# ULTRASONIC QUANTUM OSCILLATIONS IN AuZn SINGLE CRYSTAL

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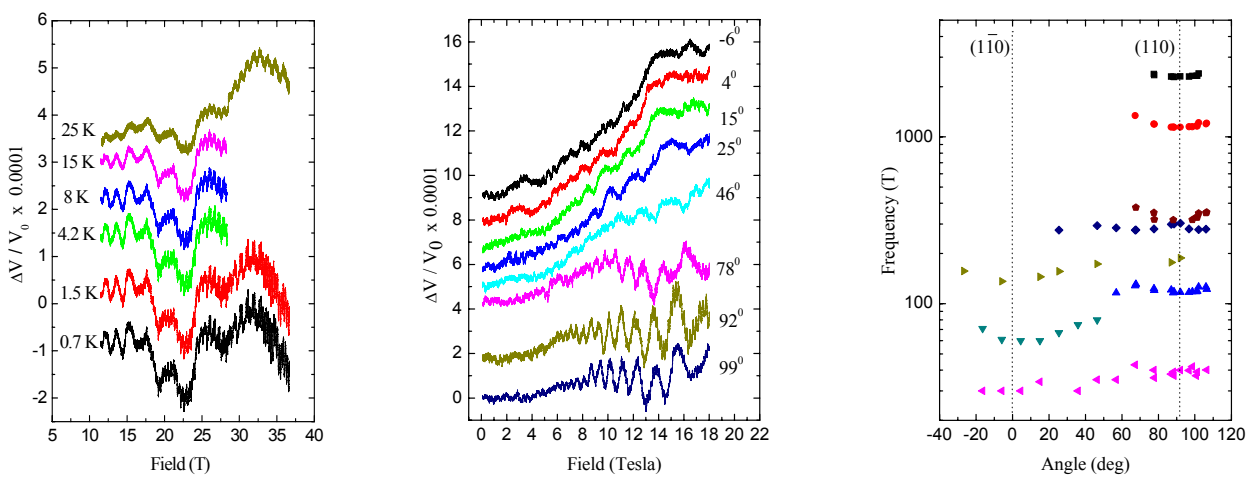
## Introduction

AuZn belongs to the subclass of materials characterized by a martensitic phase transition that exhibit a shape-memory effect, exceptionally important for a number of technological and medical applications. The interatomic bonding and consequently the properties of this simple metallic alloy are determined by the free electron gas. This is why our study is addressed to the topology of the Fermi surface. In this work pulse echo ultrasonic technique is applied in the investigation of AuZn in a magnetic field for the first time.

## Experimental Results and Discussion

The AuZn sample for this study was prepared as described in [1]. Below the martensitic transition (64 K), in presence of a domain structure, the ultrasound attenuation dramatically increases. Despite this, we were able to do the pulse-echo measurements for the first time in this temperature range. The longitudinal sound (f = 45 MHz) was propagating in the (110) direction. The measurements were carried out in the 45 T hybrid and 18 T SC magnets. The quantum oscillations of ultrasound velocity are clearly seen when the field is applied parallel to the sound wave vector (Fig.1 (a)). Rotating the sample holder allowed us to study anisotropy of this phenomenon in fields of up to 18 T. When the angle between the field and the sound wavevector increases, the oscillations become weaker (Fig. 1. (b)). While no oscillations were observed in the ultrasound attenuation in the entire angle interval used, the quantum oscillations in the sound velocity were observed up to an unusually high temperature of 25 K (Fig.1 (a)). The angle and temperature dependences of the oscillation amplitude and the frequencies of the oscillations (Fig. 1(c)) agree well with those extracted from resistivity measurements [2]. Since this study was done below martensitic transition, the diversity of the oscillation frequencies relates not only to complexity of the Fermi surface but also to the variety of domain orientations with respect to the sound and the magnetic field.




(a) (b) (c)

Fig. 1. Quantum oscillations of sound velocity in AuZn. $0^O$ and $90^O$ correspond to the field directed in (1-10) and (110) directions, respectively. (a) Relative change of ultrasound velocity versus magnetic field at different temperatures; 45 T hybrid. (b) Field dependence of ultrasound velocity at various positions of the sample with respect to the field; 18T SC magnet. (c) Oscillation frequencies (in Tesla) versus the angle between the field and (1-10) crystallographic direction. For clarity, the traces in (a) and (b) are shifted vertically.

## References

[1] T.W. Darling, *et al.*, Philosophical Magazine B **82,** 825-837 (2002).
[2] McDonald, R.D., *et al.*, J. of Magn. Magn. Mat. **272-276**, e1681-e1683 (2004).