Far-ultraviolet search for gas emission associated with the outbursts observed by OSIRIS "summer fireworks" on 67P/Churyumov-Gerasimenko

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We have previously reported Alice far-ultraviolet observations of short-duration gas outbursts on 67P, based on detection of enhanced oxygen emissions relative to those expected from H_2O or CO_2 and attributed to electron impact dissociative excitation of O_2 (Feldman et al., ApJL 825:L8, 2016). None of these events were coincident with the short dust outbursts ("summer fireworks") observed by the OSIRIS NAC in the few months before and after perihelion (Vincent et al., MNRAS 462, S184, 2016). Alice also observed dust outbursts observed by other Rosetta instruments, but no gas emission was detected (Grün et al., MNRAS 462, S220, 2016; Agarwal et al., MNRAS 469, S606, 2017). These were at much larger heliocentric distances than the "summer fireworks". Here we revisit Alice observations of the brightest of the events listed by Vincent et al. in order to search for coincident increases in gas emission. Only those events where the projection of the Alice slit on the NAC image encompasses the dust outburst are considered. In a few, but not all cases, light curves of the strongest CO and atomic emissions show enhancements at times corresponding to increases in long wavelength solar reflected light characteristic of dust production. We attribute these emissions to electron impact on CO_2 and infer sub-surface CO_2 as the driver of the outburst. Alice also observes H_2O absorption along the line-of-sight to the comet (distance of Rosetta to C-G ~200-400 km), but the water column density does not appear to vary over the course of the outburst and there is no enhancement in H I Lyman-β.