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Modeling the size of the very dynamic diamagnetic cavity of comet 67P/Churyumov-Gerasimenko

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After the first detection of the diamagnetic cavity of comet 67P/Churyumov-Gerasimenko (Goetz et al. 2015) it became apparent that the boundary of this plasma region is very dynamic. To date hundreds of short cavity crossing events were detected (Nemeth et al. 2016, Goetz et al. in press), none lasting longer than an hour. This intermittent set of short crossing events is very different from the classical cavity observation near 1P/Halley, where Giotto remained for a long time continuously inside the cavity. The distance of the boundary is larger than that predicted by recent models, so it was not clear whether these short cavity-like regions are connected to a global diamagnetic cavity, or they are due to some local effects causing similar magnetic and plasma signatures. Here we revisit the neutral-drag model of Cravens 1986 to provide a very good phenomenological approximation for the highly variable size of this dynamic region. The model uses the cometary neutral production rate and the solar wind dynamic pressure as inputs. For the production rate we use averaged and detrended data derived from ROSINA neutral density measurements (Hansen et al. 2016). The solar wind pressure comes from space weather models and independently from the magnetic field measurements of MAG derived by using a method proposed by Madanian et al. 2016. The changes in the production rate and the dynamic pressure allows us to accurately predict the size of the cavity. In addition we show that instead of the local neutral pressure, the global production rate drives the size of the cavity. We can also explain the observed asymmetry between inbound and outbound crossings of the cavity boundary.