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Abstract . We present VUU calculations of giant resonances obtained in energetic heavy ion collisions. Also is considered the case of the giant dipole in ^{40}Ca and the possibility of studying the effects of rotation on such collective modes.

The study of giant resonances (GR) in extreme situations, such as energetic heavy-ion collisions or strong rotations, is currently motivating a lot of theoretical and experimental works (1) . As was demonstrated by various authors as well in static (2,3) as dynamical (4,5) calculations semi-classical approximations provide a useful and powerful tool of investigation of nuclear collective motions. In this respect the Vlasov equation together with a Uehling Ulhenbeck collision term (VUU) for taking into account the residual interaction allows realistic simulations of collective excitations induced by heavy-ion reactions.

We use the VUU code of ref.(6,7) in which nuclei are described by the propagation in phase space of generalized coherent states. In ref (7) results concerning the isoscalar giant monopole were presented both in spherical and 3-d approaches in the case of ^{40}Ca, and were found in reasonable agreement with experimental data. We discuss here the case of the ^{139}La+^{12}C reaction whose simulation leads to monopole-like oscillations and a preliminary study of the rotating giant dipole (GDR).

THE ^{139}La + ^{12}C REACTION

In Fig. 1 is presented a VUU simulation of the ^{139}La + ^{12}C reaction at 50 MeV per nucleon and for zero impact parameter. This calculation has been motivated by a recent experiment (8). in which apparently a compound nucleus is found and sequentially undergoes fission. Together with a monopole vibration, we indeed obtain a fusion residue, as can be seen from Fig. 1 and from the fact that the pressure tensor of the system roughly becomes isotropic after t = 90 fm/c (9) . We are presently studying this reaction for various impact parameters. Another interesting point would also be to study whether our simulation actually leads to fission.

THE GDR

Our GDR calculations have been performed for ^{40}Ca and with the full (i.e. non linearized (10)) Vlasov equation. As when using coherent states,

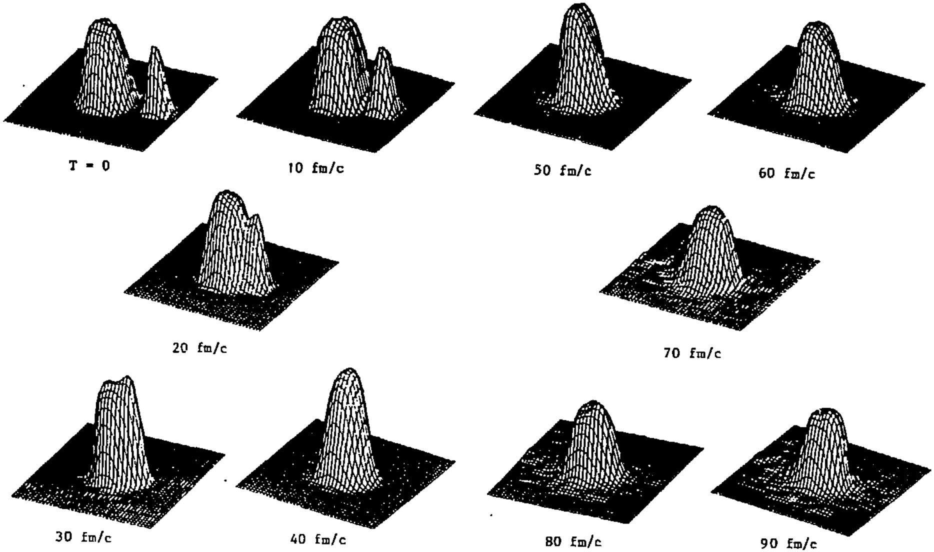

Fig. 1 . Evolution of the total density of $^{139}La + ^{12}C$ (E/A = 50 MeV and b = 0) averaged along one axis perpendicular to the collision, as a function of time. Note that beyond t 50 fm/c a fusion residue is formed, which oscillates with a monopole mode while emitting forward and backward pre-equilibrium particles.

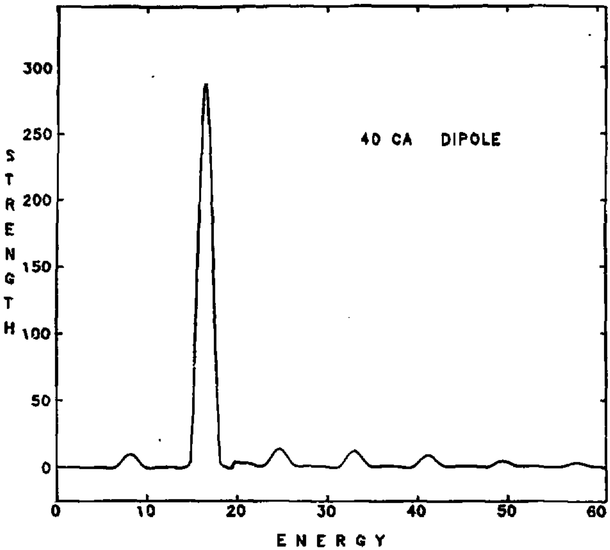

Fig. 2 . Preliminary Fourier analysis of a dipole vibration of ^{40}Ca.
(Energy E in MeV)

convolution with gaussians are involved in any integrated quantity, we have modified the T5 parametrization of the Skyrme interaction (11) in order to reproduce reasonably the static gross properties of some magic nuclei. Note that the resulting interaction, relevant for our "coherent states" description of nuclei, nevertheless has reaonsable saturation properties. In Figure 2 is shown the result of a preliminary Fourier analysis of the dipole vibration of a ^{40}Ca, built on its ground state. Such an analysis is delicate due to the coupling of the GDR to quadrupole modes. Work is in progress for interpreting properly the various components of the strength function. In order to look at the effect of rotations on the GDR, we have performed a model calculation with ^{40}Ca ($\hbar\Omega_{rot} \approx 6$ MeV). We observe in this case 2 well separated vibration frequencies respectively along and perpendiculary to the rotation axis. This result shows the possibility of looking, at least qualitatively, at the splitting of the GDR for realistic systems. We are currently studying the case of ^{20}Ne (1) for which rotation is expected to induce very noticeable effects.

In this note we have presented examples of applications of the VUU formalism to the study of giant resonances. Although our results are still preliminary, they demonstrate the relevance of such an approach, in spite of the difficulty inherent to a self consistent description of nuclear collective motion. Work is in progress for extending our simulations to various physical situations.

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