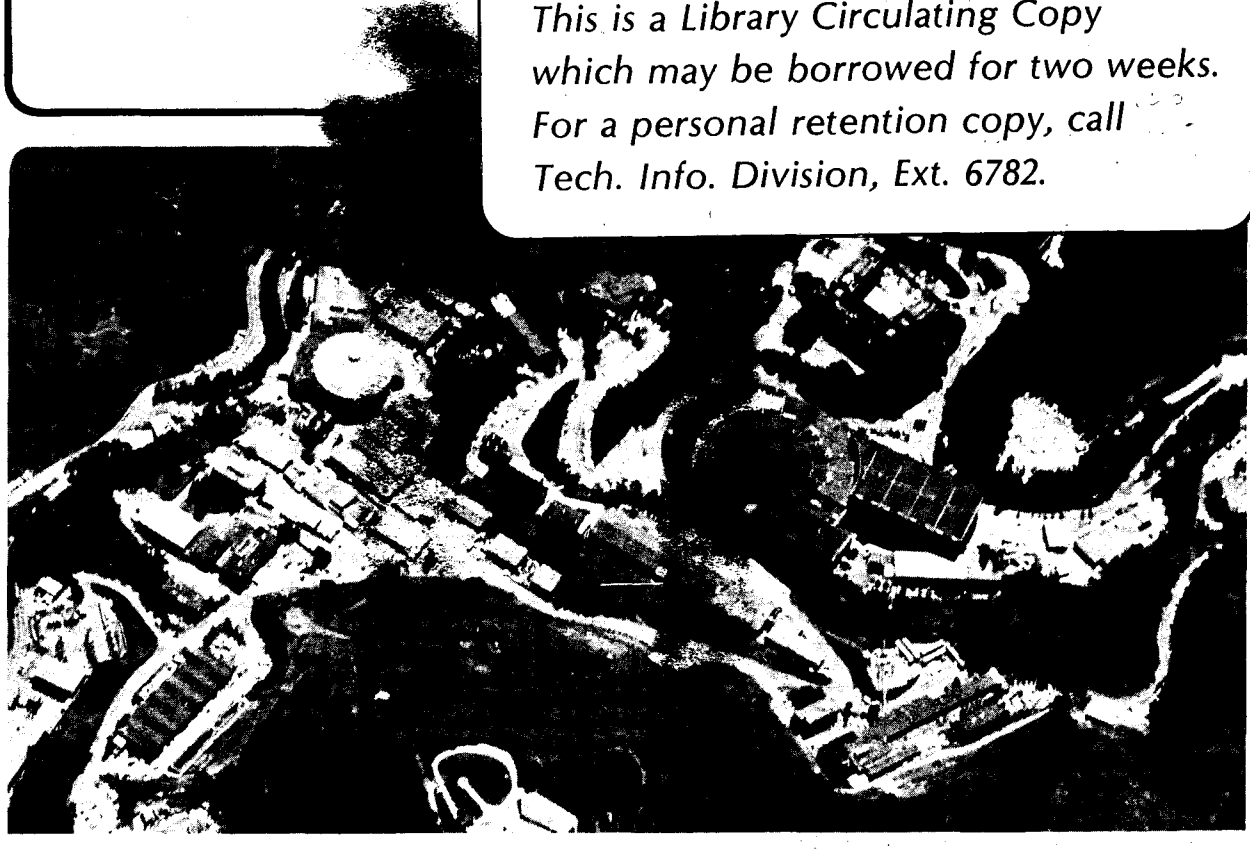

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DISCLAIMER

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ABSTRACT

The Berkeley Particle Data Group is engaged in a major modernization of its primary project, the *Review of Particle Properties*, a compilation of experimental data on elementary particles. The goal of this modernization is to develop an integrated system for data storage, manipulation, interactive access, and publication using modern techniques for database management, text processing, and phototypesetting. The existing system and the plans for modernization are described. The group's other projects and the computer systems used are also discussed.

I. INTRODUCTION

The Berkeley Particle Data Group (BPDG) compiles data and other information in high energy physics. The best known of these compilations is the *Review of Particle Properties*, now in its twenty-sixth year. The database for this review is a small (4 Mbyte) and highly evaluated database which is used to determine best values for the properties of elementary particles. The system used to maintain this database is being modernized.

