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Ignition of HMX and RDX

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The research presented here addresses questions in two separate areas, both concerned with the behaviour of explosives when impacted or shocked. The explosives examined were RDX and HMX, both commonly used military explosives which are desirable for their relative insensitivity.

The first section is a broad investigation of the causes of ignition in columns of shocked granular RDX and how these mechanisms are affected by the shapes and features of the RDX crystals. A shock sensitivity hierarchy was constructed for eleven RDX samples of different sizes and with different morphological features. By examining the details of how a shock is transmitted through a granular material, and how the crystal features affect the associated stresses and temperatures, it was possible to determine which crystal features were most important in determining sensitivity for each particle size of RDX.

The second section is concerned with a solid-state phase change in HMX. This explosive molecule has several possible shapes in the solid state and a change from the usual beta form to the delta form is known to occur on heating. Until recently, no technique was available to investigate this phase change on the very short timescales during impact. The two molecular shapes have different symmetry properties and consequently the phenomenon of second harmonic generation can be exploited to investigate the phases present with nanosecond time resolution. Chapter 6 describes the modification of impact apparatus at the Cavendish Laboratory to look for and investigate this phase change. Chapter 7 covers a continuation of this research at Los Alamos National Laboratory to examine further the details of the transition.