



# ***HYDROGEN IN NATURAL GAS WITH TDLAS***

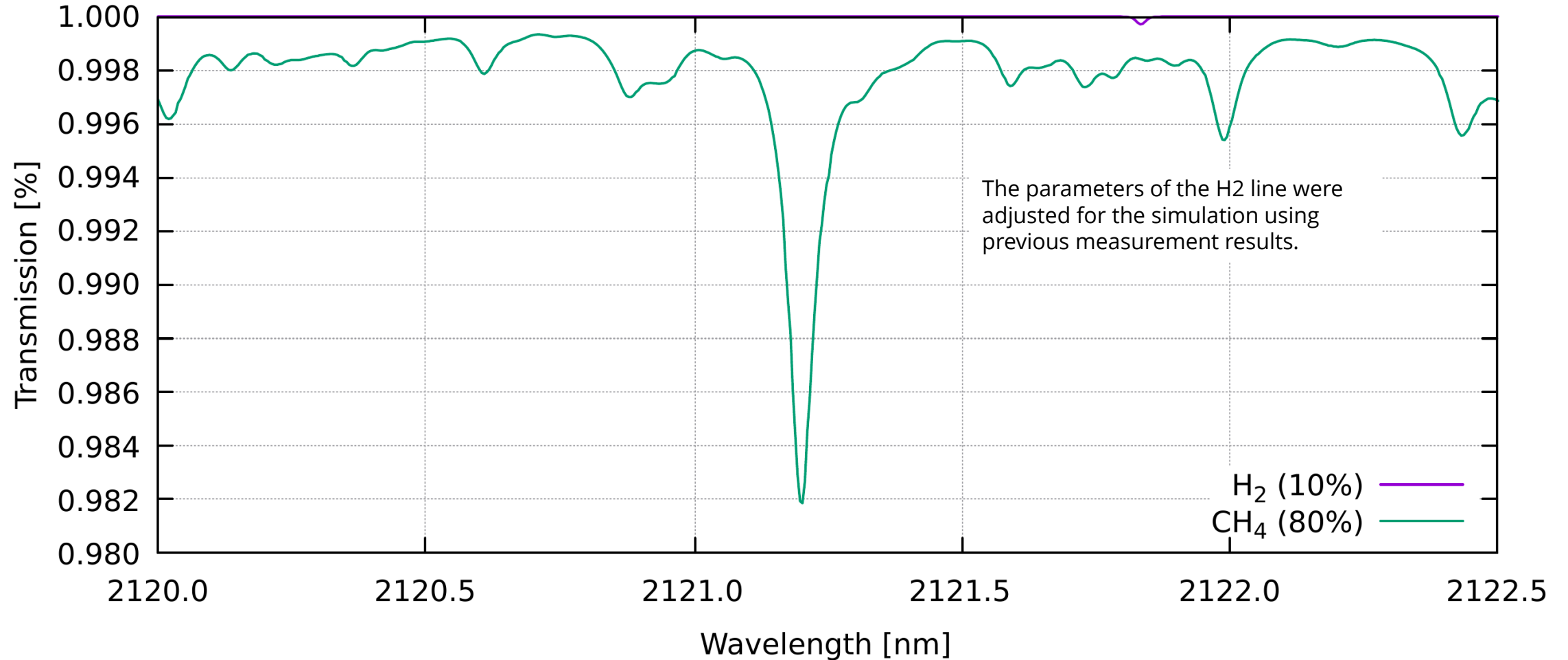
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# Application case: Hydrogen in Natural Gas