To set this modernization project in context it is useful to describe briefly the group, its projects, and the systems which it now uses. The Review-of-Particle-Properties system is then discussed in detail.

BPDG is a mixture of high energy physicists, computer scientists, and technical associates, totaling five full-time equivalents. Some BPDG physicists do part-time research as well as data compilation. Additional expertise is obtained from two full time LBL researchers, a theorist and an experimentalist who, together with me, form the PDG Steering Committee. Their primary focus is on physics issues. They attend all group meetings and work directly on some projects.

The BPDG makes the information it compiles available through publications and computer searchable databases. BPDG work is done in collaboration with a large number of institutions, including CERN, Durham, Helsinki, Serpukhov, SIN, and SLAC.

II. COMPILATION PROJECTS

The BPDG is currently involved in four compilation projects:

1) *Review of Particle Properties*;
2) *Current Experiments in Elementary Particle Physics*;
3) *Major Detectors in Elementary Particle Physics*;
4) *Documents Containing Data in Elementary Particle Physics.*

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The *Review of Particle Properties* is published every two years, 1982 being the 25th anniversary edition [1]. Ten thousand copies of the 1982 edition and 15,000 copies of an associated summary data booklet, pocket diary, and laboratory address list were distributed on request. The content of this review is continuously revised to reflect current trends in physics, but the system for maintaining it has not kept pace. This system and its modernization are described in detail below.

The group's second project, *Current Experiments in Elementary Particle Physics*, now in its fifth edition, contains summaries of the 479 most recent approved experiments in elementary particle physics [2]. The associated EXPERIMENTS database is maintained on SPIRES, the Stanford Public Information Retrieval System, at Stanford Linear Accelerator Center (SLAC), as well as on BDMS, the Berkeley Database Management System at LBL. SPIRES and BDMS are described below.

The group's third project, *Major Detectors in Elementary Particle Physics*, contains descriptions, drawings, and performance characteristics of detectors in an updatable loose-leaf format [3]. This is not a database project but does use UNIX-TROFF phototypesetting, described below. The one-page detector descriptions are cross-referenced to the EXPERIMENTS database and its associated publication.

The group's fourth project, *Documents Containing Data in Elementary Particle Physics*, is primarily a computer database, the DOCUMENT file. A published version of this database appeared in 1978 [4]. The DOCUMENT database is composed of bibliographic information obtained from the SLAC-SPIRES HEP database [5], to which we add systematic indexing by the parameters most likely to aid a physicist in locating high energy physics data: reactions studied, beam momentum, particles studied, type of data measured, accelerator, detector, etc. Russian documents are indexed by the COMPAS group at the Institute of High Energy Physics, Serpukhov [6]. This database has been maintained with BDMS at LBL and Serpukhov. In the near future the BPDG plans to add the DOCUMENT file data indexing directly to the SLAC-SPIRES HEP database rather than to maintain a separate DOCUMENT database at LBL. A BDMS version of the DOCUMENT file will continue to be provided to collaborators. Interactive access will be available through the SLAC-SPIRES system in 1984 and a new printed version will appear in 1985.

III. COMPUTER SYSTEMS USED BY BPDG

The BPDG uses three major systems to maintain and publish its compilations:

1) SPIRES, the Stanford Public Information Retrieval System [7];
2) BDMS, the Berkeley Database Management System [8];
3) The UNIX-TROFF phototypesetting system [9].

Both SPIRES and BDMS are general-purpose database management and information retrieval systems. We use SPIRES primarily as a tool for interactive distribution of our database information. The SPIRES system is well known to the high energy physics community, at least in the U.S.A. It is a powerful, user-friendly, fully developed system. It has the disadvantage of being tied to IBM-370 architecture, however, so it cannot be used at LBL or at most of the institutions that collaborate with us.

BDMS was developed by BPDG primarily to provide a SPIRES-like system which was transportable. BDMS was written in machine-independent Fortran and has been implemented on IBM, CDC, VAX, Hitachi, and ICL computers. However, it is really only the core of a database management system and lacks many of the refinements that SPIRES has.

V. THE NEW PARTICLE PROPERTIES SYSTEM

The new system should:

1) accept the present input format;
2) run at CERN for the Meson Section;
3) include literature-search and encoding-status information;
4) allow analysis programs to access data;
5) allow data transfer to text files;
6) allow selection and formating of verification information;
7) replace line-printer output by output of publication quality;
8) reduce by-hand paste-up;
9) allow use of Greek symbols and various fonts in output;
10) allow interactive user access to the database.

