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# COMMENT ON: "2005 VL1 IS NOT VENERA-2"

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## ABSTRACT

I show that the small differences between the orbital parameters of the dark comet 2005 $VL_1$ and the Venera 2 spacecraft (reported in arXiv:2503.07972) are of the magnitude expected from gravitational deflection by a close encounter of Venera 2 with Venus.

## 1. INTRODUCTION

Seligman et al. (2024) identified a population of near-Earth objects (NEOs) that exhibit statistically-significant non-gravitational accelerations with no coma, and labeled them "dark comets". Loeb & Cloete (2025) reasoned that one of these objects, 2005 $VL_1$, was at closest approach to Earth in late 1965, around the time when the Venera 2 spacecraft was launched to explore Venus. The observed $H$ magnitude of 2005 $VL_1$ is consistent with a high reflectance from the full surface of Venera 2 including its Solar panels. As known for Venera 2, 2005 $VL_1$ arrived within a short distance from Venus, a highly improbable coincidence ($\lesssim 1\%$) for the orbital phase of a near-Earth object that does not target a close approach to Venus. Indeed, 2005 $VL_1$'s orbital parameters are similar to the reported values for Venera 2. Given the area-to-mass ratio of Venera 2, Loeb & Cloete (2025) showed that 2005 $VL_1$'s non-gravitational acceleration and negligible transverse acceleration match the values expected from Solar radiation pressure.

Subsequently, McDowell (2025) as well as Spada (2025, private communication) argued that the small differences between the orbital parameters of 2005 $VL_1$ and Venera 2 imply that they are not the same object. Here, I show that the small differences in orbital parameters between these objects could have been caused by gravitational deflection and unrecorded maneuvers during the flyby near Venus.

## 2. GRAVITATIONAL DEFLECTION NEAR VENUS

The fractional velocity shift of Venera 2 as a result of its passage at an impact parameter $b$ and a velocity $v$ relative to Venus is given by (Binney & Tremaine 1987),

$$\delta \equiv \left(\frac{\delta v_\perp}{v}\right) = \left(\frac{2GM}{bv^2}\right) \ , \tag{1}$$

where $G$ is Newton's constant and $M = 4.9 \times 10^{27}$ g is the mass of Venus. Adopting $v \sim 30$ km s$^{-1}$ and $b = 24 \times 10^3 b_{24}$km [1], we get $\delta \sim 3\% \times b_{24}^{-1}$. The perihelion distance, $r_{\rm peri} = a(1-e)$, is 0.718 au for Venera 2 and 0.698 au for 2005 $VL_1$. The small difference between these values by $\sim 3\%$ is similar in magnitude to the expected value of $\delta$. An inclination change by $\delta$ in radians corresponds to $1.7^\circ \times b_{24}^{-1}$.

Radio communication with Venera 2 stopped on February 10, 1966, about 17 days before its closest approach to Venus from which there was no data return[1]. If the flyby of Venera 2 near Venus was at a lower speed or distance than assumed above, then the gravitational deflection and unrecorded maneuvers of the spacecraft near Venus as well as any additional orbital perturbations over the past 60 years, could have resulted in the shifts required to match the final orbital elements of Venera 2 to those of 2005 $VL_1$.

[1] https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=1965-091A

## ACKNOWLEDGEMENTS

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