



# Move from Electrons beam to Laser for Titanium welding

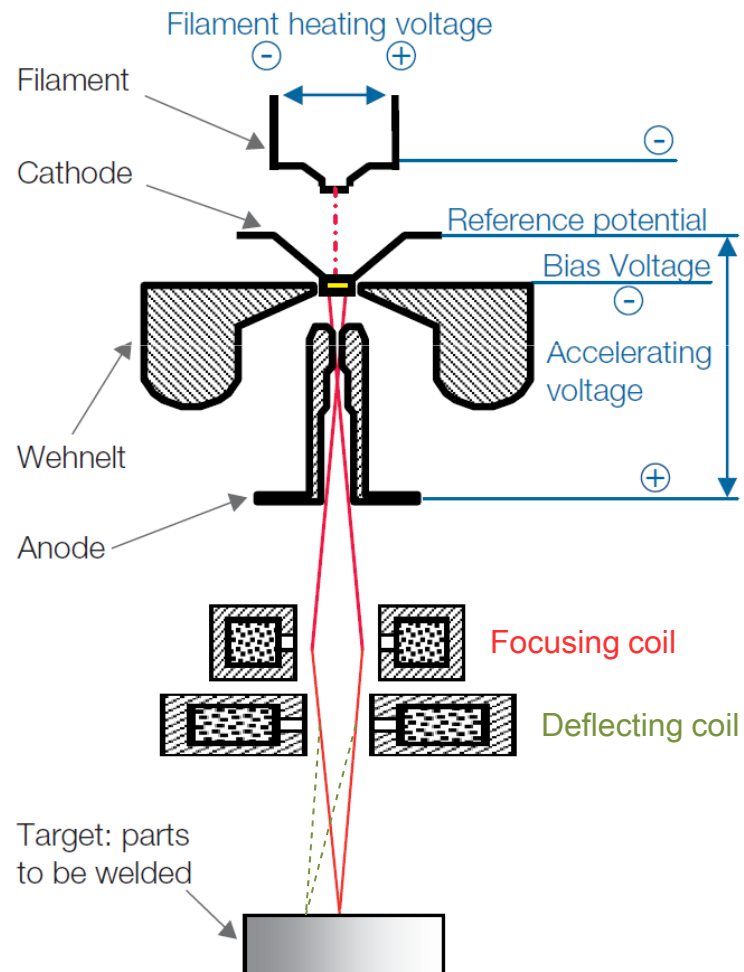
Michel Normandon

SAFEL

