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CHINA: The Galaxy-II Computer and Nuclear-Related Research

Nuclear-weapons-related work took place on a Galaxy-II computer at the Beijing National Meteorological Center ***Of the possible explanations for this activity, the most plausible involves software testing by Chinese nuclear weapons researchers in preparation for the receipt of their own Galaxy-II. The indigenously developed Galaxy-II is an adequate high-performance computer for meteorology and nuclear weapons modeling, but falls far short of current US and Japanese supercomputer performance levels.***

Reported Nuclear-Related Activities at NMC

the NMC's Galaxy-II is the second to be built; the first Galaxy-II is at the military-affiliated institute in Changsha where it was produced, and the third machine is to be delivered to IAPCM in November 1994. NMC weather-forecasting work occupied the Galaxy-II for at least four to six hours per day.

A range of scenarios could explain the reported nuclear-related computational activities at the NMC:

- The scientists from IAPCM could have been running test programs and/or portions of their nuclear modeling hydrocodes on the NMC Galaxy-II to gain experience with the computer before their institute receives its own machine. ***This is the most likely scenario—it is precisely what US weapon designers often do to learn in advance how to optimize use of a new computer system before they take delivery and can run full nuclear simulations in their own secure facilities.***

- The IAPCM researchers could have used the Galaxy-II at NMC for actual nuclear design work. ***This is less likely, but possible.*** The NMC Galaxy is located in a relatively open institute and is part of a network with many other computers. ***Chinese nuclear modeling on the machine at NMC would run some risk of detection by nonnuclear researchers, including foreign personnel. Nevertheless, even part-time computational access to the Galaxy at NMC could help IAPCM designers accelerate progress on their projects, and they might judge the risks of detection to be acceptable.***

If the most probable scenario is correct and the Chinese nuclear modelers were running test programs (or code fragments) primarily to gain experience with the Galaxy-II, then their use of NMC computers would probably end when IAPCM receives its own Galaxy in late 1994. On the other hand, ***NMC facilities have clearly been used to support Chinese nuclear weapons research. If a Cray computer at NMC were diverted to such uses, it would be of significantly greater utility than the Galaxy-II to the Chinese in their nuclear computations. Safeguards could detect, but not prevent, such a diversion in place.***

Technical Analysis—The Chinese Galaxy-II

NMC researchers have been using an indigenously developed Chinese high-performance computer, the Galaxy-II, since October 1993, according to open Chinese publications and The Galaxy-II is on an NMC network where it is front-ended by a US-origin microcomputer and can share data with other US and Chinese systems. Development of the Galaxy-II computer began in 1986 at the National Defense University of Science and Technology in Changsha. In 1988 the NMC contracted to acquire the first production-model Galaxy-II for use in its medium-range weather forecasting work. ***The development of the Galaxy-II has been relatively slow as compared with progress in the Western high-performance computing industry during the past decade.***

The Galaxy-II is, according to published specifications, a four-processor computer with a clock rate of 20 nanoseconds (equivalent to 50 megahertz)—slower even than a 1978-vintage Cray-1 (12.5 ns), and far behind current high-end Japanese and Cray systems (which are in the 4-ns area). According to the Chinese press the Galaxy-II has a total shared main memory size of 256 megabytes—better than a Cray-1 but much less than current Western supercomputers. The Chinese state that the Galaxy-II has two independent 10-megabit-per-second input/output (I/O) subsystems—

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which if true is very slow and likely to be a significant limitation for users who need to move large data sets through the system. Overall, the Chinese have claimed that the Galaxy-II can perform 400 million 64-bit floating-point operations per second (MFLOPS). ***that each processor of a Galaxy-II can achieve 400 MFLOPS, given its slow clock rate, small main memory size, and limited I/O bandwidth, the four-processor Galaxy-II as a whole probably can achieve only a composite theoretical performance (CTP) of 400 to 500 million theoretical operations per second (MTOPS). The Galaxy-II's performance thus falls far short of current-generation Western supercomputers; it is comparable to that of today's high-end scientific/engineering workstations, now available in the West for under $100,000.***

The Galaxy-II is an adequate computer for medium-range numerical weather forecasting, but Chinese meteorologists almost certainly would prefer to have faster, reliable, easier-to-use Cray systems. Most computational weather centers around the world use Cray systems, so compatible hardware would enable the Chinese to share software and algorithms much more easily with their colleagues. ***A Japanese supercomputer would be a second choice for meteorological applications, but significantly behind a Cray in utility and requiring additional investment of time and software development resources.***

The Chinese have stated openly that they plan to build a successor machine, the Galaxy-III. This future computer is to be a massively parallel system with 128 processors initially, and will ultimately use up to a thousand processors. ***It will probably rely heavily on Western components.*** The scheduled date for completion of the first Galaxy-III is 1998, and the ultimate design performance is claimed to be many billions of floating-point operations per second. ***The slow production schedule of the Galaxy-III assures that, even if it is finished on time, it will be eclipsed by Western advanced workstations and will not be competitive with future US or Japanese supercomputers.***

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