

Sebastian Eisenhut

Faculty of Mechanical Science and Engineering // Institute of Power Engineering
Schaufler-Chair of Refrigeration, Cryogenics and Compressor Technology

C3Or4A-04

New design data for ortho-parahydrogen converters

CEC 2025, Reno // 2025/05/21

SPONSORED BY THE



Federal Ministry
of Education
and Research

Contents

1. Motivation
2. Measurement setup
3. Results
4. Conclusion



[MolecularProducts]

Sizing of ortho-para converters – (still) a gamble

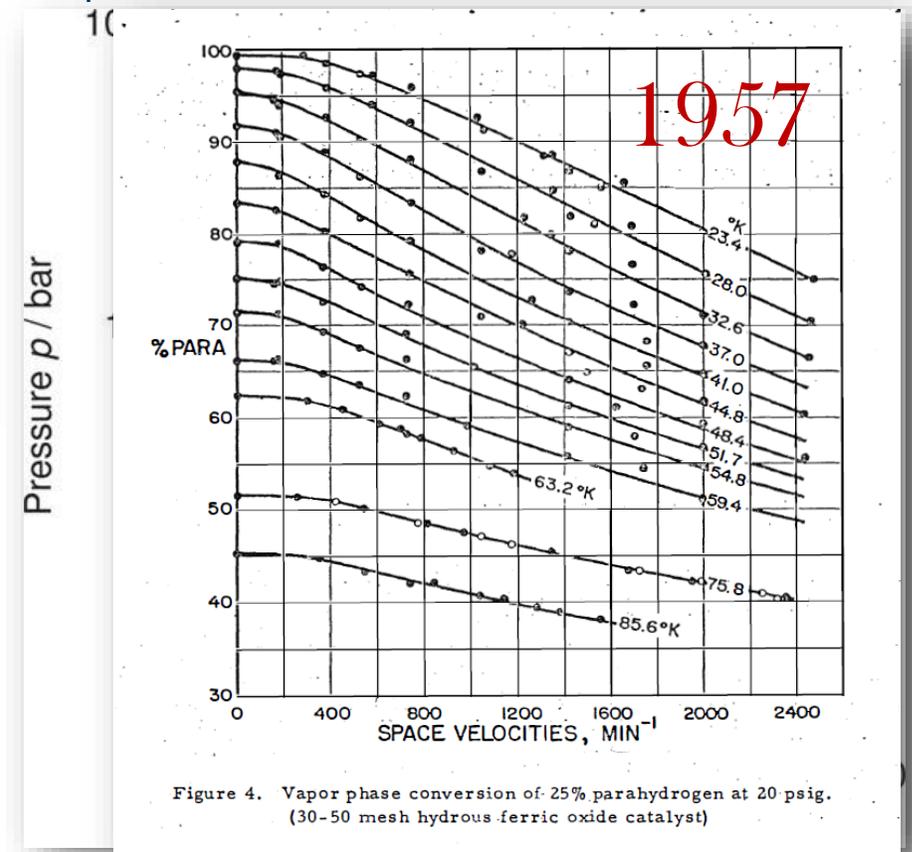
Correct **sizing of the ortho-para converter is essential** for the overall plant

