# Pressure and Field Tuned Magnetism in the Honeycomb Antiferromagnet $Na_3Ni_2BiO_6$

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Hydrostatic pressure offers a contolled and effective means to modifying the crystal structure and exchange interactions without chemical substitution. In this context, the layered nickelate compound $Na_3Ni_2BiO_6$ is a promising structure to test the influence of pressure on its magnetic properties. It crystallizes in the monoclinic α-$NaFeO_2$-type structure, where $Ni^{2+}$ ions ($S$ = 1) form two-dimensional honeycomb layers and develop long-range antiferromagnetic order with ($T_N \approx 10.4$ K) and a positive Curie–Weiss temperature, ($\theta_{CW}$ = 13.3 K) [1]. Here, we present a systematic study of the magnetic response of polycrystalline $Na_3Ni_2BiO_6$ as a combined function of applied magnetic field ($H$) and hydrostatic pressure ($p$).

At $\mu_0H$ = 0.1 T and no applied pressure, we observe the antiferromagnetic transition at 10.5 K. The Curie-Weiss fit of the high-temperature susceptibility gives an effective moment $\mu_{eff}$ = 3.25 $\mu_B/Ni^{2+}$ and $\theta_{CW}$ = 13.7 K, consistent with earlier reports [1]. $T_N$ decreases with increasing magnetic field, from 10.5 K at 0.1 T to 8.30 K at 7 T, in agreement with previous work [2]. Moreover, we find that hydrostatic pressure, in combination with the applied magnetic field, suppresses the antiferromagnetic transition temperature as shown in Fig. 1, $\Delta T_N/\Delta p$ increasing in magnitude from −0.2 to −0.58 K/GPa with increasing pressure and field. We tentatively attribute this shift to an anisotropic compression of the layered structure, as observed in the structurally similar compound $Na_3Co_2SbO_6$ [3]. These results show that the magnetic ground state of $Na_3Ni_2BiO_6$ is tuneable by the combined action of magnetic field and pressure. Future work will aim to extend these measurements to single crystals and to higher pressures accessible with diamond anvil cells.

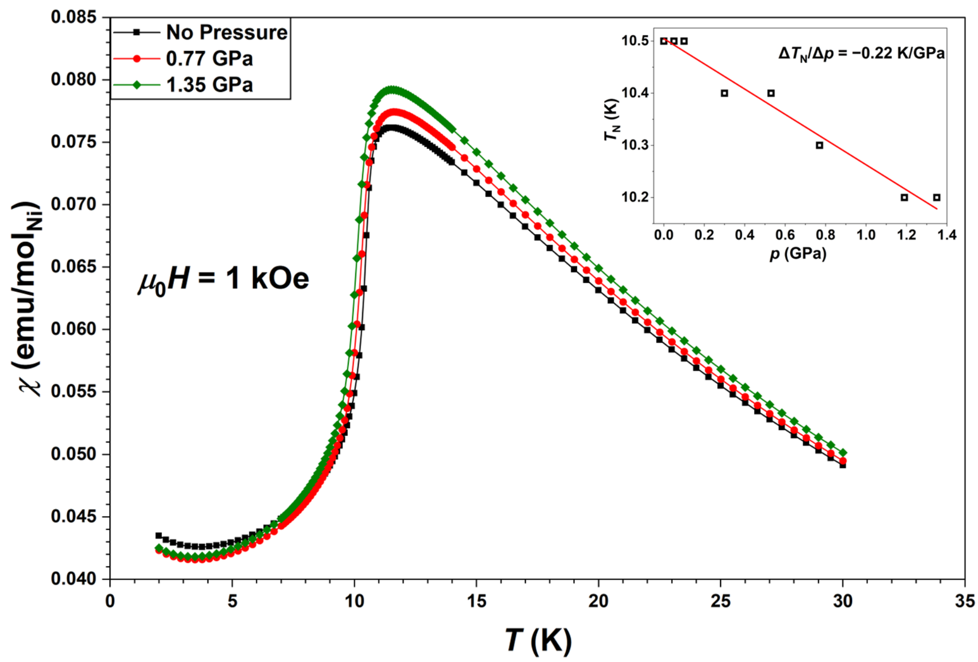


Fig. 1. Temperature dependent susceptibility of $Na_3Ni_2BiO_6$ at $\mu_0H$ = 1 kOe under pressures of 0, 0.77, and 1.35 Gpa, respectively show a progressive suppression of the $T_N$. Decrease in $T_N$ as a function of pressure (Inset).

1. E. M. Seibel *et al.*, "Structure and magnetic properties of the α-$NaFeO_2$-type honeycomb compound $Na_3Ni_2BiO_6$". *Inorg.Chem.* 52, 13605-13611, **2013**.
2. Y. Shangguan *et al.*, "A one-third magnetization plateau phase as evidence for the Kitaev interaction in a honeycomb-

lattice antiferromagnet". *Nat.Phys*. 19, 1883-1889, **2023**.
3. E. Poldi *et al*., "Pressure tuning of Kitaev spin liquid candidate $Na_3Co_2SbO_6$". *Commun.Phys.* 8, 310, **2025**.