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Development and validation of a THERMAL Regulated AtMOspheric Simulation Chamber (THALAMOS)

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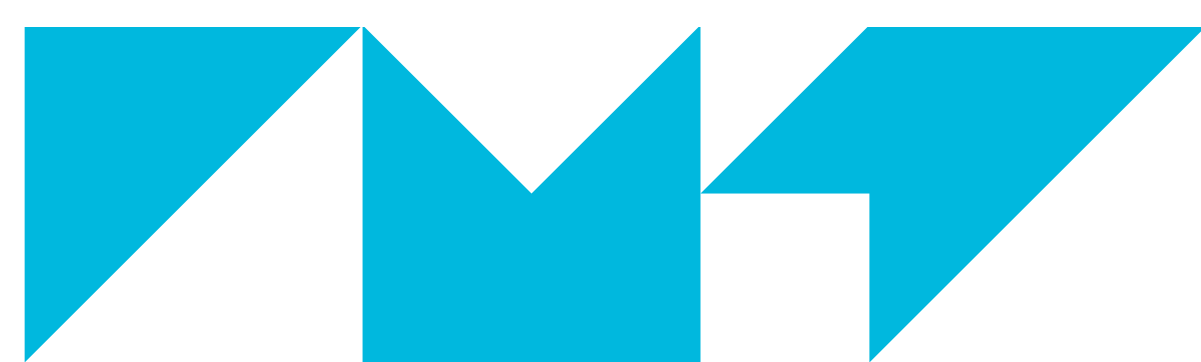
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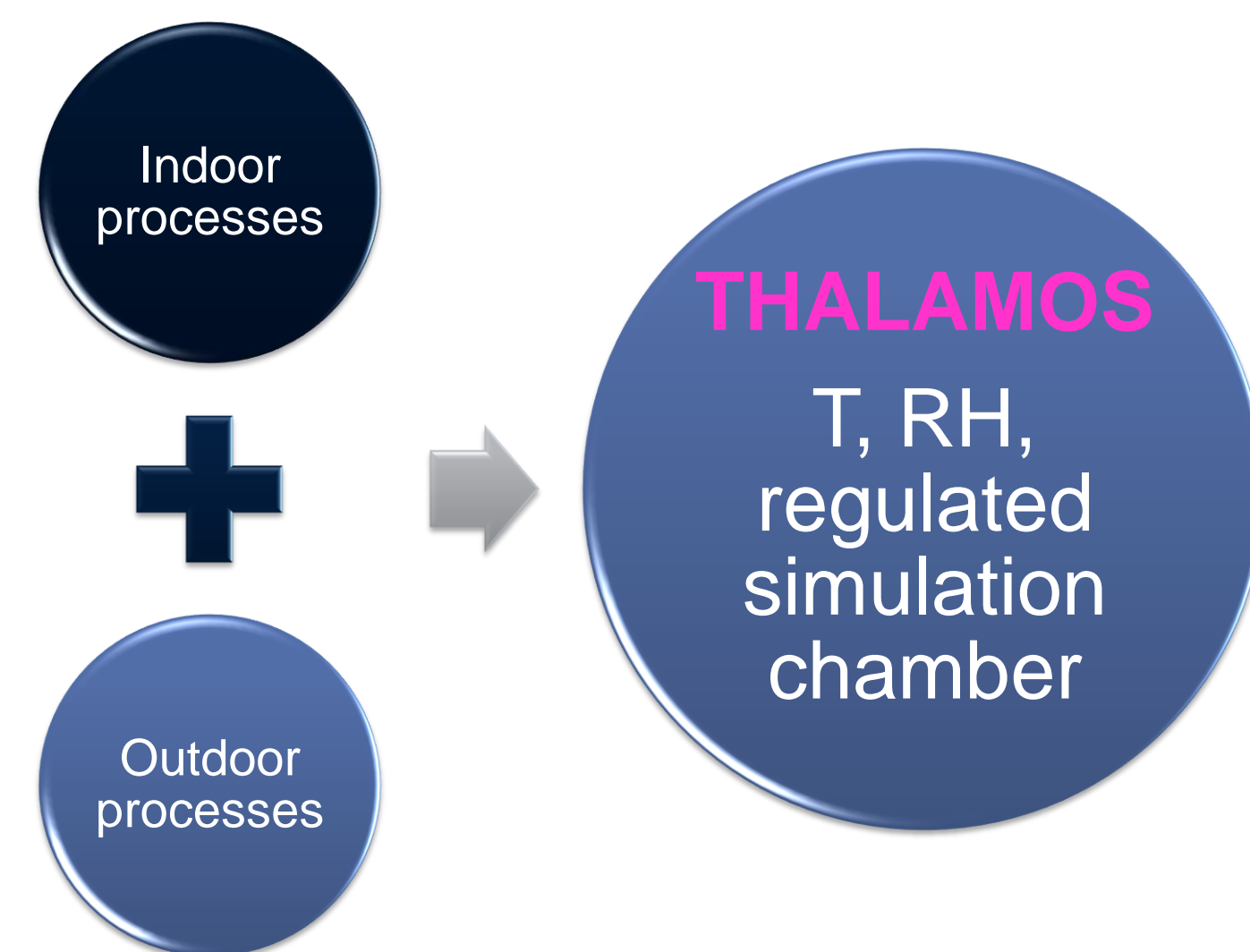
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Development and validation of a Thermal regulated Atmospheric Simulation Chamber (THALAMOS)

