Motivation
- Photodissociation of simple molecules creates radicals in grain mantle ices:
  - Radical-radical addition reactions on grain surfaces efficiently form complex organic molecules (COMs):

\[
\begin{align*}
\text{CH}_3\text{OH} & \xrightarrow{\text{hv}} \text{CH}_2\text{OH} + \text{H} \\
 & \quad \rightarrow \text{CH}_2\text{O} + \text{H} \\
 & \quad \rightarrow \text{CH}_3 + \text{OH}
\end{align*}
\]
- Methanol photodissociation is a major source of organic radicals in interstellar ices
- Methanol photodissociation branching ratios are not well-known and need to be experimentally measured
- The effects of varying methanol photodissociation branching ratios need to be tested via astrochemical modeling

Laboratory Measurements of Methanol Photodissociation

Objective:
- Accurately determine gas-phase methanol photodissociation branching ratios

Experimental Approach:
- Methanol photodissociation is conducted using VUV plasma discharge lamps in the 120-200 nm wavelength range
- Products are stabilized using a supersonic expansion
- Methanol depletion and/or product formation is probed with direct absorption millimeter/submillimeter spectroscopy
- Depletion of methanol signal is quantified (Figure 2) and enhancement of photodissociation product signals are monitored
- A search is underway for the spectroscopic signatures of the product radicals

Results & Future Work
- Photodissociation branching ratios influence relative abundances of COMs in the ISM
- Branching ratios favoring CH$_2$O channel on grain surface gave best match to methyl formate observations
- Depletion of methanol signal is reproducible; vibrational excitation, temperature change are negligible
- Quantitative gas-phase measurements of branching ratios are underway; results will be incorporated into future models
- Wavelength dependence of photodissociation will be tested
- Modeling results will be compared to other molecular clouds

Table 1. Photodissociation branching ratios tested in model

<table>
<thead>
<tr>
<th>Designation</th>
<th>CH$_2$OH:CH$_3$O:CH$_3$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard$^1$</td>
<td>20:20:60</td>
</tr>
<tr>
<td>Öberg$^2$</td>
<td>73:15:12</td>
</tr>
<tr>
<td>Hydroxymethyl</td>
<td>90:5:5</td>
</tr>
<tr>
<td>Methoxy</td>
<td>5:90:5</td>
</tr>
<tr>
<td>Methyl</td>
<td>5:5:90</td>
</tr>
</tbody>
</table>

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