Monitoring hazardous near-Earth-object debris at 1 au using interplanetary magnetic signatures resulting from meteoroid-asteroid collisions

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While telescopic observations can determine accurately the orbits of potentially hazardous NEOs, they do not resolve the debris trail that accompanies these objects. The density of impactors increases with decreasing size, and these smaller objects upon impact can release material from the parent object and at times may completely disrupt it. This material leaves the region in which the collision occurred with momentum gained or lost in the collision and may move out of the original safe orbit into one that is hazardous to Earth. Thus we are at greater risk of a hazardous collision than our telescopic observations lead us to believe. Because material in these debris trails suffers disruptive collisions with the numerous but much smaller solar system meteoroid populations, and because this material becomes ionized and interacts with the solar wind, we can use magnetometers in space to monitor the amount and size distribution of potentially hazardous objects near 1 au. We have applied this to materials accompanying asteroid 138175 in its orbit around the Sun. Statistical results reveal that those materials are of tens of meters in diameter and have significant dispersion about the asteroid's orbit. A temporal study from 1970s to present shows that the lifetime of those co-orbiting materials are decades, which can be explained by their orbital resonance with Earth and Venus.