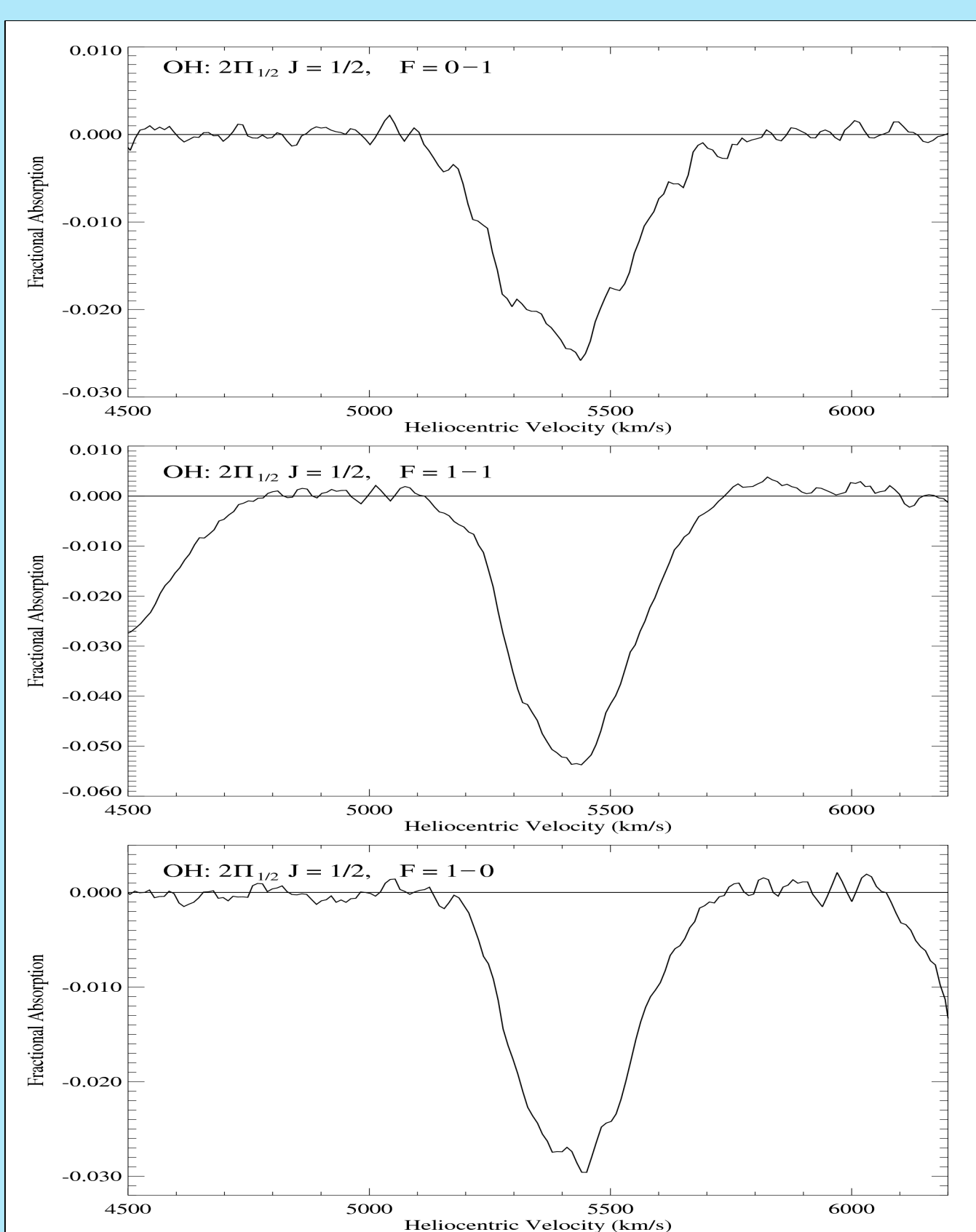


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## ABSTRACT

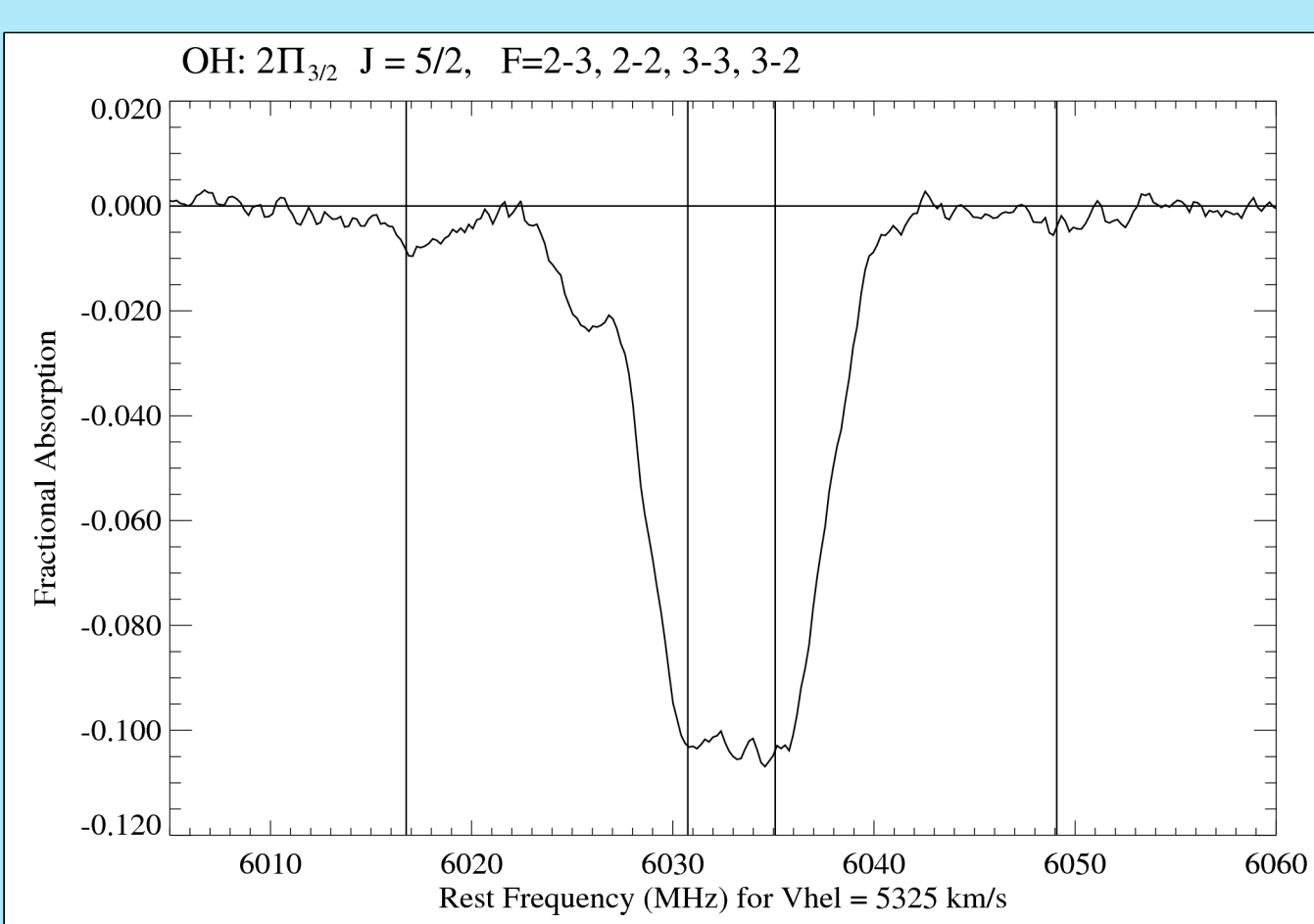
We are presently conducting a cm-wave molecular line census in Arp 220, the nearest Ultraluminous Infrared Galaxy (ULIRG) and prototype OH-megamaser source, using the Arecibo 305-m telescope. The main ground-state lines of the OH radical have long been known to show strong maser emission. Our observations confirm that the satellite ground-state lines show a mixture of emission and absorption. Among the initial detections are also  $\lambda 6$ -, 5- and 4-cm lines of excited-OH. All appear in absorption, and have brightness ratios within a given multiplet that are close to those expected in local thermodynamic equilibrium. An unidentified absorption appearing near 1611 MHz could either be due to the pre-biotic molecule, formic acid, or the  $^{18}\text{OH}$  equivalent of the 1667-MHz OH main line. In view of a possible adjacent absorption that could be the  $^{18}\text{OH}$  equivalent of the 1665-MHz OH line, and greater consistency in velocity with other Arp-220 molecular lines, identification of the 1611-MHz line with  $^{18}\text{OH}$  is more likely. Also, a possible detection of the 6668-MHz methanol molecule in absorption has been made. The implied total column density of methanol is derived assuming the reality of the feature.