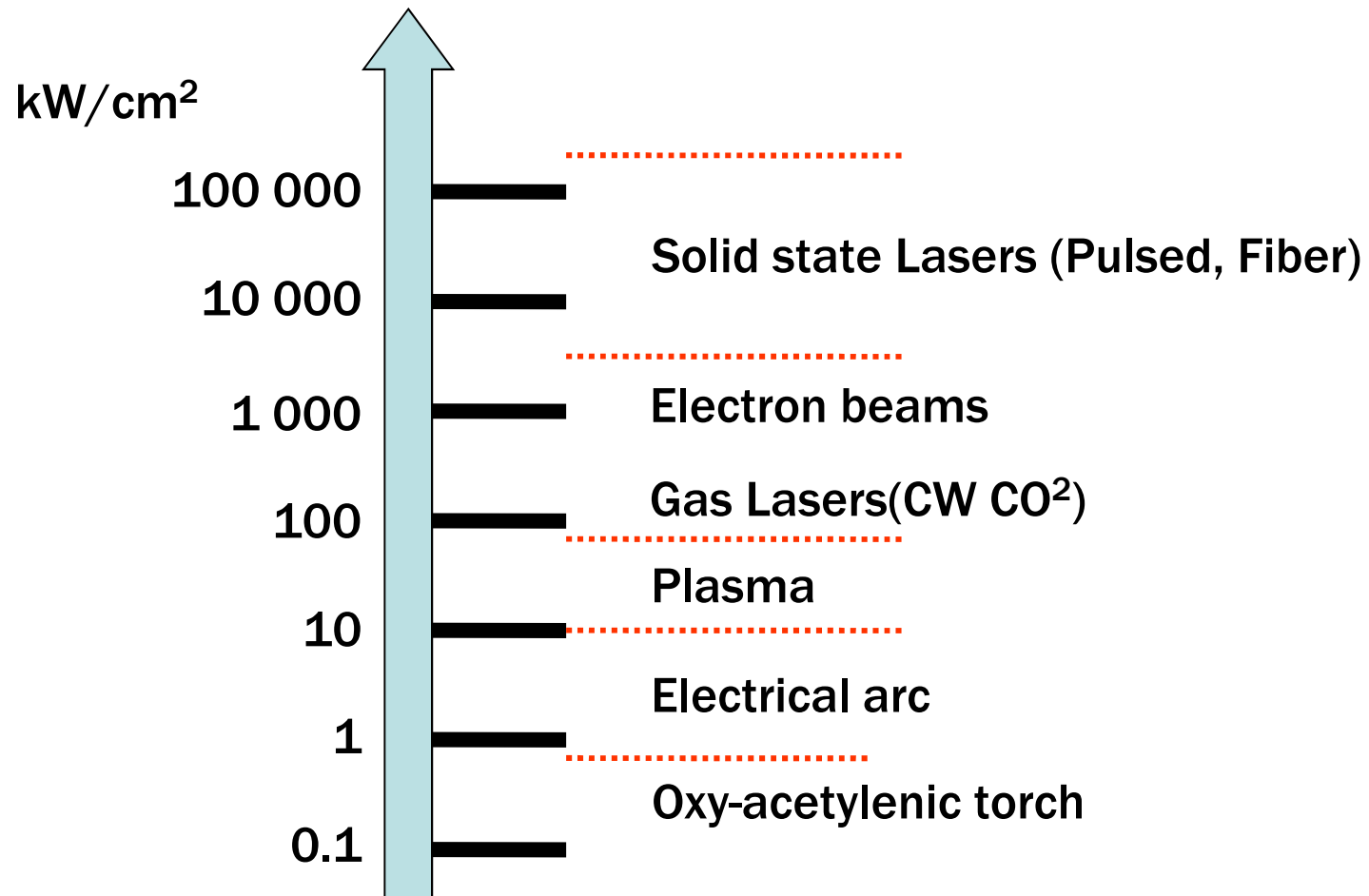
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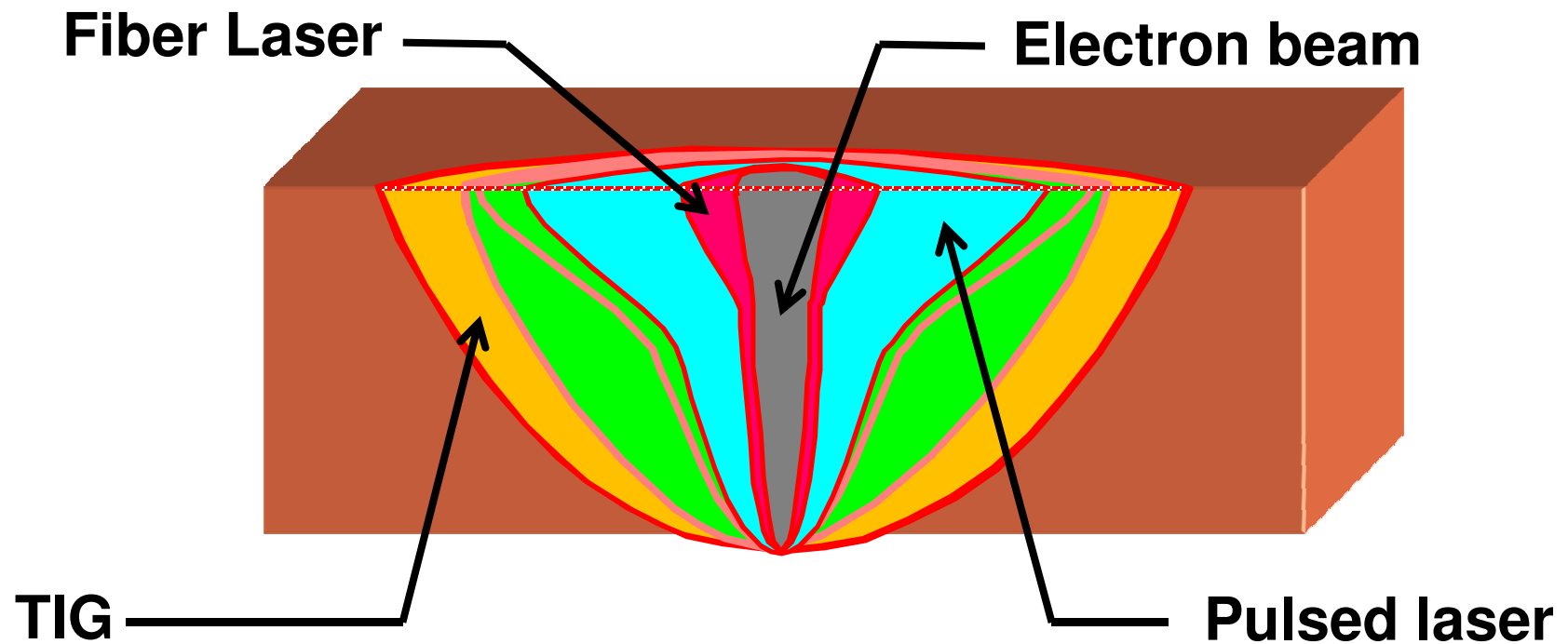
# Electron gun principle



