We report on a magnetic and structural investigation of layered antiferromagnetic system vanadium (III) fluoride. VF3 crystallizes in a distorted ReO$_3$ structure (R-3c) with rotated undistorted VF$_6$ octahedra. The V$^{3+}$ cations are arranged in a triangular lattice with the possibility of exhibiting magnetic frustration. Polycrystalline samples of VF3 were investigated using heat capacity, dielectric, magnetic susceptibility, synchrotron and neutron powder diffraction methods. Combining our results, we report the first evidence for a first order phase transition resulting from the ordering of the t$_{2g}$ orbitals below 105-110 K. This transition reduces the symmetry to C$_{2}$/c. We further confirm that VF3 undergoes a long-range antiferromagnetic order at $\sim$19 K in accordance with literature [1]. The antiferromagnetic order results in a magnetic structure with the magnetic moments alternating between a parallel and b parallel alignments in the ab plane.


Keywords: Orbital Ordering, Fluoride, magnetism