Material from LPNHE Paris

In AIDA-2020 the LPNHE is beneficiary of a group
LAL Orsay, LPNHE Paris, Pisa,
MPP Munich, Uni Padova
(+ externals interested in the topics)

Projects on external funding: Reflecs & Reflecs2

REFLECS

REFroidissement LÉger au CO_2 en Silicium

- CNRS Defi instrumentation
- Reflecs (2014) & Reflecs (2015) projects; project leader: M.Bomben
- Goals:

1. Develop cooling building blocks for HEP and more
2. Study fundamental properties of 2-phase fluids in micro-channels

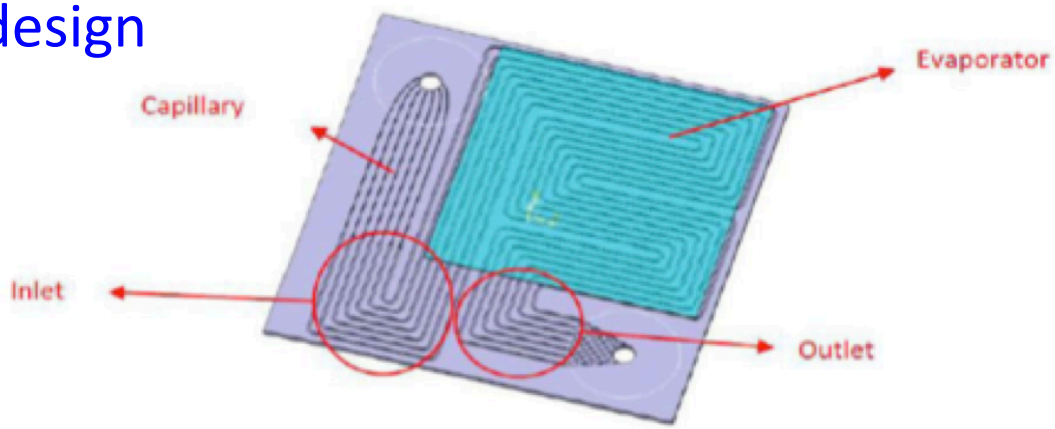
Partners

The Reflecs & Reflecs2 project

- Two main research axes

1. Develop cooling building blocks for HEP and more
   - Not only using CO_2 (*e.g.* R1234ze(E))

- SNAKE design



Dimensions optimized thanks to DII-Padua colleagues

7 parallel 120 µm deep, 200 µm wide channels, with a 700 µm pitch.

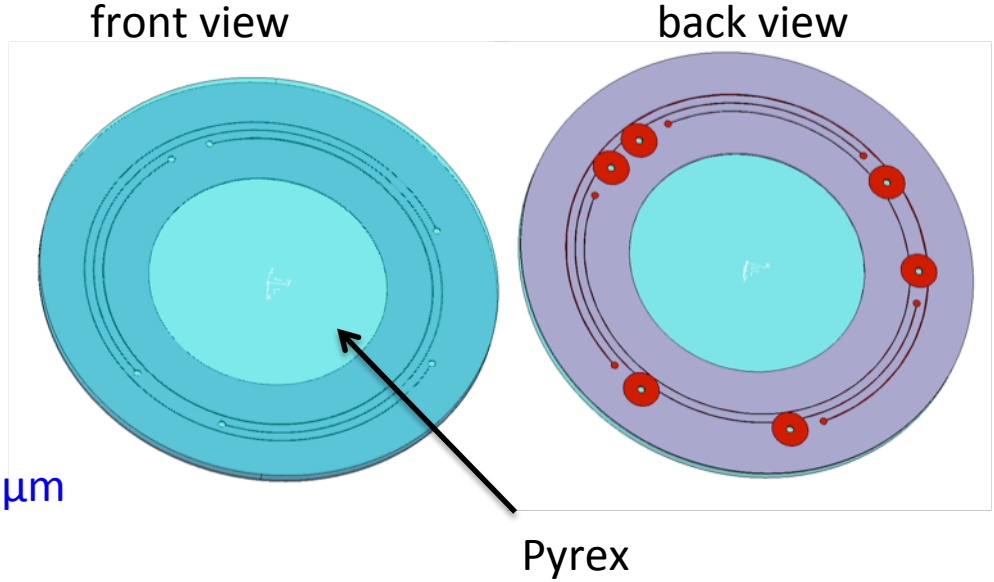
The Reflecs & Reflecs2 project

- Two main research axes

2. Study fundamental properties of 2-phase fluids in micro-channels

2. In particular in high pressure* regime
3. 30-100 bars: lack of data and models in literature

- Doughnut design



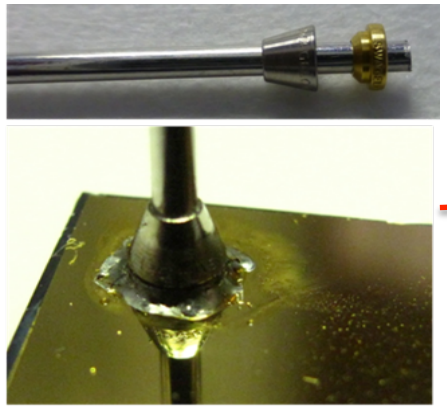
Three concentric circular channels, 200 µm deep, 200, 150 and 100 µm wide