### $\lambda 6$ -cm Excited OH Absorption Lines



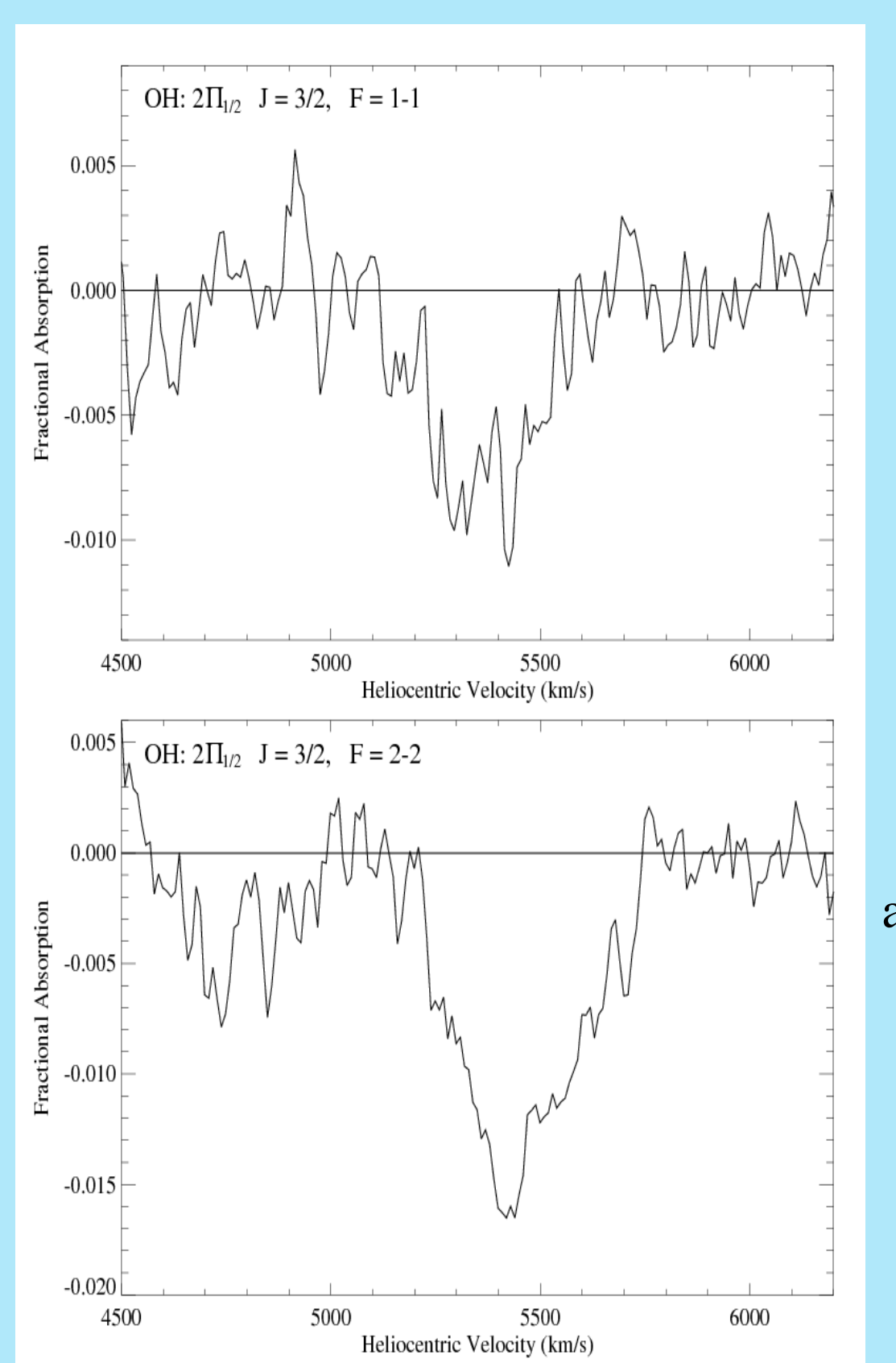
The  $\lambda 6$ -cm lines of excited-OH transitions  $^2\Pi_{1/2}, J=1/2, F=0-1, 1-1$  and  $1-0$  have intensity ratios close to 1:2:1, the LTE values. The intensity ratio of the 4750 and 7820-MHz absorption lines in the  $^2\Pi_{1/2}$  ladder yield an LTE excitation temperature of about 88 K.

