HYDROGEN PEROXIDE ON THE ICY GALILEAN SATELLITES.
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**Introduction:** Hydrogen peroxide has been detected on the icy Galilean moons of Jupiter using the Galileo Ultraviolet Spectrometer. It is expected that the peroxide is a product of radiolysis and photolysis [1, 2]. The moons’ orbits are embedded in Jupiter’s magnetosphere; charged particles and photons may impinge on the surface, breaking up the water molecules. Products of bombardment of water ice that have already been detected at the Galilean satellites include H (detected escaping from Ganymede and Callisto [3]), \( \text{O}_2 \) (inferred from oxygen airglow at Europa and Ganymede [4] and detected on Ganymede’s trailing hemisphere [5, 6]), and \( \text{O}_3 \) (detected on Ganymede’s trailing hemisphere [7, 8]). Hydrogen peroxide can be added to this list of products as a result of recent Galileo measurements.

**Europa:** The Galileo NIMS experiment detected hydrogen peroxide on Europa’s leading hemisphere by identifying a distinctive 3.5 \( \mu \text{m} \) band, which was found to agree with a laboratory-measured reflectance of 0.3\% \( \text{H}_2\text{O}_2 \) in water ice [9]. Through a collaborative effort, it was found that in the same location on Europa, the UVS-measured reflectance agrees with the laboratory spectrum of \( \text{H}_2\text{O}_2 \) (0.3\% concentration by weight) in water ice at 80 K [R. W. Carlson, pers. comm.] (Fig. 1).

**Ganymede and Callisto:** The peroxide signature has also been detected in UVS spectra of Ganymede and Callisto, although it is somewhat less distinct on the darker satellites than on Europa. Figures 2 and 3 show UVS-measured reflectances of Ganymede and Callisto compared to models that include the 0.3\% \( \text{H}_2\text{O}_2 \)-water ice mixture (shown in Fig. 1) plus a flat reflectance to simulate the dark absorbing material on Ganymede and Callisto. On Ganymede, the feature appears most obviously on the leading hemisphere.

![Figure 1](image1.png)

**Figure 1.** Radiance coefficient (calibrated data/solar spectrum) of Europa’s leading hemisphere (centered near 120° W) compared to lab-measured \( \text{H}_2\text{O}_2 \)-water ice mixture normalized to Europa spectrum at 3000 Å.

Hydrogen peroxide in water ice is somewhat distinctive in the UV, and features a flattening of the reflectance longward of 2900 Å. The hydrogen peroxide feature is detected in observations of Europa’s leading hemisphere.

![Figure 2](image2.png)

**Figure 2.** Radiance coefficient (calibrated data/solar spectrum) of a region on Ganymede’s leading hemisphere (centered near 0° N, 85° W) compared to a model including lab-measured \( \text{H}_2\text{O}_2 \)-water ice mixture plus a flat reflectance.

On Callisto, the feature is less obviously constrained to the leading hemisphere. It appears, somewhat weakly, in almost all observed locations on Callisto. The primary exception is on the leading anti-Jovian quadrant, where we do not detect the feature.

**Discussion:** The hydrogen peroxide signature is likely due to bombardment by photons and/or charged particles. We explore the possible relationships between the peroxide and the other known absorbers on the icy satellites (i.e., ozone on Ganymede, \( \text{SO}_2 \) on Europa). We model the measured albedos to investigate the amounts of hydrogen peroxide detected in locations on each satellite.
Figure 3. Radiance coefficient (calibrated data/solar spectrum/μ₀) of a region on Callisto’s leading hemisphere (centered near 10° N, 60° W) compared to a model including lab-measured H₂O₂-water ice mixture plus a flat reflectance.

References: