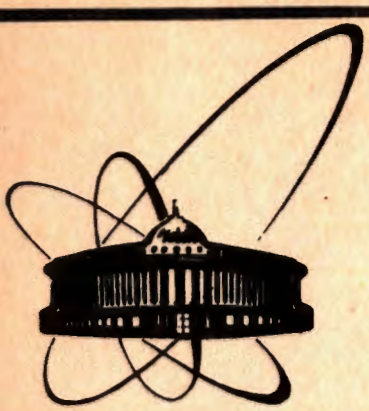

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PAW/GKS IMPLEMENTATION ON IBM PC UNDER MS DOS

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1. Introduction

Modern personal computers based on the 32-bit microprocessors such as IBM PC AT/386/486 approach by their technical parameters (4-8 bytes of RAM memory, 100-150 bytes of local disk space, a speed of some MIPS, display with 1024x768 pixels) to personal workstations. In contrast to them, the prices of these PCs are essentially lower. This caused their wide using in our institute and in other physical centres of Eastern Europe.

However, in reality the using of such computers as workstation of the physicist is not possible without the advanced application software using in HEP. Therefore, the aim of our work was adaptation of the main CERN Program Library[1] packages on the IBM PC under MS DOS.

From our point of view, operating system MS DOS is more preferable for such a configuration of PC (up to 8 Mb RAM and 100 Mb hard disk) than UNIX which needs 60-80 Mb hard disk and some Megabytes RAM memory only for itself.

As the programming environment the NDP system (Numerical Data Processing, see, for instance,[2]) was taken, which is oriented to 80386/486 microprocessors. This system includes: NDP LINKer, DOS Extender, compilers FORTRAN, C, Pascal, ASM. NDP allows one to use all available (including Extended) memory of PC in the Protected mode.

2. CERNLIB and GKS Implementation under MS DOS

CERN software used for simulation and analysis in High Energy Physics can be presented in the form of 3-level structure (see the Table).

Table. CERN Program Library main packages used in HEP.

An experimental setup description and events generation		Physics Analysis
GEANT, GXINT		**PAW**
HBOOK4	**KUIP ZEBRA**	**HPLOT5, HIGZ**
KERNLIB		**GKS**

Besides splitting to levels it is possible to retrace two branches:

1. not requiring graphics interface
   KERNLIB, ZEBRA, HBOOK4, KUIP, GEANT (excepting GEANG);
2. the graphical branch
   GKS, HIGZ, HPLOT5, GXINT, GEANG, PAW.

The packages interconnection defines the order of adaptation from low to high level and from first to graphical branch.

Below we present some adaptation details just in such an order.

Let us note that the most package codes are on FORTRAN-77, excepting the low level packages: KERNLIB and GKS, the part of which are written in ASSEMBLER and C. We tried to make minimal changes in sources, selecting the most convenient PATCHY "IF-parameters" and only in essential cases entering changes (by "CRADLEs").

KERNLIB. To implement the KERNLIB we used KERNFOR package, which contains (alternative to ASSEMBLER) FORTRAN and C variants of programs. FORTRAN programs adaptation was concerned mostly with the MS DOS and NDP systems features (word length, number of bytes, bits and bytes order, etc.). Some of C codes, used for saving and restoring state of program and for timing, were rewritten.

ZEBRA. Several serious bugs in the Memory manager ZEBRA-package /3/ were detected and corrected during PAW system installation. They were connected with a destruction of bank address after garbage collection in the case of using RZ and FZ files.

KUIP. Some problems were solved by providing of possibility for local editor call in interactive mode of KUIP (Kit for User Interface Package) /4/.

GEANT. By implementation of GEANT /5/ we included F.Carminati's (CERN) corrections file GCORR and our computer-independent corrections, connected with some errors detected by us and other users of GEANT from some experimental groups.

GKS. The Graphical Kernel System (GKS) /6/ defines a common interface to computer graphics for application programs. As the GTS GRAL Company (Darmstadt, Germany) does not possess the MS DOS version of GKS, so we have done GKS adaptation independently. The GTS-GRAL version of GKS-2D for VAX was taken as a source code.

We used TEKTRONIX 4010/4014 as virtual devices. In order to emulate these terminals on IBM PC we adapted the emulator from MS KERMIT system. It converts ESC-codes for TEKTRONIX to the drawing commands for EGA/VGA PC's display. As the Kermit Emulator is able to work only in REAL mode, the switching from PROTECTED mode to REAL mode is used (Fig.1).

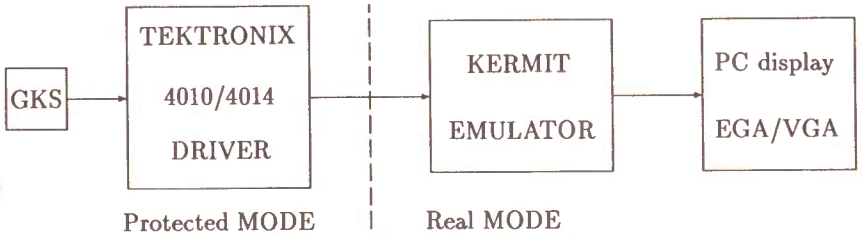

Fig.1. GKS data-flow diagram.

