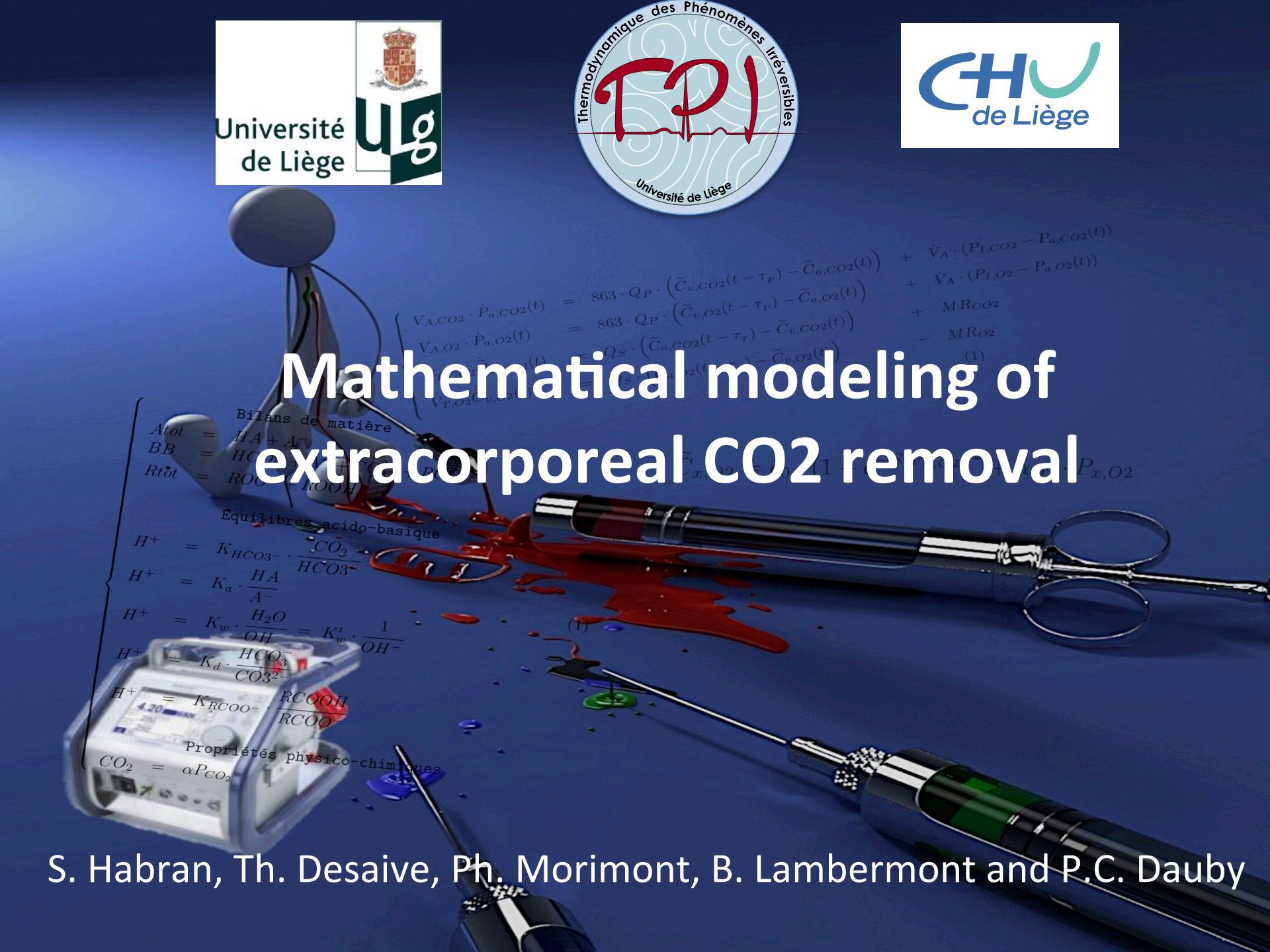
Université de Liège
Thermodynamique des Phénomènes Irréversibles
TPI
Université de Liège
CHU de Liège
Mathematical modeling of extracorporeal CO2 removal
S. Habran, Th. Desaive, Ph. Morimont, B. Lambermont and P.C. Dauby

# Introduction

*Pulmonary insufficiency*

*Intensive care unit*

- Severe pulmonary diseases
  - Ventilator
  - ECLS
- Protective ventilation
  - High FIO2
  - High respiratory frequency
  - Low tidal volume

