VDL Group

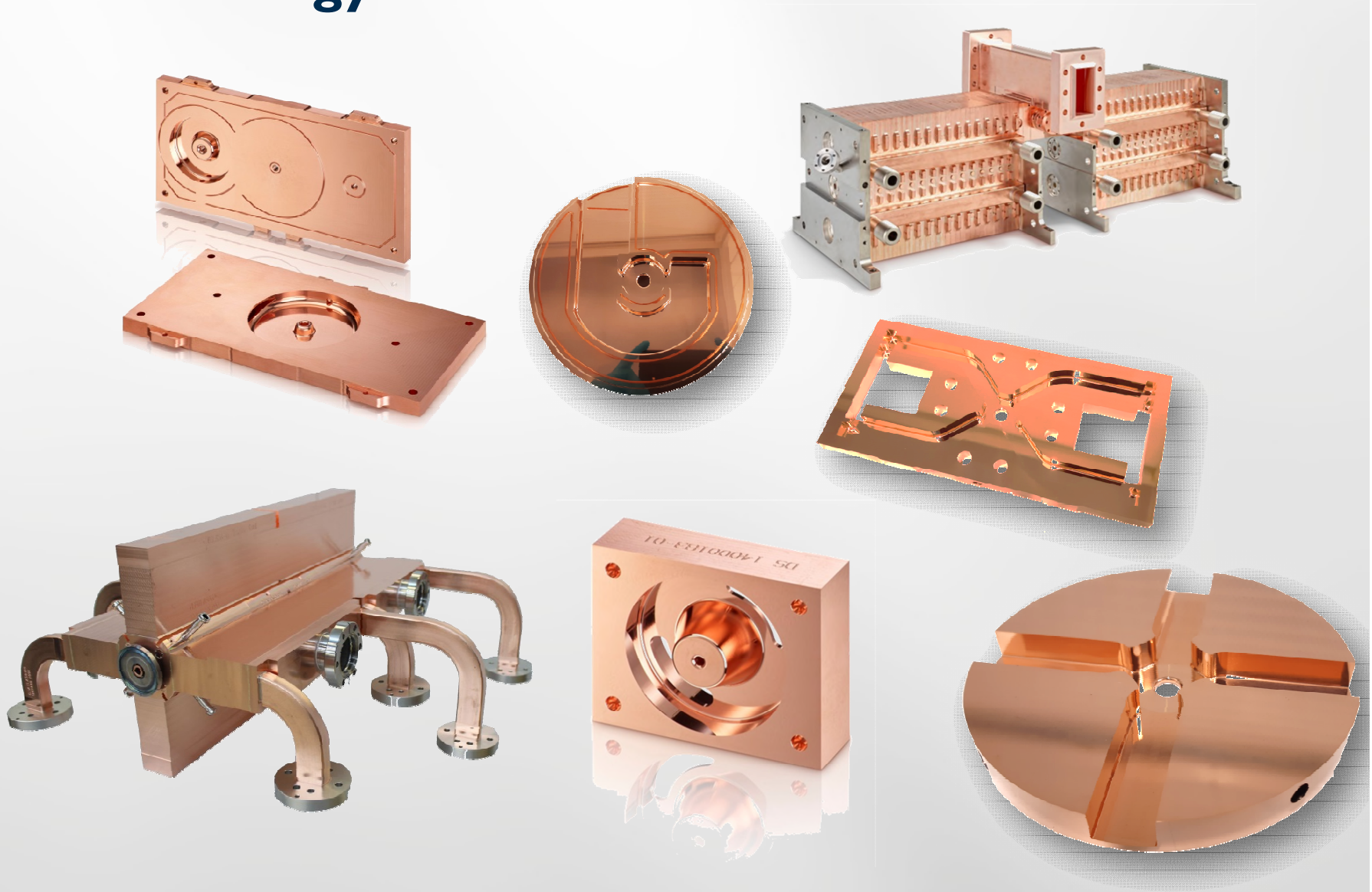
Strength through cooperation

Miranda van den Berg

Courtesy SwissFEL PSI

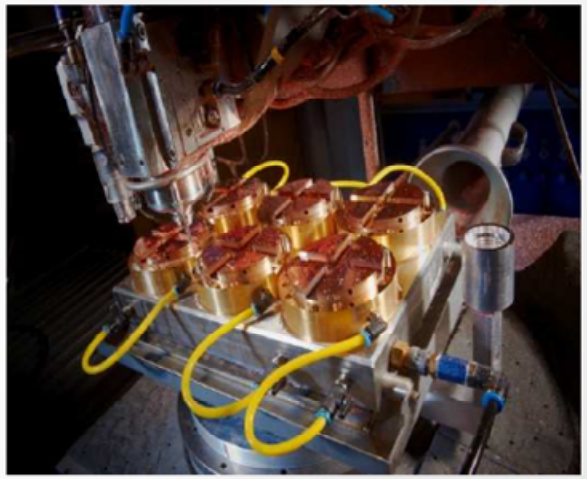
VDL ETG Science and Technology

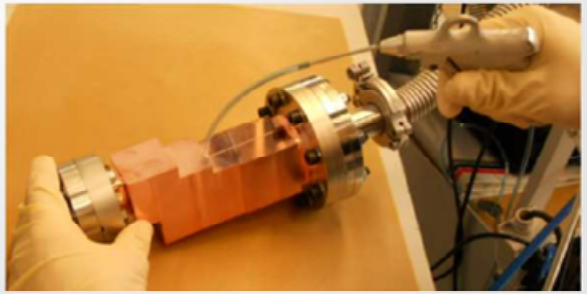
- Space
- Astronomy
- **Accelerators**



Most relevant competences are in-house

- High Precision Machining (HPT)
- Ultra High Precision Machining (UPT)
- Metrology
- Sheet Metal
- Welding/Vacuum Brazing
- Vacuum Technology
- Clean room assembly
- Electromagnetic technology
- Functional frames
- Complex Assemblies
- Cleaning
- Functional qualification
- Engineering
- Industrialization & Redesign





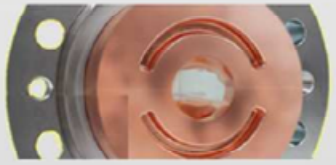
X-band RF components

- PET structures

- HP Loads

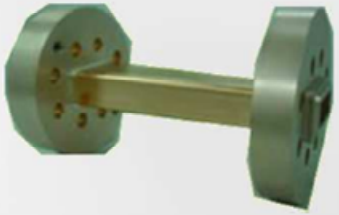
- Hybrids

- Pumping ports



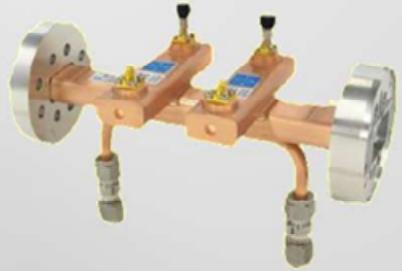
- Splitters

- Waveguides



- RF flanges

- Directional coupler



Why VDL Science & Technology?

- Big science projects and related spin-offs have business potential, for example
  - At this moment ESO E-ELT, CERN CLIC, PSI SLS, PSI SwissFEL
  - Its spin-offs (like ADAM, SMART*LIGHT, Cosine, and others) could grow to significant business levels
- VDL strengthens its (technical) competences via S&T to better enable our mainstream businesses
  - For example, teaming up with PSI and CERN provides crucial accelerator (network) knowledge to support our existing customers and to create opportunities for new start-ups
  - Cross synergy: DIFFER - heat pipes, PSI – TFS smart-stage, PSI – VDL Bus, ESO/TNO – actuators and positioning
  - Strengthening our technology roadmap (eg precision machining, vacuum, handling, positioning, functional qualification)
- VDL continuously renews its sources of inspiration & innovation (applied research)
- Excellent marketing tool for the VDL Group