Remark that the orientation of graphical packages to the GKS allowed additionally to use all abilities of GKS, for example, a set of fonts, GKS metafiles, segment storage and so on.

After installation of GKS the adaptation of other graphical packages required some technical work, connected with definition of available configuration based on GKS.

HIGZ. While adapting HIGZ (High level Interface to Graphics and Zebra) /7/, some problems were connected with graphical editor and with "device viewport".

PAW. Installation of Physics Analysis Workstation (PAW) /8/ system on GKS allowed to find and to correct mistakes in low level packages (ZEBRA, KUIP, HIGZ, GKS), which were not detected earlier. By the implementation of PAW, which is an important tool for a physical results visualization and their analysis, is finished equipping of workstation of the physicist on the IBM PC.

Many packages were checked while creating the GEATORS program (on GEANT) for setup simulation and data analysis for Superconducting Toroidal Spectrometer (STORS) project /9/. Figure 2 gives the example of graphical representation of this setup and of the particle trajectories, obtained by the interactive version of GEATORS. This picture was first written as RZ-file, edited in PAW and produced as metafile in LaTeX format for the given article.

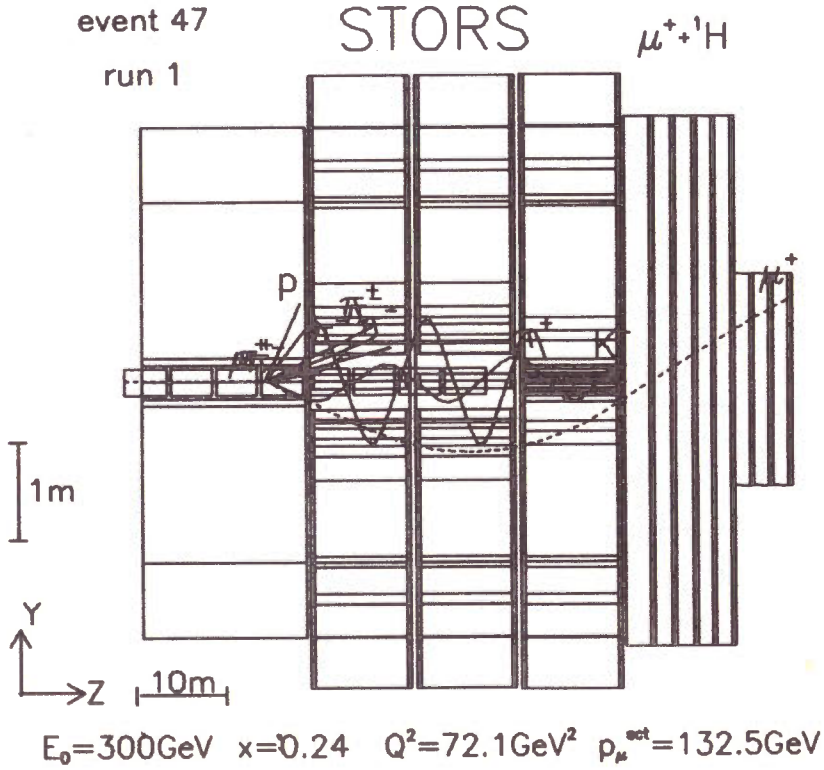

Fig.2. The experimental setup STORS: the event with deep inelastic muon scattering simulated by GEATORS program.

3. Conclusion

As it was mentioned by R.Brun et al. at the last International Conference "Computing in HEP'91", CERN "source and binary libraries are available for most of the machines and operating systems with the exception of the MS DOS environment" /10/.

Now CERN Program Library is available on IBM PC under MS DOS.

This means that physicists can be provided with a relatively cheap computer such as IBM PC AT/386 with sufficiently high performance, wide graphic and interactive facilities and modern software environment. By this means a PC has become comparable with workstations and this allows physicists to make full investigation process from program development for large experiments simulation up to visualization and fitting of obtained results.

The adapted packages are used now in more than 20 experimental groups of JINR (Dubna), IHEP (Serpukhov), Moscow University and in some institutes of JINR Member States.

4. Acknowledgements

The authors would like to thank all their colleagues, especially V.Balashov, for continuous interest and cooperation.

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Иванов В.В., Хасанов А.М., Пальчик В.В. E11-92-248
Адаптация PAW и GKS на IBM PC в MS DOS

Представлены результаты адаптации на IBM PC AT/386/486 в MS DOS графической системы GKS и основных пакетов библиотеки CERN (KERNLIB, ZEBRA, HBOOK, HPLOT, HIGZ, KUIP, PAW, GEANT и т.д.). Это позволяет рассматривать такие компьютеры как эффективное и удобное рабочее место физика-экспериментатора.

Работа выполнена в рамках проекта КОНТРАСТ/СИНС в Лаборатории вычислительной техники и автоматизации ОИЯИ.

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PAW/GKS Implementation on IBM PC
Under MS DOS

The adaptation of GKS and CERN Program Library packages (KERNLIB, ZEBRA, HBOOK, HPLOT, HIGZ, KUIP, PAW, GEANT and so on) on the IBM PC AT/386/486 under MS DOS, that allowed to consider such computers as the effective and convenient working place of physicist, is presented.

The investigation has been performed at the Laboratory of Computing Techniques and Automation, JINR.

Preprint of the Joint Institute for Nuclear Research. Dubna 1992