  ⇒ High $pCO_2$

  ⇒ blood acidosis

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  - High FIO2
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  - Low tidal volume
  - ⇒ High $pCO_2$
  - ⇒ blood acidosis
- $ECCO_2R$ = vv-ECLS with low blood flow
- $ECCO_2R$ => $pCO_2$ decrease

- The goal: decrease the $pCO_2$ rapidely with small canula

⇒ **Find an optimal blood flow across the device**

# Introduction

*Pulmonary insufficiency*

*Intensive care unit*

**Recovery**

- Severe pulmonary diseases
  - Ventilator
  - ECLS
- Protective ventilation
  - High FIO2
  - High respiratory frequency
  - Low tidal volume

  ⇒ High $pCO_2$

  ⇒ blood acid

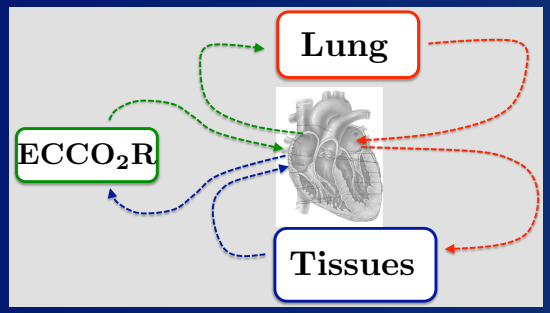
$ECCO_2R$ = w blood flow

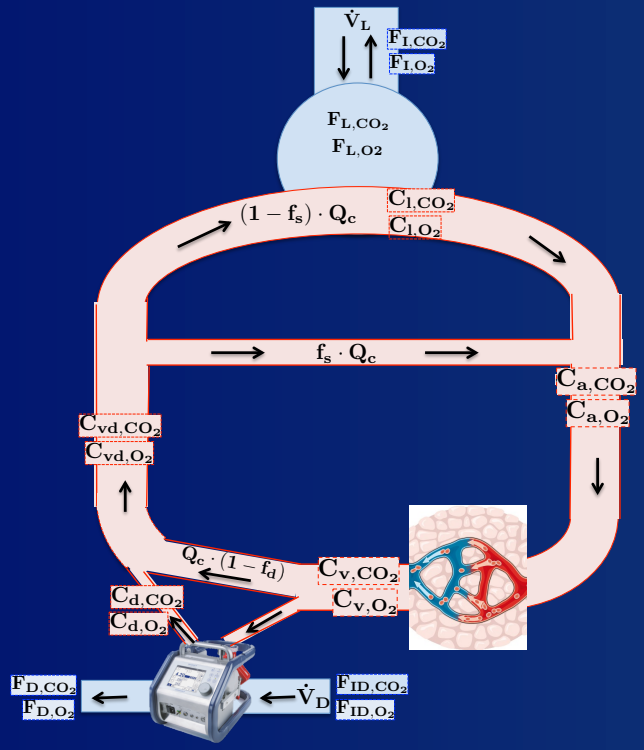
$ECCO_2R$ => e

The go $CO_2$ rapidely with small canula

⇒ **Find an optimal blood flow across the device**

# Methods




- Lumped parameters model with 3 compartments
  - Lung
  - Tissues
  - $ECCO_2R$ device

- The mathematical model considers
  - Pulmonary shunt
  - Equilibrium between alveoli and pulmonary capillaries

