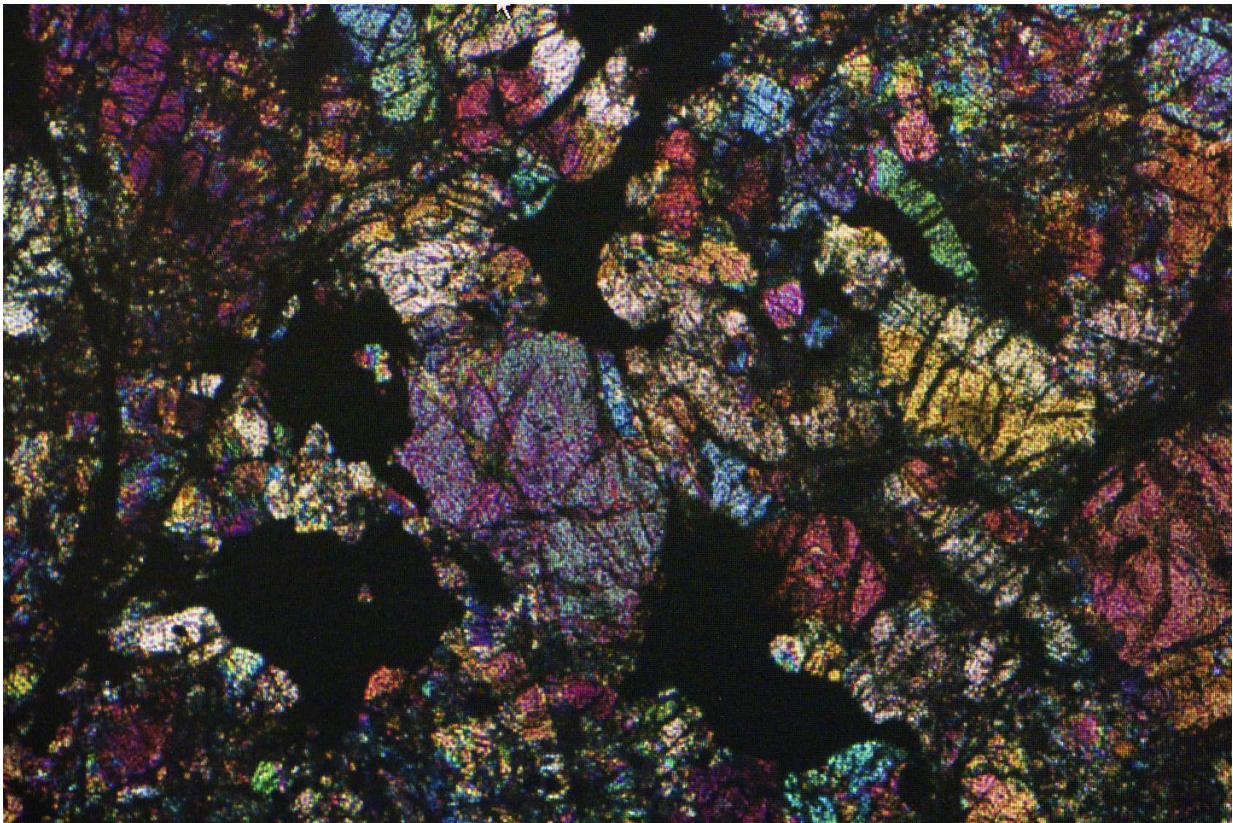


# Researchers seek to deflect asteroids, preventing their collision with Earth

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The Chelyabinsk meteorite belongs to a group known as ordinary chondrites.  
Credit: JOAN COSTA / CSIC

An international project, led by Spain's National Research Council,  
(CSIC) provides information on the effects a projectile impact would

have on an asteroid. The aim of the project is to work out how an asteroid might be deflected so as not to collide with the Earth. The research, published in *The Astrophysical Journal*, focuses on the study of the asteroid Chelyabinsk, which exploded over Russian skies in 2013 after passing through the atmosphere.

The probability that a kilometre-sized [asteroid](#) could have devastating consequences after impact with the Earth is statistically small. However, objects a few tens of meters across reach the Earth's atmosphere far more frequently.

The results of this study indicate that the composition, internal structure, density and other physical properties of the asteroid are fundamental in determining the success of a mission that launches a kinetic projectile to deflect the orbit of a dangerous asteroid.

On February 15, 2013, an asteroid with a diameter of approximately 18 metres exploded over the Russian town of Cheliabinsk, producing thousands of meteorites that fell to Earth. The fragmentation of this object in the atmosphere illustrates the principle that Earth's atmosphere acts as an efficient shield, even though more than a thousand meteorites hit the ground, each with a total mass exceeding one ton. Despite the asteroid's small size, the shock wave it produced when penetrating the atmosphere at hypersonic speed caused hundreds of injuries and considerable material damage.

"Studying the chemical and mineralogical composition of the Chelyabinsk meteorite allows us to grasp the importance of the collision compaction processes that asteroids suffer as they near the Earth. The results of this work are extremely relevant for a possible mission in which we want to efficiently deflect an asteroid which is close to Earth," says CSIC researcher Josep Maria Trigo of the Institute of Space Sciences. Thus, following rigorous and systematic work, the new study

has discovered the properties of the materials that the asteroid is made of. In particular, the hardness, elasticity and fracture resistance, which could all be determinants for the success of a kinetic projectile attempting to deflect an asteroid's orbit.

## **The experiments**

The Chelyabinsk meteorite belongs to a group known as ordinary chondrites. The CSIC researchers chose it because it was considered representative of the most potentially dangerous asteroids in terms of its component materials. Potentially hazardous asteroids that threaten the Earth suffer many collisions before reaching our planet; therefore, their consistency increases and their minerals appear battered.

These experiments have been carried out using an instrument known as a nanoindenter. This consists of a small piston tipped with a diamond head that applies a predefined pressure on the material and generates small notches in it, while measuring both the depth achieved and the material's elastic recovery time. Therefore, it is possible to determine key parameters such as fracture strength, hardness, elastic recovery time, or [Young's modulus](#). As the researcher Carles Moyano explains, "As ordinary chondrites are quite complex and heterogeneous rocks consisting of minerals with different properties showing varying degrees of collision damage, a comprehensive study is required. In this case, the study required around two years of work."

The measurement of the mechanical properties of the Chelyabinsk meteorite was carried out at the nanoindentation laboratory led by ICREA researcher Jordi Sort from Barcelona's Autonomous University. The study also included several European experts involved in the European Space Agency's proposed Asteroid Impact Mission. Thanks to these experiments being conducted by these meteorite pioneers, we are possibly closer to successfully facing any future encounter with

asteroids.

Provided by Spanish National Research Council

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