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X-ray catastrophe focusing with ferroelectrics STEPHEN DURBIN, Purdue University, TERRENCE JACH, NIST, SUNGWON KIM, Penn State University, VENKATRAMAN GOPALAN, Penn State University — Familiar ripple patterns reflected from water waves and the characteristic cusp of light seen in the bottom of a coffee cup are examples of catastrophe optics, where focusing occurs without need for highly engineered optical elements; catastrophe theory provides the mathematical tools needed to describe the stability and topology of the caustics that produce these effects. We have discovered catastrophe focusing in the diffraction of hard x-rays from crystalline wafers of ferroelectric lithium niobate, by diffracting monochromated synchrotron undulator radiation from surface planes while applying a voltage across the thin crystal. The presence of anti-phase ferroelectric domains causes a rippling of the surface that produces focusing at an x-ray CCD camera a half meter away. The catastrophe focusing pattern can be uniquely controlled by the applied voltage. These results suggest possible applications of catastrophe optics to x-ray microfocusing, and to the use of voltage-controlled patterned ferroelectrics as a new concept in x-ray optical devices.

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