### $\lambda 5$ -cm Excited OH Absorption Lines

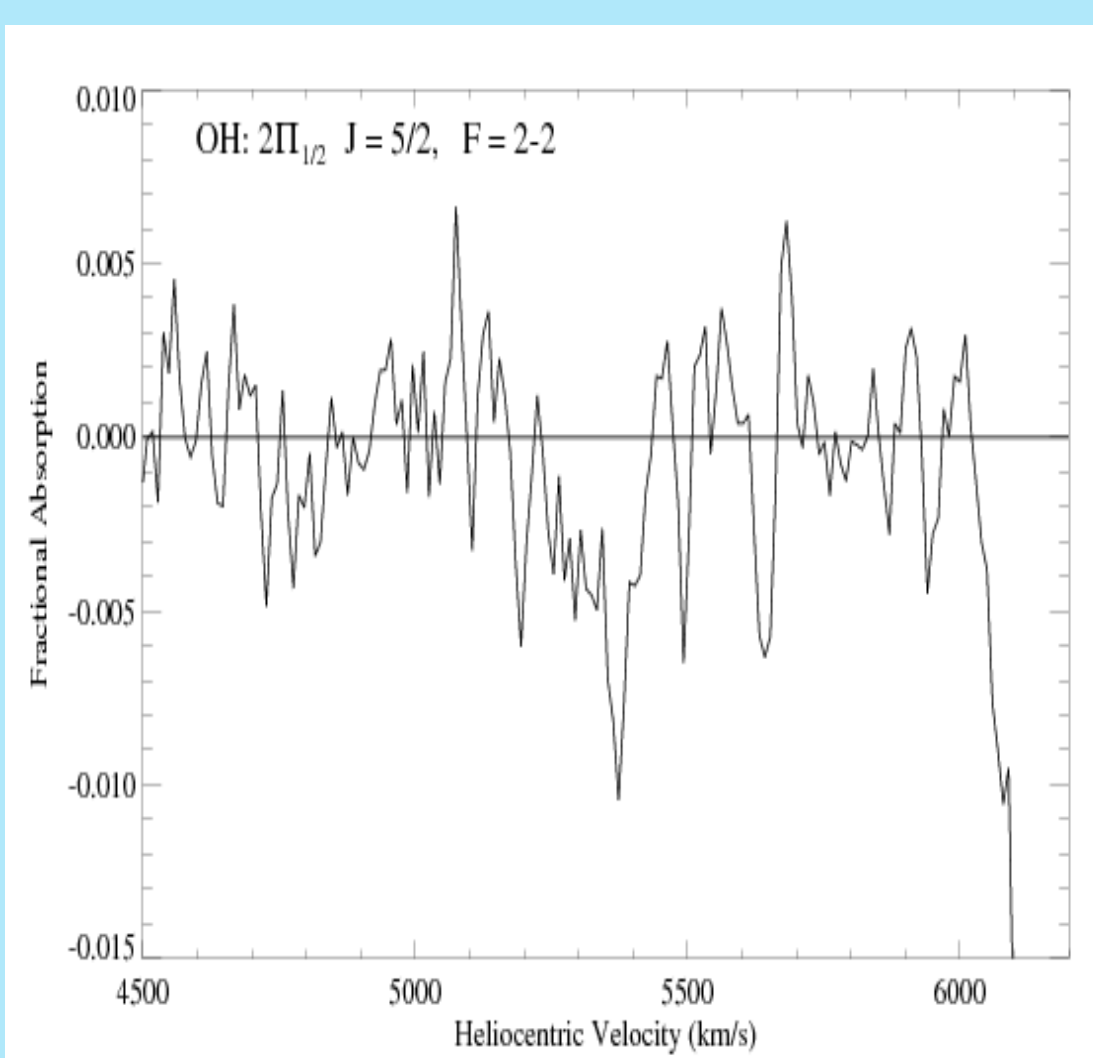


The  $\lambda 5$ -cm lines of excited-OH transitions  $^2\Pi_{1/2}, J=3/2, F=2-3, 2-2, 3-3$  and  $3-2$  have intensity ratios of 1:13:13: $<0.4$  (LTE = 1:14:20:1). This may be due to saturation or an asymmetric line shape.