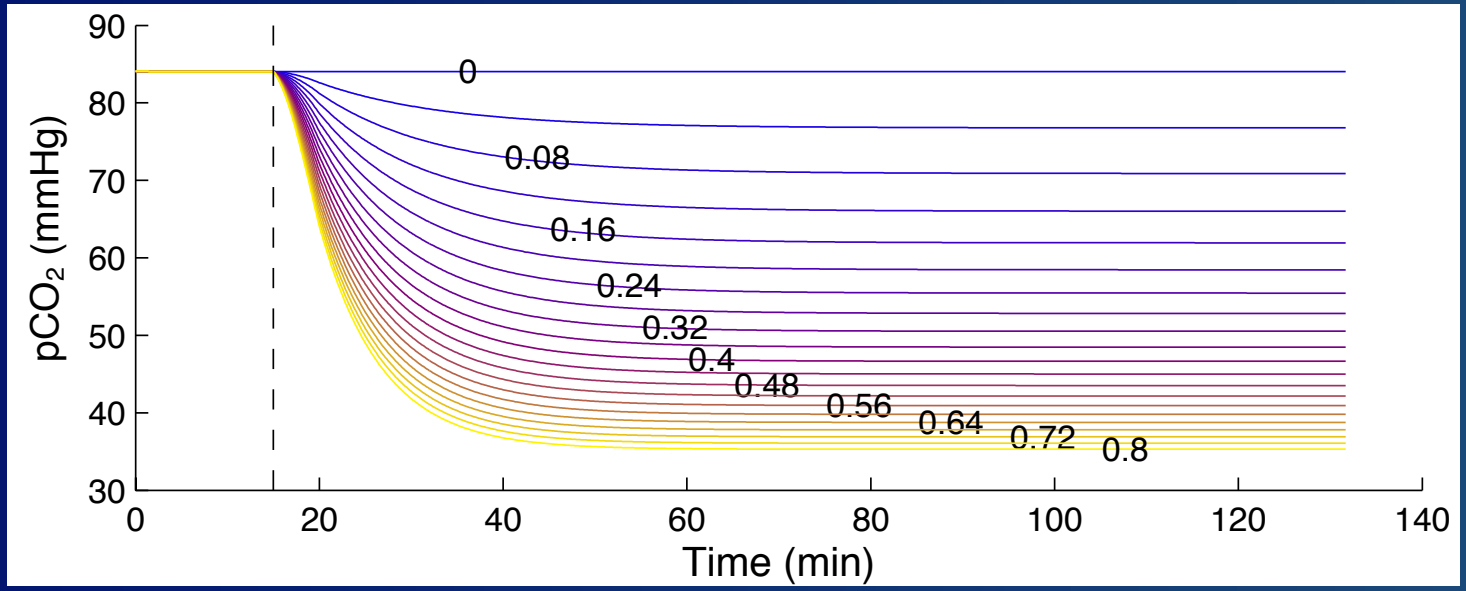
- Validation = predictions of the model vs experimental data.

- Data:
  - Weight
  - Cardiac output
  - Tidal volume
  - Respiratory frequency
  - Arterial and venous blood samples

=>The mathematical simulation is specific to the subject

# Results

- Blood flow sensibility

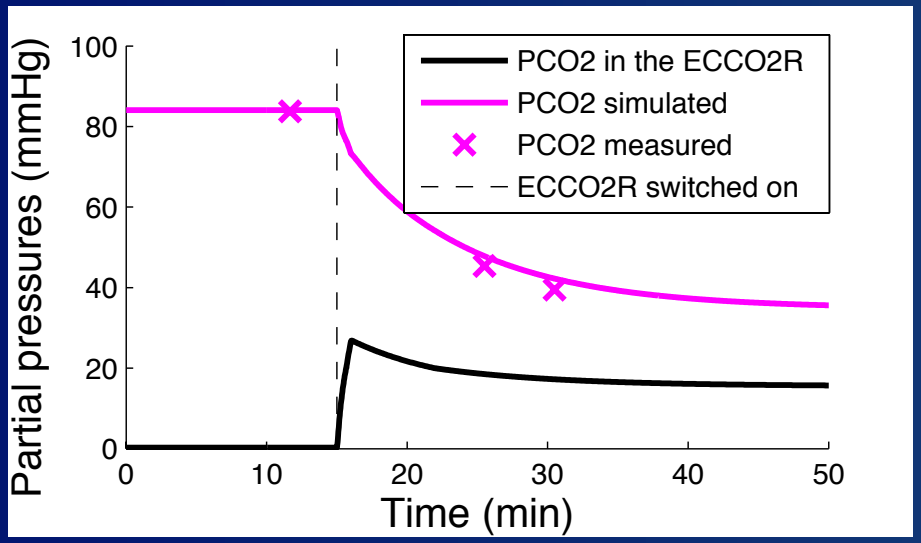


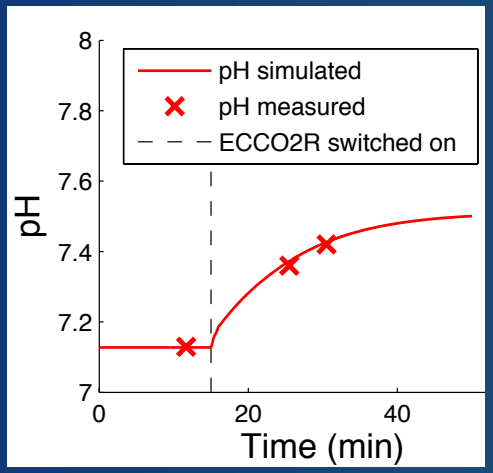

- Decrease is faster for large values of the flow
- 0.6 l/min seems to be a good compromise.
- First step towards an **optimized clinical use of $ECCO_2R$.**

Thank you for your attention
My poster will be shown in gold room SaBPoT4.8
on Saturday morning at 10:00-11:30

# Additional results

- Validation




- Good agreements between the experimental and calculated time evolution of $pCO_2$ and pH in arteries