Gas leak tests of straws

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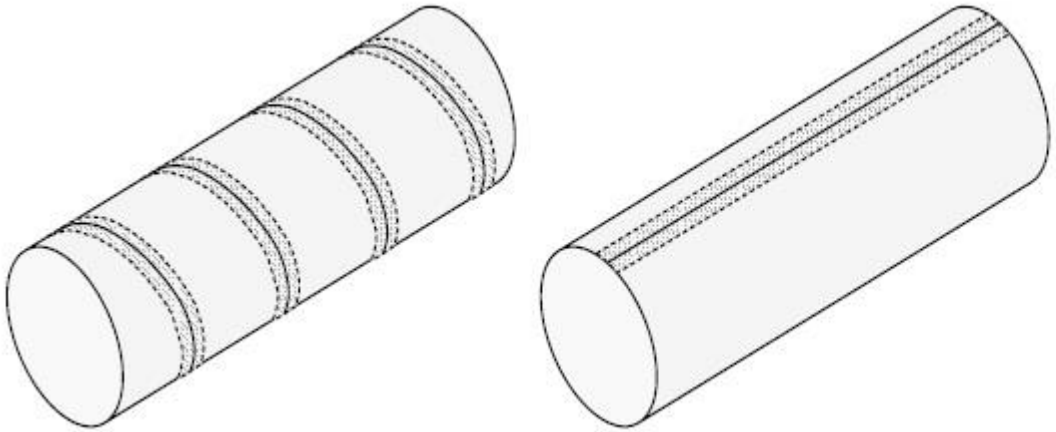
STT Prototype meeting 11.05.2022

Introduction

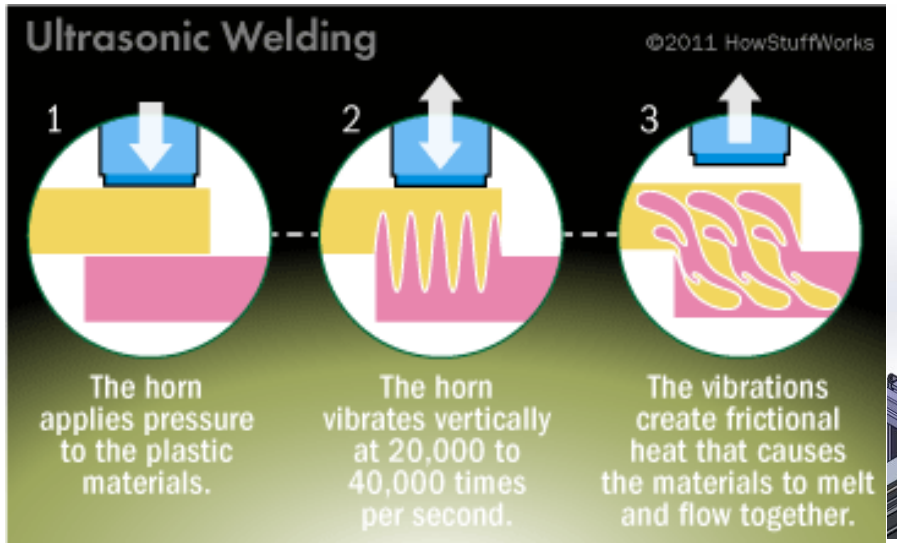
- New straw tube technologies
- Quality tests
- R&D of Mechanical properties
- Gas leakage study

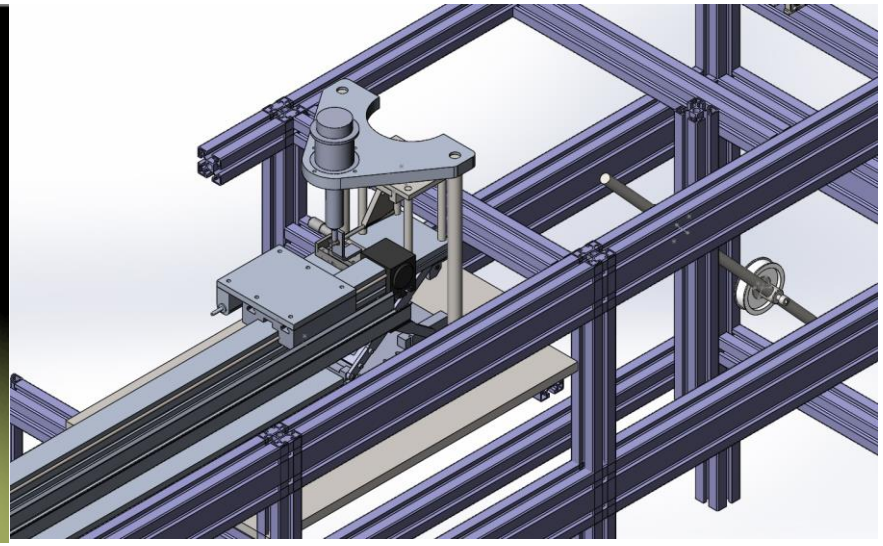
New design straw tubes



- Two tape Double wounded glued straw tube
- One tape single seam straw made by ultrasonic welding technology
- 36 µm thickness 10 mm diameter for NA62 experiment
  20 µm thickness 9.8 mm diameter for COMET Phase-1 experiment
  12 µm thickness 5 mm diameter for COMET Phase-2 experiment
- 20 µm thickness 5 mm diameter for DUNE ND STT detector