- **Efficiency & cost**
- Technical & financial **risks**

BUT: Data on activity of the catalyst *totally insufficient*

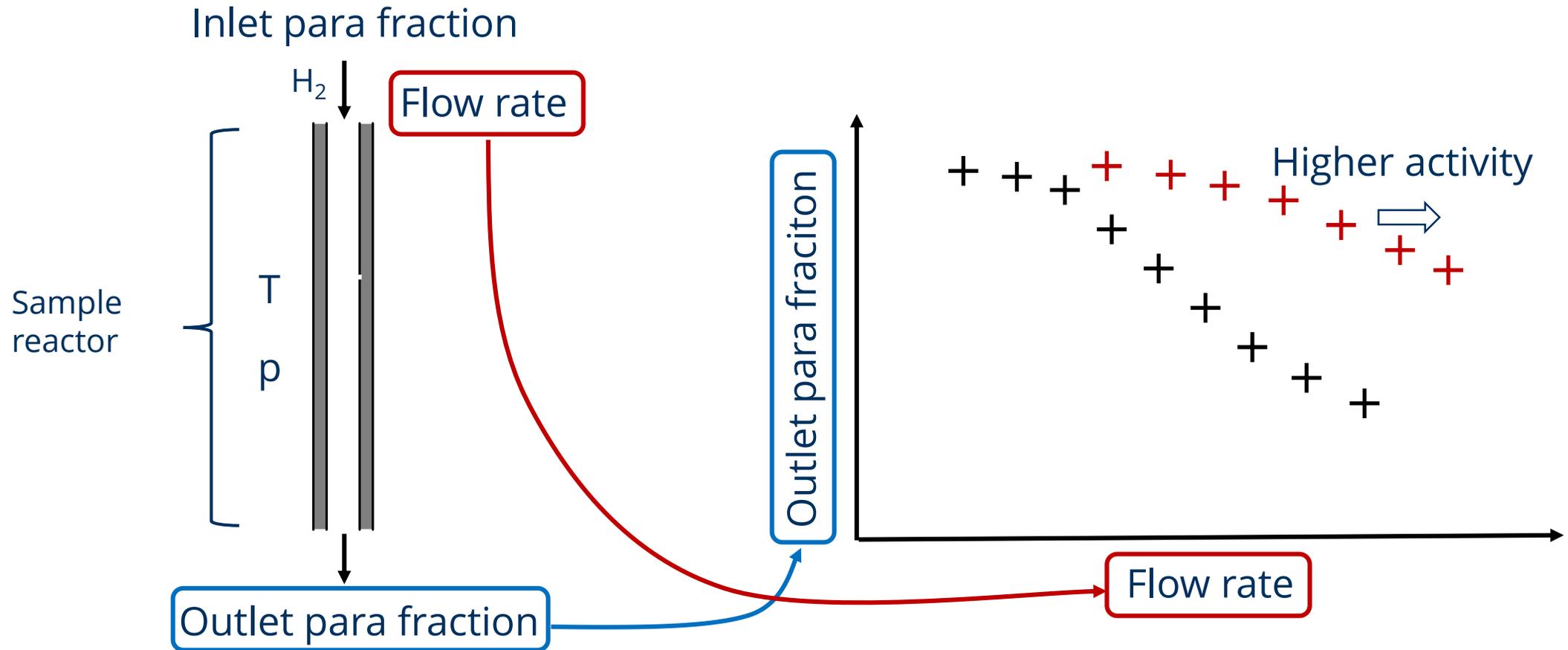
- **Rather old** (from 50s and 60s)
- **Inconsistencies**
- **Operating range** of modern converters **only partly covered**

There is an **urgent need for new design data** for ortho-para converters.