Accelerator spin-offs - applications

Accelerators

Electron

- Low energy application *(large market)*
- Material treatment *(existing / growing market)*
- E-beam Welding *(growing market)*
- SEM/ TEM *(existing market)*
- Fundamental research *(niche market)*

Generating radiation

- Collision with target to generate X-Ray *(existing and large market)*
  - X-ray imaging *(large market)*
  - Tumor treatment *(large market)*
  - Sterilization *(existing / growing market)*
  - Security *(proof of concept)*
- Free Electron Laser wide range of wavelengths *(growing market)*
  - Materials and biological research *(growing market)*
  - Light source lithography *(ideas)*
  - Defense (USA) *(ideas)*
  - Fundamental research *(niche market)*

Proton

- Tumor treatment *(small but growing market)*
- Materials Research *(small market)*
- Proton beam lithography *(ideas)*
- Fundamental research (niche market)

Other elements

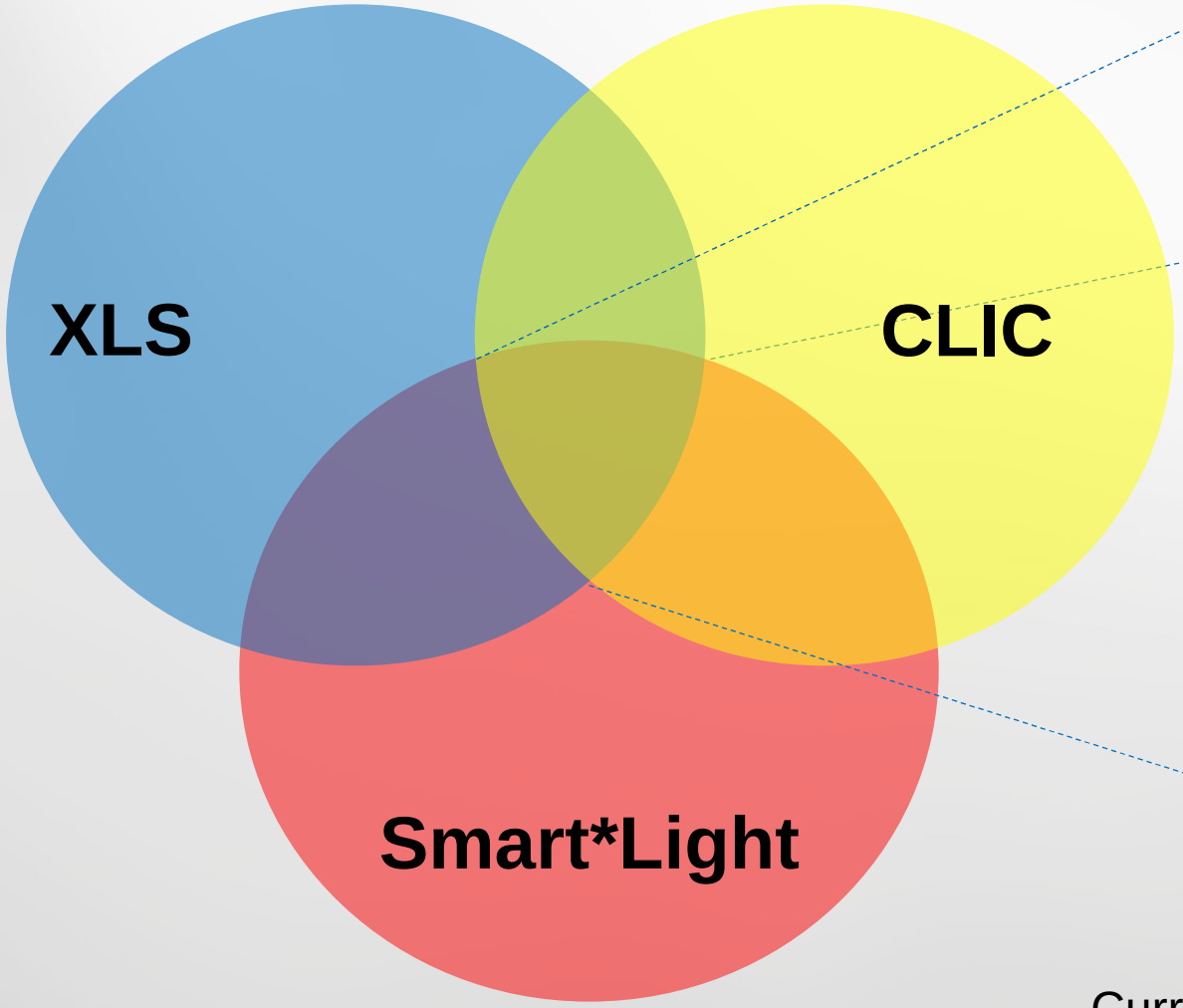
- Tumor treatment *(proof-of-concept)*
- Material treatment *(growing market)*
- Fundamental research *(niche market)*