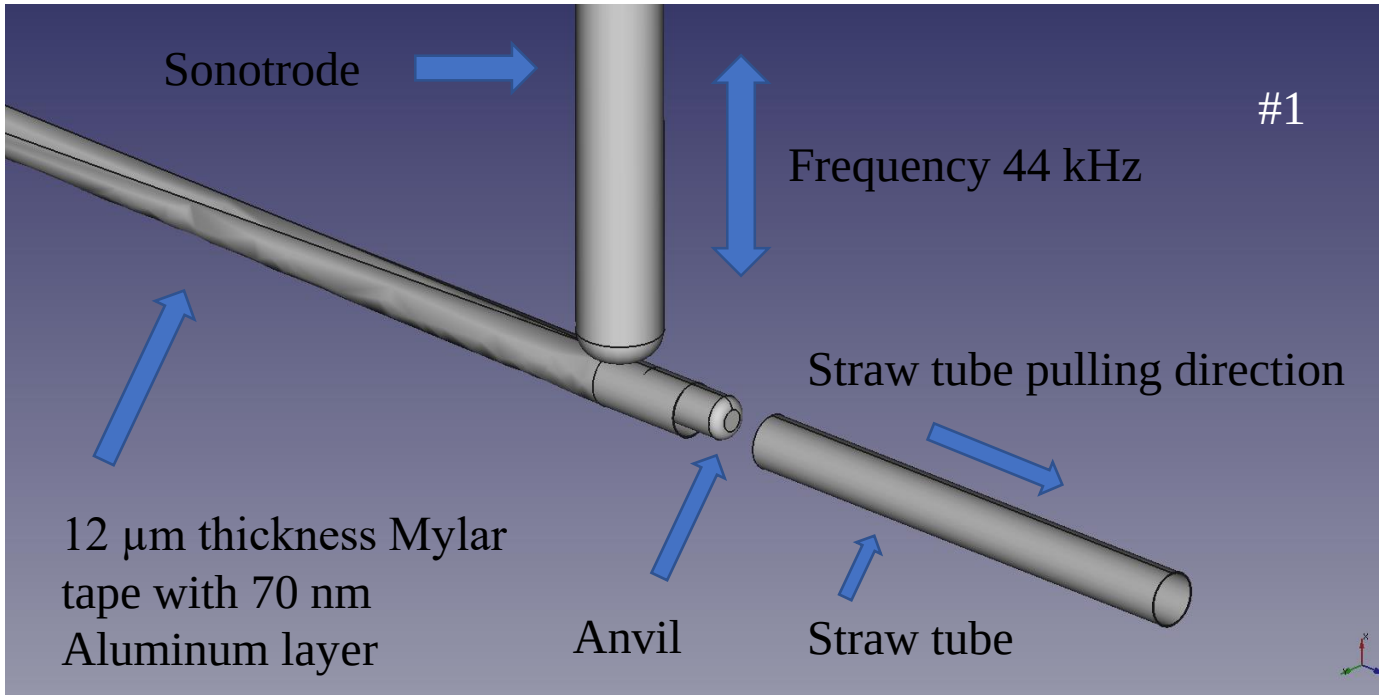
Ultrasonic welding technology

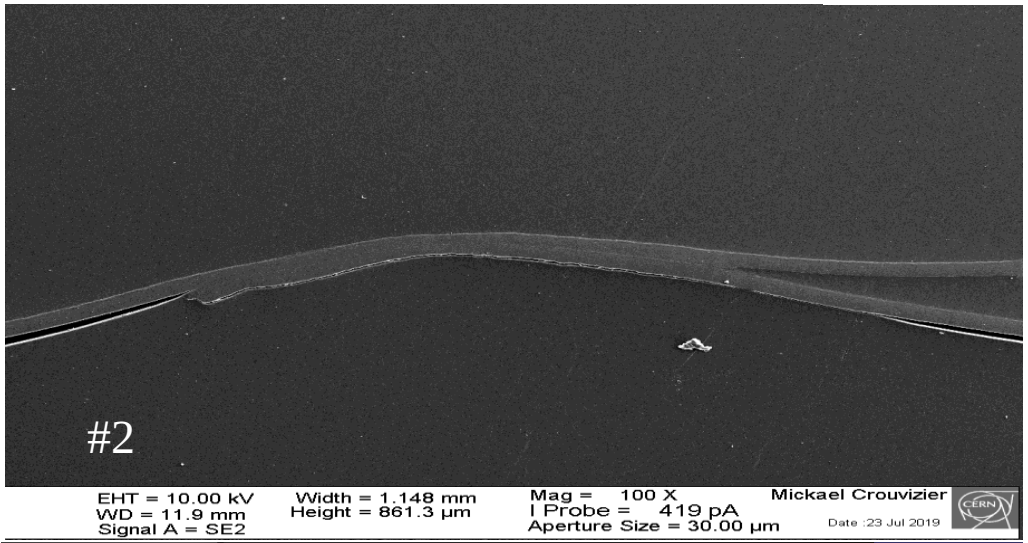


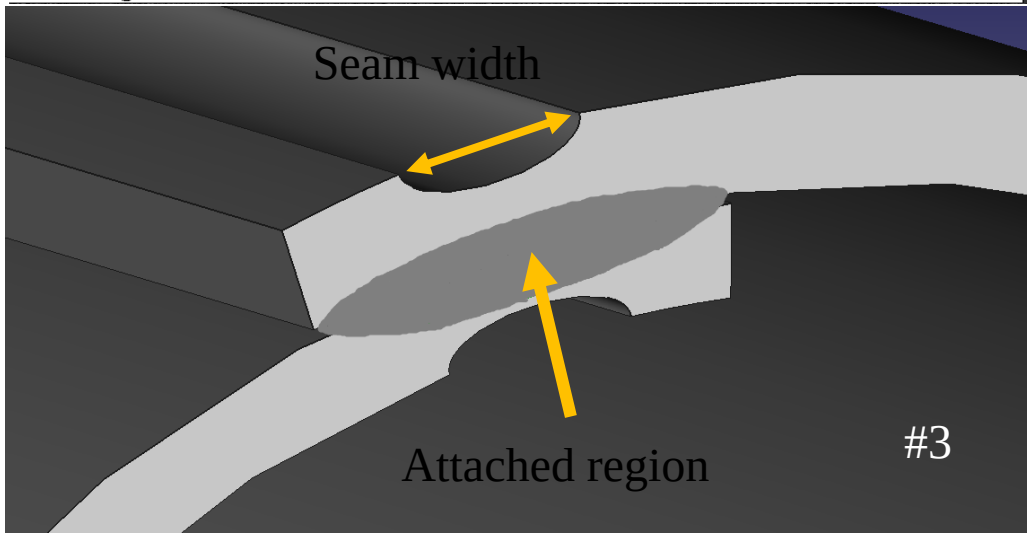


- Ultrasonic generator with welding sonotrode head
- Ultrasonic welding process, melting Mylar in local point and attaching edges of tape to each other to form cylinder tube
- Principal welding machine design
- NA62 welding machine in working process