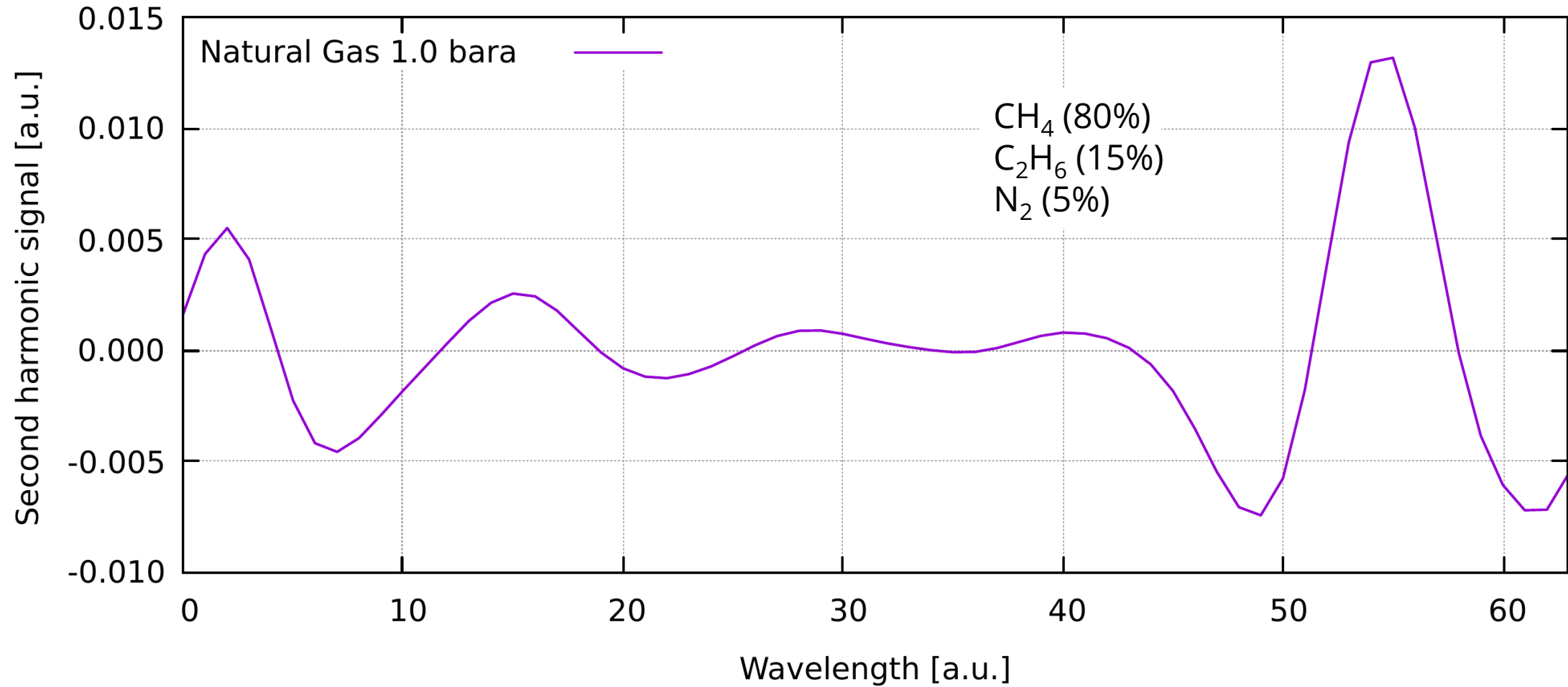
- H<sub>2</sub> is increasingly being used as fuel for vehicles, trains, ships, airplanes, and many other applications.
- Furthermore, blending H<sub>2</sub> with natural gas (NG) using existing pipeline networks is seen as a possible first step towards decarbonizing natural gas systems.
- Accurate metering is an important task when it comes to supplying energy to end users; the end user wants to know what energy content they are receiving, and the supplier wants to bill accordingly.