The Reflecs & Reflecs2 project

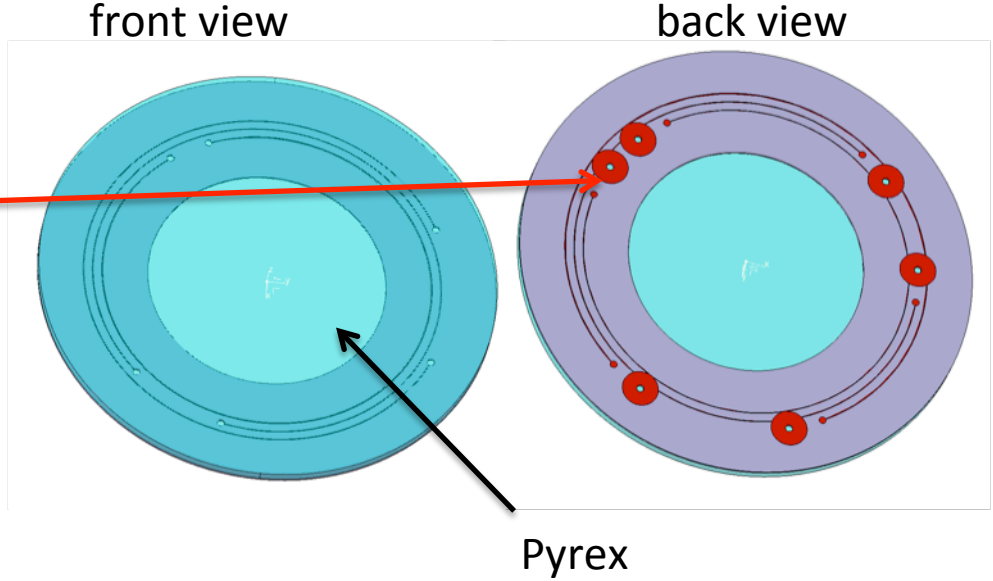
- Two main research axes

2. Study fundamental properties of 2-phase fluids in micro-channels

2. In particular in high pressure* regime
3. 30-100 bars: lack of data and models in literature

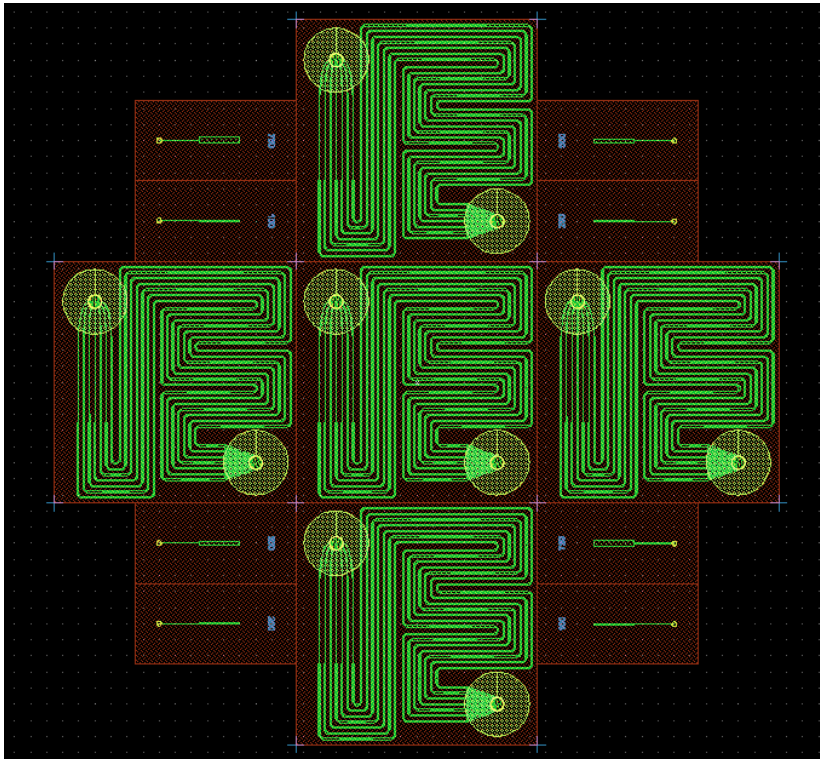


External connection for tests



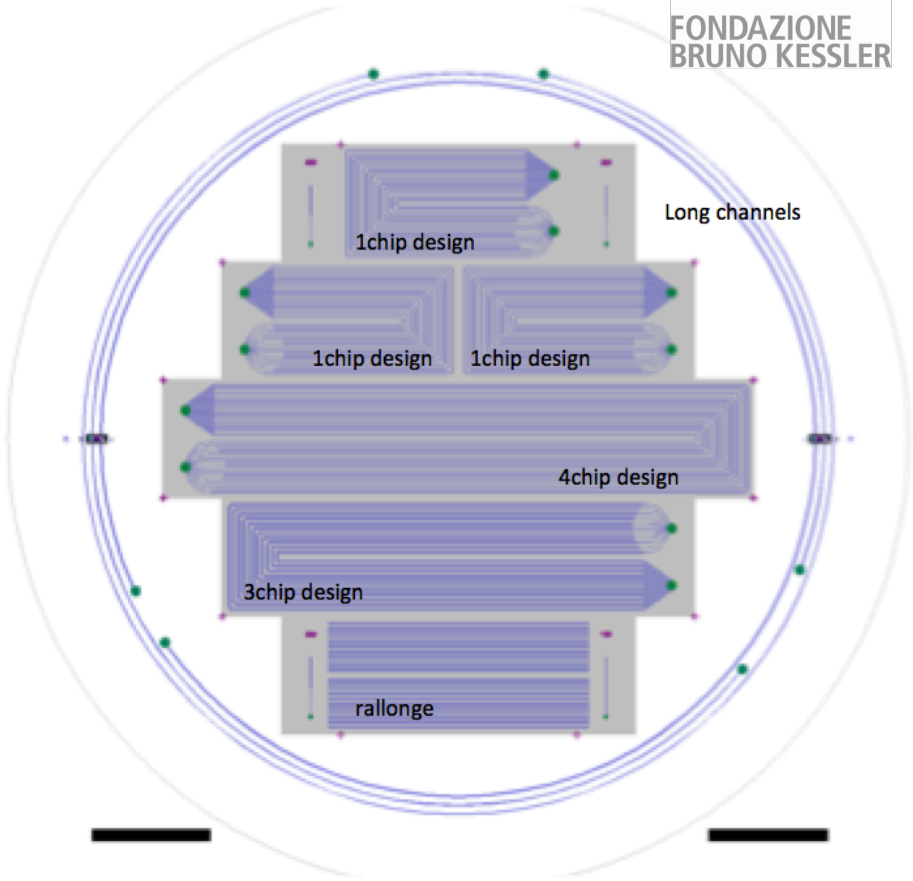
Two productions of silicon etched µ-channels

