# MAGNETO-OPTICAL EFFECT IN THE S = ½ QUASI-TWO DIMENSIONAL ANTIFERROMAGNET $K_2V_3O_8$

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## Introduction

Thermochromic, electrochromic, piezochromic, and photochromic materials have attracted a great deal of attention in recent years due to the compelling underlying physics as well as possible device applications. An applied magnetic field can also induce high-frequency dielectric properties changes. This work focuses on the optical and magneto-optical properties of $K_2V_3O_8$, which offers an opportunity to explore coupling in layered, inhomogeneously mixed-valent systems.

## Methods

Magneto-optical experiments were carried out over a wide energy range at 4.2 K, concentrating on the ab plane response for H || c. Complementary LSDA calculations were also done to elucidate the microscopic nature of the excitations.

## Results and Discussion

Figure 1 displays the crystal structure, optical properties, projected density of states, and a close-up view of the variable temperature dynamics of the 6.5 meV vibrational mode in $K_2V_3O_8$. Two large magneto-optical effects, centered at ~1.19 and 2.5 eV, are attributed to field-induced changes in the $V^{4+}$ d to d on-site excitation due to modification of the local crystal field environment of the $VO_5$ square pyramids with applied magnetic field. Taken together, the evidence for a soft lattice, the presence of multiphonon fine structure on the sharp 1.19 eV magneto-optical feature, and the fact that these optical excitations are due to transitions from a nearly pure spin polarized V d state to hybridized states involving both V and O, suggest that the magneto-dielectric effect in $K_2V_3O_8$ is driven by strong lattice coupling.

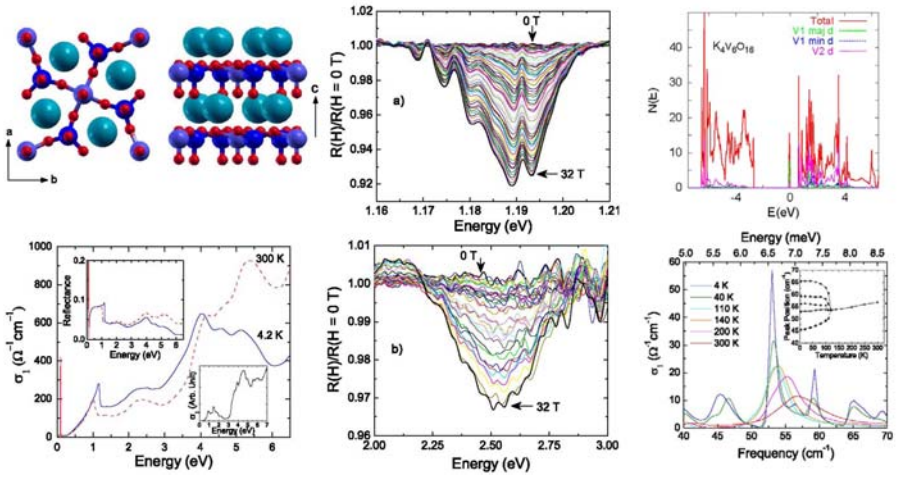


**Figure 1.** Structure, optical conductivity, magneto-optical effects, calculated density of states, and variable temperature vibrational properties of $K_2V_3O_8$.

## Conclusions

Based upon combined spectroscopic measurements and electronic structure calculations, we find that the magneto-optical effect in $K_2V_3O_8$ is driven by strong lattice coupling.

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