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Crystal plasticity in shock-compressed hcp-iron

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Iron is a key constituent of planetary core and an important technological material. Here, we combine *in situ* ultrafast X-ray diffraction at free electron lasers with optical-laser-induced shock compression experiments on polycrystalline Fe to study the plasticity of hexagonal close-packed (hcp)-Fe under extreme loading states. We identifiy the deformation mechanisms that controls the Fe microstructures and observe a significant time-evolution of stress over the few nanoseconds of the experiments. These observations illustrate how ultrafast plasticity studies can reveal distinctive materials behavior under extreme loading states and will help constraining the pressure, temperature, and strain rate dependence of materials behavior in planetary cores.