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STANDARDS FOR DATA PROCESSING IN HIGH ENERGY
AND NUCLEAR PHYSICS EXPERIMENTS

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STANDARDS FOR DATA PROCESSING IN HIGH ENERGY
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ABSTRACT

The need for basic standards and common practices in High Energy and Nuclear Physics experiments is increasing with the size of experiments and the number of participants. Following a recommendation by the European Committee for Future Accelerators, a working group has been set up to find areas of data processing in which such standards can be established. The aims and activities of this group are presented.

1. INTRODUCTION

The increasing size and complexity of High Energy and Nuclear Physics experiments has led to a corresponding increase in the size of collaborations required to carry out this research. It is already becoming difficult for some physicists, especially from small institutes and universities, to participate in these collaborations while fulfilling their teaching and other duties at home.

If widespread activity in this field is to continue and flourish, it is urgent that methods are found which enable useful work to be done at home stations as well as at central laboratories. Also, more economic use must be made of available resources.

A basic requirement is that experiments should be designed around a framework of agreed conventions and standards, such that modularity is possible, with well-defined interfaces between the various parts. An added advantage of this approach is that each standard hardware or software module can be developed to a reasonably high degree of sophistication. This is less likely when similar but different modules are developed in parallel.

The adopted conventions must not, and need not, place any restrictions on the physics programme nor on the introduction of up-to-date technology and techniques. Obviously, only certain parts of each experiment will be implementable using standard modules. Special needs will always require ad hoc treatment. The intention is to avoid those irrelevant and unnecessary complications and incompatibilities which absorb money and manpower non-productively.

2. EUROPEAN INITIATIVE

It is felt by many members of the physics community, that various aspects of physics data handling and processing are suitable for standardisation. We have already had good experience with hardware standards such as CAMAC and, to a lesser extent, with software standards such as FORTRAN. Similar conventions are needed in many other areas, such as high-speed trigger processing, histogramming, and so on (1).

In November 1979, ECFA, the European Committee for Future Accelerators, launched a major effort in Europe to collect together all information on physics data handling standards already used by the community, emerging standards, and topics where a consensus is required but not yet established. The Committee recommended that a Working Group should be set-up, and this is being done by E.Lillestol, University of Bergen, Norway, and E.M.Rimmer, CERN, Geneva, Switzerland. Similar efforts are under way in the USA, and we will keep in contact with those groups.

The ECFA decision resulted from a consideration of the logistics involved in performing an experiment at LEP, the Large Electron-Positron Colliding Beam machine, planned for operation in Europe during the coming decade (2,3,4,5). The number of physicists collaborating in each experiment could well exceed 100, from many participating institutes (6,7). Therefore it is essential that this present initiative achieves some measure of success before these experiments reach the planning stage (8). Of course, the results of the work will benefit experimentalists at all laboratories.

3. LONG-TERM AIMS

We intend to compile a reference manual which should provide easy access to information about the basic building blocks available to an experimentalist and the "interfacing" requirements for their assembly. This should enable physicists to design parts of their experiments either by using existing modules, or by constructing new modules which internally satisfy some special need and are "plug-compatible" with other parts of the experiment.

This manual will be built up as a set of computerised text files, initially on the CERN IBM WYLBUR/SCRIPT system. With the increasing use of international networks, the files should eventually be readable from terminal stations in many laboratories and institutes. In the meantime, we will set up a mailing list for distribution of hard copies.

The manual will be divided into several sets of chapters, some of which will be periodically updated while others will remain more static. The manual will evolve to cover the introduction of improved methods and technologies, while some parts of it will eventually become obsolete.

A possible grouping of chapters is:

External standards: These are standards such as CAMAC and FORTRAN, already adopted by bodies other than the physics community. Under this heading, each chapter will provide a brief overview of the standard with a comprehensive bibliography. Warnings will be provided of any well-known problems with the standard.

Internal standards: These are standards generated within the physics community, such as high-speed detector read-out systems, and histogramming packages. In many cases, these chapters will consist of comparative surveys of the various "standards" used at the different laboratories. It is hoped that such information will eventually lead to convergence in some areas.

Emerging standards: These chapters will cover areas where work is in progress to define new standards, both external and internal, such as PASCAL and FASTBUS. They will mainly take the form of status reports and are intended to stimulate feedback so that the physics community can influence the development of these standards.

4. FORMATION OF THE WORKING GROUP

A questionnaire (9) was circulated in March 1980 to about 100 physicists, programmers and engineers, of whom more than 30 replied (10,11). Many of the replies included very detailed comments and suggestions. A group of ECFA representatives and other interested people discussed these replies at a meeting at CERN in May 1980. The project was presented both in an invited paper (ref.8) and in the poster session of the Uppsala Conference on Experimentation at LEP in June 1980. It is also being presented (here) at the European Physical Society Conference on Computing in High Energy and Nuclear Physics in Bologna, September 1980.

As a result of the discussions already held, we have begun to form a small number of sub-groups, each consisting of about 5 people with an "organiser". Each sub-group will investigate a particular topic or set of inter-related topics with the ultimate aim of preparing part of the final reference manual. We hope to augment these sub-groups and finalise their composition at the Bologna Conference, after which they can begin their work.

During the preliminary stages, the group will publish a series of Newsletters, about 3 per year, to inform the community of progress, difficulties and so on. A draft version of the Manual should emerge within a year or so.

The provisional list of sub-groups cover topics such as:

- Microprocessor busses, facilities and applications
- Data Acquisition
- Graphics, histogramming, command processors

Software libraries
FORTRAN
Off-line calibration and analysis
Bookkeeping and documentation
etc.

We strongly urge anyone who is interested to participate to contact either Lillestol or Rimmer. Also, we are interested in any comments or constructive criticism, even from those who feel that they cannot invest much effort. The importance of this work is already appreciated by the management of several laboratories and institutes and we are sure that the project will receive increasing support as it gains momentum.

5. CONCLUSIONS

Physics experiments are growing in size, complexity and cost. Larger and larger teams of physicists, engineers and programmers are needed to perform them. A framework is required around which the members of these teams can work in an independent yet coherent and mutually compatible way. This implies agreement on standards and common practices.

A substantial part of physics data handling and processing lends itself to the application of standard hardware and software modules. Modularity gives all physicists, especially from small institutes, the possibility to make a meaningful and useful contribution to a large collaboration. Once defined, a standard module can be developed and refined so that the best possible tools are available to experimentalists.

The effort, launched by ECFA, to isolate and/or define data processing standards is a new venture for the physics community. It will succeed only with hard work, patience and cooperation on the part of all those involved, both in the Working Sub-Groups and in the community in general. It is essential that the effort should produce a solid basis for future data processing standards. We therefore ask for the support, encouragement and participation of all high-energy and nuclear physicists.

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