Physical Sciences

A line for an X-ray laser

One of the necessities for making an X-ray laser is finding an energy transition of an atom or ion that generates an X-ray wavelength and for which the population inversion (more atoms or ions in the higher than the lower energy state) necessary for lasing can be produced. Some time ago a group from the University of Paris VI at Orsay, France, led by P. Jaeglé, suggested that a particular transition of triply ionized aluminum that emits a wavelength of 117.4 angstroms might have the property.

In the Oct. 28 PHYSICAL REVIEW LETTERS they report an experiment that shows the transition has that quality in a dense laser-produced plasma. A beam from a neodymium laser turns solid aluminum into a plasma, and in that plasma the X-ray population inversion occurs. The experimenters figure that in a plasma column one centimeter long and a hundredth of a centimeter across energy in the amount of 1.5 to 2 ten-thousandths of a joule would be stored. If that could be delivered in 10 nanoseconds time, a 15- to 20-kilowatt soft X-ray pulse would result.

A laser for communications

A tiny piece of solid made of alternate layers of gallium arsenide and gallium aluminum arsenide is presented as a laser to power optical communications systems. It was developed by a group from the California Institute of Technology and the Hitachi Central Research Laboratories led by Amnon Yariv of Caltech.

The laser, which is typically 1/60-inch long by 1/250-inch thick, has corrugations built into its crystalline structure that provide the reflections necessary for coherence, thus doing away with the necessity of mirrors at the ends. The light that is emitted is in the near infrared. The wavelength depends on the spacing of the corrugations, and several lasers with different spacings and hence wavelengths can be built into one crystal. The signals would feed into a transmission system made of optical fibers.

The device, which is called a distributed feedback injection laser, is powered by an electric source that need only be a few volts. Electrons are introduced into the solid from one side and holes (electron deficiencies) from the other. They meet in the middle and generate a burst of energy that the solid converts to light. A description is in the Nov. 1 APPLIED PHYSICS LETTERS.

A massive photon from vacuum

To a theoretical physicist a vacuum is not simply empty space. If a sufficiently strong force field is present, the energy stored in it may make particles pop up out of the vacuum.

In the Oct. 28 PHYSICAL REVIEW LETTERS R. A. Cover of KMS Fusion, Inc., and Gabor Kalman of Boston College propose that in a very strong magnetic field (trillions of gauss and more) a kind of massive photon, a particle possessing the qualities of a photon but having a rest mass, would appear. This massive photon would be unstable with an extremely short lifetime and would decay into an electron-positron pair.

No one knows for sure how strong the magnetic fields around collapsed astronomical bodies such as black holes may be, but if they are strong enough to produce the massive photons, assuming the theory is correct, then the radiation they emit should be substantially affected by the process.

Information Sciences

International data control

The maxim that "knowledge is power" takes on new meaning in an age of computers. Data banks of personal information bestow on youthful indiscretions an embarrassing permanence, and electronically digested national "intelligence" has become a vital weapon in the modern arsenal. Governments are at last moving to cope with the practical and ethical problems of mass information. Sweden has instituted a Data Inspection Board to protect individuals from misuse of stored information about them, and two recent international meetings focused on aspects of the problem.

The Organization for Economic Cooperation and Development held a seminar on policy issues in Paris this summer and drafted a summary statement to guide governmental legislation. Its recommendations: Standards for the operation of personal registers should be established, following assessment of likely developments, with adequate protection for individual privacy. Each citizen should have the right to inspect information about him in all public and private records and to correct or challenge incorrect data. Nations should cooperate to harmonize minimum protective standards and should use great care in implementing programs involving data collected on all citizens.

An International Symposium on Information Systems held in Varna, Bulgaria, in October, dealt with establishment of international networks to share scientific and technical data, which is growing at 10 to 12 percent a year. The meeting was organized by the International Atomic Energy Agency, which devised the first such network and is currently helping the Food and Agriculture Organization set up a similar system. The objective of the program was to encourage links between existing information systems.

Next, the data cartridge

Magnetic tapes were fine for storage of massive amounts of information—so long as no one needed it quickly. A long walk to the tape storage room becomes an eternity compared with the sub-microsecond calculations of a modern computer. And while magnetic disks offer quick access to data, they are prohibitively expensive for passive storage of huge quantities of seldom needed information. Now IBM has developed a fist-sized "data cartridge" that combines some of the best features of tapes and disks.

Like tapes, large amounts of data can be stored relatively cheaply; like disks, the data can be quickly retrieved. The new cartridges can each hold 50 million characters of information and are stored in a mechanically accessed honeycomb structure, whose total volume of information will be equivalent to a library of about 47,200 reels of tape.

Computers help fertilizer problem

The Tennessee Valley Authority and several fertilizer manufacturers around the country have begun using Control Data Corporation's "Cybernet" network to ease the critical shortage of fertilizer. Making fertilizer is a tricky business, involving huge quantities of natural gas, lots of electricity, and a complex transportation system. In part, current shortages have resulted from lack of information on what materials were available, and where, and how they could best be shipped. Now an executive can tap into a computer model of the market directly from his office and make decisions on what fertilizer to produce based on what materials are available and what products are most needed.