Comet C/1908 R1 (Morehouse) as an analog of comet C/2016 R2 PanSTARRS

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Although comets are typically regarded as nitrogen-depleted relative to protosolar levels, the long-period comet C/2016 R2 (PanSTARRS) exhibited significant $N_2{}^+$ concentrations in its coma and tail, in contrast to its low CN presence and scarcity of H_2O. In this study, we revisit the long-period comet C/1908 R1 (Morehouse), distinguished by its intense emission bands of $N_2{}^+$ and CO^+, to probe potential parallels with C/2016 R2. We leverage the New Astrometric Reduction of Old Observations (NAROO) project's advanced sub-micrometric scanner to re-evaluate the historical spectroscopic plates of this comet. Our analysis extends to evaluating its dynamic trajectory and dissecting tail morphology records. Our findings indicate that C/1908 R1 underwent no significant close encounters during its passage through the inner solar system, suggesting that it is dynamically new and directly originates from the Oort Cloud. We ascertain a preliminary $N_2{}^+/CO^+$ ratio of 0.08, along with a dust-poor composition, particularities it shares with C/2016 R2. CN was present, but this may be a result of its closer perihelion (0.9 au compared to C/2016 R2's 2.8 au). Moreover, by synthesizing observations of the tail's structure over the three-month period of visibility, we uncover a link between tail dislocation phenomena and aurora borealis sightings on Earth. This association underscores the comet's tail's heightened sensitivity to solar wind fluctuations due to its volatile makeup. C/1908 R1 (Morehouse) emerges as one of the most unaltered relics of our Solar System's formation, and positions itself as an analog to C/2016 R2. This underscores the imperative to preserve and re-examine historical astronomical datasets, not only for historical significance but as a critical resource for contemporary scientific advancement.

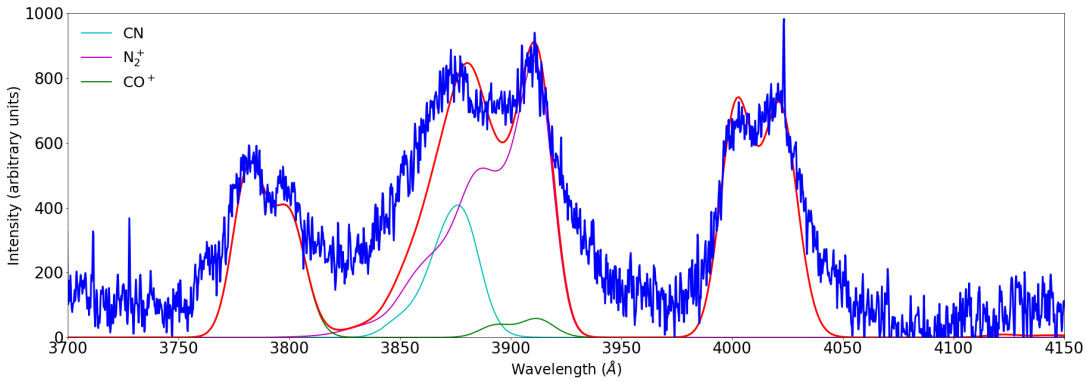

Figure 1: First attempt for modeling the observational spectrum (in blue) for the night 31 October. It is based on the sum of CO^+ emission bands ((4,0) around 3790 Å, (5,1) near 3900 Å and (3,0) near 4010 Å) plus CN (0,0) band (near 3880 Å) plus N_2^+ (0,0) and (1,1) bands near 3900 Å. The overall fit appears in red and is based on a N_2^+/CO^+ ratio for the species along the line of sight of about 8%. This spectrum is an average of the area around the nucleus.