- IEF, Orsay



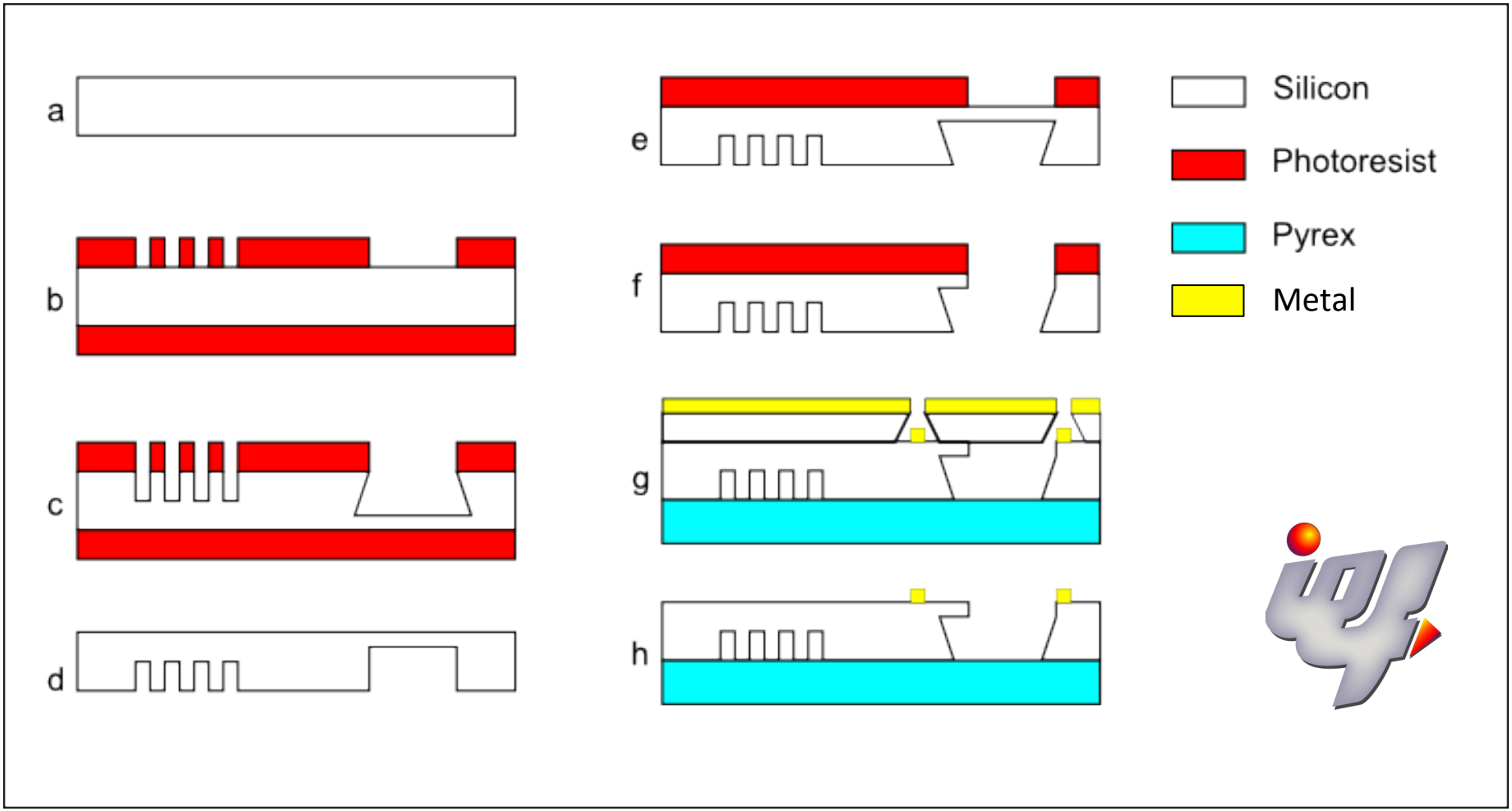
- On 4” wafers

- FBK, Trento – Italy



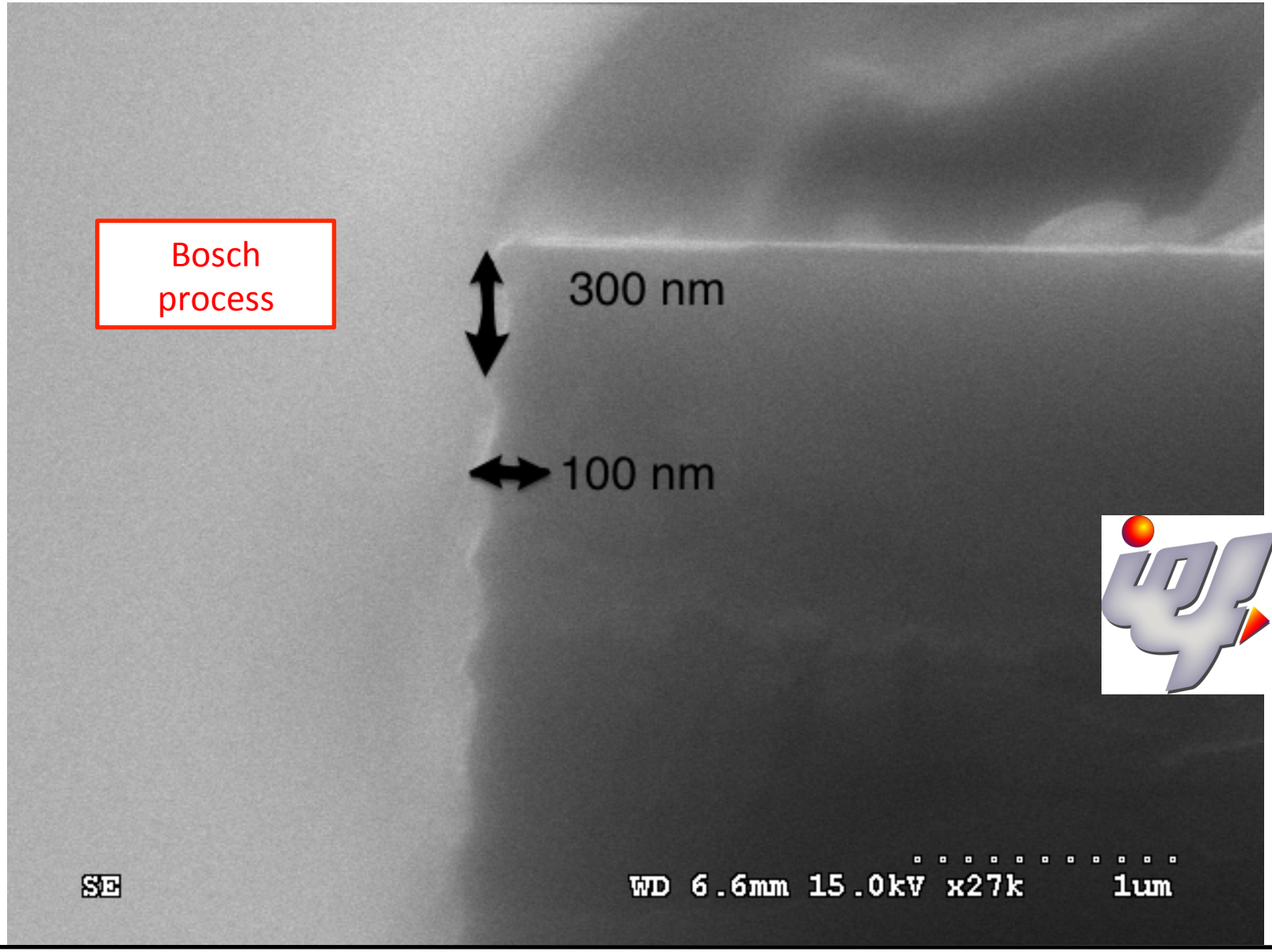
- On 6” wafers

Fabrication process

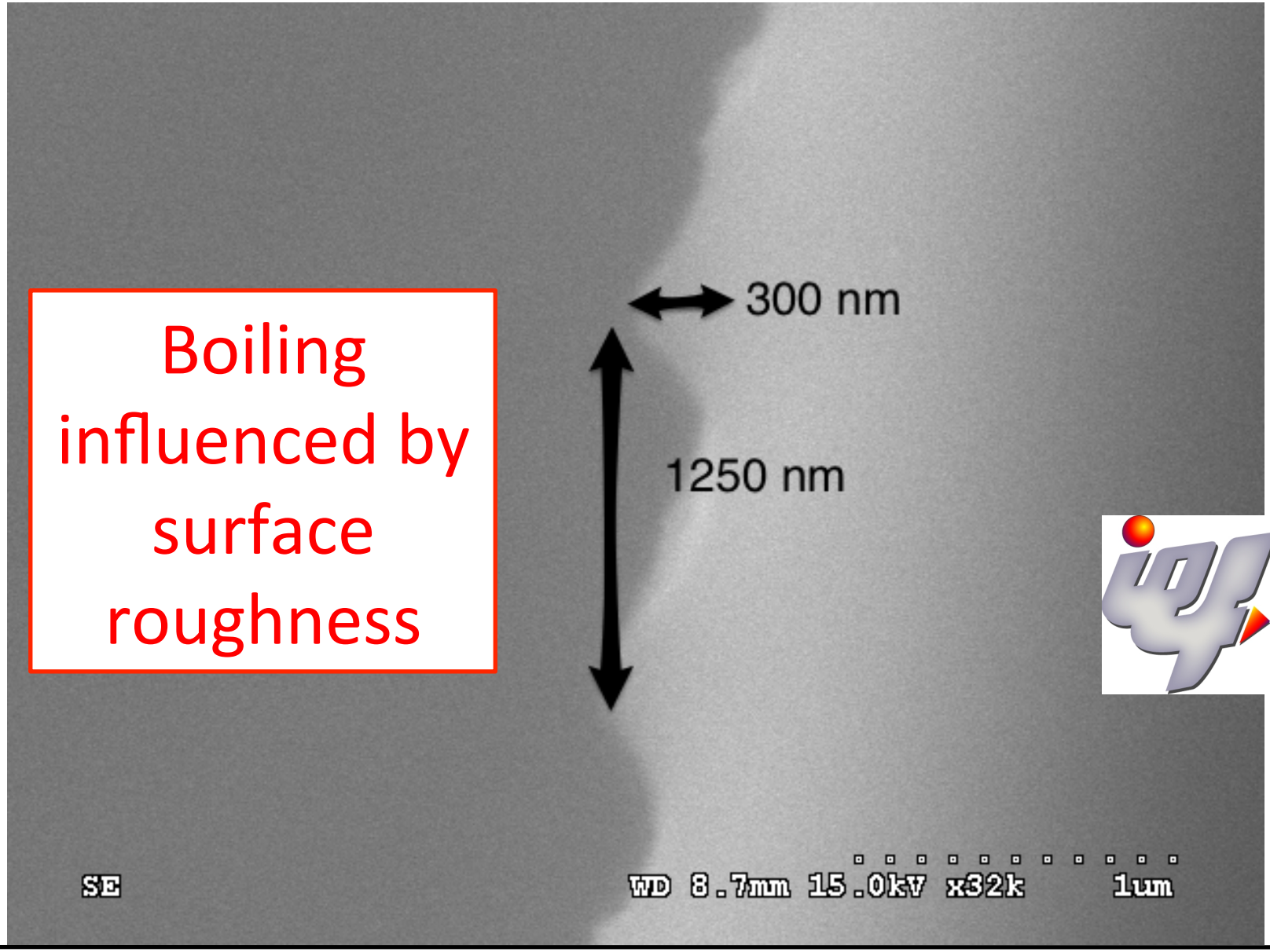


