LABORATORY FOR TESTS OF SUPERSONIC GAS SEPARATOR TECHNOLOGIES - INFRASTRUCTURE

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cleaner energy for a sustainable future

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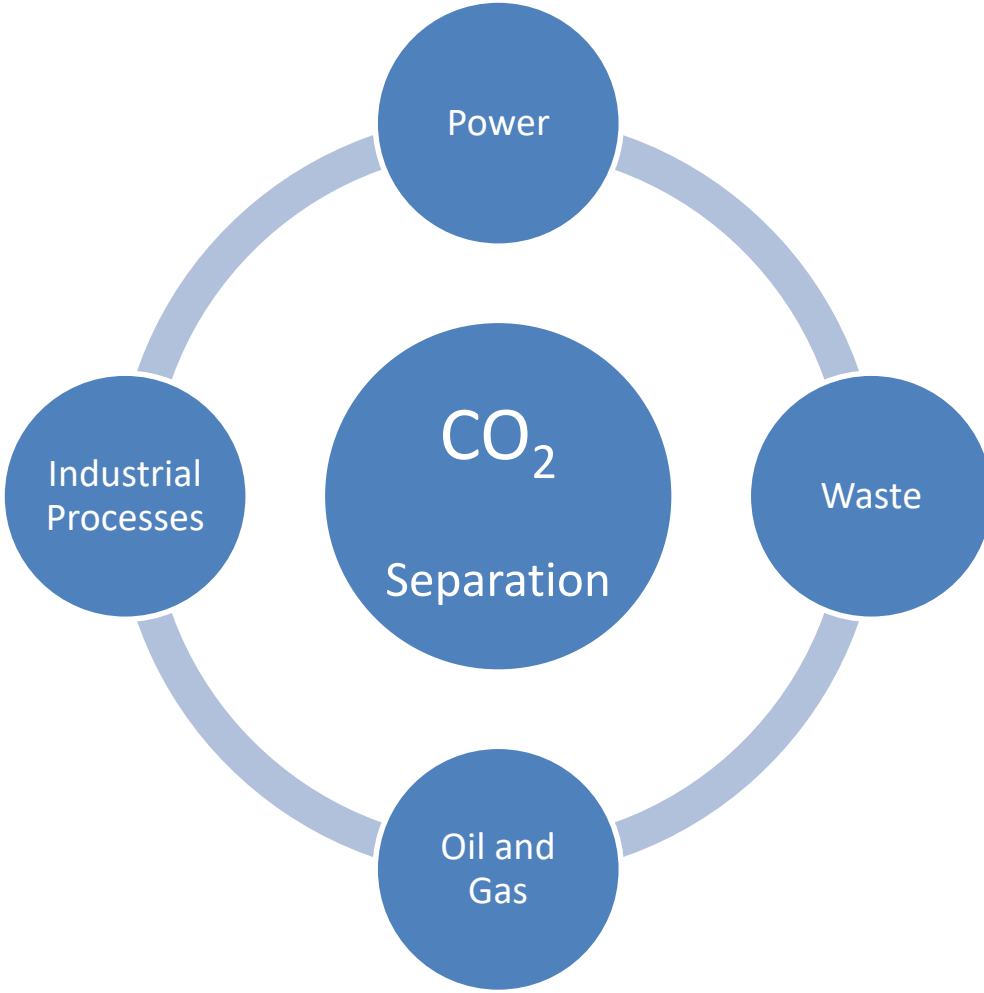
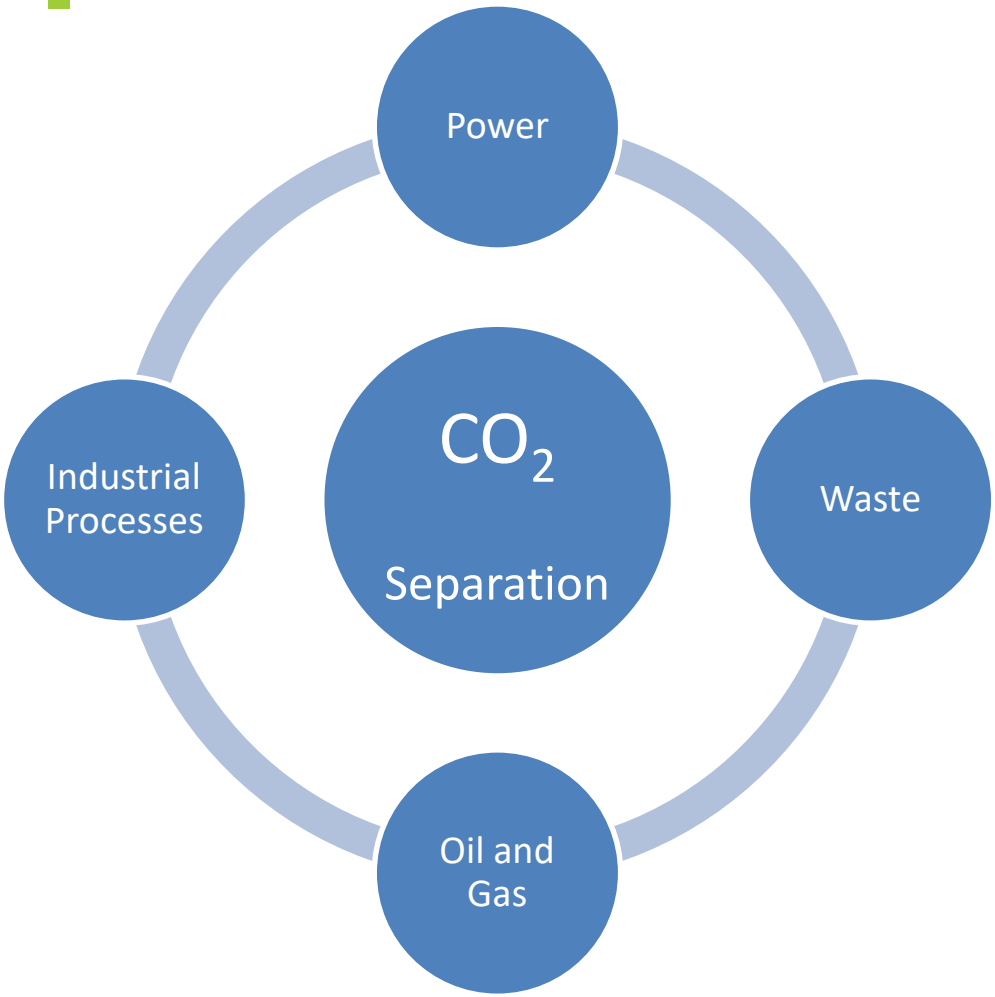
Carbon dioxide separation