### $\lambda 4$ -cm Excited OH Absorption Lines

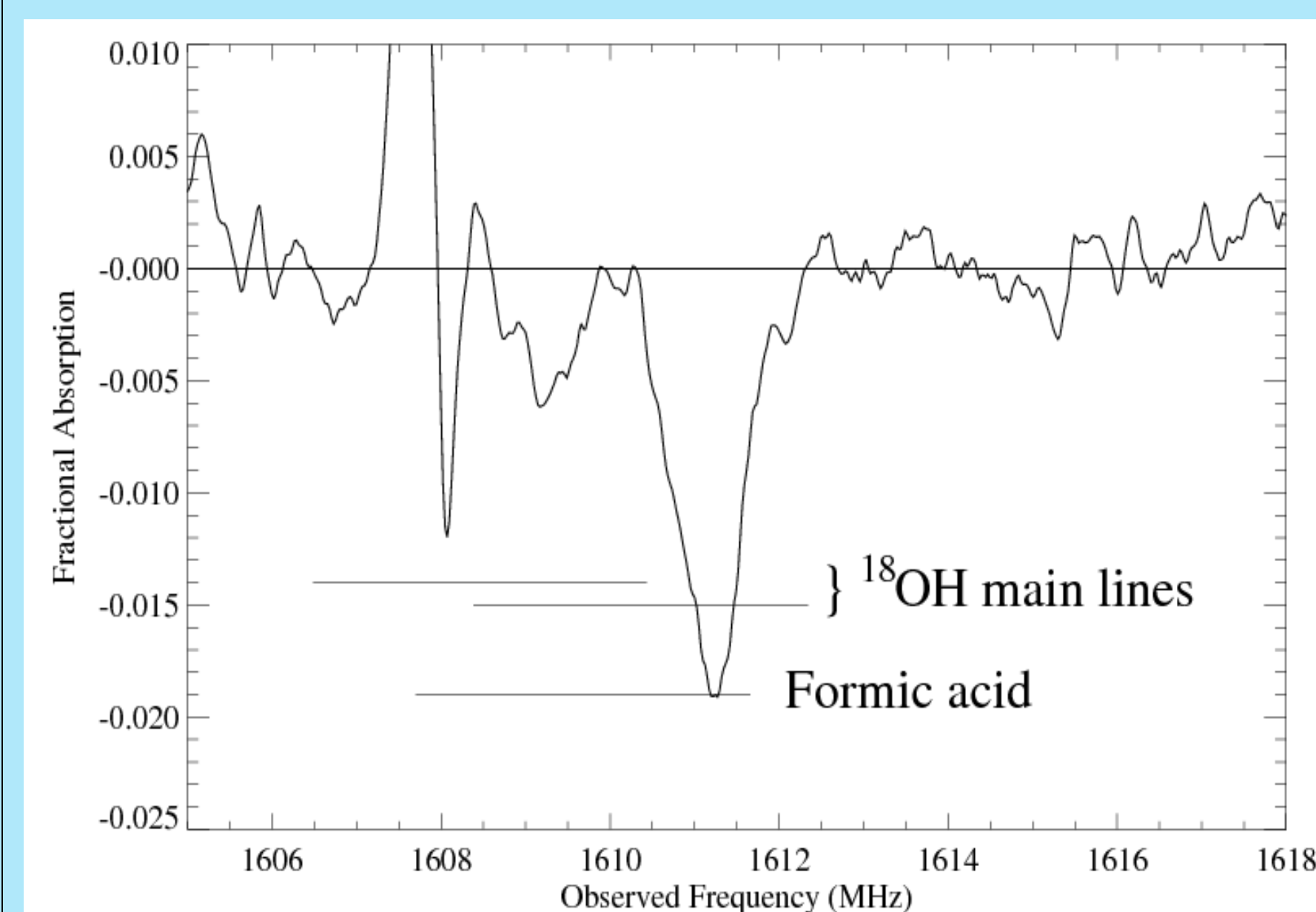


First detection in Arp 220 of the  $\lambda 4$ -cm excited OH transitions  $^2\Pi_{1/2}, J=3/2, F=1-1$  and  $2-2$ .