To satisfy these requirements, an integrated system of database management and phototypesetting is needed. We plan to continue using the UNIX-TROFF phototypesetting system. The options being considered for a database management system are DATATRIEVE [11], BDMS, and SPIRES. A fourth database management system, ERIS [12], is being studied in conjunction with some joint research on database machines being done by the LBL Computer Science and Mathematics Department and BPDG.

DATATRIEVE and ERIS run at LBL on a VAX computer under VMS and UNIX systems respectively. They are relational database management systems with the usual fixed field length and simple record structure and file structure. SPIRES and BDMS allow a more complex hierarchical record structure with multiply occurring data elements of arbitrary length. The file structure of BDMS is flat-file while that of SPIRES can be chosen to be flat-file, hierarchical, or network.

The data structure of particle properties data can be handled adequately by any of the database management systems under consideration. Particle properties data generally fits a hierarchical structure as is shown in Fig. 1. However, there is a network relationship between decay modes and branching ratios since one branching ratio involves several decay modes and one decay mode can appear in several branching ratios. Another network relationship exists in the overall database when one includes the publications as entities. One publication can include data on many particle properties, and data on one particle property can appear in many publications. While BDMS does not support network relationships, its record structure matches the predominant hierarchical structure well, so we do not rule it out. Since the data structure does not give us clear guidance in the selection of a system, we are assessing the relative merits of these systems for our application by implementing a test portion of the database on each of the systems and then testing the implementation with a typical set of updates, searches, and output formats.

The system chosen will be utilized as shown in Fig. 2. The data will be accessed in two ways, through the database management system's standard front-end and through a Fortran host-language front-end. The standard access will be used for online searching and some editing. The Fortran host-language access will be used for line-mode editing, analysis programs, and producing final output listings in a UNIX-TROFF protocol.

Text sections, such as the notes to be inserted in the final output listings, will be maintained as separate UNIX-TROFF files outside the database. The Fortran host program will insert the separate text sections in the places specified by location information stored within the database. If data are to be transferred from the database into the text sections,

this will be indicated within the text by escape strings that contain data identification and formating information.

This system will allow us to produce publication quality output from our database and analysis programs, and to combine this output with text containing data from the database.

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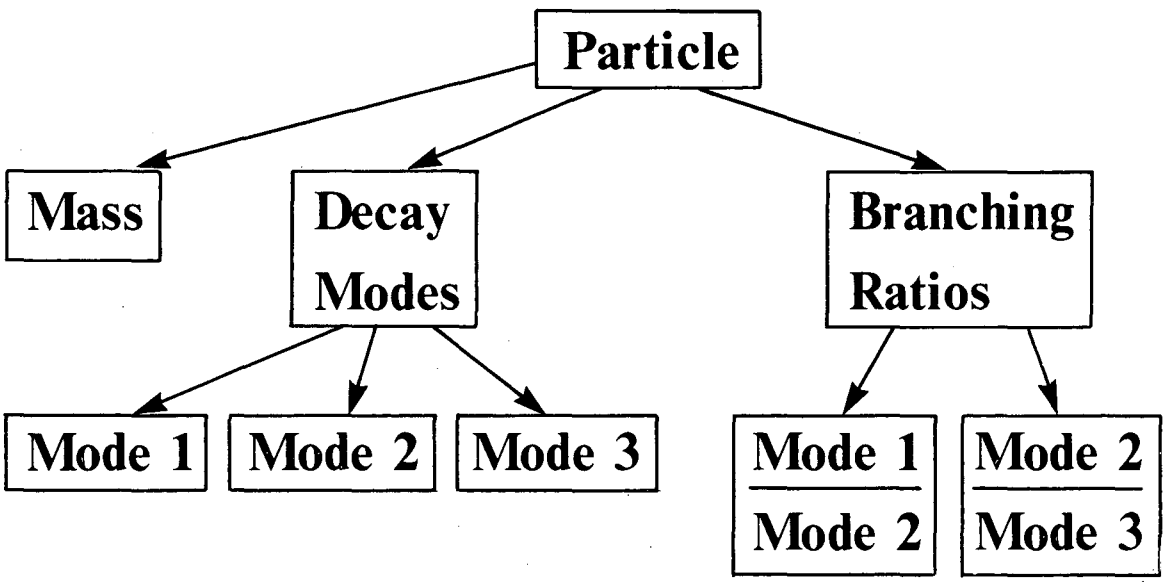

Fig. 1. Data structure of particle properties data.

