Summary of the Session on Standardization of Accelerator Description and Codes

ICAP98, Monterey, September 16, 1998

E.Keil, F. Pilat, R.Talman

A session devoted to the discussion of standardization of accelerator codes and description was held at ICAP 98. Accelerator projects in the present and even more so in the future are often large scale collaborations between national and international institutions. The easy and reliable transfer of accelerator information as well as sharing of codes are becoming real necessities if time and resources are not to be wasted in duplication of efforts. To promote discussion along those lines, C.Iselin, E.Keil and R.Talman circulated a letter to the accelerator community which called for a new accelerator description standard (ADS) in January 1998. The letter [1] outlines the motivation and the desired features of such a description. Shortly afterwards, in February 1988, a workshop was held at BNL to coordinate software development for the US-LHC Collaboration and in this framework the issue of a standard accelerator description was further discussed. Given the immediate need to circulate LHC accelerator information among the collaborating laboratory, a format, the SXF [2] (Standard eXchange Format) was proposed and agreed upon during the workshop and developed in the few following months. In the meanwhile, N.Malitsky developed the ADXF (Accelerator Description eXchange Format) which is an answer to the ADS requirements based on industrial software standards.

The purpose of this session at ICAP98 was to initiate the discussion of lattice and codes standardization among a wider audience, to evaluate what has been done so far and to form a plan for the future.

The session, chaired by E.Keil and R.Talman, had the following agenda:

- E.Keil, "Call for Standards in Optics Programs"
- R.Talman "Call for Standardization of Lattice Description Interchange"
- Brief, prepared, concrete, positive suggestions
- General discussion of features that are appropriate for the standards
- Discussion of next steps

E.Keil in his talk described the software practices of the past and the present in accelerator physics and explained his vision of the future. The past has seen the development of optics programs (MAD, SAD, SYNCH,TEAPOT, TRANSPORT, etc.) usually by individuals or small group working together in one place. Such programs have been used elsewhere by other groups but modifications have rarely been integrated into the 'official version'. Such programs are monolithic objects that do not lend themselves easily to adaptation and expansion. Single programs do not do everything and the present solution to that is typically writing a new program for specific purposed rather than adapting an existing one. Also, a lot of effort goes into developing, maintaining and transporting codes across platforms, as well as integrating capabilities of other programs. The clear message of the talk was that the accelerator physics community cannot afford to continue along these lines, since machines like the

LHC and beyond are built by global collaborations. The exchange of physics algorithms among programs, sites and platforms must be simplified. Data should be held in databases as clearly defined objects and accessed by service routines. Code modules should operate on and generate data in the database. Physics modules should be invoked and accessed via scripting languages and their internal organization screened from the user. The goal is to create a code environment that is truly distributed and sufficiently user friendly that users actually like to write new modules in this framework. Modules are developed and maintained in one place and used in many places.

R.Talman in his talk presented and discussed the content of the Keil-Iselin-Talman letter advocating a new accelerator description standard, and later summarized the characteristics of formats that have been recently proposed as examples for ADS, the SXF and the ADXF.

The ADS is based on the following general principles:

- It should serve from the *design* phase, through the *engineering design* and *analysis*, to the *operation* of the accelerator.
- It should generalize SIF (Standard Input Format)
- It should contain only element and lattice description and no beam dynamics, so that it can be used by any physical model.
- It should respect modern computer science standards, especially in the areas of database management and accessibility over networks.

ADS should mimic SIF where possible but should accommodate new requirements, such as *flexibility, full-instantiation, multiple realization, minimal completeness* and *extensibility.* Other possible features that have been suggested include *ideal-actual* distinction between design and realized values, *error bars* for parameters and *nested line* preservation.

In the last few months two examples of accelerator descriptions have been developed, the SXF and the ADXF. The former was developed by a collaboration between BNL, CERN, Cornell and FNAL for the purpose of easy lattice information exchange within the US LHC Collaboration. It is a fully-instantiated, flat, ascii format that resembles a single MAD sequence but extends it by including error and deviation information in addition to the design information. Parsers to and from SXF exists for the following codes: TEAPOT, MAD8 and MAD9 through the 'database' DOOM, COSY and TevLat. SXF is being used for RHIC modeling as well.