Normal Conducting X-band

2019, VDL Science & Technology

Synergy

Multiple X-band projects



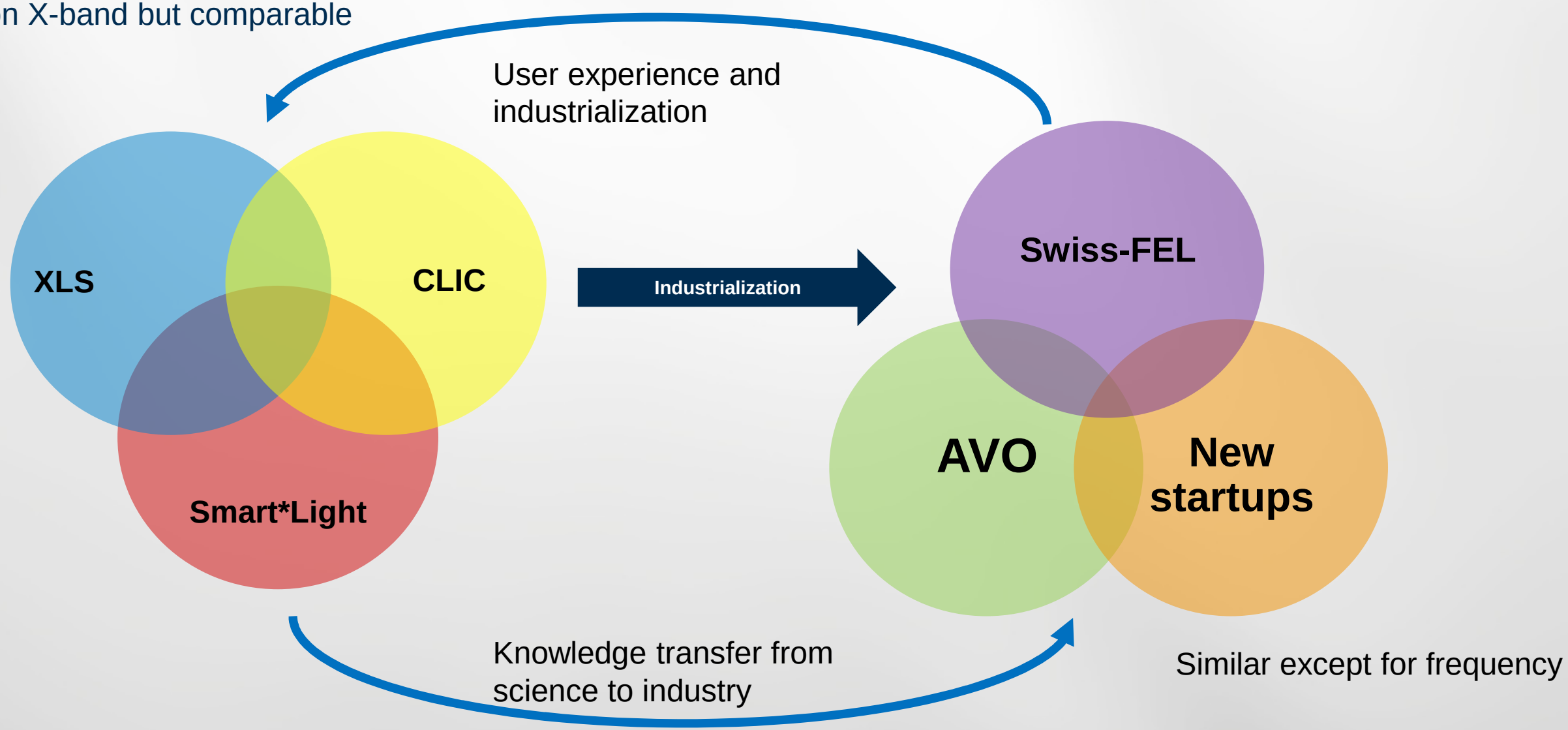
- X-band
- Normal conducting
- High gradient
- Cu-OFE
- Brazing