Ultrasonic welding technologies

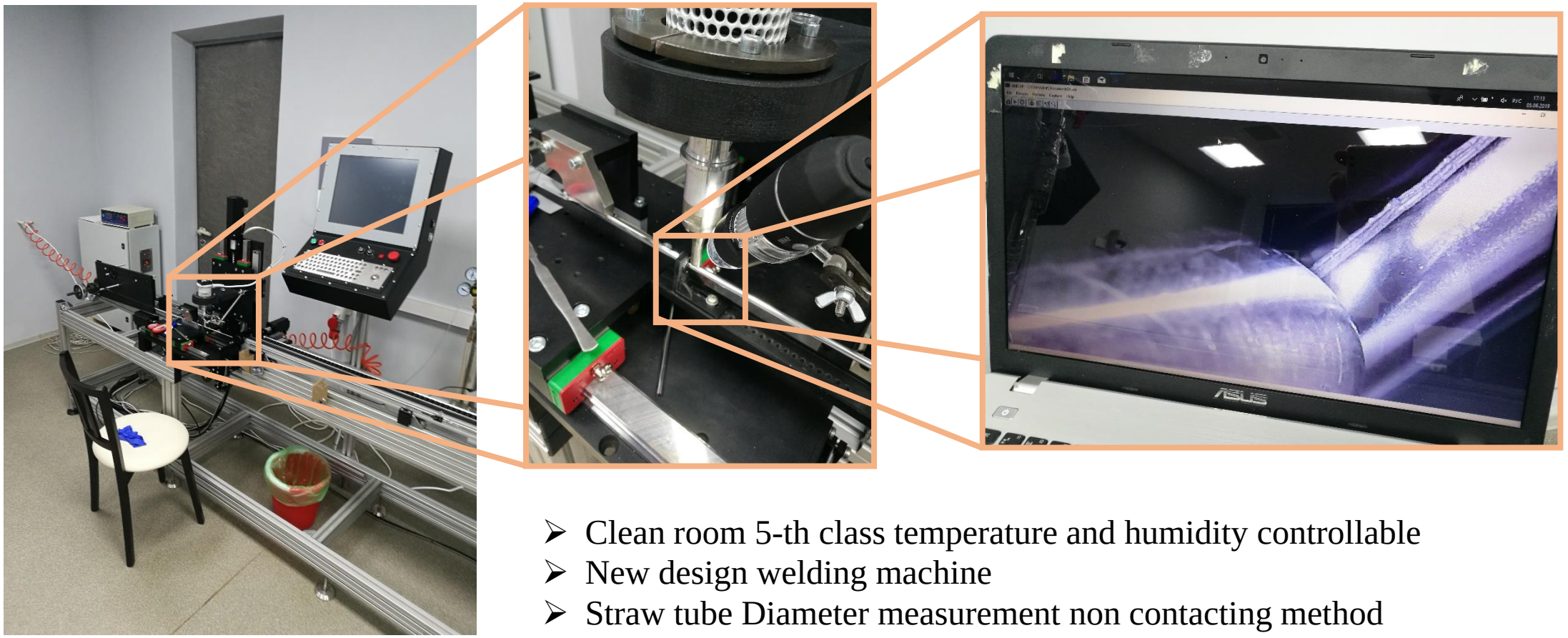






- Welding process diagram. A single tape with a thin layer of metal, is wound into a cylindrical shape by means of a mold. Where the ultrasonic sonotrode attaches the overlapping edges of the tape # 1
- Straw tube seam at intersection # 2
- Welding site structure at intersection # 3

Preparing laboratories and new production line for 5 mm straw tube



- Clean room 5-th class temperature and humidity controllable
- New design welding machine
- Straw tube Diameter measurement non contacting method
- Quality controlling stands, tube pressurization observing gas leakage

Quality Control

- Using NA62 & standard:
  - Tube diameter control
  - Material elongation
  - Seam quality control
  - Pressure & gas leakage measurement
  - Resistivity measurements