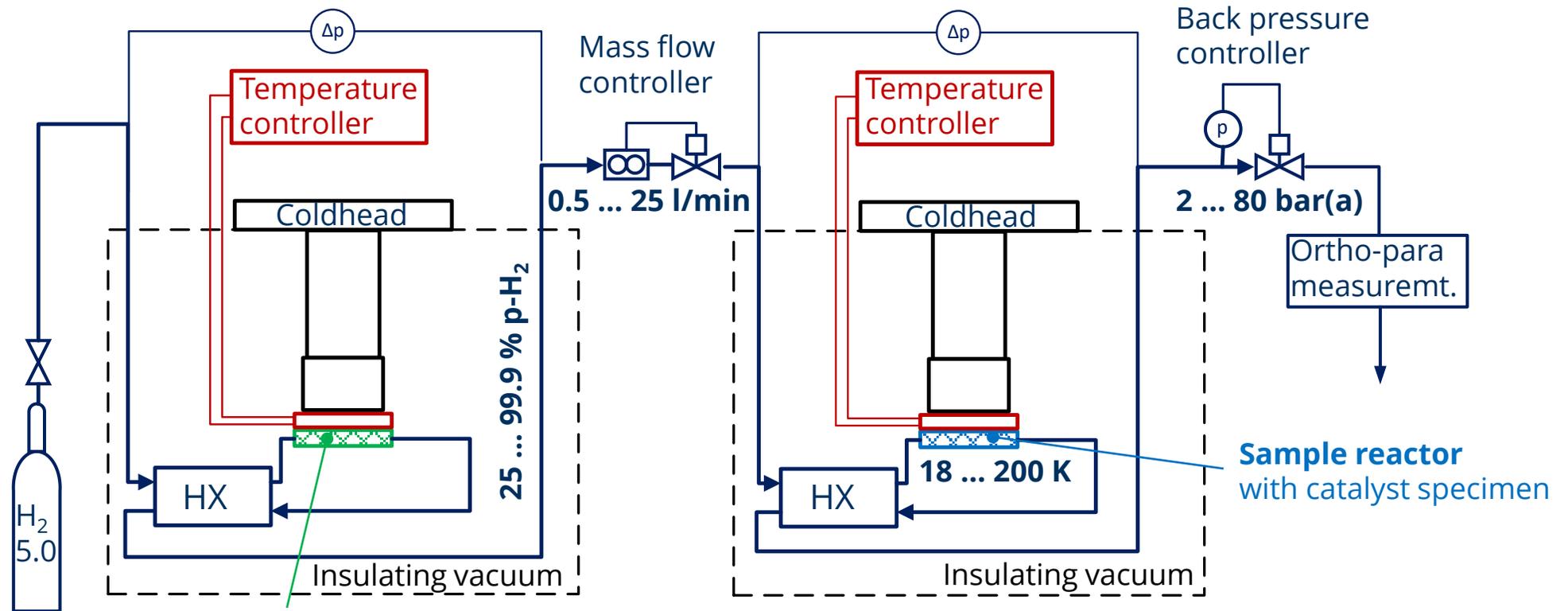


[Donaubauer 2019]
[Weitzel 1957]

Measurands



(Much) simplified P&ID



Preconverter

OPPC – Ortho-Para Precision Converter

CTC – Catalyst Test Cryostat



lonex campaign – an overview

28 measurement runs (22 short runs, 6 long runs)
1001 data points taken

... of which

2 long runs (**266** data points) were discarded
due to hydrogen purity issues

~7 min per data point (gas phase conversion)

~25 min per data point (liquid phase conversion)

Activation study

Key questions

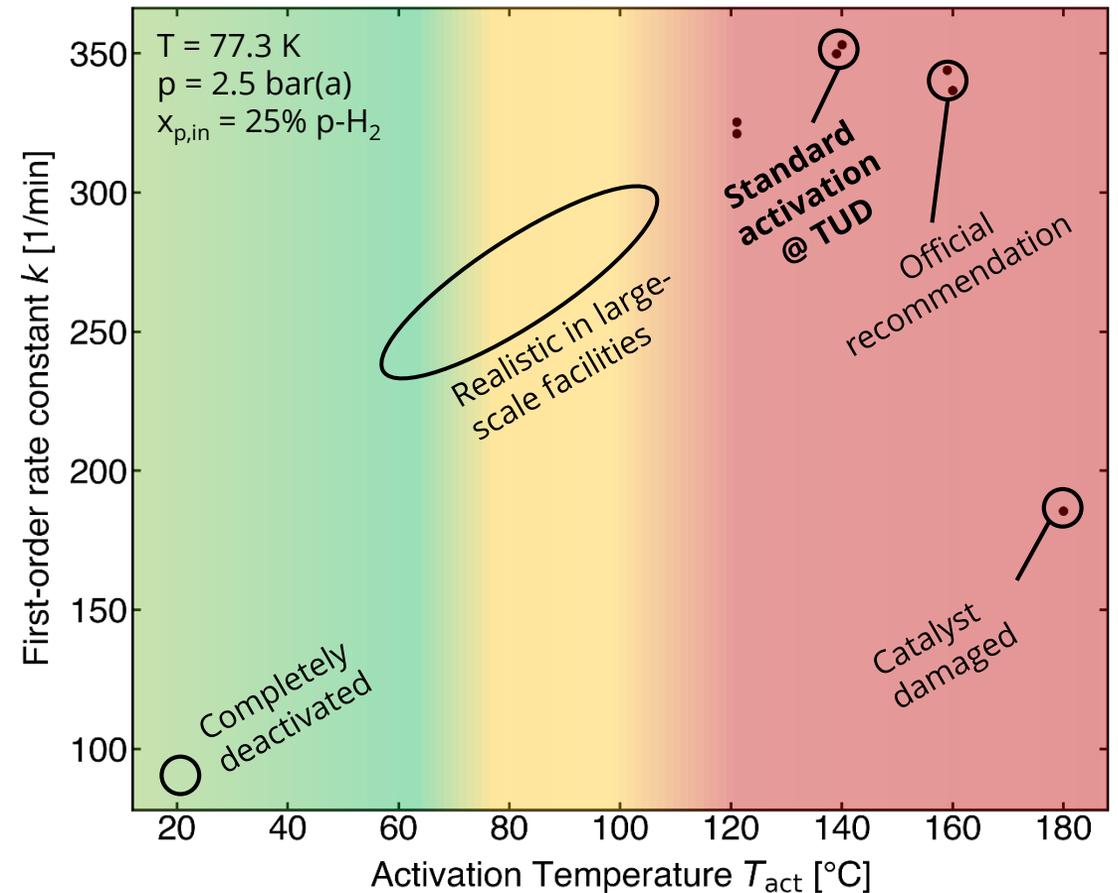
- **Optimal** activation for **maximum** activity?
- **140°C, 16 h, low H₂ flow**
- **Realistic** activation for **industry** applications?
- **100°C yields ~80% of max. activity**