Carbon dioxide is present in many processes. Environmental regulations demand each time less release into atmosphere.

Conventional separation processes are costly. An effective way of carbon dioxide separation is based on the supersonic process, which is the main goal of this research.



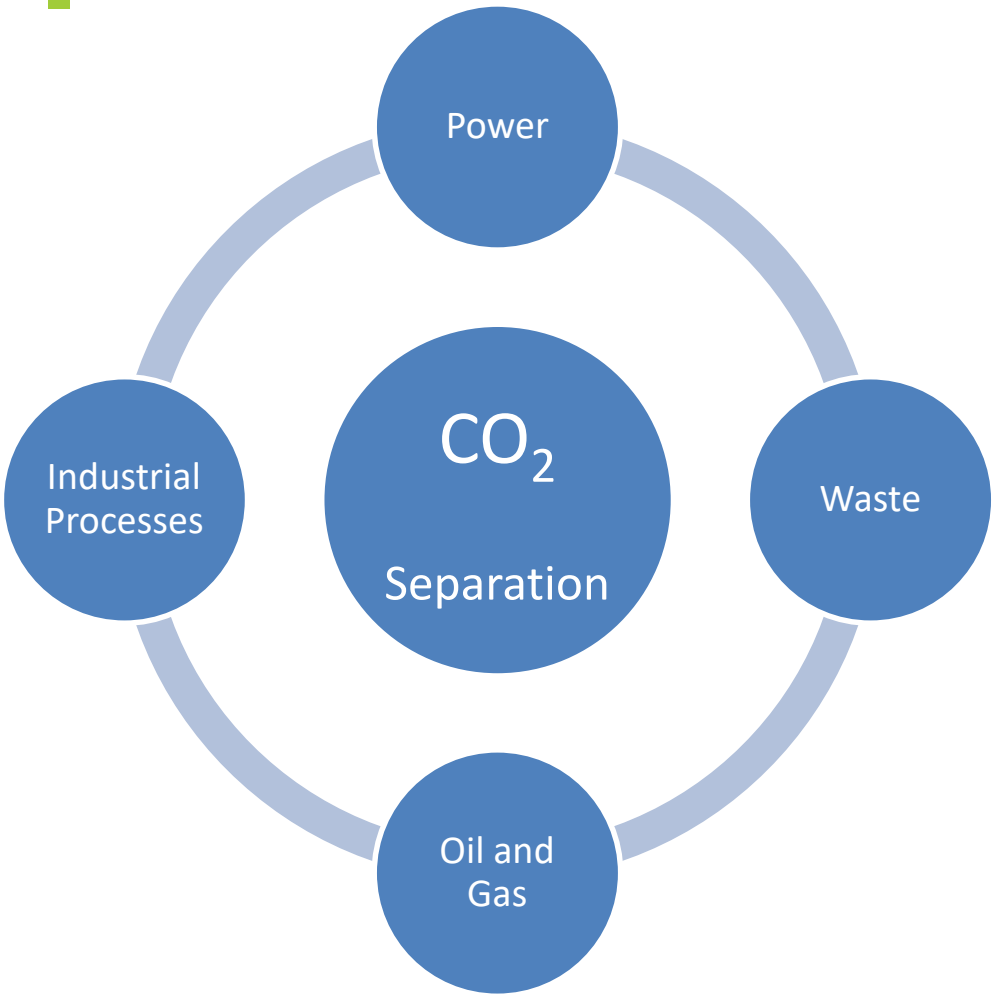
Carbon dioxide separation



Supersonic gas separation

- No moving parts.
- No energy consumption.