Similar at FBK

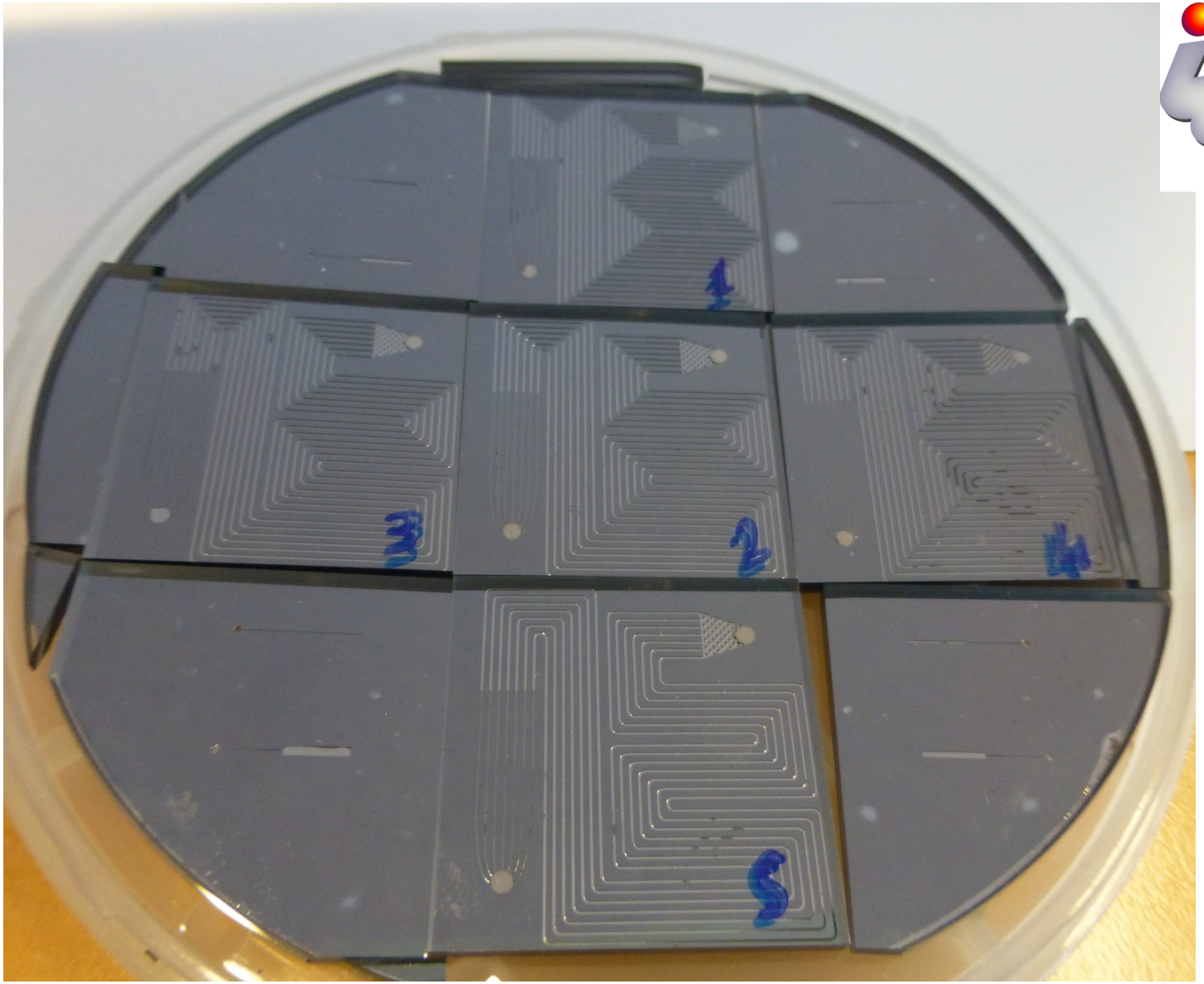
Scalloping



Scalloping

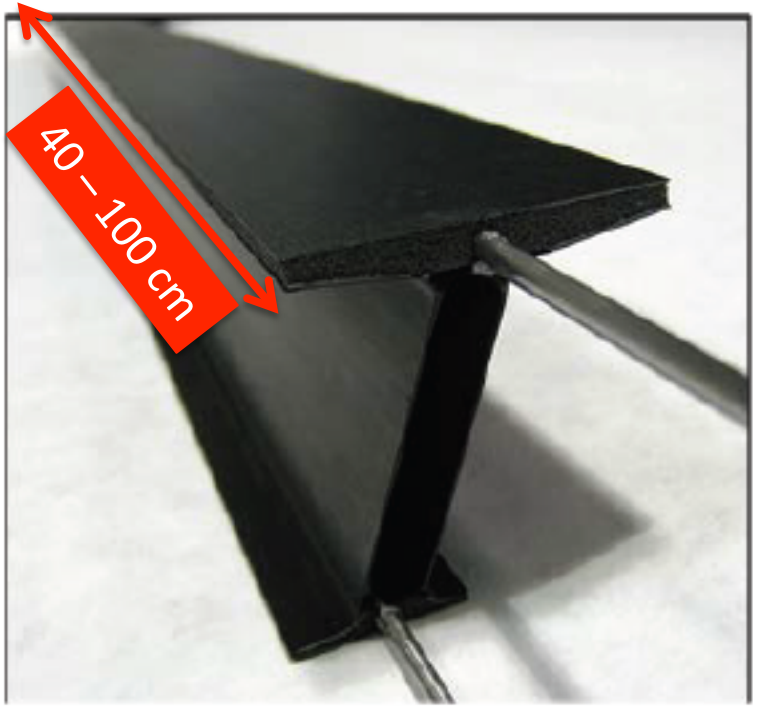

Boiling influenced by surface roughness
300 nm
1250 nm
SE
WD 8.7mm 15.0kV x32k
1um