ADXF was recently developed by N.Malitsky and R. Talman. ADXF is also implemented as a fully-instantiated, flat, sequence-like object but emphasizes the use of modern computer standards since the format is based on XML. XML (eXtensible Markup Language) provides a file format for data, a schema for describing data structure and a mechanism for extending and annotating HTML with semantic information. This ensures connection to new technologies, tools (parsers, editors, browsers) and connectivity to databases. More information about the SXF and ADXF can be found elsewhere in these Proceedings [2][3]. A schematic comparison of the two formats by R.Talman is shown in Table 1.

A discussion then followed where participants had the opportunity to share their experience and express their opinion concerning standards for codes and accelerator description.

Table 1: Comparison of SXF and ADXF

Property	SXF (Standard eXchange Format)	ADXF Accelerator Description eXchange Format
ease of parsing	high	high
truly flat	yes	yes
distinction ideal/actual	yes	no
programming language	ad hoc	XML
sophistication of environment	low	high
payoff of environment	low	high
symbolic parameters	no	no
algebraic expressions	no	no
lattice hierarchy	no	no
readability by physicist	high	low
expandable to databases	no	yes

Concerning code standardization, the issue was raised about validation of the algorithms used in the modules. As usual, testing the code with simple questions helps validating it. Also, in general, nothing prevents the existence in the shared environment of more than one module that answer the same physics questions. Another important point that was highlighted is the desirability to set a standard on how accelerator data are stored in databases, be it a commercial database, i.e. Oracle or Sybase, or a non commercial product such as DOOM. As a concrete step towards the creation of a standard code environment, large existing programs should be partitioned with independent routines taking care of physics operations (survey, matching, tracking, etc.). This is actually already achieved in several Object Oriented environments, for example the ones spun off from the CLASSIC collaboration and the UAL (Unified Accelerator Library), but there is no code sharing or coordination among them. The importance of good documentation was also stressed if one is to operate in a shared environment.

Concerning accelerator description standardization, an issue that was raised by several participants was the desirability for the accelerator description to carry girder-correlated geometry information. It was quickly realized that the ADXF would naturally allow for the geometry to be included by extension of the "Accelerator Node" structure. Another capability that part of the audience was not ready to give up is lattice hierarchy. SXF and ADXF, being more focused towards analysis and operational scenarios than design, do not support it. Another point that was raised, and it is very important, is the capability of grouping elements in families. This could describe magnet bussing information, or magnet packages (correctors with several correction lay-

ers) but also describe elements that are geometrically constrained, such as elements sitting on common bases. The latter are of particular concern for linear colliders; an accelerator description must model this if it is to be of any value for linear colliders. SXF and ADXF support families minimally in the form of explicit lists of the fully-instantiated names of the elements making up the families. They could also, in principle, be augmented by one or more named "trees" of the previously defined unique element names giving different hierarchical "views" of the same elements.

The Session may have been useful to encourage discussion about code and accelerator description standardization among a wider audience, and beyond the small groups that initially started to raise the issue about a common code environment and about the ADS. As a partial answer to the ADS initiative two prototype formats have been developed in the past few months and they can be used as a starting point towards the definition of an agreed upon standard. The aim of this document is to be circulated among the people who participated in the session and to call for feedback on the issues we raised. On a time scale of about six months it would be appropriate to reconvene and progress towards an agreement on code and description standards.

References

[1] C.Iselin, E.Keil, R.Talman, "Call for a new accelerator description standard", Beam Dynamics Newsletter, April 16, 1998

[2] H.Grote, J.Holt, N.Malitsky, F.Pilat, R.Talman, C.G.Trahern, "SXF (Standard eXchange Format): definition, syntax, examples", RHIC/AP Note 155 and these Proceedings

[3] N. Malitsky, R.Talman, "Accelerator Description Exchange Format", these Proceedings