- High recovery ratio even for high CO_2 concentration.

Carbon dioxide separation

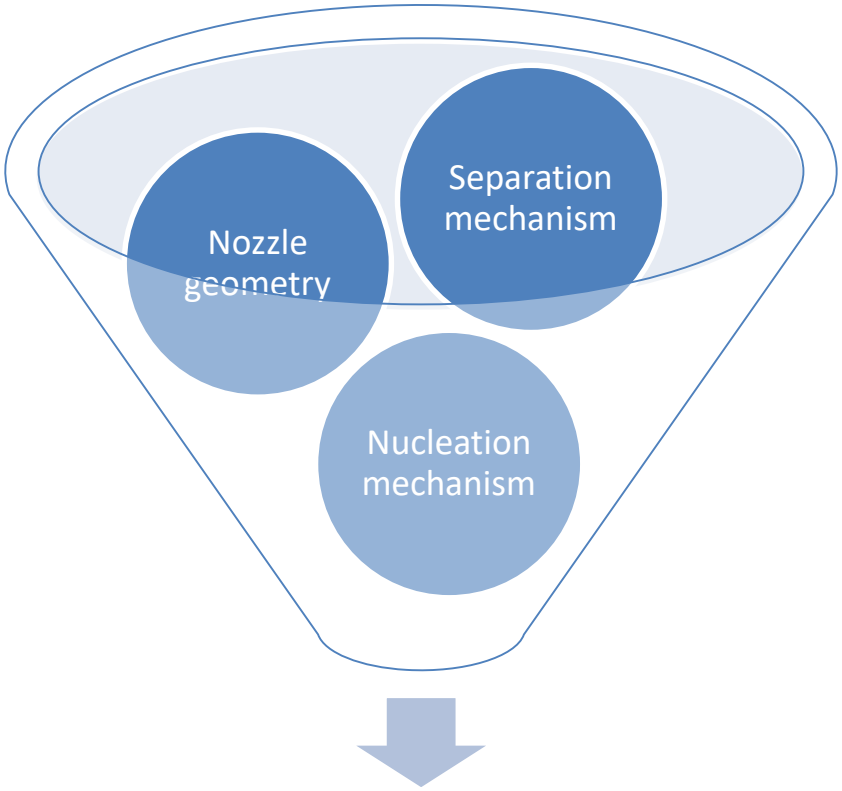


Supersonic gas separation

- No moving parts.
- No energy consumption.
- High recovery ratio even for high CO_2 concentration.

- CCS (Carbon, capture, and storage).
- Carbon dioxide recycling.

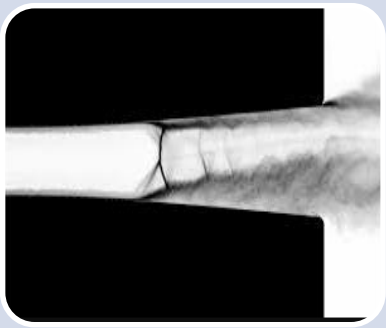
Goal

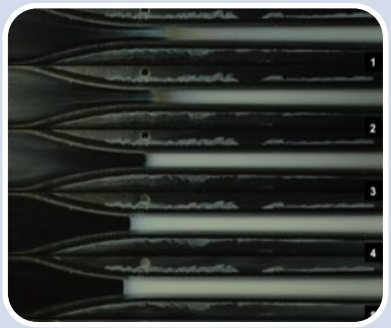


Optimized supersonic separators

Why experimental evaluation?