Because 20 micron Mylar for DUNE is almost twice thinner than tapes for NA62, all controlling procedures are more sensitive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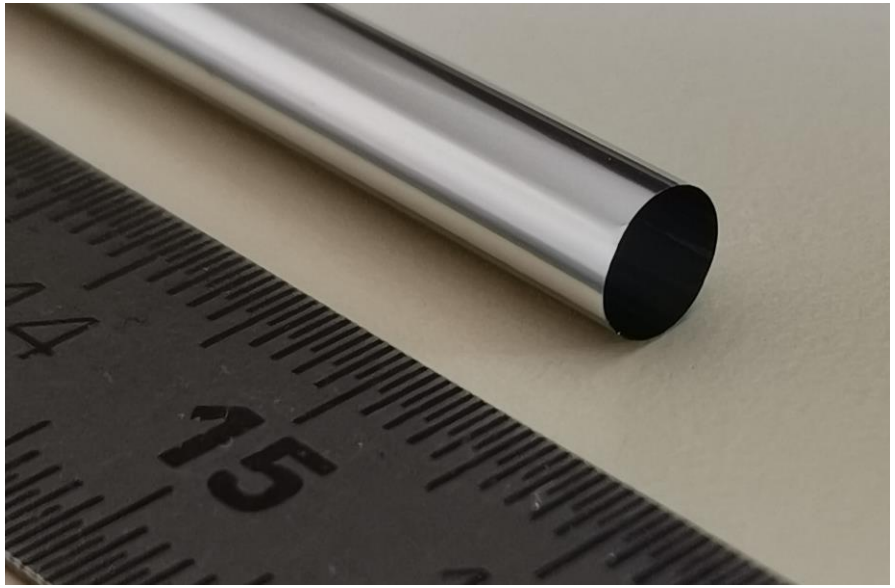