General Context - Objectives

Smog chambers, are unique tools for investigating crucial atmospheric processes in both gas and heterogeneous phase; they are supposed to provide a controlled, but realistic environment, aiming to simulate atmospheric conditions without any meteorological or emissive impact that occurs in real Atmosphere. Since environmental chambers first designing, back to the mid-1980s, several small- to large-scale facilities have been developed worldwide.

In the framework of the current study, a multi-purpose, medium size, Teflon atmospheric simulation chamber was designed and constructed, **THALAMOS (Thermal regulated Atmospheric simulation chamber)**, that can be operated in a wide temperature range (-40° to 100° C), at atmospheric pressure (760 Torr). THALAMOS is a unique experimental tool aiming to simulate both extreme outdoor and indoor processes and provide with both kinetic and mechanistic information with regard indoor and outdoor VOCs' Atmospheric degradation. To the best of our knowledge, **THALAMOS** is the first simulation chamber that can be operated in wide temperature range, at least in national level.

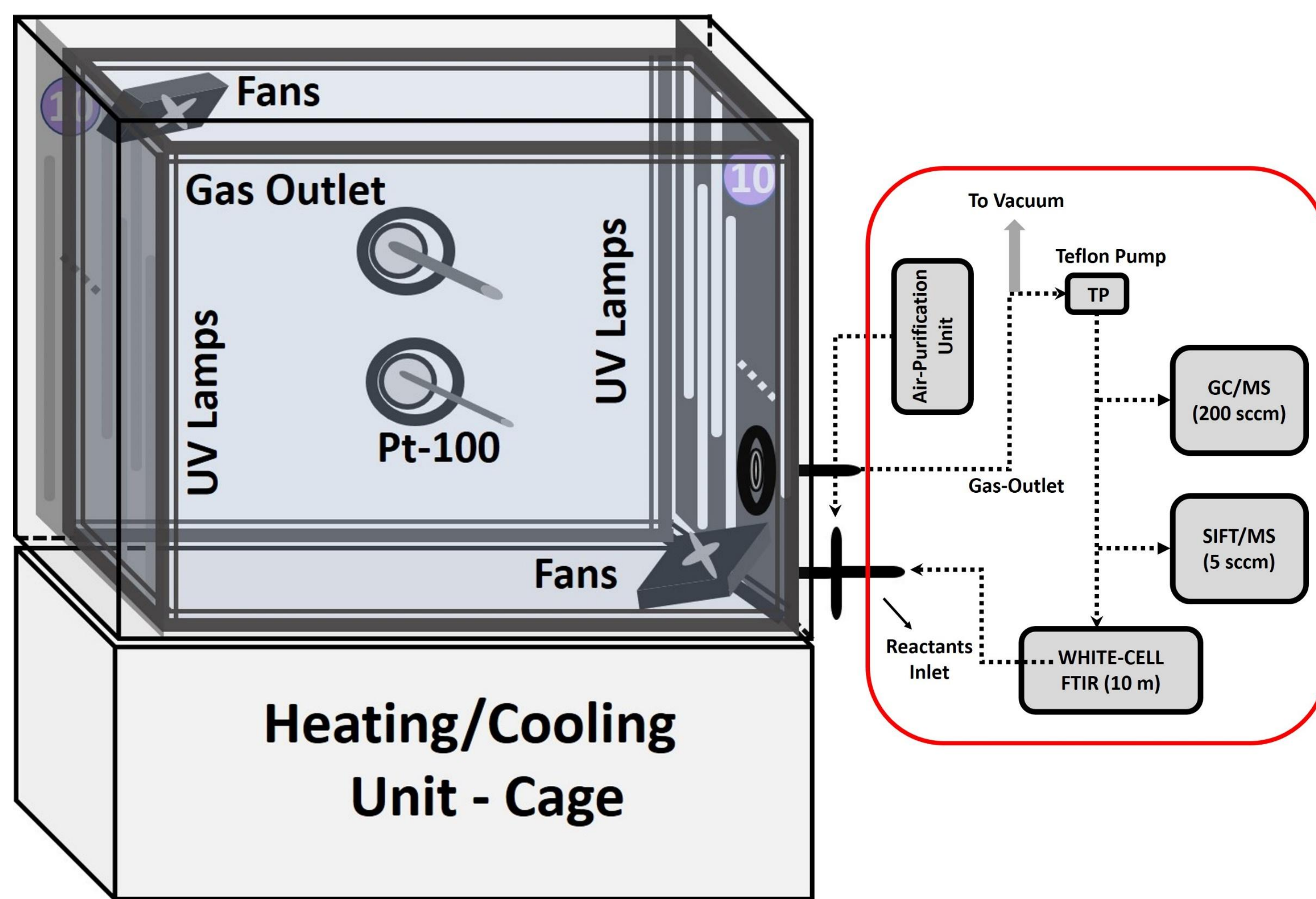


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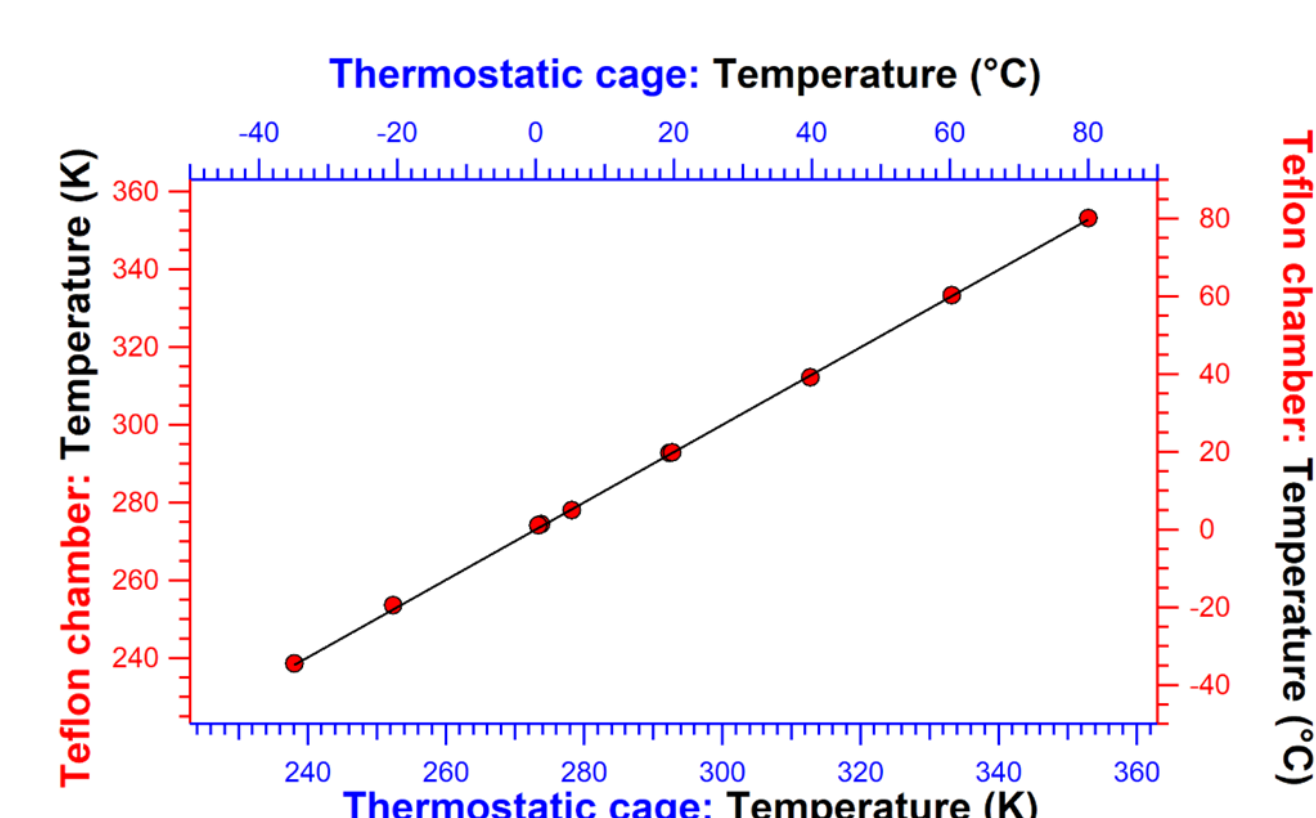
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THALAMOS: General Description