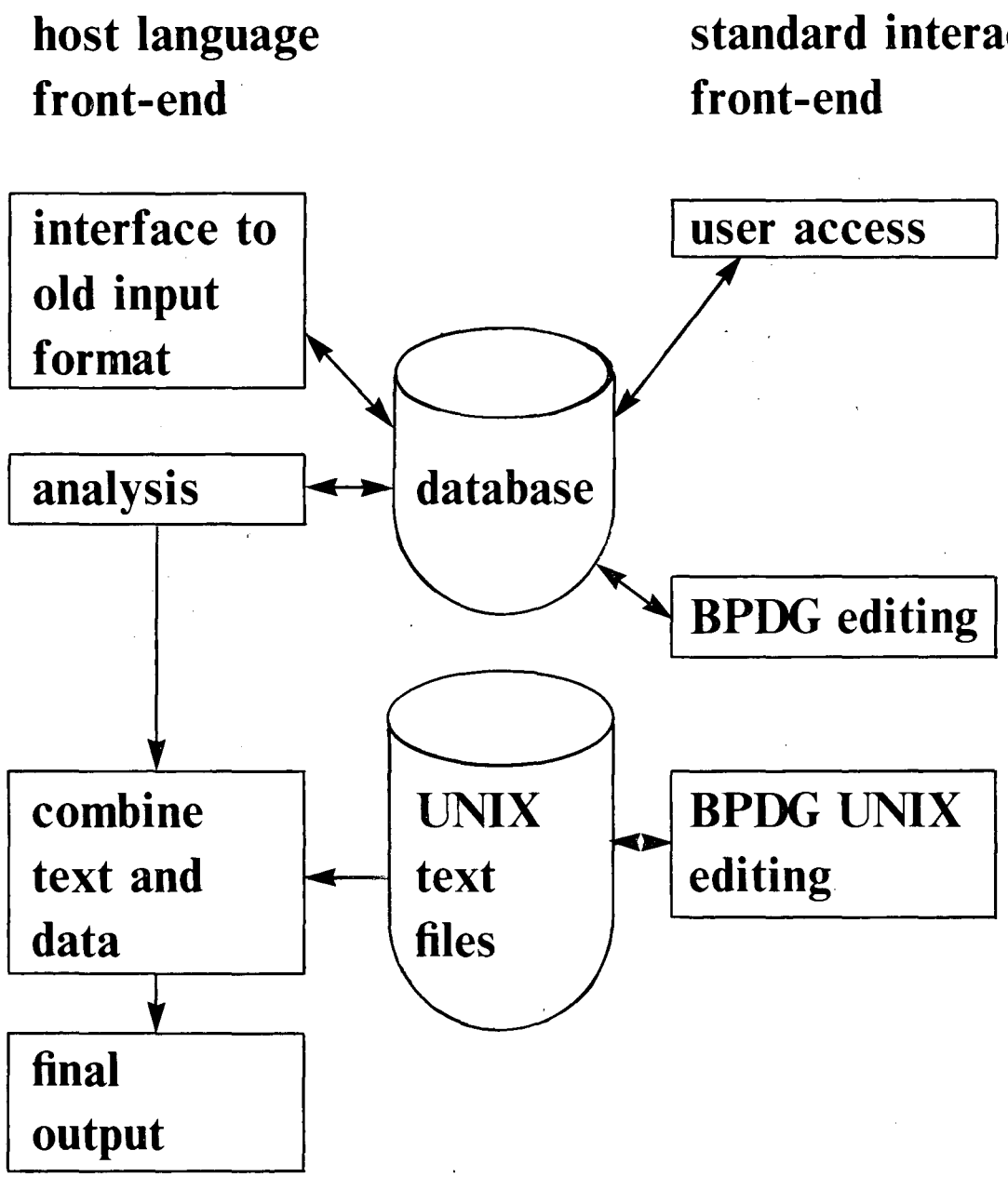

Fig. 2. Access to database and text files.

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