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◉ **Impact Risk Assessment and Decision to Act**

Measuring the Performance of Impact Monitoring

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NEODyS and Sentry are two impact monitoring systems that have been operational at the University of Pisa (since 1999) and at JPL (since 2002), providing the list of known Near Earth Asteroids (NEA) with a non-zero probability of an Earth impact [1]. As required by the International Astronomical Union, the results of these two systems are cross checked before any public announcement of an impact risk above an agreed level, as measured by the Palermo Scale [2].

The main purpose of these systems is to solicit astrometric follow-up to either confirm or, more likely, dismiss the risk cases announced, i.e. the asteroids with so called Virtual Impactors (VI) [3]. This is achieved by communicating the impact date, the Impact Probability (IP) and the estimated impact energy.

What is the reliability level of these announcements? There is a probability threshold, called generic completeness limit [1], that the two systems have set as a goal. The generic completeness is the highest impact probability IP^* of a VI that could possibly escape detection, under the simplified hypothesis of full linearity of the map on the Target Plane [4]. The NEODyS system at UniPi has recently upgraded its generic completeness limit to the same level as JPL (i.e. $IP^* = 10^{-7}$), and has increased the sampling interval from $[-3, 3]$ to $[-5, 5]$ in the σ confidence parameter.

To make sure that only few VIs above the generic completeness limit can escape detection we perform a global comparison of NEODyS and Sentry. Since the detection of a VI below the generic completeness level is statistical, this comparison only makes sense for VIs with $IP > IP^*$.

We recently improved the NEODyS performance, lowering the generic completeness limit by a factor of 4, and increasing the computational load by a factor of 2. As a result the total number of detected VIs has doubled. The number of VIs (N_{VI}) as a function of IP now follows a power law with $N_{VI} \sim IP^{-2/3}$ for IP down to the generic completeness limit (see figure 1), which we are trying to intepret as a mathematical property of the ensemble of all the VIs, taking into account the number of possible resonant returns [5]. This improved performance has been obtained thanks to a better sampling the Line Of Variation, a line in the space of initial conditions representing the spine of the confidence region, where the orbital

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solutions are compatible with the observations [6]. The new method uses a sampling equispaced in probability, and allows an optimal use of computational resources.

A careful comparison between the full list of VIs by NEODyS and by Sentry shows that the differences for $IP > IP^*$ are only significant for 20 cases, which we analyzed to identify possible weaknesses in the procedure.

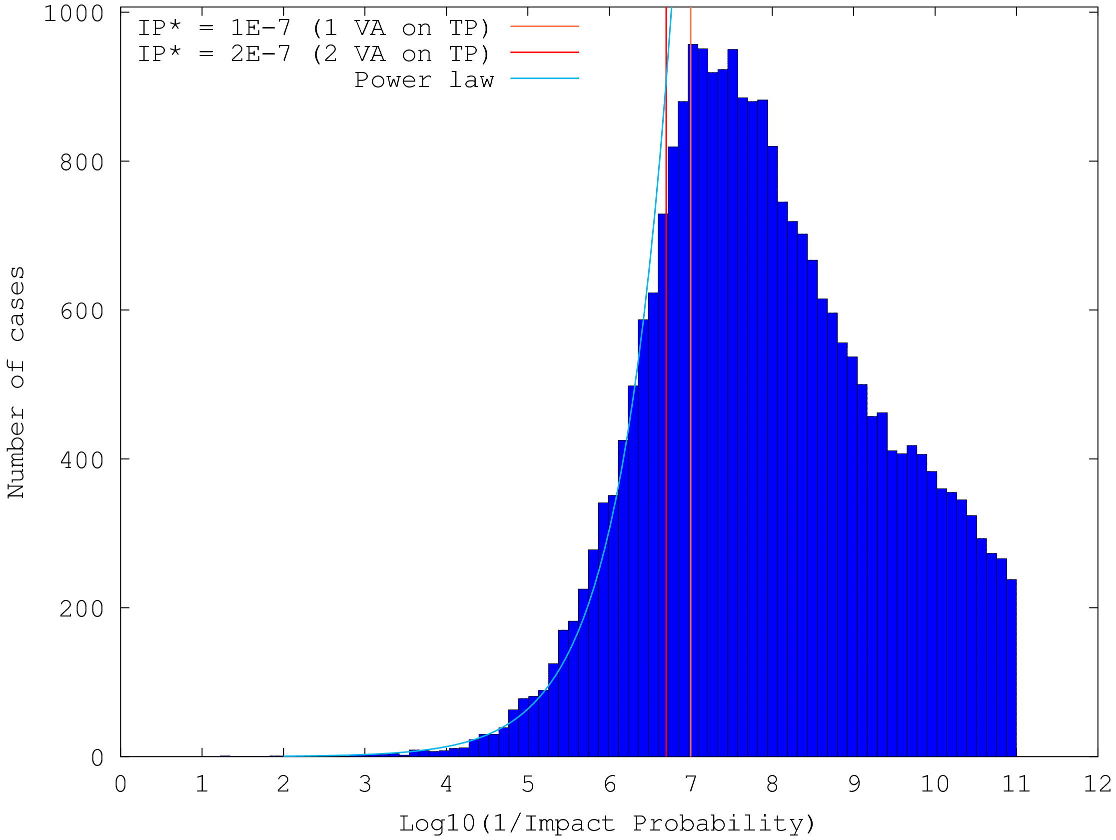

Figure 1: Histogram of the number of VIs as a function of the Impact Probability. *Light blue line:* power law $N_{VI} \sim IP^{-2/3}$.

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