$$\frac{\partial \rho_i}{\partial t} + \nabla \cdot \rho_i \mathbf{v} = -\nabla \cdot \mathbf{j}_i$$





Compressible Flow

- Real Gas
- Multi species

Shockwaves

-Normal

- Oblique

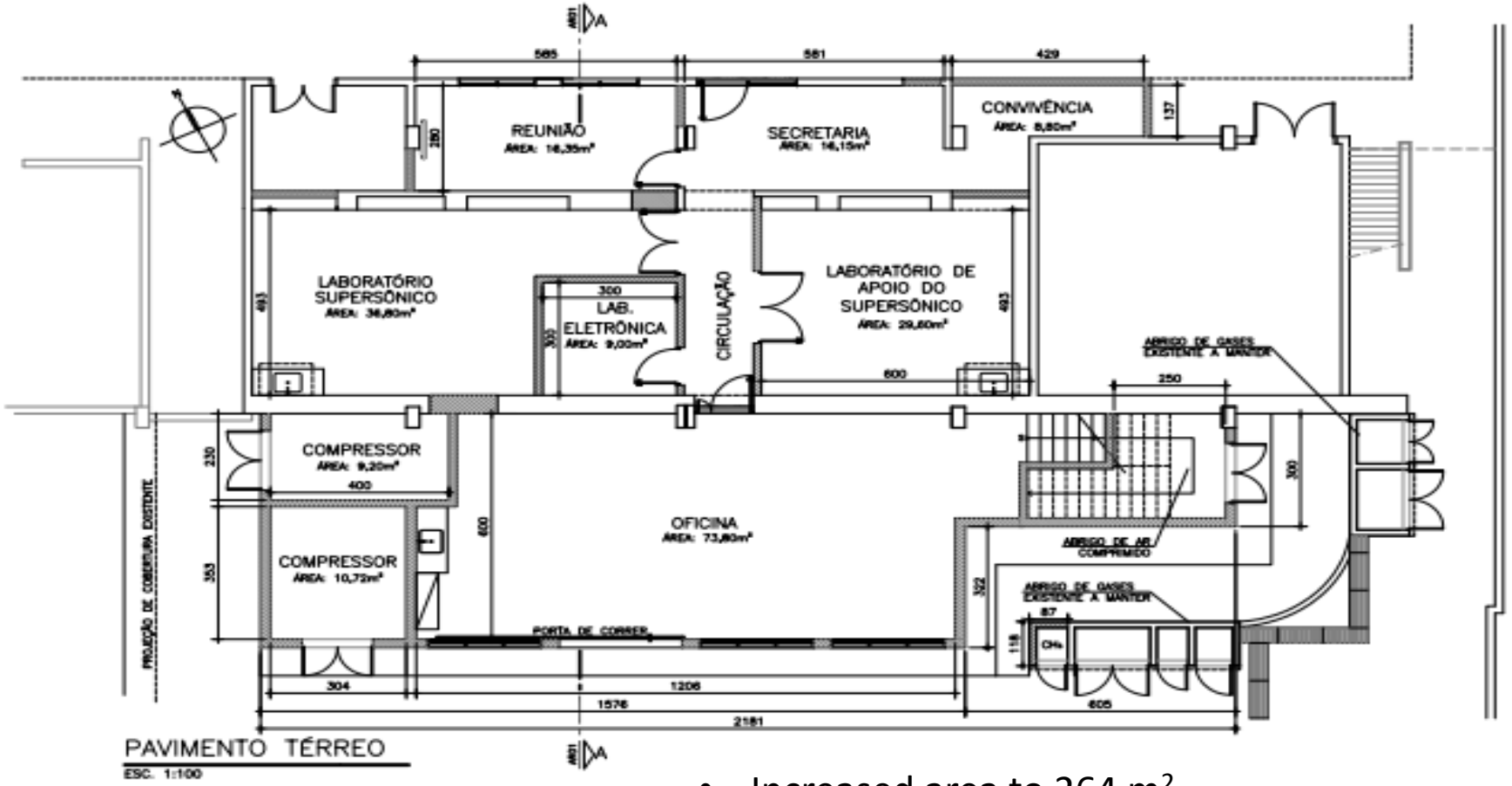
Phase change

-Homogeneous and heterogonous nucleation

Multiphase Flow

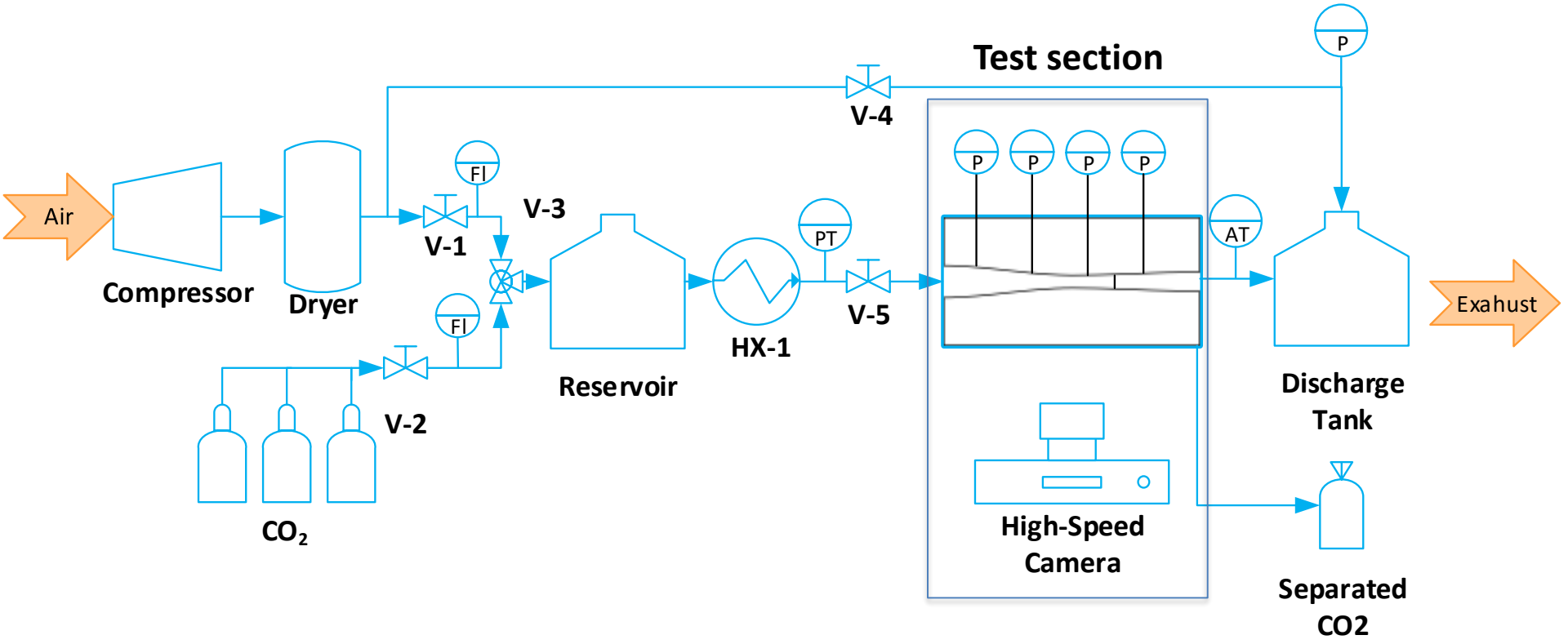
-Swirled flow