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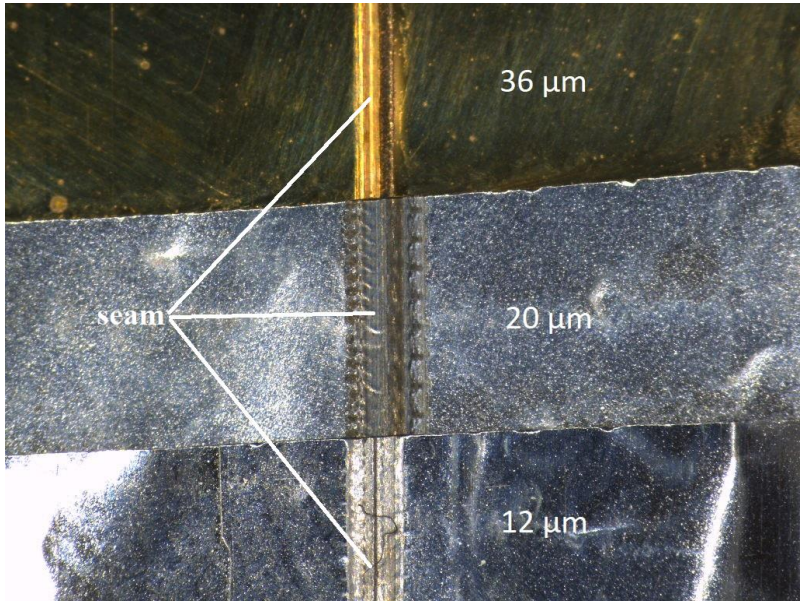
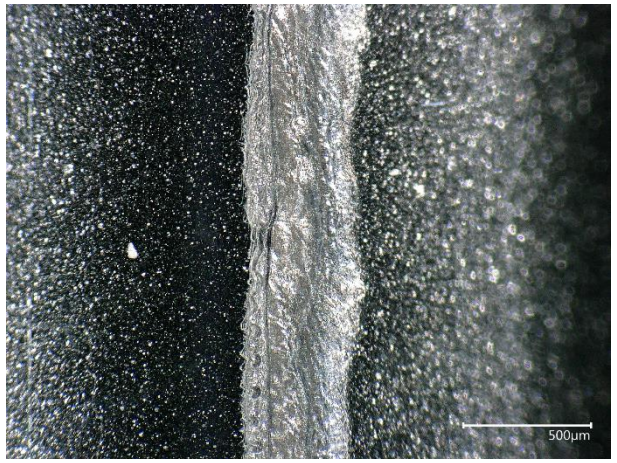
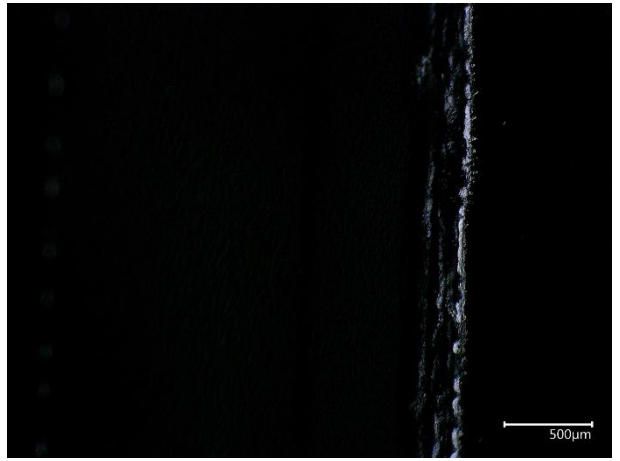
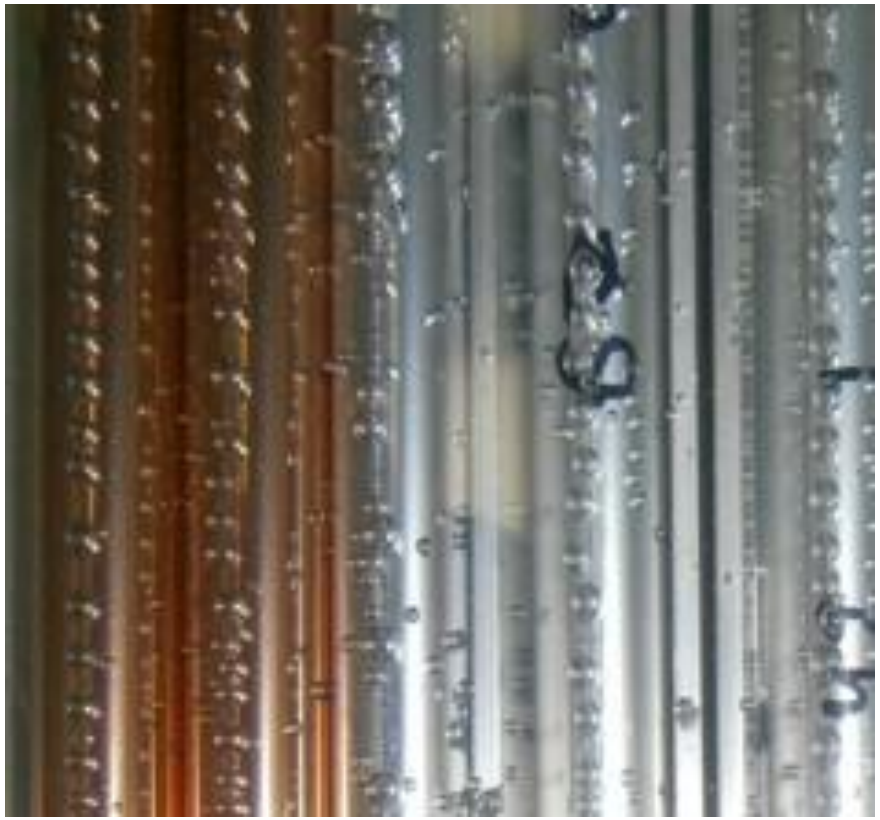
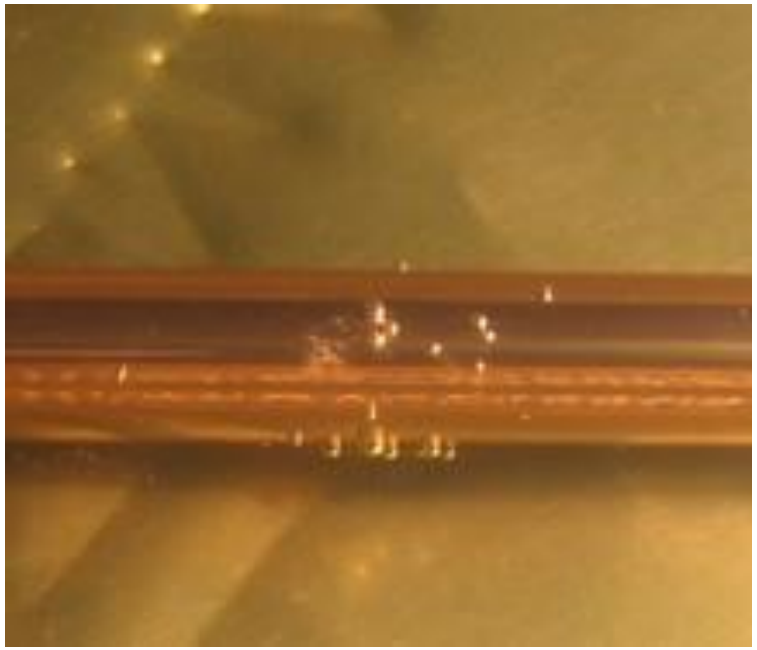