Parameters	Values
Volume	600 L (Titrated)
Temperature range	235 – 373 K
Light sources	<ul style="list-style-type: none"> 10 to 20 UV-A (Philips PL-L 24W/10/4P), λ_{max} 365nm 10 to 20 UV-C (OSRAM HNS-L 24W 2G11), $\lambda = 254$ nm
Mixing efficiency	< 1 min after reactants injection
Operational conditions	Static (dilution rate $< 10^{-7}$ s ⁻¹) or slow flow
Bath gas	<ul style="list-style-type: none"> Zero Air (RH ca. 2% at 293 K) Extra pure zero air (RH < 2ppm, CO, CO₂ < 80 ppb)

Temperature response



Acknowledgements



THALAMOS Validation

Strategy

Determine the rate coefficients of well documented reactions as a function of temperature

Relative rate method

$$\frac{d[S]}{dt} = -k_1 [S][X]$$

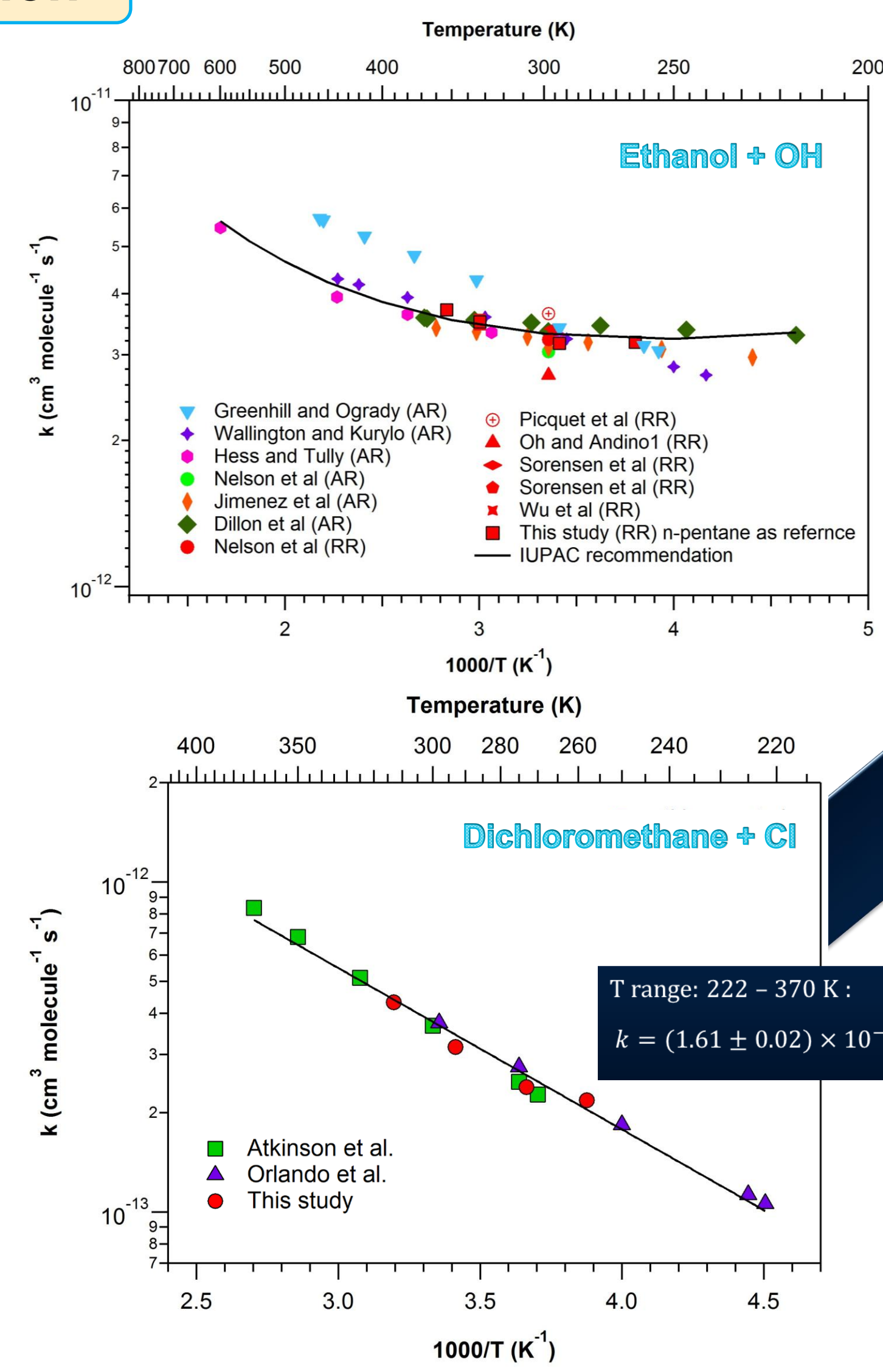
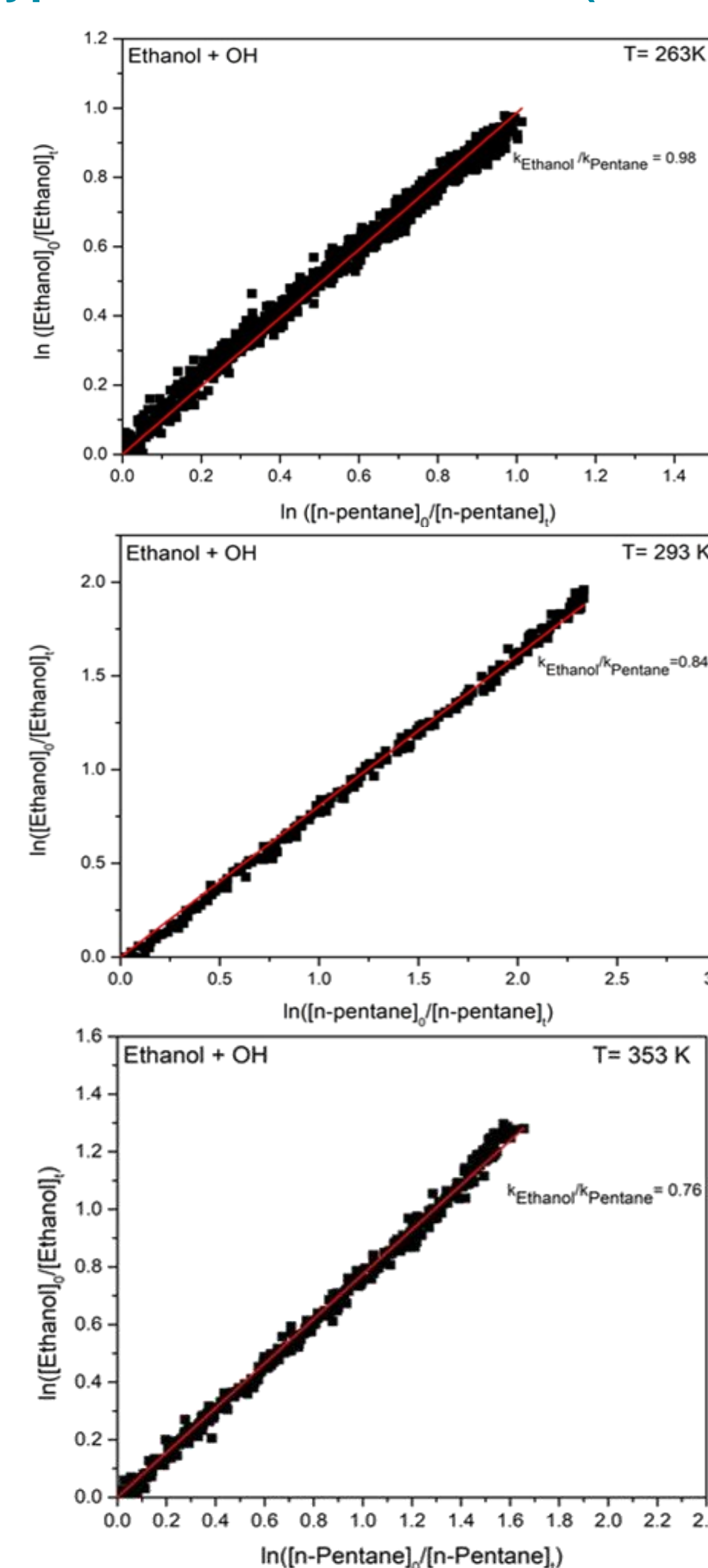
$$\frac{d[R]}{dt} = -k_{ref} [R][X]$$