Infraestructure Supersonic lab expansion

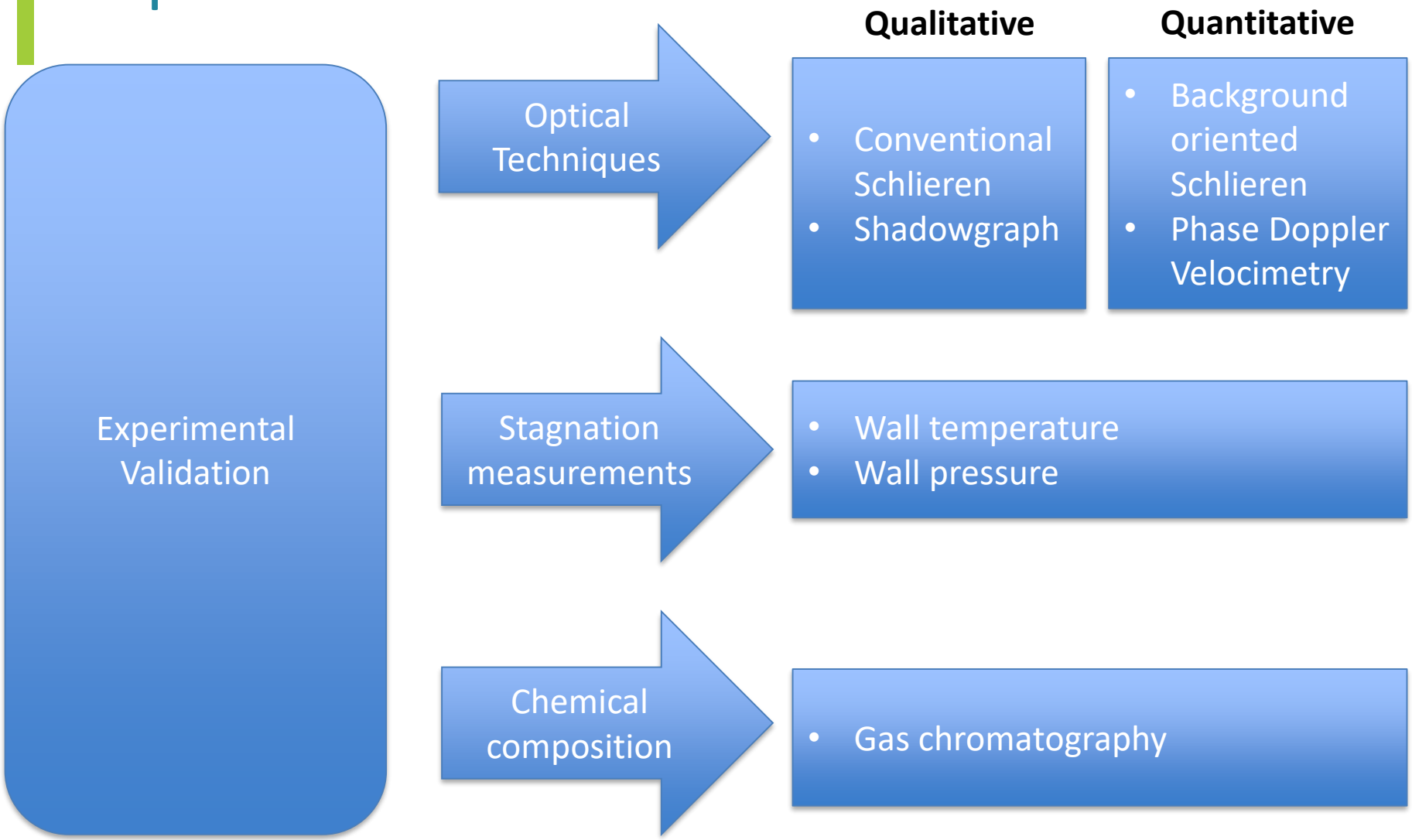


- Increased area to 264 m^2.
- Infrastructure for high pressure compression.
- Fast prototyping.
- Machining workshop.