36 µm
seam
20 µm
12 µm

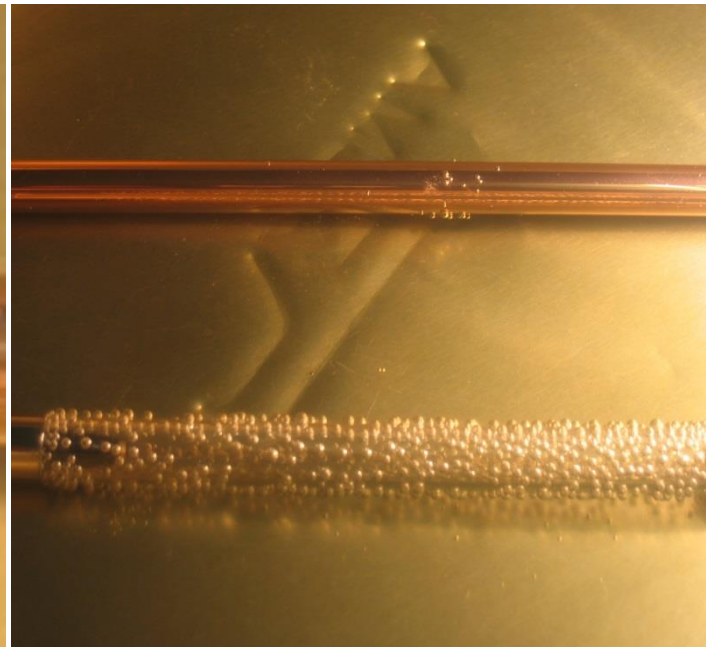

500µm


500µm

Visual demonstration test of gas diffusion in straw tubes using helium

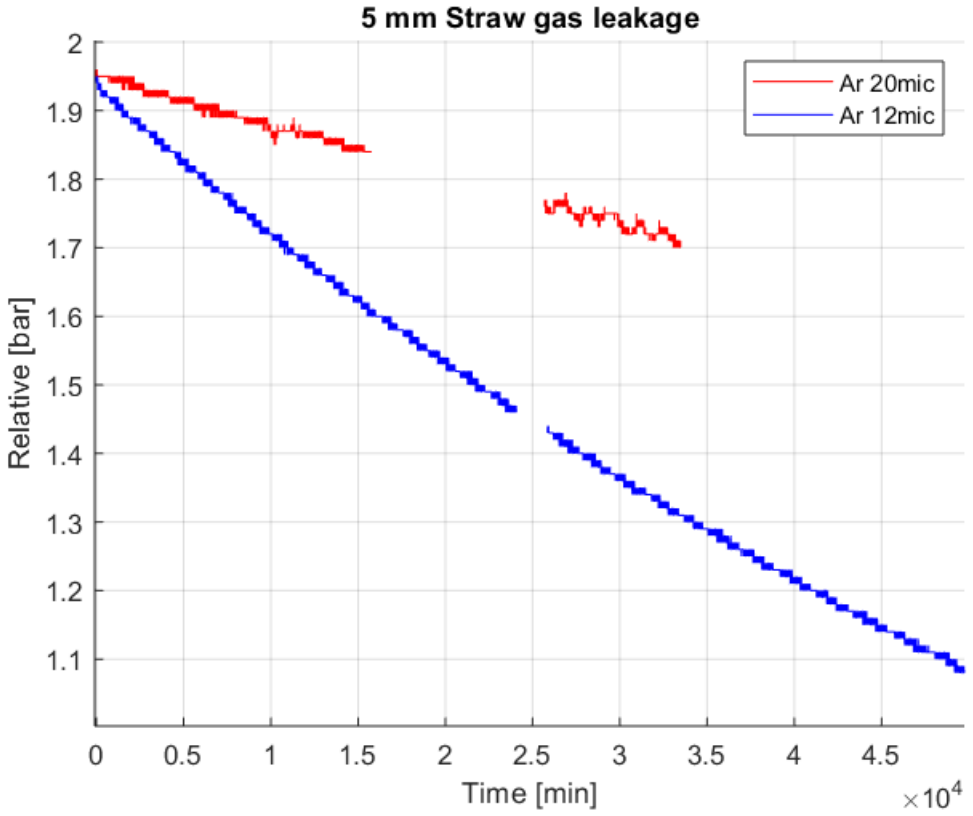


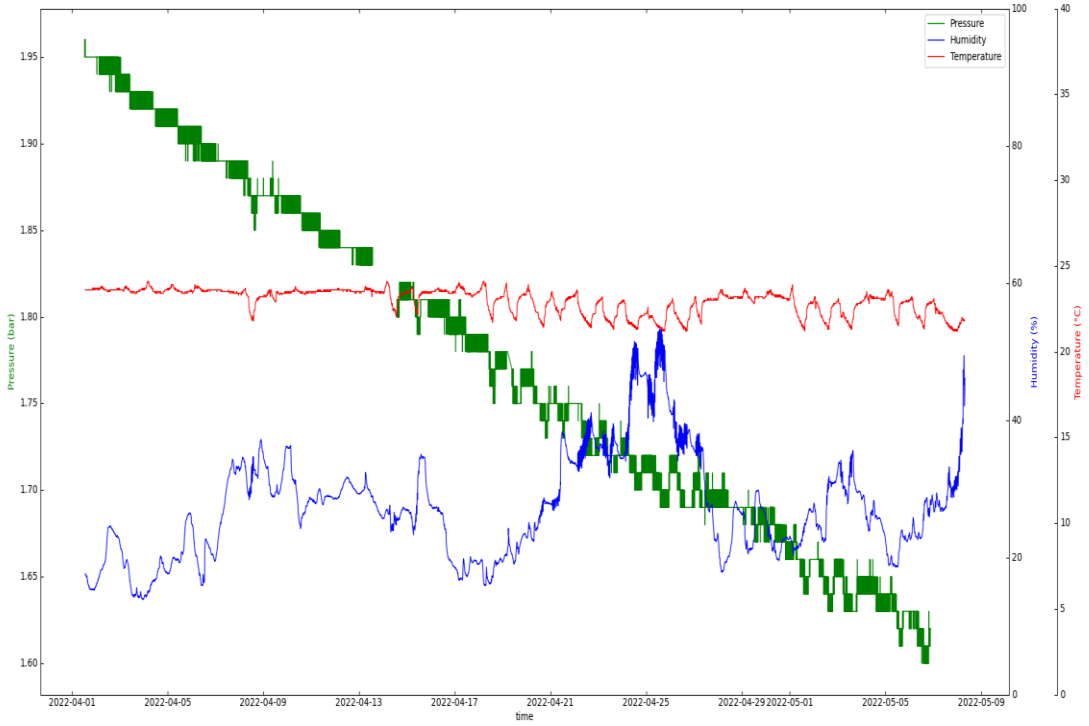




Shown above are metalized and pure mylar tubes.
Helium is used for the tests, the internal pressure in straw is 2 bar relative
Straws for leak visualization are submerged in water
In metal-free tubes, we have an equal distribution of the diffusion process
In metalized straws mainly weld area is a place for gas leak since the metal layer is a difficult barrier to gas diffusion then mylar