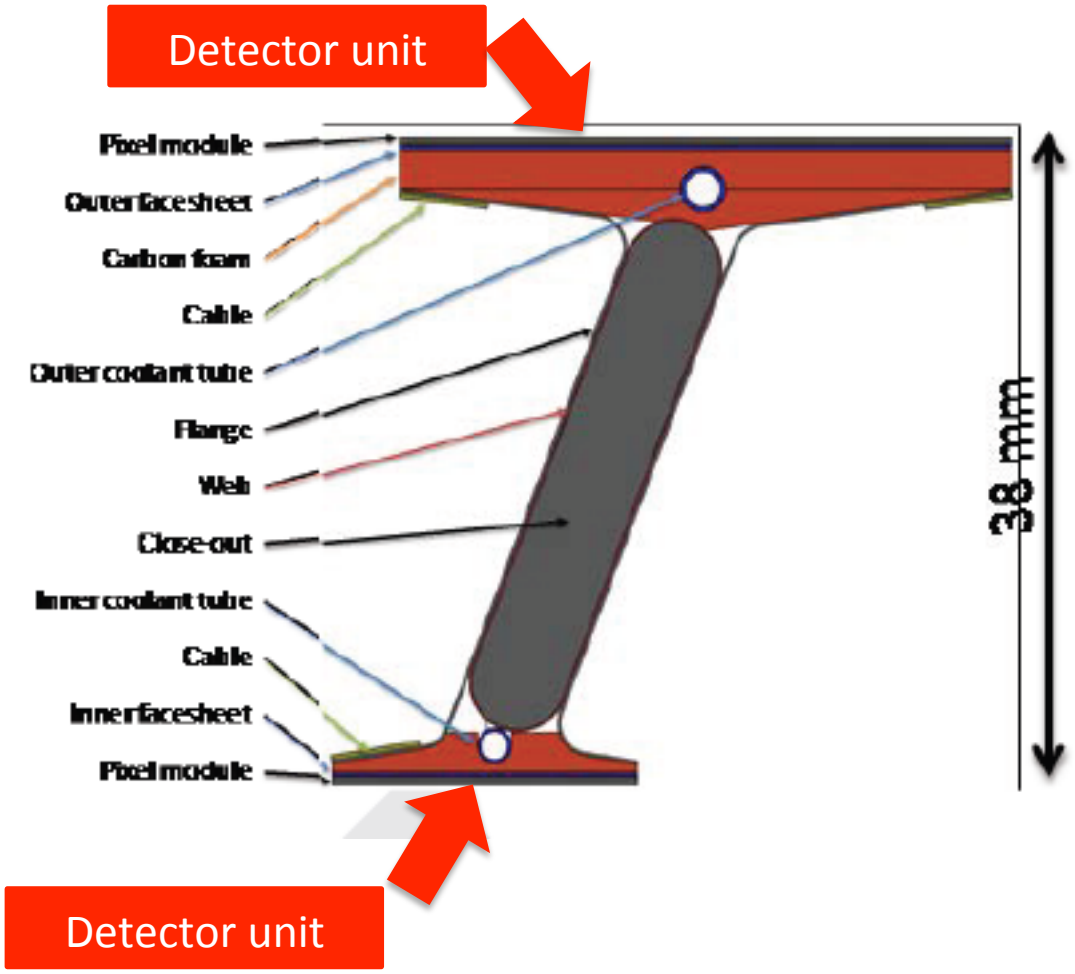
First trials



ATLAS new stave

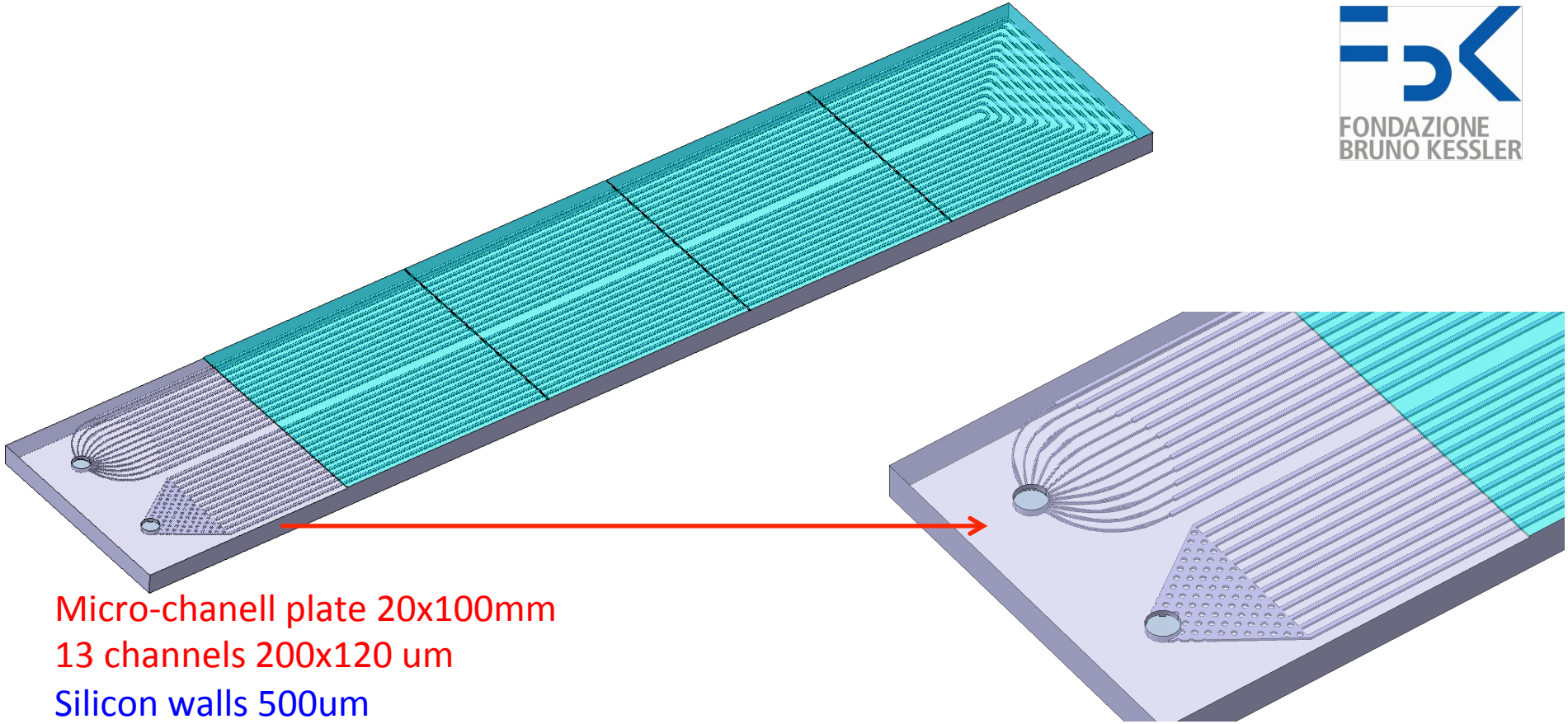
- Stave example





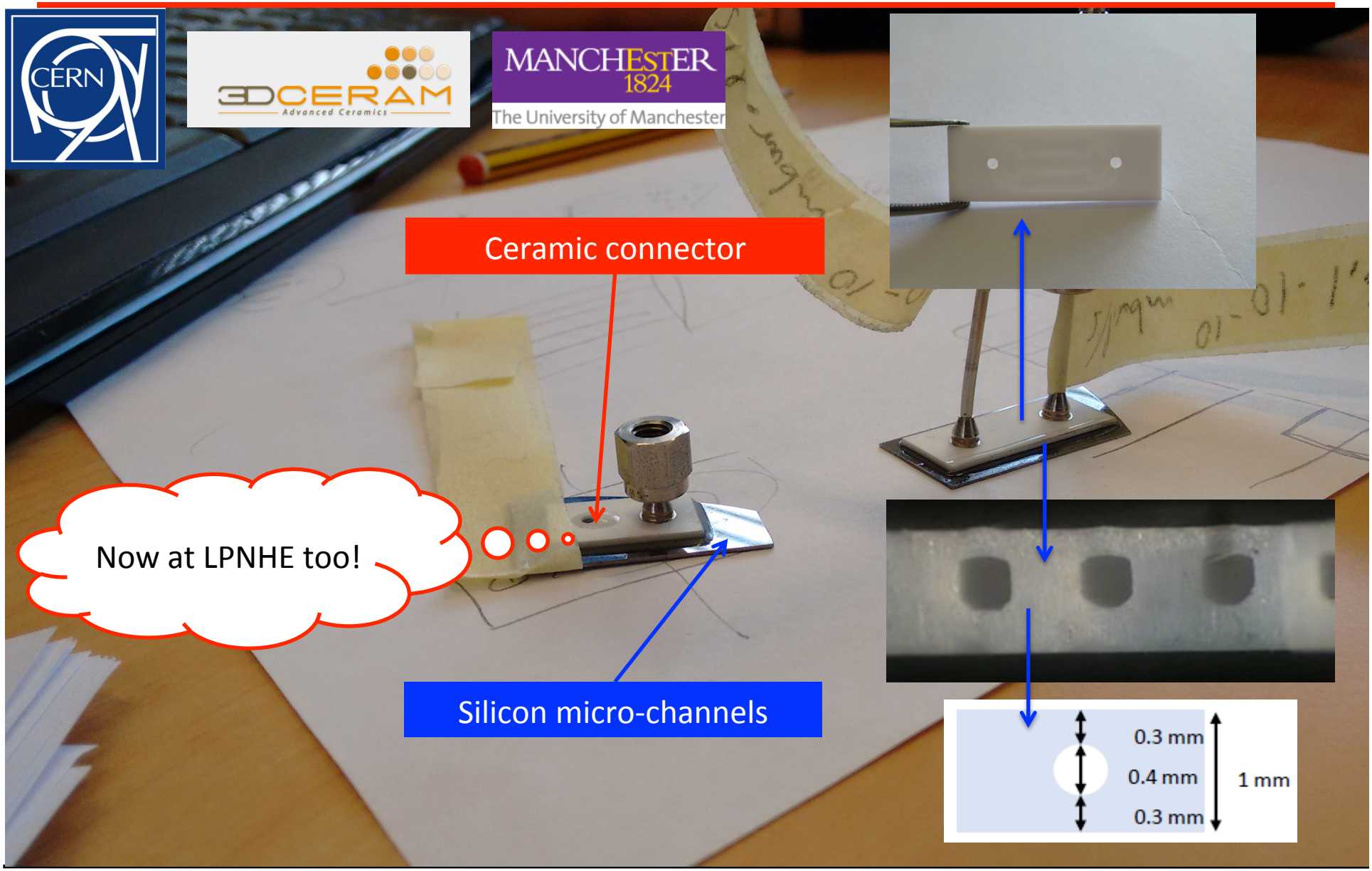
- 40-100 cm long

FBK production: mini-stave for 4 modules

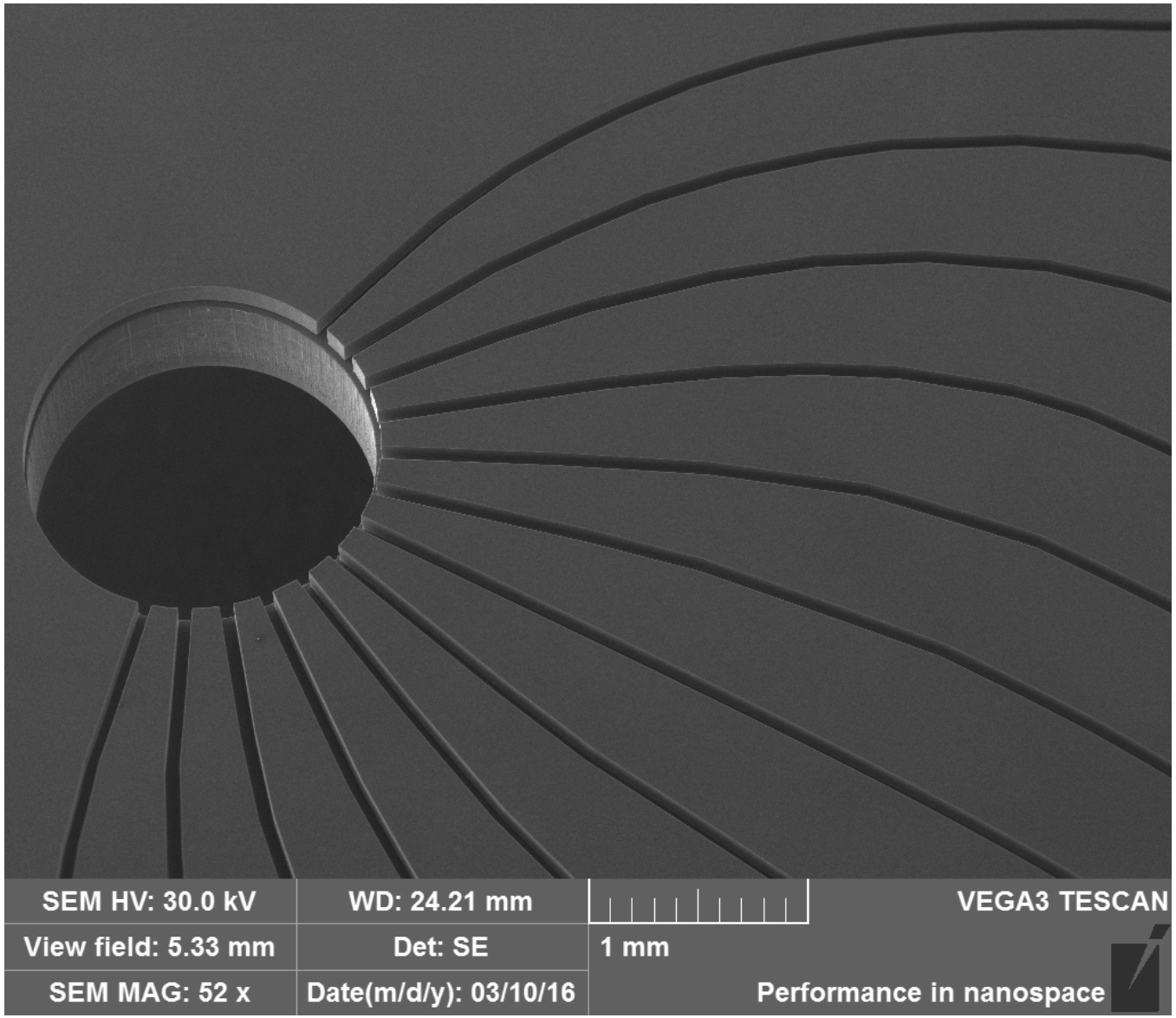


Micro-chanell plate 20x100mm
13 channels 200x120 um
Silicon walls 500um
Inlet restrictions 60x120um: same lenght 6mm for all
Inlet outlet holes 1.6 mm diameter
Pillars in the outlet: 350um diameter
Shortest channel: 165 mm
Longest channel: 199 mm

Ceramic connectors (and microchannels)