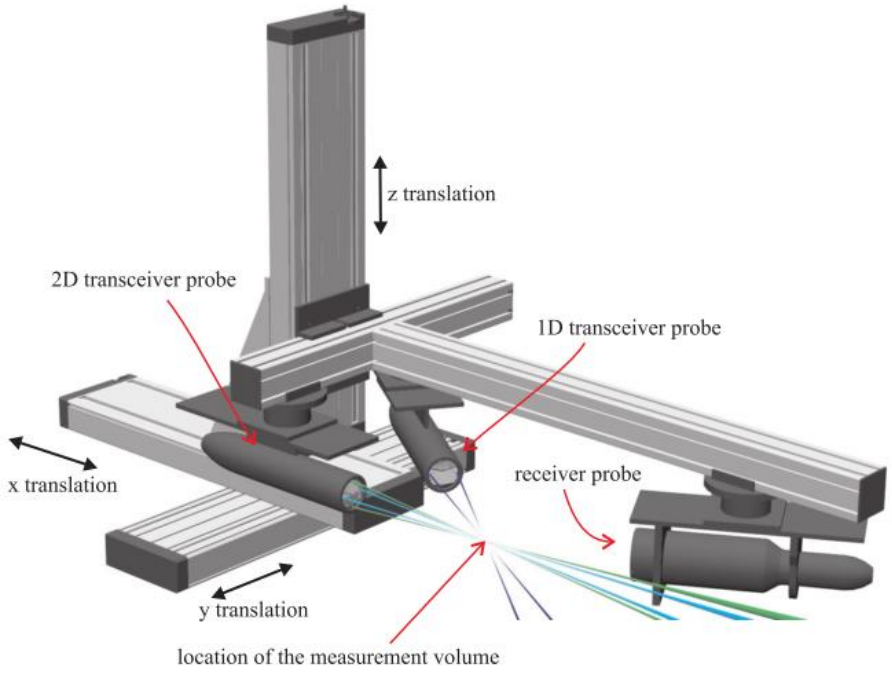
Test rig Process diagram

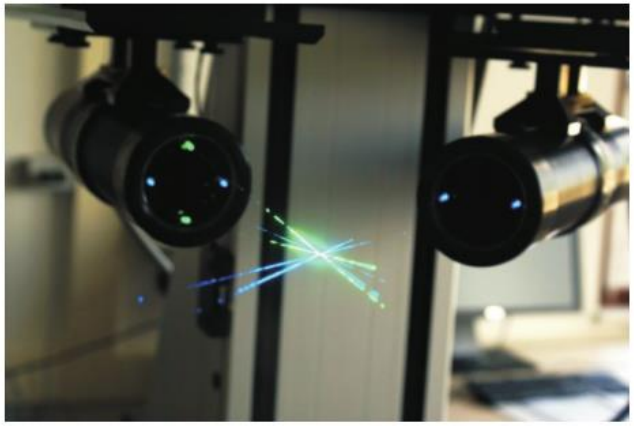


Separator Validation



Phase change characterization





Phase Doppler Velocimetry

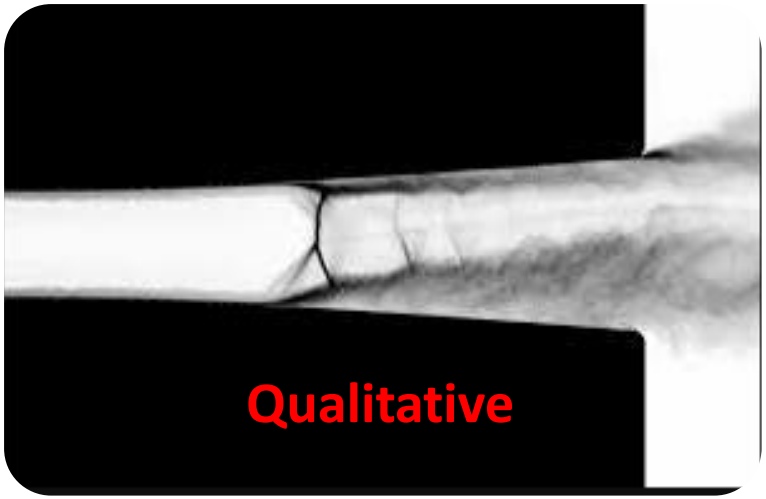
- Particle size
- Particle velocity

Evaluation of homogeneous and heterogeneous nucleation

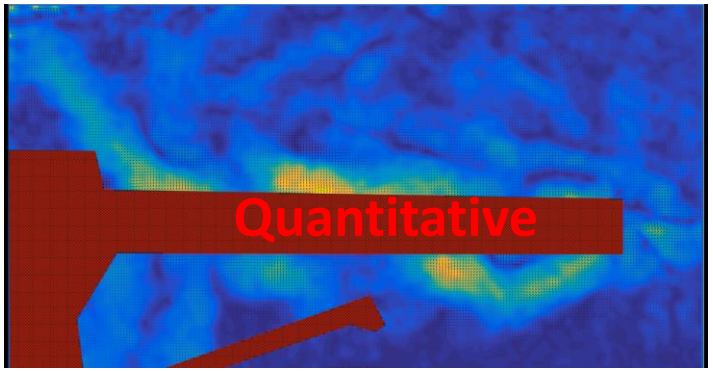
Droplet behavior and thermal separation in Ranque-Hilsch vortex tubes. PhD Thesis.