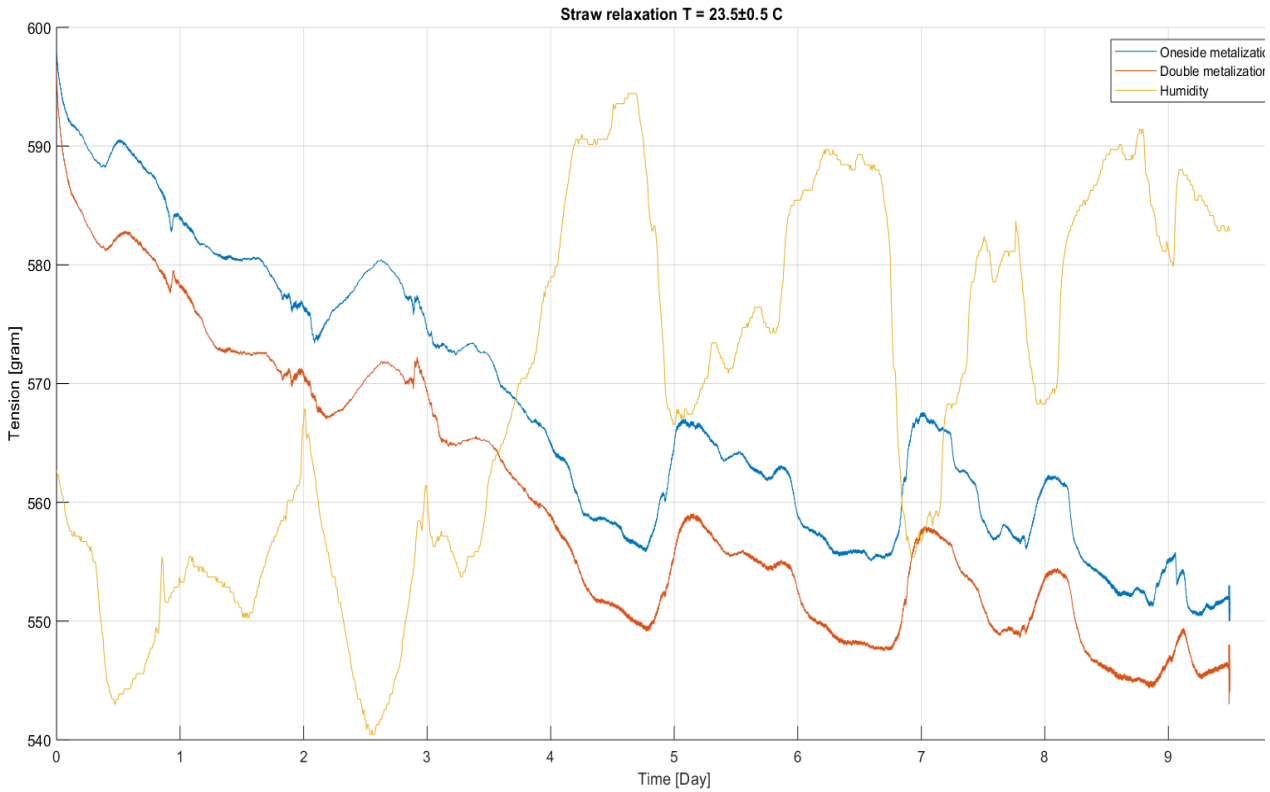
Preliminary measurements for gas leak

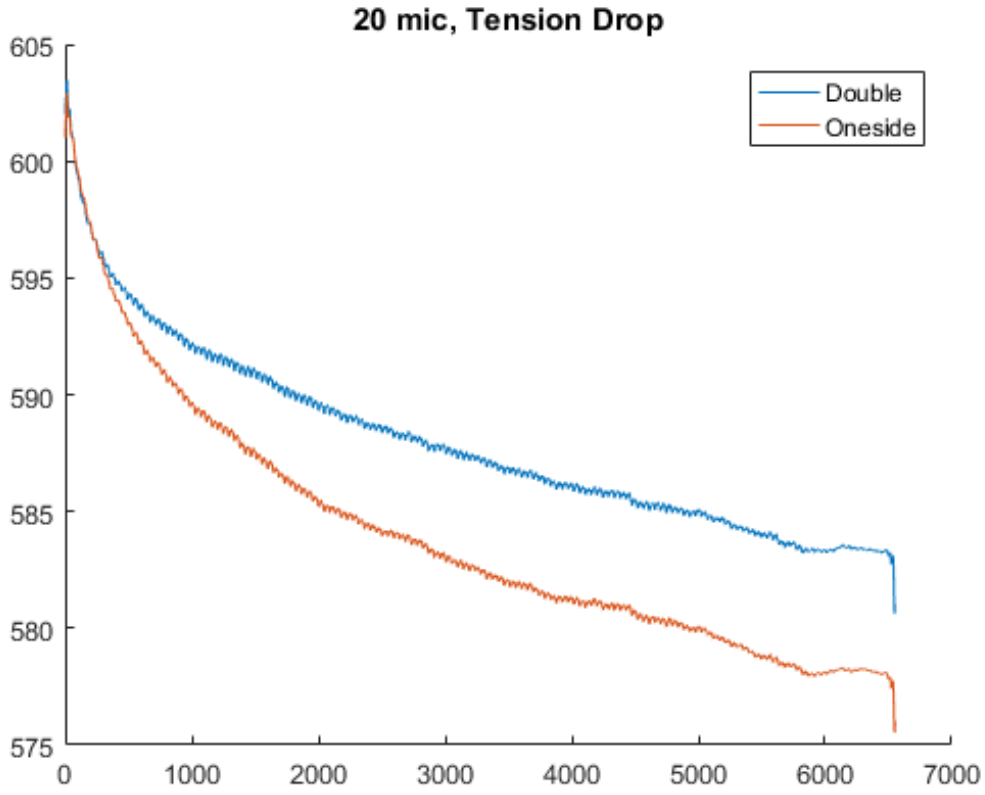




Gas leak test for 12/20 µm 5 mm diameter straw tubes of 1 m length
By rough calculations loss is: 0.01 bar/day for 20 µm and 0.03 bar/day for 12 µm

Preliminary measurements for straw relaxation





Straw tube relaxation test after installation into the frame and fixing it in a stretched position
Double and single metallization straws of 1m length are used in this test.

Thank you for attention