Ultrasonic measurements have been performed on three ternary Yb-based single crystals, YbTGe (T = Pt and Cu) and YbNi$_3$Al$_9$. Within them, YbPtGe shows the orthorhombic $\epsilon$-TiNiSi-type structure and it is reported as a heavy-fermion ferromagnet with the magnetic transition temperature of $T_C = 5.4$ K. Another one with $T = $ Cu, YbCuGe compound has a hexagonal structure and it has been reported as a metallic antiferromagnet with $T_N = 4.2$ K. It is also proposed that this compound contains geometrical magnetic frustration due to the competition of exchange interaction within the quasi-two dimensional Yb plane of which Yb ions form a triangle. Recent researches suggested that both these YbTGe (T = Pt and Cu) show magnetic anisotropy which can be ascribed to the crystal electric field (CEF) effect. However, these two compounds contain different type of CEF (orthorhombic and trigonal CEF for YbPtGe and YbCuGe, respectively). Ultrasonic measurements and related theoretical calculation have been performed on these two compounds in order to clarify these CEF effects and to investigate the magnetic phase transition in these compounds.

For YbPtGe, the transverse elastic moduli $C_{44}$, $C_{55}$, and $C_{66}$ exhibit a softening characteristic with a peak around 150 K while the longitudinal moduli $C_{11}$, $C_{22}$, and $C_{33}$ show a continuous hardening in the temperature ($T$) range above $T_C$. For YbCuGe, the transverse elastic moduli $C_{44}$ and $C_{66}$ show similar softening which begins at 120 K and stops at about 20 K. On the other hand, the longitudinal moduli $C_{11}$ and $C_{33}$ modes show a continuous hardening above $T_N$. Theoretical strain-susceptibility fitting of transverse modes of these two compounds indicate that the softening results from a quadrupole interaction between the ground and excited Kramers doublets of
orthorhombic and trigonal CEF for YbPtGe and YbCuGe, respectively.

As for the elastic moduli below $T_C$, abrupt elastic hardening is observed in $C_{22}$, $C_{33}$, and $C_{55}$ while $C_{11}$, $C_{44}$, and $C_{66}$ exhibit a step-like softening in YbPtGe. Similar step-like softening below $T_N$ is detected in $C_{33}$ and $C_{44}$ modes in YbCuGe compound, and elastic hardening appears in $C_{11}$ and $C_{66}$ modes. The difference between the softening and hardening of elastic moduli below $T_C$ ($T_N$) in YbPtGe and YbCuGe may be due to the magnetostriction or a different dominant coupling between a strain and an order parameter. Phase diagrams with a magnetic field ($H$) parallel to the $a$-, $b$-, and $c$-axis are obtained by the measurements of the $T$ and $H$ dependences of all the elastic moduli for both of these two compounds.

The third ternary Yb-based compound YbNi$_3$Al$_9$ is proposed as a helical magnet in 4f-electron system. It has a trigonal ErNi$_3$Al$_9$-type structure which belongs to the enantiomorphous space-group $R32$. The Sommerfeld coefficient of 110 mJ mol$^{-1}$ K$^{-2}$ suggests the heavy fermion behavior of YbNi$_3$Al$_9$ and it shows typical features of a heavy-fermion antiferromagnet with a Neel temperature of $T_N = 3.4$ K. The magnetic ordering in YbNi$_3$Al$_9$ can be the chiral helimagnetic due to interplay of the RKKY and DM interactions in the chiral crystal. Kondo effect combined with the CEF excited state in this compound is also revealed in previous report. To investigate the CEF effect and the antiferromagnetic ordering at $T_N$, we carried out the ultrasonic measurements on a YbNi$_3$Al$_9$ single crystal. What’s more, by this measurement, the possible reaction of the chiral magnetic structure to the ultrasound can be detected and CEF level are clarified by the theoretical fitting. Acoustic de Hass-von Alphen effect is observed in the magnetic field dependence of elastic modulus for the magnetic field parallel to the $a$-axis. The existence of chiral structure in this compound is indicated by the reaction of elastic moduli below $T_N$ with different modes of $C_{44}$ and $C_{66}$. The possible mechanism of the new rotational invariance effect of this chiral magnet without magnet field was proposed in this work.