Further findings

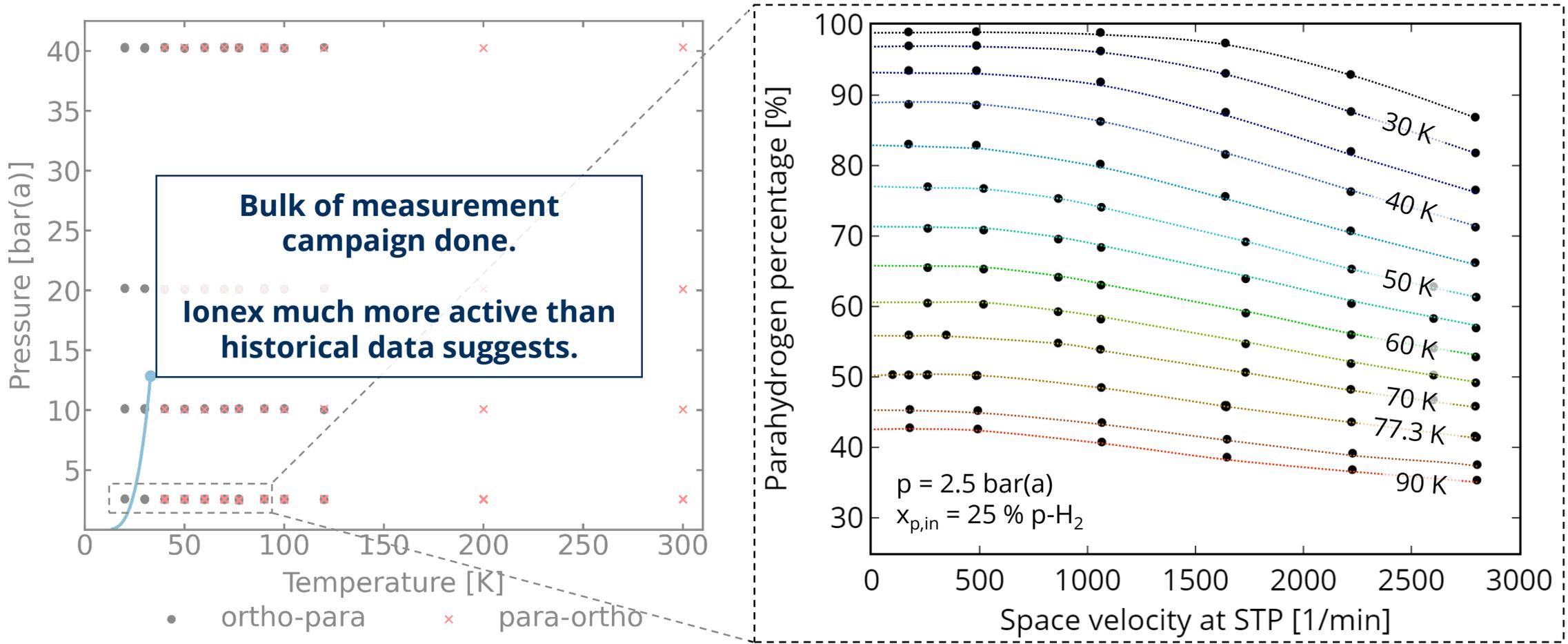
- **16 h is sufficient** (at least for short cat. beds)
- **Gas flow is key** to remove impurities
- Reduction of pressure / evacuation:
helps with activation but is not realistic

Standard activation for kinetic measurements:
140 °C, 16 h, 1.5 bar(a), low H₂ flow