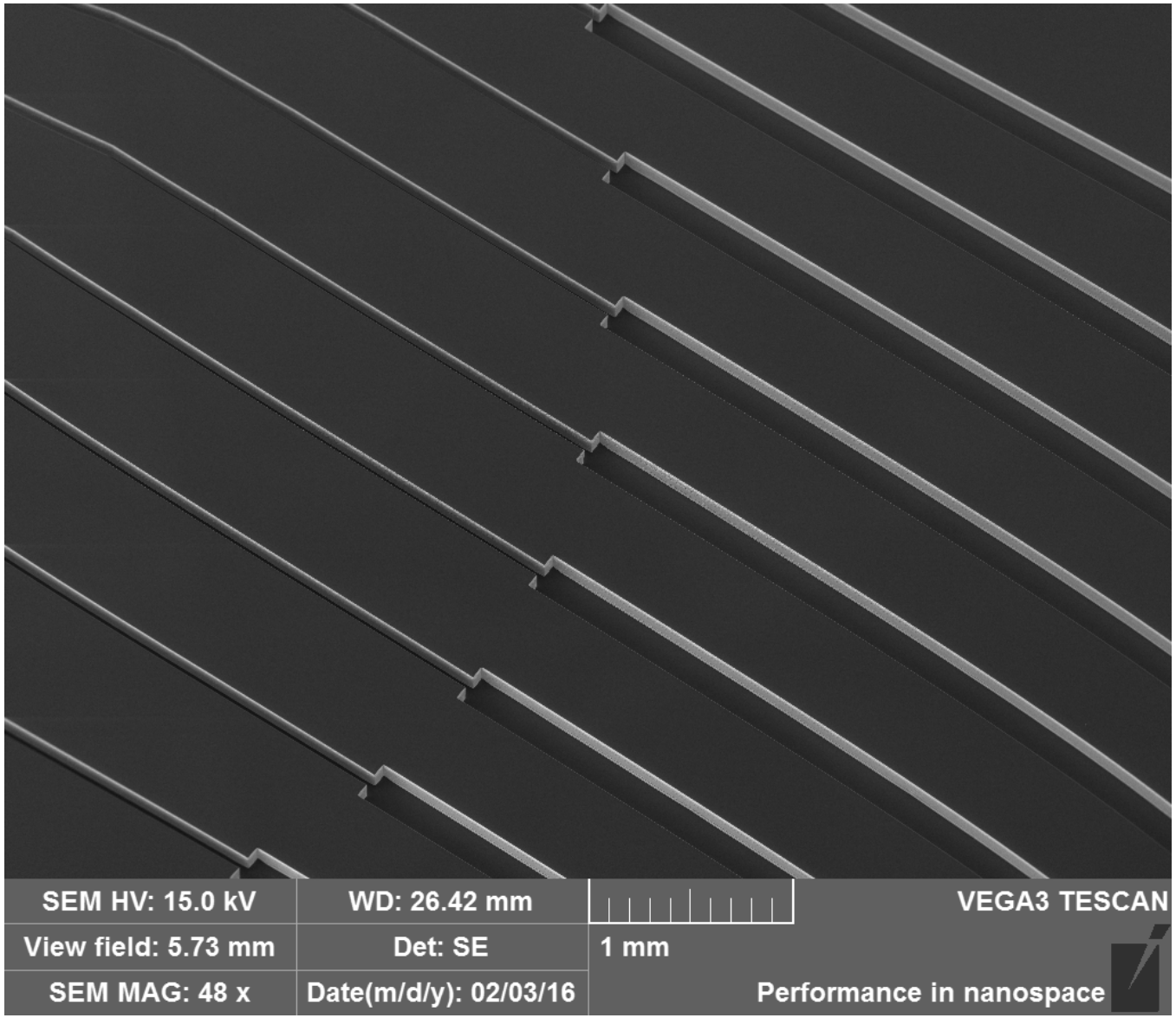


First pictures from FBK - inlet



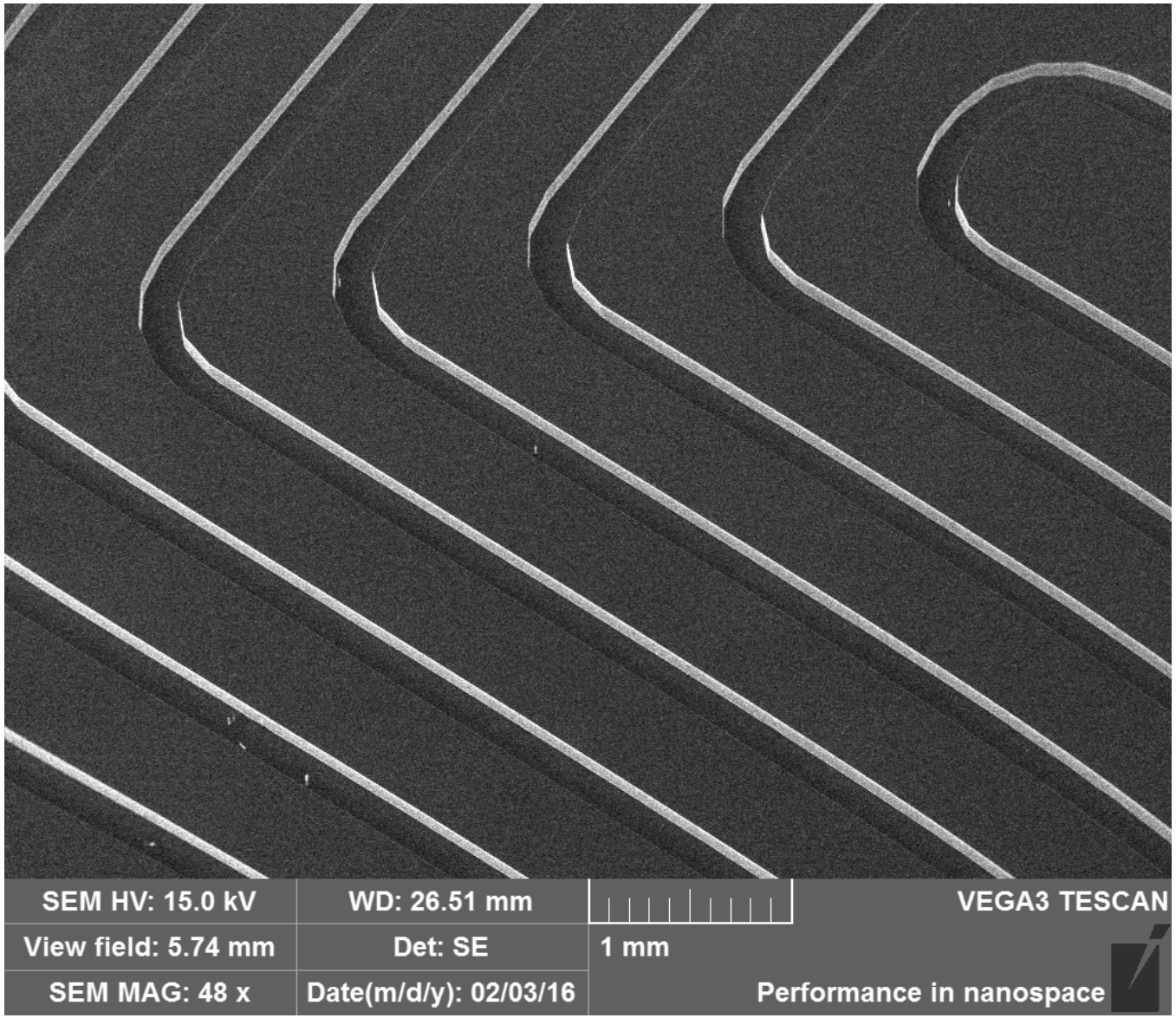
FONDAZIONE BRUNO KESSLER

First pictures from FBK – channels restrictions



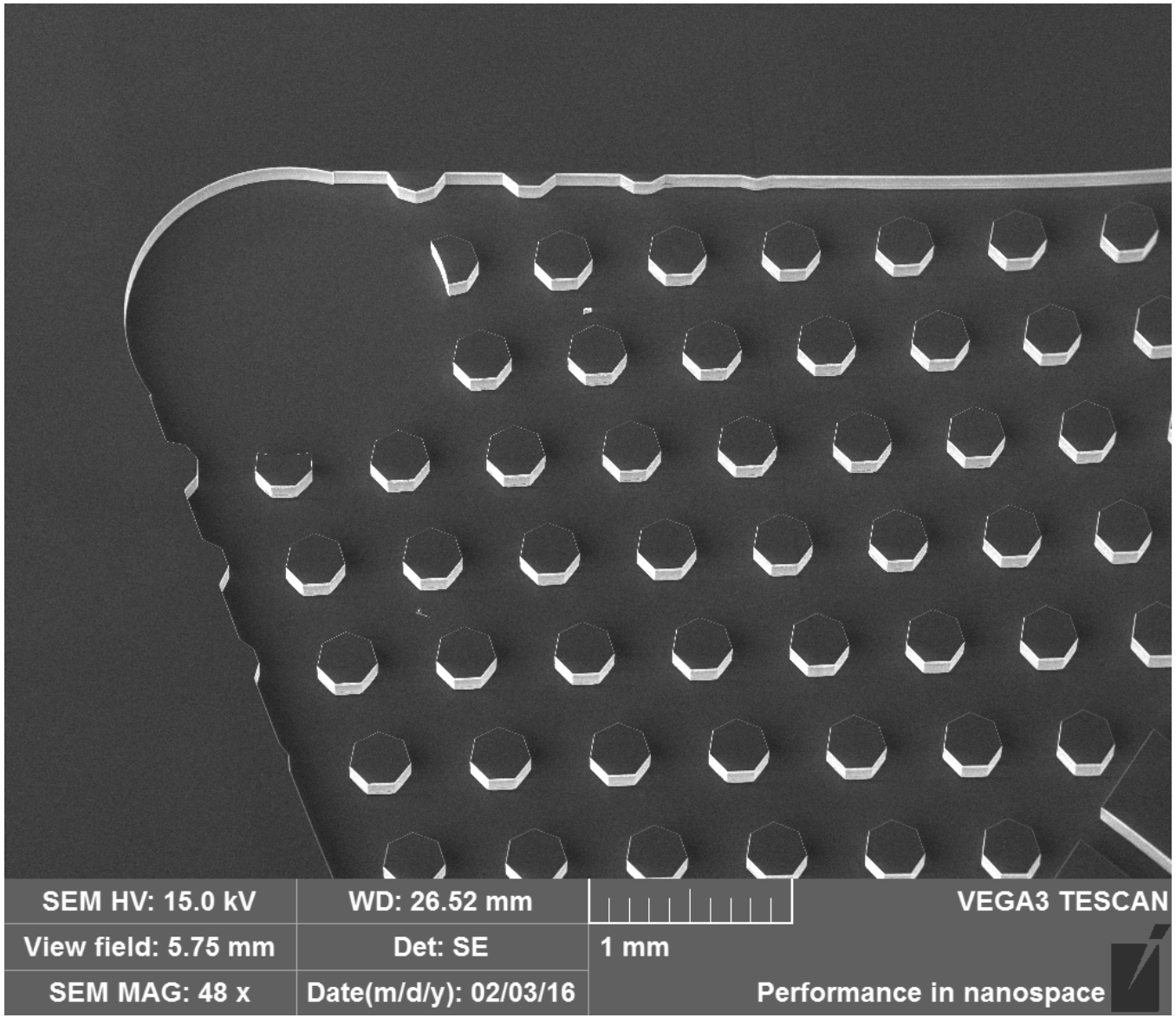