# Transmission simulation of H2 in CH4



Source: Gordon, I.E., Rothman, L.S., Hargreaves, R.J. et al., "The HITRAN2020 molecular spectroscopic database", Journal of Quantitative Spectroscopy and Radiative Transfer 277, 107949 (2022)

# Second harmonic spectrum of Natural Gas



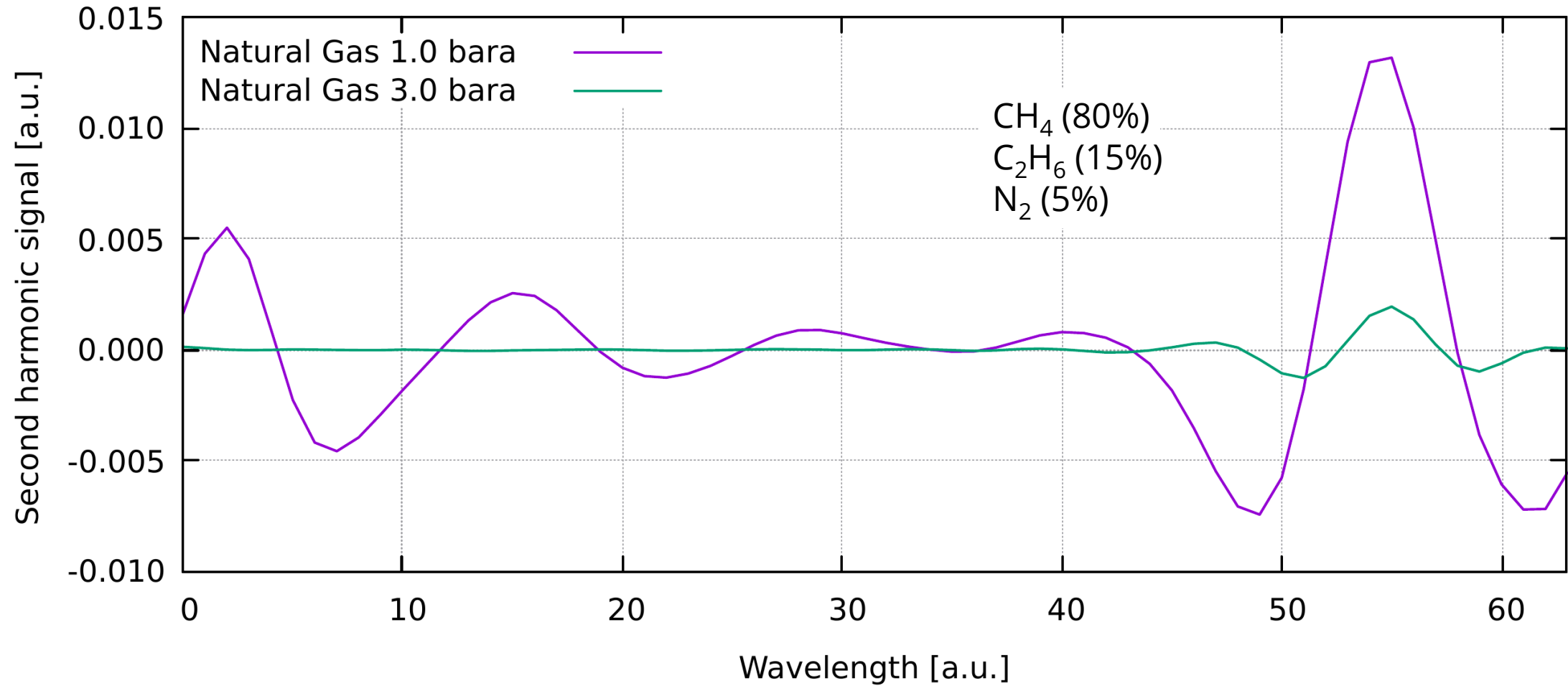
Extractive MP setup

# Remove interference

- The line widths of the molecular transitions of H<sub>2</sub> are about 5x narrower than those of the potentially interfering lines of CO<sub>2</sub>, CH<sub>4</sub>, and NH<sub>3</sub>.
- If the modulation amplitude and the software filter parameters are optimized for the narrow H<sub>2</sub> line, interfering signals from other gases can be suppressed by up to a factor of 7. See also *Avetisov et al (2019)*.
- For a further reduction of interfering signals of adjacent absorption lines, the fact can be used that the H<sub>2</sub> line width is much less pressure dependent than that of other gases, in particular that of hydrocarbons. See also *Avetisov et al (2019)*.
- By increasing the pressure in the multi-pass cell to around 3 bara (other pressures might be used as well), the background signal from natural gas can be suppressed very efficiently.