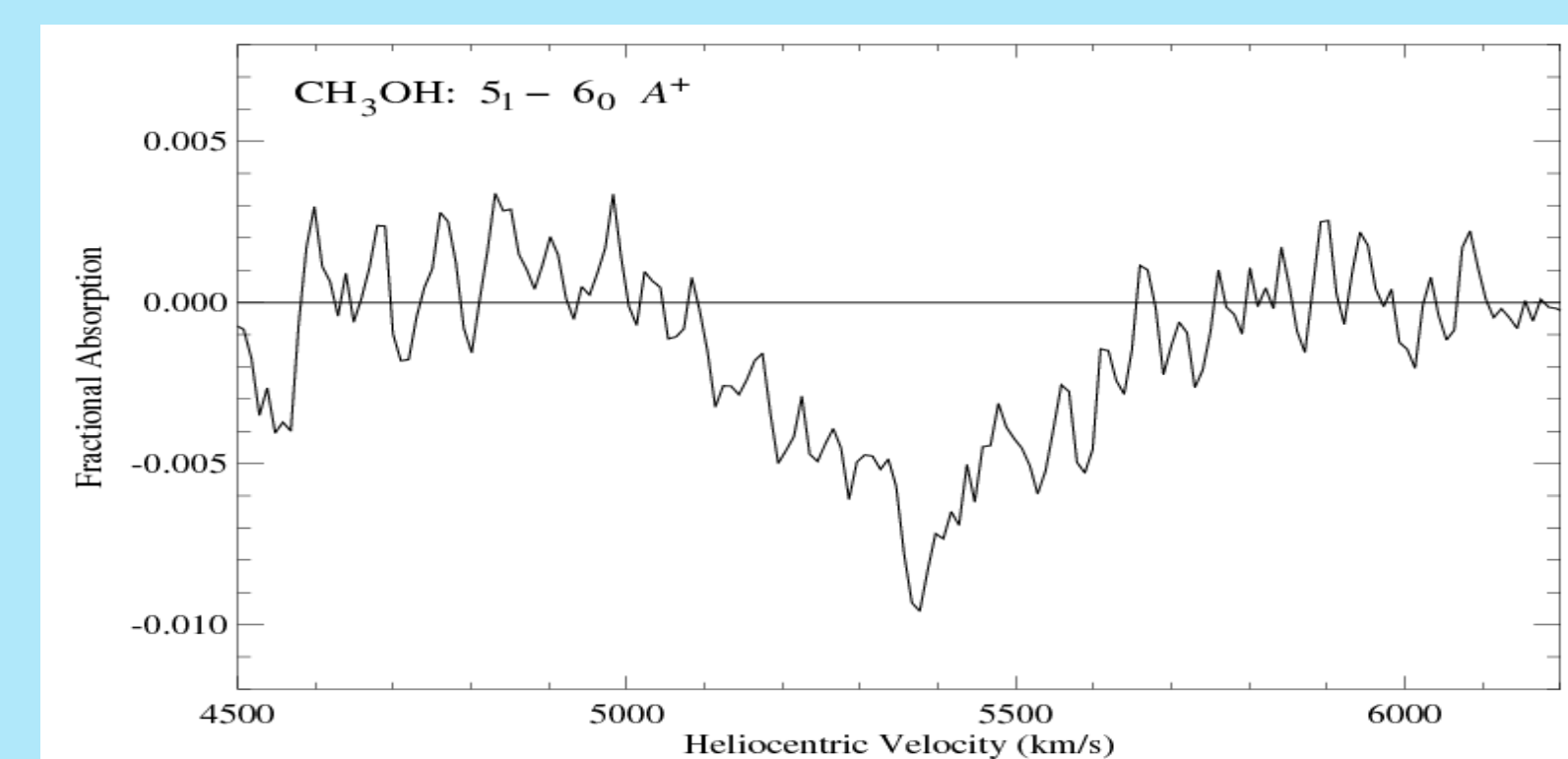
Possible detection in Arp 220 of the  $\lambda 4$ -cm excited OH transition  $^2\Pi_{1/2}, J=5/2, F=2-2$ .

