

## Determination of isotope ratios in the Martian atmosphere from observations of H<sub>2</sub>O and CO with Herschel/HIFI

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### Abstract

As part of the guaranteed time key programme “Water and related chemistry in the Solar System” (KP-GT HssO, [1]) Mars has been observed during two periods in April and June 2010 with the HIFI instrument [2] of the Herschel Space Observatory [3]. We observed several rotational transitions of H<sub>2</sub>O and its isotopes H<sub>2</sub><sup>17</sup>O, H<sub>2</sub><sup>18</sup>O, and HDO at the very high frequency resolution of 1 MHz and with a instantaneous frequency coverage of 4 GHz. These observations allow not only to obtain information about the vertical distribution of water vapour, but allow also to determine the isotopic ratios <sup>17</sup>O/<sup>16</sup>O, <sup>18</sup>O/<sup>16</sup>O, and D/H.

To constrain the temperature structure of the Martian atmosphere between ground and about 80 km altitude additional observations of several rotational transitions of CO and its isotopes C<sup>17</sup>O, C<sup>18</sup>O, and <sup>13</sup>CO have been performed within a few days of the water vapour observation. First results of the CO observations have been already published by Hartogh et al. [4].

Using our standard line-by-line radiation transfer model we analyze the complete set of data to derive a new set of isotopic ratios. The additional observations of CO transitions allow to investigate the consistency of the oxygen isotopic ratios as obtained from two different constituents of the atmosphere. Finally we will carefully explore the data for indications of possible deviations from a uniform mixing of the isotopologues.

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HIFI has been designed and built by a consortium of institutes and university departments from across

Table 1: Summary of the observed transitions.

molecule	transition	frequency [GHz]
H <sub>2</sub> O	110-101	556.93599
H <sub>2</sub> O	211-202	752.03310
H <sub>2</sub> O	312-303	1097.36481
H <sub>2</sub> <sup>17</sup> O	110-101	552.02071
H <sub>2</sub> <sup>17</sup> O	312-303	1096.41513
H <sub>2</sub> <sup>18</sup> O	110-101	547.67675
H <sub>2</sub> <sup>18</sup> O	312-303	1095.62877
HDO	211-202	599.92668
HDO	312-303	753.41112
CO	5-4	576.26772
CO	6-5	691.47307
CO	8-7	921.79972
C <sup>17</sup> O	7-6	786.28046
C <sup>18</sup> O	7-6	768.25142
C <sup>18</sup> O	10-9	1097.16269
<sup>13</sup> CO	7-6	771.18387

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