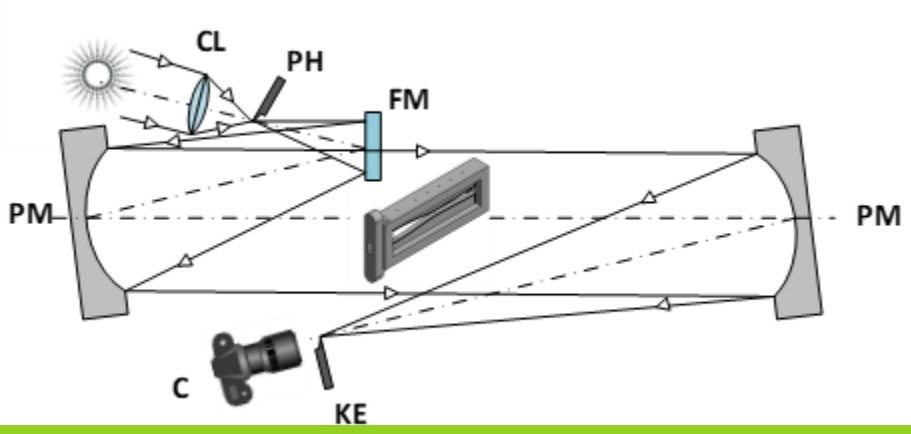
Shockwaves Characterization

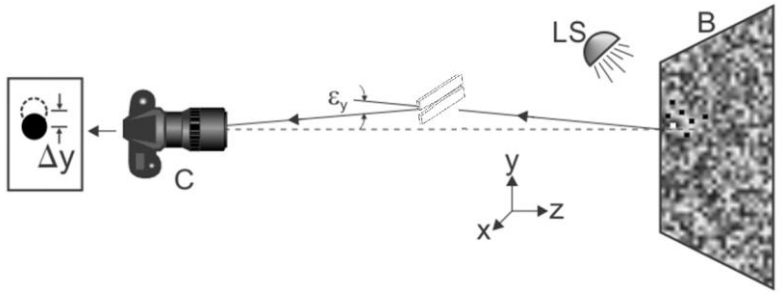
Schlieren



Background Oriented Schlieren



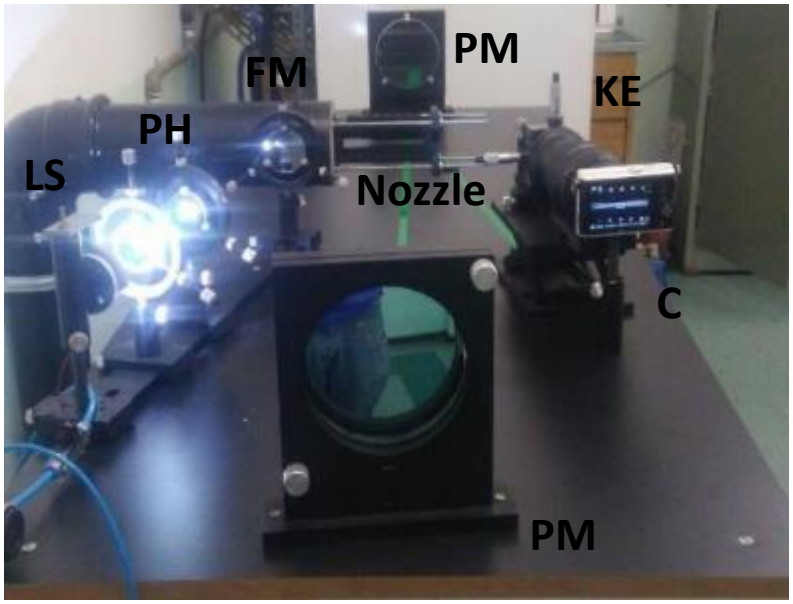


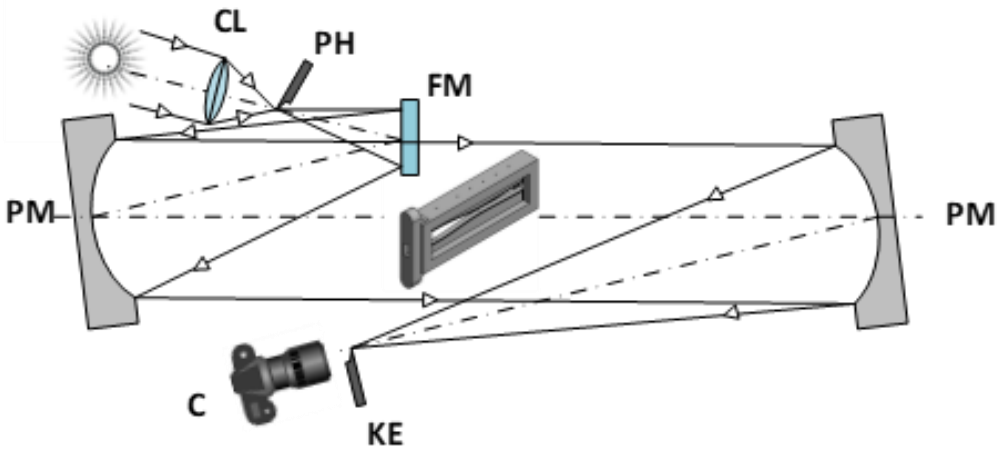


Goals

- Give the adequate and safe infrastructure for the supersonic separation evaluation, focusing in the following components:
  - Gas conditioning and compressing:
    - Tanks: 5 m^3 at 40 bar.
    - Air dryer and oil removal.
    - Compressor: 40 bar @ 100 m^3 /h FAD.
    - Mixing chamber.
  - Data acquisition:
    - High speed camera $1x10^{-6}$ s shutter speed.
    - Fast response pressure transducers.
    - Gas chromatography.

Initial tests





LS: Light Source
PH: Pin Hole.
PM: Parabolic Mirror.
C: Camera.

CL: Converging Lens.
FM: Flat Mirror
KE: Knife Edge.

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