### Formic Acid or $^{18}\text{OH}$ Absorption?



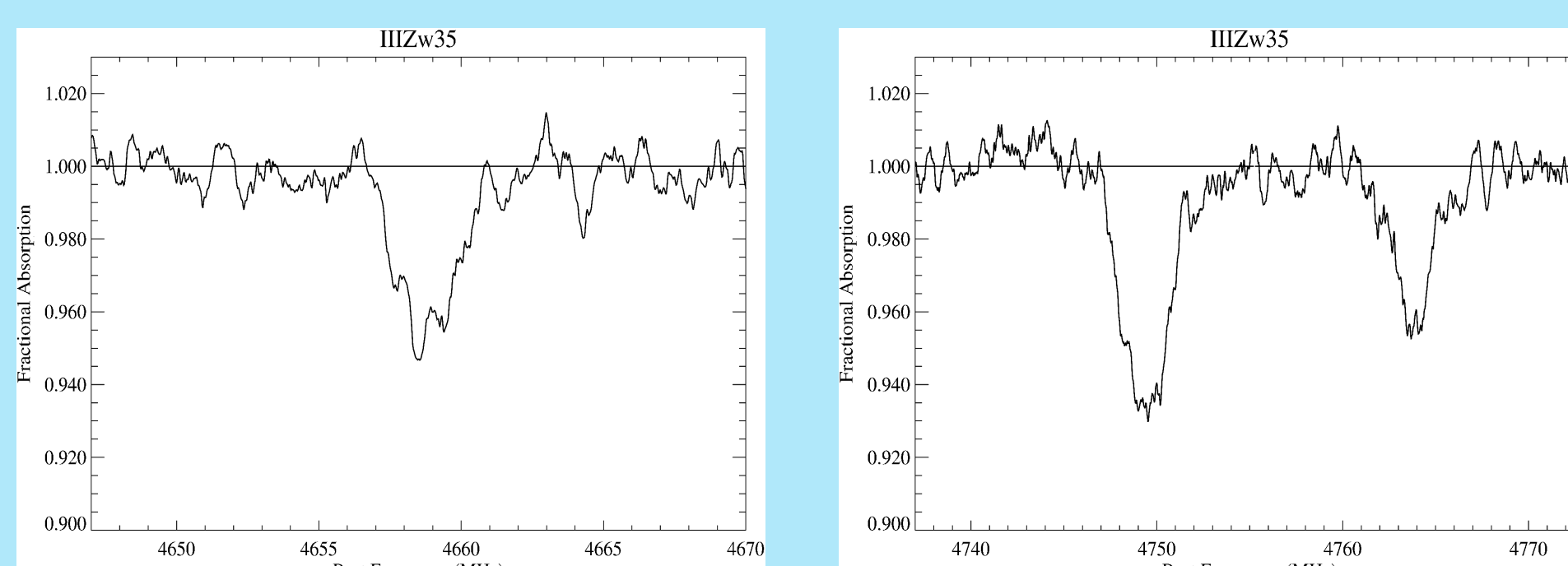
This absorption line(s) could be either HCOOH or  $^{18}\text{OH}$ . Their expected locations are indicated by horizontal bars. The band is affected by RFI from Glonass at  $\sim 1605$  MHz but the reality of the dominant absorption feature is verified by its absence in spectra of the bandpass calibrator.

### 6.7 GHz Methanol Absorption



Possible detection of the  $5_1-6_0 A^+$  (6.7 GHz) methanol line in absorption in Arp 220. If confirmed, this will be the first 6.7 GHz methanol detection beyond the local group. Implied column density is  $2.5 \times 10^{17} \text{ cm}^{-2}$ .

### OH in other ULIRGS



In late December, with the Arecibo 305-m telescope, the present observing team detected the  $\lambda 6$ -cm lines of excited-OH in the ULIRG, III Zw35. The continuum emission against which the absorption occurs is extremely weak, about 30 mJy.