$$\ln\left[\frac{[S]_0}{[S]_t}\right] = \frac{k_1}{k_{ref}} \ln\left[\frac{[R]_0}{[R]_t}\right]$$

OH kinetics
C₂H₅OH + OH → products
C₃H₁₂ + OH → products (reference)

Cl kinetics
CH₂Cl₂ + Cl → products
CH₄ + Cl → products (reference)

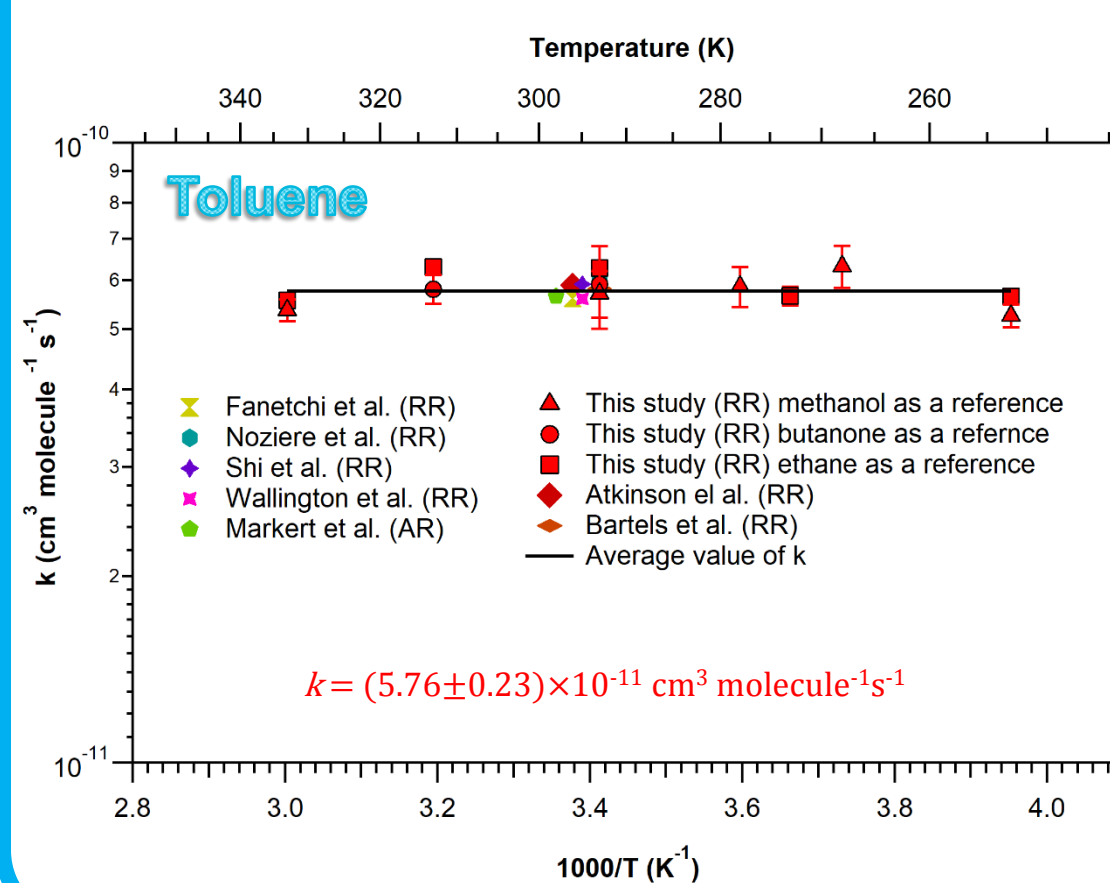
Typical RR Measurements (SIFT-MS)



