sign in 10^{-9} sec; the hopping would give a breadth of 10^9 sec^{-1} to the line. A similar effect might occur with a frozen defect, if the defect goes into a high-symmetry site, but locally alters the spring constants to stabilize the distorted phase. Halperin points out that at this time there is no direct evidence that defects are present. Axe believes that it will be extremely difficult to distinguish experimentally between the dynamic-impurity effect and other explanations.

Another approach has come from molecular dynamics computer simulation of models for structural phase transitions. These were done for two dimensions by Toni Schneider and Eric Stoll (IBM Research Center, Zurich), and for one-dimensional systems by Serge Aubry (Saclay), and Thomas R. Koehler (IBM, San Jose). What all of these have in common is the appearance of microscopically substantial clusters (microdomains) of the new structural phase, appearing before the transition temperature has really been reached; moreover, according to Krumhansl, numerical analysis shows that these are responsible for the strong zero-frequency or central-peak spectral component. (Schneider and Stoll have produced a film showing the formation of clusters, which is available on request.)

Until recently, though suggested occasionally on heuristic grounds, no direct theoretical demonstration from the starting Hamiltonian explained the appearance of these microdomains. At the San Juan conference Krumhansl reported on work done by him and J. Robert Schrieffer (Penn), in which they demonstrated formally (in one dimension) that both the statistical mechanics and the dynamics of the nonlinear displacement field indeed lead to such structures. Last year Krumhansl and Alan Bishop (Cornell) showed that the two-dimensional structural phase transition could be described using the same model.

Recently David Moncton and Frank Di Salvo (Bell Labs) working with Axe found a central peak in a layered metal—tantalum diselenide; it shows a charge density wave instability. R. Bhatt and William L. McMillan (University of Illinois) have attributed this central peak to electronic effects.

As Halperin noted, there may not be a unique explanation for all the observed central peaks. —GBL

French heavy-ion laboratory under way

Last fall the French national heavy-ion laboratory was authorized for construction at Caen in Normandy. The project is known as "GANIL" (Grand Accélérateur National d'Ions Lourds), and the accelerator is expected to be capable of producing heavy ions from carbon to uranium.

Total cost is estimated at 210 million francs, including the building, beam transport and experimental area. The first building is now under construction; it is expected to house a group of engineers and technicians by the end of the year. By 1980 the machine is expected to be completed.

Some years ago it was decided to concentrate French nuclear-physics efforts on nuclear-structure studies with medium-energy light particles (Saturne accelerator) and construction of a large heavy-ion accelerator (GANIL) (PHYSICS TODAY, April 1974, page 121). The GANIL laboratory is jointly sponsored by the Commissariat à l'Energie Atomique and the Institut National de Physique Nucléaire et de Physique des Particules.

The accelerator will consist of two separated sector-focused cyclotrons, the first one acting as an injector for the second after the beam is passed through a stripper. The characteristics of the two cyclotrons are exactly the same—four sectors, each weighing 400 tons, internal radius 0.75 m, external radius 3 m, $K = 400$ MeV (where $E = Kq^2/A$ and E is the energy gained by an ion with charge number q and mass A)—so that the energy gain in each is equal to 16. The accelerating system will operate through two dees at a voltage of 250 kV.

In front of the first separated sector cyclotron is a small circular injector delivering any type of ion between C^{2+} and U^{9+}. The energy reached at the exit of the first cyclotron is high enough for most of the ions being stripped off so that the charge is multiplied roughly by four. Because the beam entering into the second cyclotron transports ions with four times the charge of those exiting from the first cyclotron, the revolution frequency should be four times greater. The matching problem for the accelerator system has been resolved in a very simple manner by using the same oscillator frequency (in a range 3–14 MeV) for both cyclotrons but with harmonic number eight for the first cyclotron and two for the second.

With such an accelerating system, O^{2+} ions are accelerated to 5.2 MeV/nucleon in the first cyclotron and after stripping into O^{8+}, to 95 MeV/nucleon by the second machine; U^{36+} reaches around 9 MeV/nucleon.

The planned energy/nucleon will be approximately 100 MeV/A for light ions up to neon, decreasing with increasing mass (around 50 MeV/A for krypton) and 15 MeV/A for gold. Marc Lefort (Institut de Physique Nucléaire, Orsay) told us that the justification for the choice of cyclotrons was the desire for intense and energetic beams of light and medium-mass ions (between $A = 10$ and $A = 100$) as well as very strict requirements for beam qualities, such as very good emittance and very good energy resolution. For that purpose, the second cyclotron will employ a flat-topping technique. Thus, Lefort said, GANIL's capability will differ from UNILAC in Darmstadt, Germany. Two beams will be available simultaneously in the experimental area, and it will also be possible to use each cyclotron separately for ions at smaller energies and higher intensities, because there will be no stripping.

During 1976 magnets will be ordered, plans for the injector will be completed, and models for accelerator cavities will be made. The main building for the accelerator is expected to be finished in mid-1978; so the magnets could be set up and magnetic-field measurements could begin by the end of 1978. In 1977 the construction of accelerating cavities and rf amplifiers is expected to begin so that they would be in place by the end of 1978. The first beam is expected to be produced in 1980.

The GANIL laboratory will be used as a national facility with many connections with other European heavy-ion machines, particularly UNILAC and the Nuclear Structure Facility at Daresbury, UK. Most of the physicists will prepare experiments at their own laboratories (Strasbourg, Grenoble, Lyon, Orsay and Saclay), moving to Caen only when they need the beam. However, Lefort notes, there will certainly be a lively new nuclear-physics center in Caen.

A users committee has been created recently that will define needed ancillary equipment, and an advisory board will look after connections between GANIL and the main nuclear-physics laboratories existing in France and Europe.

Oak Ridge to study tokamak impurities

The Impurities Study Experiment, a tokamak with easily replaceable inner chamber walls, will be built at Oak Ridge National Laboratory. The $2.5-million research device is expected to begin operation in early 1977.

Investigations into impurities that impede the energy-release process in experimental fusion plasmas will employ the ISX facility in tests of chamber walls with varying shapes and compositions. Researchers hope to learn which materials and configurations result in the least foreign matter entering the plasma.

The ISX will be operated by Oak Ridge and General Atomic of La Jolla, California; the two organizations conducted conceptual design studies for the device in the 1974–75 period. □