

# Soft X-ray Resonant Diffraction from Single Crystals

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Resonant X-ray diffraction has developed into a major technique applicable to many materials. We will report on the extension of resonant diffraction into the soft X-ray region (500 –1500 eV). We have published examples of the huge resonant enhancements of charge and magnetic scattering that can be obtained at the  $L$ -edges of  $3d$  transition metal oxides [1,2]. In this talk we will review the first resonant soft X-ray diffraction observations of charge, spin and orbital ordering from bulk single crystals. We have recently studied the low temperature phase of  $\text{La}_{0.5}\text{Sr}_{1.5}\text{MnO}_4$  that displays charge, spin and orbital ordering. Energy scans at constant wavevector have been compared to theoretical predictions and show that at all temperatures there are two separate contributions to the observed scattering, direct Goodenough orbital ordering and strong cooperative Jahn-Teller distortions of the  $\text{Mn}^{3+}$  ions. Our results also suggest a strong coupling between the spin and orbital degrees of freedom. We have also applied this technique to the study of other materials such as holmium and  $\text{UAs}_{1-x}\text{Se}_x$  ( $x = 0.15$ ) where incommensurate magnetic diffraction has been observed at the Ho  $M_V$  and U  $N_{IV}$  and  $N_V$  edges.

## References

- [1] - S.B. Wilkins, P.D. Hatton, M.D. Roper, D. Prabhakaran and A.T. Boothroyd. Phys. Rev. Lett. **90** (18) 187201 (2003)
- [2] - S.B. Wilkins, P.D.Spencer, P.D. Hatton, S.P. Collins, M.D. Roper, D.Prabhakaran and A.T. Boothroyd Physical Review Letters. **91** (16) 167205 (2003)