FONDAZIONE BRUNO KESSLER

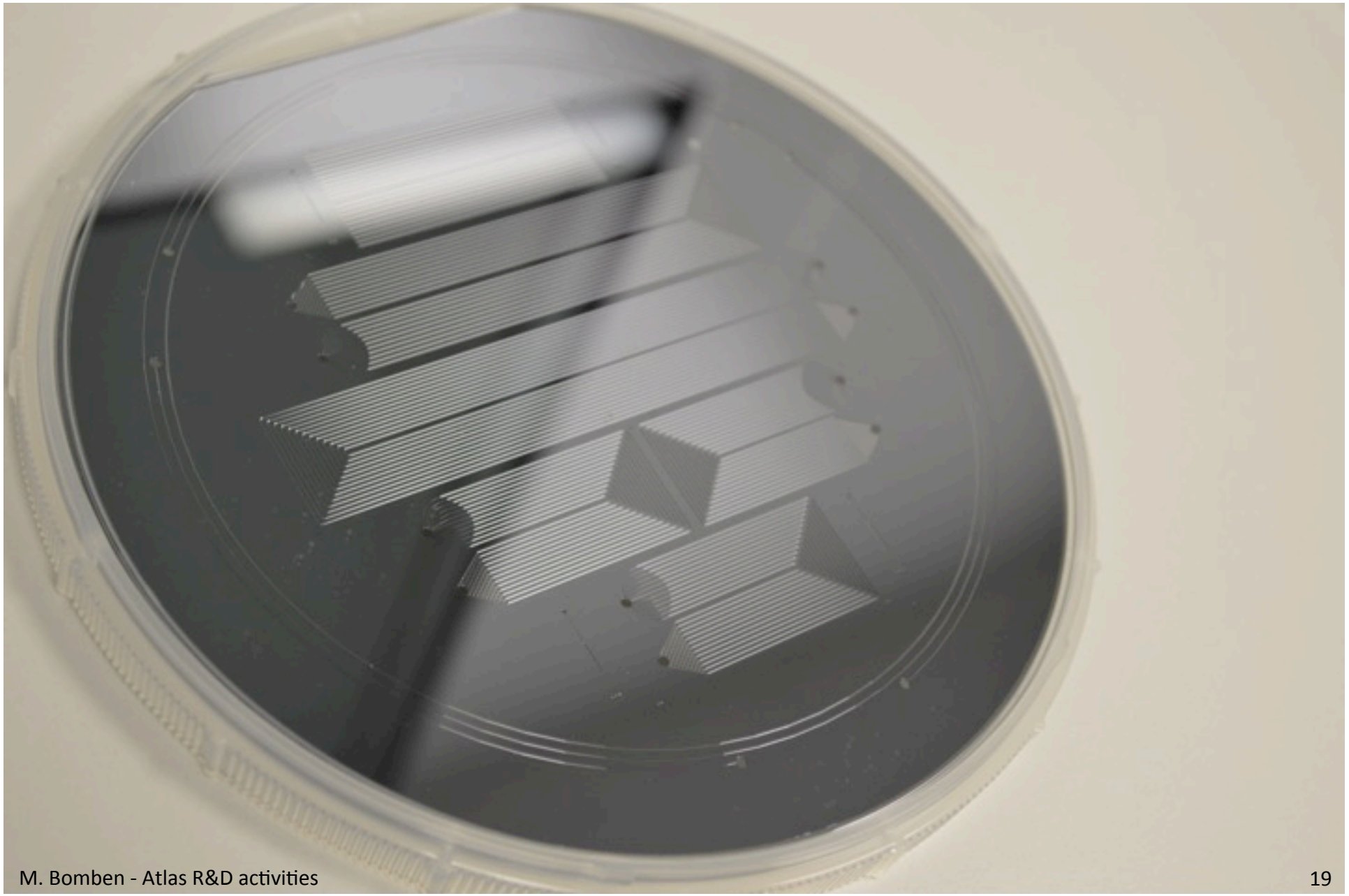
First pictures from FBK – curved channels



FONDAZIONE BRUNO KESSLER

First pictures from FBK - outlet



FONDAZIONE BRUNO KESSLER

Another picture