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230 years of AGN monitoring: Frequency of cloud occultation events in AGN & constraints for clumpy torus models

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Abstract. We systematically search for discrete absorption events in the vast archive of the Rossi X-ray Timing Explorer. This includes dozens of nearby type I and Compton-thin type II AGN and covers timescales from days to over a decade for individual objects. We are sensitive to discrete absorption events due to clouds of full-covering, neutral or mildly-ionized gas with columns 10^{22-25} cm^{-2} transiting the line of sight. We detect 13 eclipse events in 8 objects, roughly tripling the number of previously published events from this archive. Despite sensitivity to events with N_H up to 10^{24-25} cm^{-2}, we measured no Compton-thick eclipses in our sample. Peak column densities span 2.5–19 $\times$ 10^{22} cm^{-2}. Event durations span hours to months. We infer the clouds distances from the black hole, assuming Keplerian motion, to span 0.2–80 $\times$ 10^4 Schwarzschild radii. We find no statistically significant difference between the individual cloud properties of type I and II objects. The presence of eclipses in both type Is and IIs argues against sharp-edged cloud distributions. The type II AGN show a level of "base-line" X-ray absorption that is consistent with being constant over timescales from 0.6 to 8.4 yr. This can either be explained by a homogeneous medium, or by X-ray-absorbing clouds that each have NH $\ll$ 10^{22} cm^{-2}. Considering the "selection function" of the monitoring, we derive the probability of cloud occultation events. Finally, we derive the first X-ray statistical constraints for clumpy-torus models.