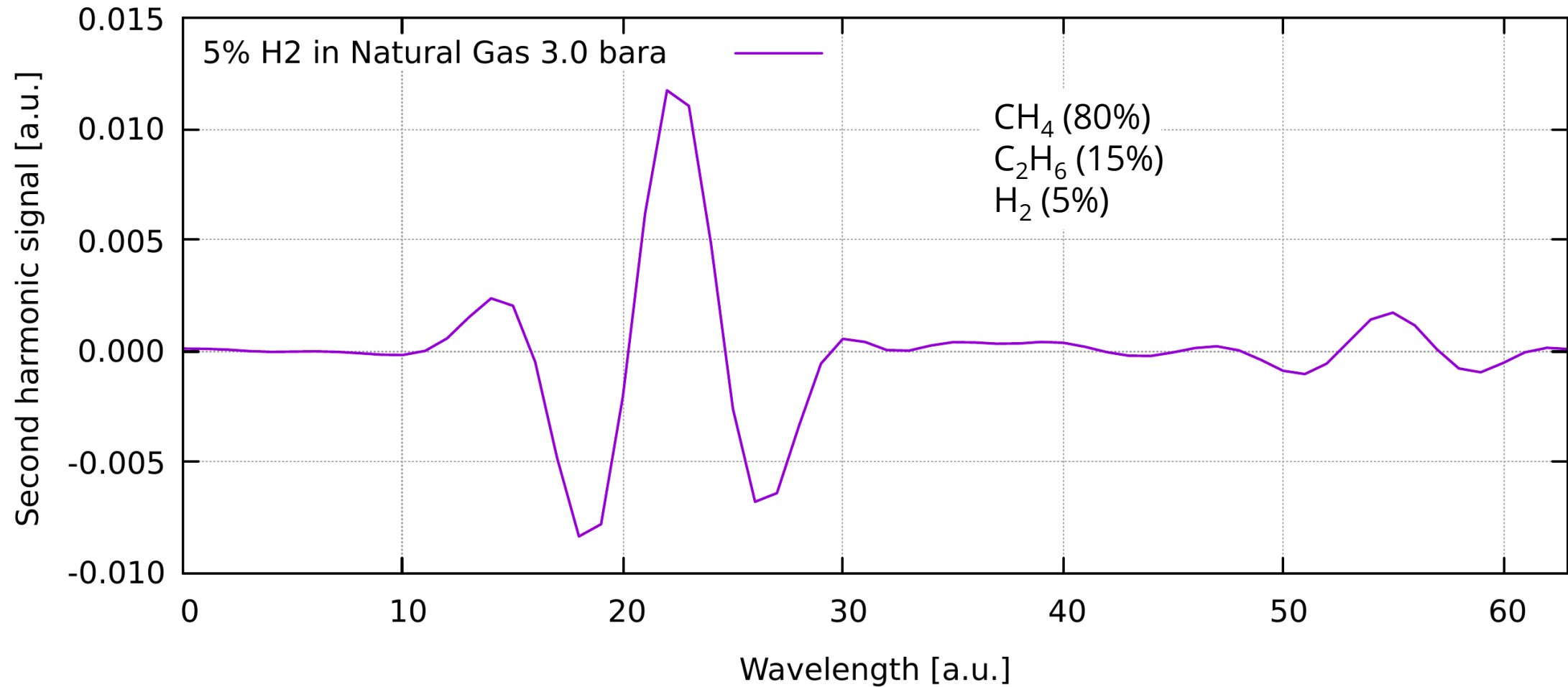
Source: Avetisov, V., Bjørøy, O., Wang, J., Geiser, P., Paulsen, K.G., "Hydrogen Sensor Based on Tunable Diode Laser Absorption Spectroscopy", *Sensors* 19, 5313 (2019)

# Second harmonic spectrum of Natural Gas



Extractive MP setup

# 2nd harmonic spectrum of Hydrogen in Natural Gas



Extractive MP setup

# Hydrogen in Natural Gas