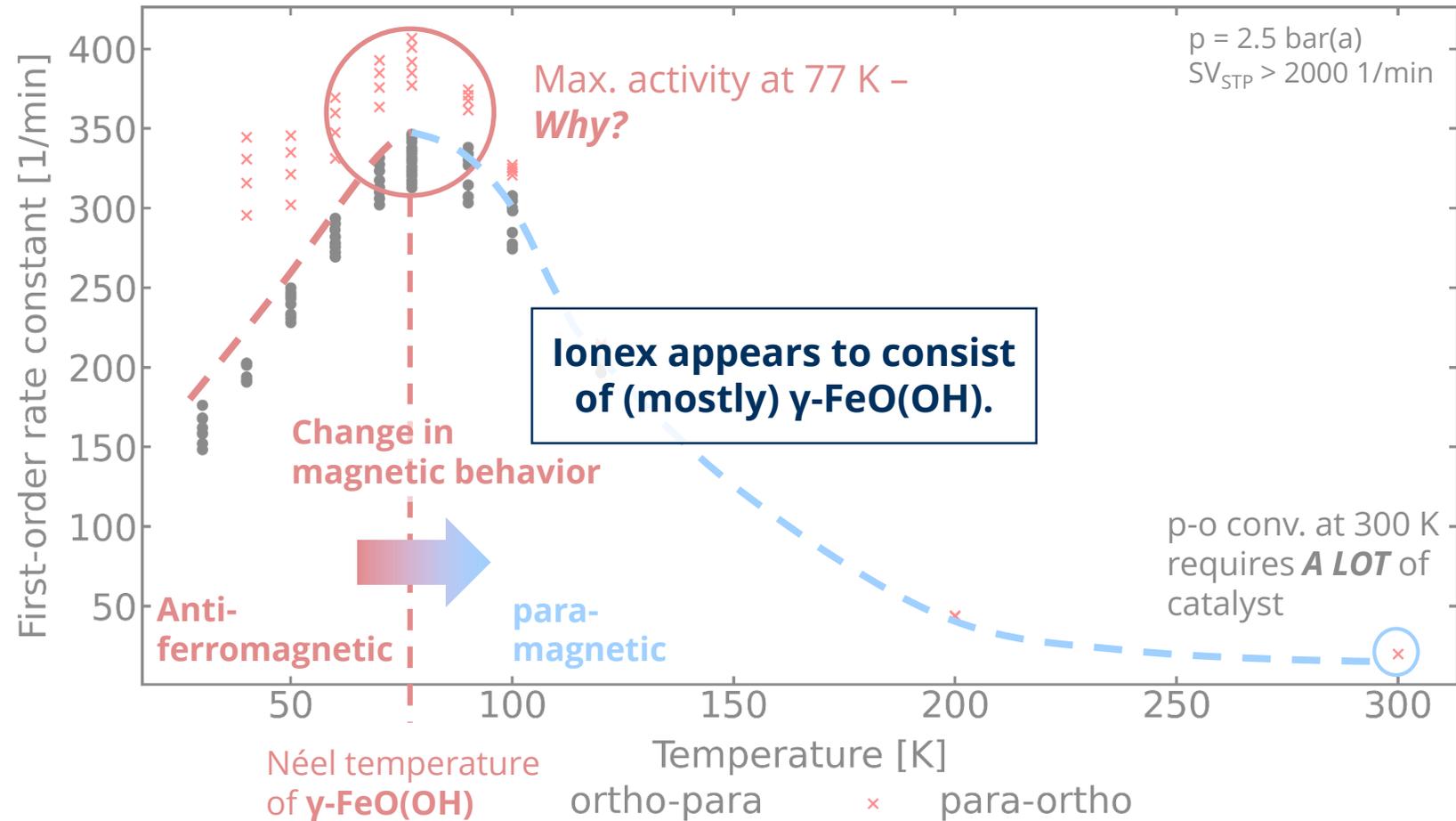
Samples exposed to air prior to activation
Activation: 16 h, low H₂ flow, 1.5 bar(a)



Measurement campaign: Kinetic data



Temperature-dependency of activity



Conclusion

New design data for ortho-para converters to be published soon.

- **Comprehensive set of new data for Ionex available**
- **Ionex much more active** than historical data suggests
- Optimal and realistic **activation procedures** found
- **Loss of activity** at higher temperatures likely due to **magnetic phase change**

Next steps

- Some detail measurements on mass and heat transfer limitations
- Final kinetic modelling