- Linac
- Pulse-compressor
- Pumping ports
- Bi-couplers

Current: Copper components and their (sub)assemblies
Future: High power tested modules and systems

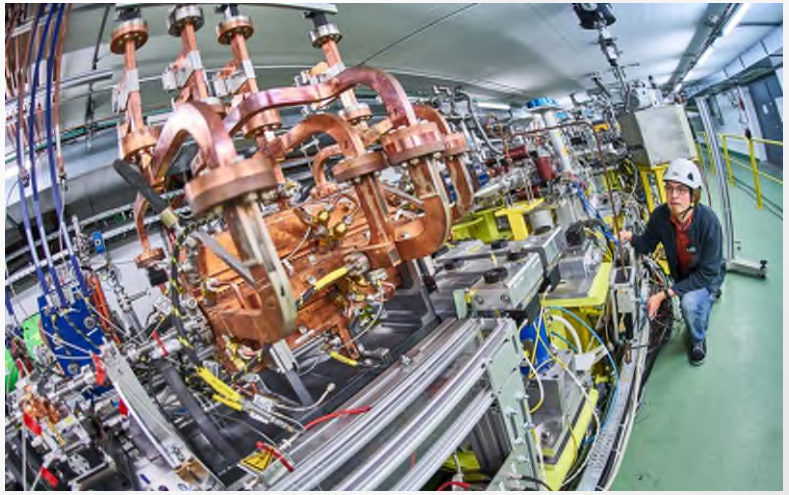
Spin-offs

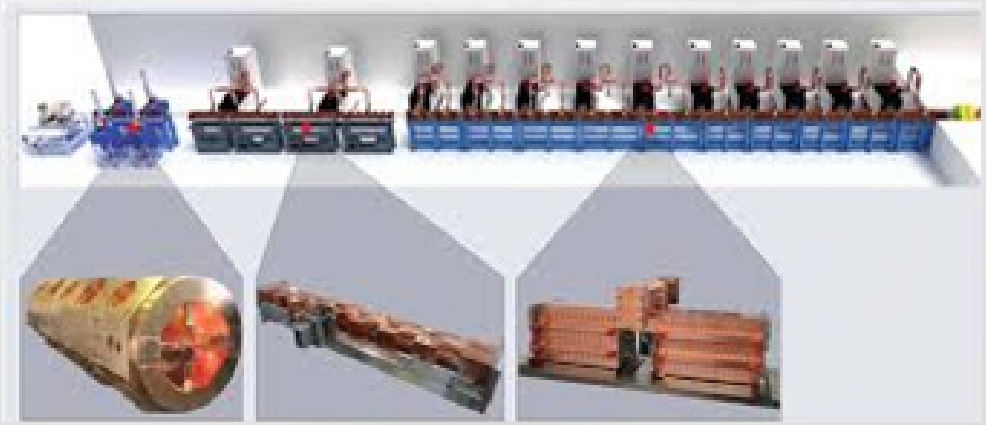
Non X-band but comparable



Requests to industry from spin-offs

- Manufacturability
- Standardization → Modular design
- Series production on module level → system integrator
- Testing
- Cost optimization
- Business development





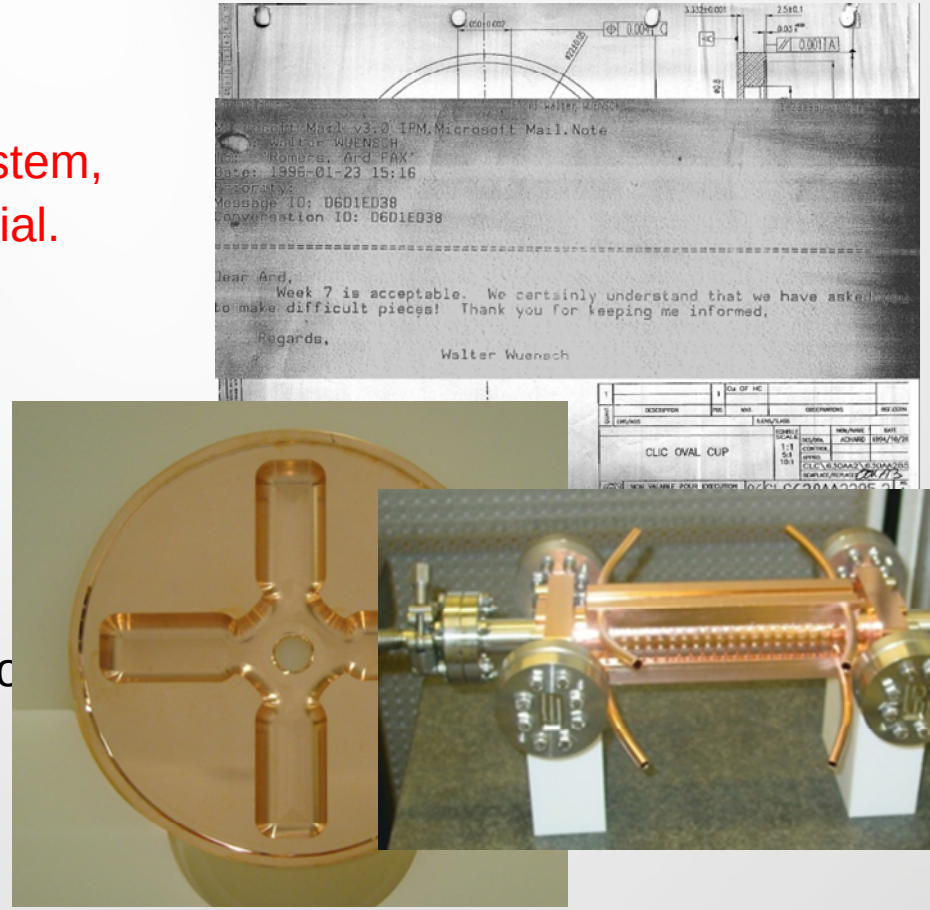
Joined development with academia

DfX

For a successful industrialization of a modular X-band accelerator system, a joined early development between industry and academia is essential.

Academia/science has fundamental and functional knowledge

- Manufacturing technology → relax tolerances where possible
- Joining technology → brazing instead of bonding
- RF testing → Relationship between geometry, tolerance and functio
- Tuning → reduce labor intensive manual tuning
- Serviceability and End-of-Life decommissioning → design



Realisation

Multiple X-band projects