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A PLANETARY DEFENSE DISCUSSION ON HOW MUCH WARNING TIME THE DINOSAURS HAD BEFORE THE CHICXULUB IMPACT EVENT

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ABSTRACT

As impact events are known to have severe effects on the geological and biological evolution of the Earth, the need to detect potentially hazardous objects that might collide with the Earth, and to potentially protect our planet from asteroid impacts, has been recognized. For example, a large impact event marks the transition from the Cretaceous to the Paleogene eras, 66 million years ago, forming the ca. 200-km-diameter impact structure at Chicxulub, Mexico, which caused a severe mass extinction. The most iconic species that has fallen victim to the impact, the dinosaurs, literally had no chance.

Today, we have a technological society with a lot of relevant knowledge. At conferences related to planetary defense, such as the present one, there are “exercises” involving the fictitious discovery of potentially dangerous Near-Earth objects (NEOs) that possible impact the Earth. Two main options related to a potentially dangerous impactor are discussed, one with the NEO discovered several years before collision, with a chance to use (future) technology to potentially alter the course of the object to avoid impact, or alternatively that a (maybe smaller) object is only detected weeks or days before impact, just leaving the chance to refine the impact location, leaving possibly enough time to evacuate an area. This second option was evident in 2013 at Chelyabinsk, as an about 20-m-diameter object exploded at ~25 km altitude with an energy of about 30x the Hiroshima atomic bomb, which would have caused fatalities had it occurred directly above a densely inhabited area. Aside from all the communication and warning issues in both cases, other interesting questions, related to the currently often debated mistrust in authorities and science, arise.

For example, how long before the collision would the dinosaurs have seen the incoming Chicxulub-impactor in the night sky, or even the day sky? If we do not consider for now that the vision of dinosaurs may have been different from what human eyes can see, our recent work (Bazso and Koeberl, in prep.; Koeberl and Bazso, Abstr. 369330, GSA Annual Meeting, Portland, 2021) indicates that this was surprisingly late. As the impactor was of carbonaceous-chondritic composition, it had a low albedo (maybe around 10%). Other factors to consider include the approach

velocity and the phase angle of the asteroid (relative to the sun). This yields night-sky visibilities at about lunar distance, and day-sky detection at a distance of less than that for geostationary satellites. This results in a “time to impact”, at a slow 15 km/s velocity, on the order of less than 10 and 0.5 hours, respectively. Considering that this range value is for a fairly large asteroid, it is not surprising that smaller ones, which are also potentially dangerous, may escape early detection unless their orbits are already known. This is an important lesson for those who mistrust science and want to wait and “see with one’s own eyes”, as it leaves dangerously little time to do anything. This leaves the question if we really have much better chances than the dinosaurs?

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Comments:

(Alternative session: Impact Effects & Consequences; Oral preferred but if necessary Poster accepted)