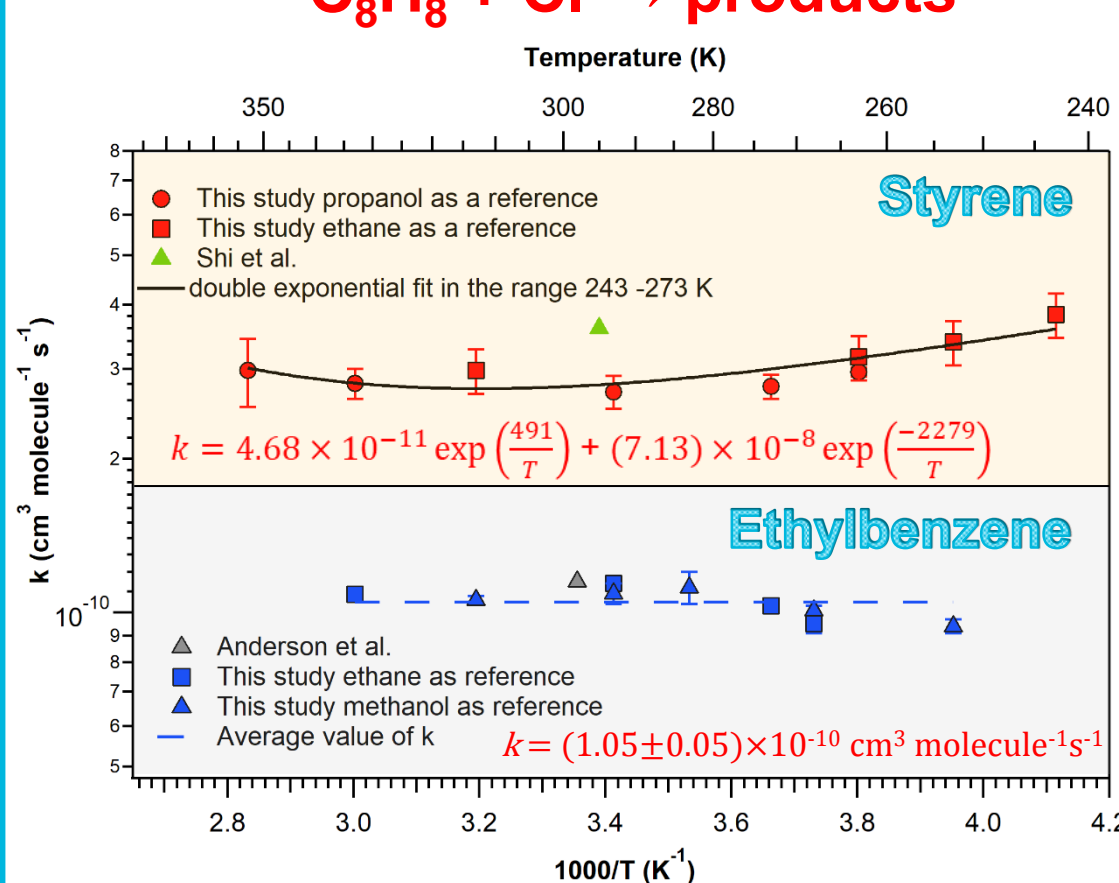
THALAMOS Validated

Cl Reactivity Towards Aromatic H/C

C₇H₈ + Cl → products



C₈H₁₀ + Cl → products C₈H₈ + Cl → products



Undergoing Research:

- > Cl Initiated Oxidation of Aromatic Hydrocarbons
- > Furan-based Biomass Burning Products Degradation via Reaction with the Major Atmospheric Oxidants: Kinetics and Mechanism
- > VOCs Reactivity Towards NO₃ Radicals as a Function of Temperature: Kinetics and Mechanism
- > SOA Formation as a Function of Temperature
- > Heterogeneous reactions of liquid/solid particles with atmospheric pollutants

Acknowledgements

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