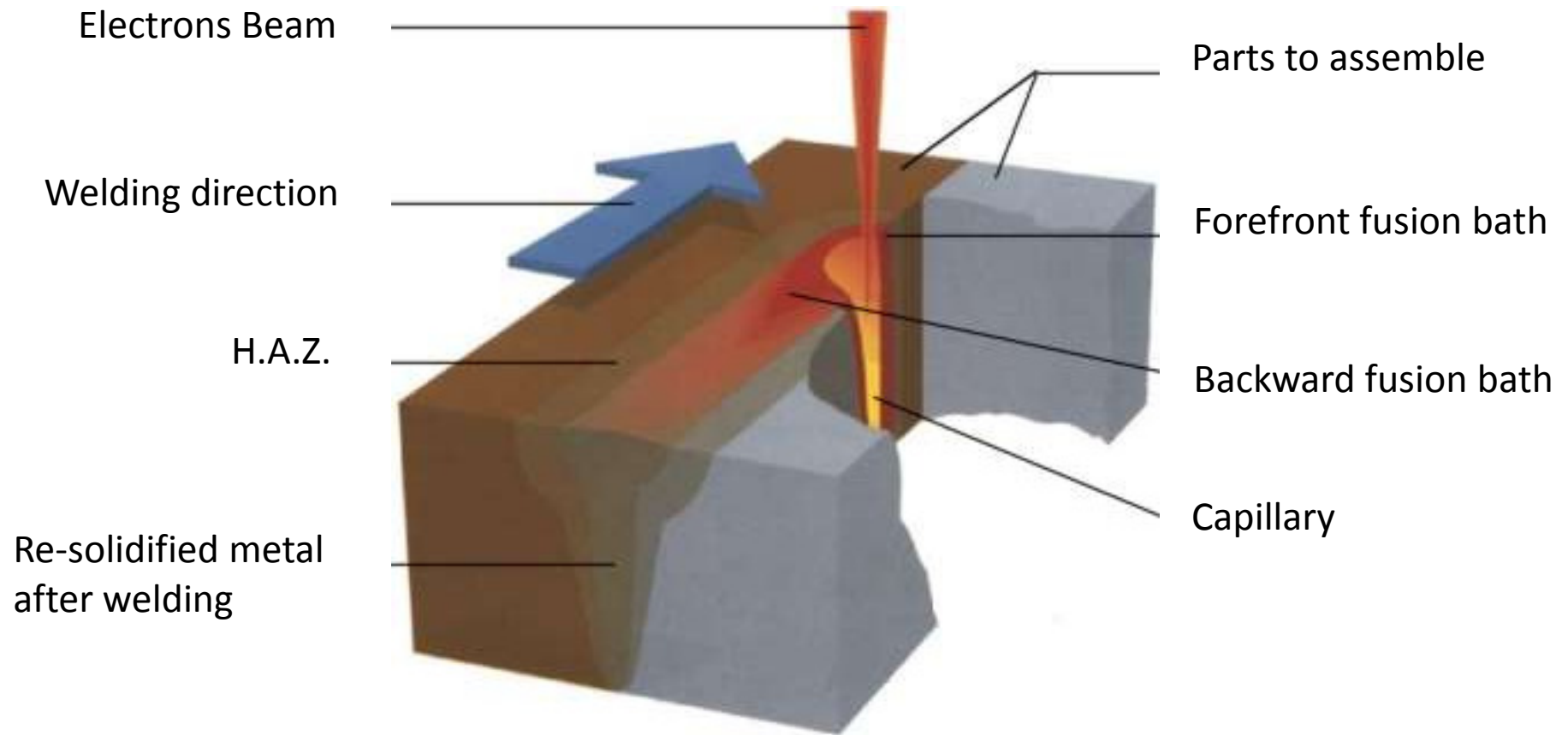
# Comparison between different energy sources



# Comparison of Melted Zones



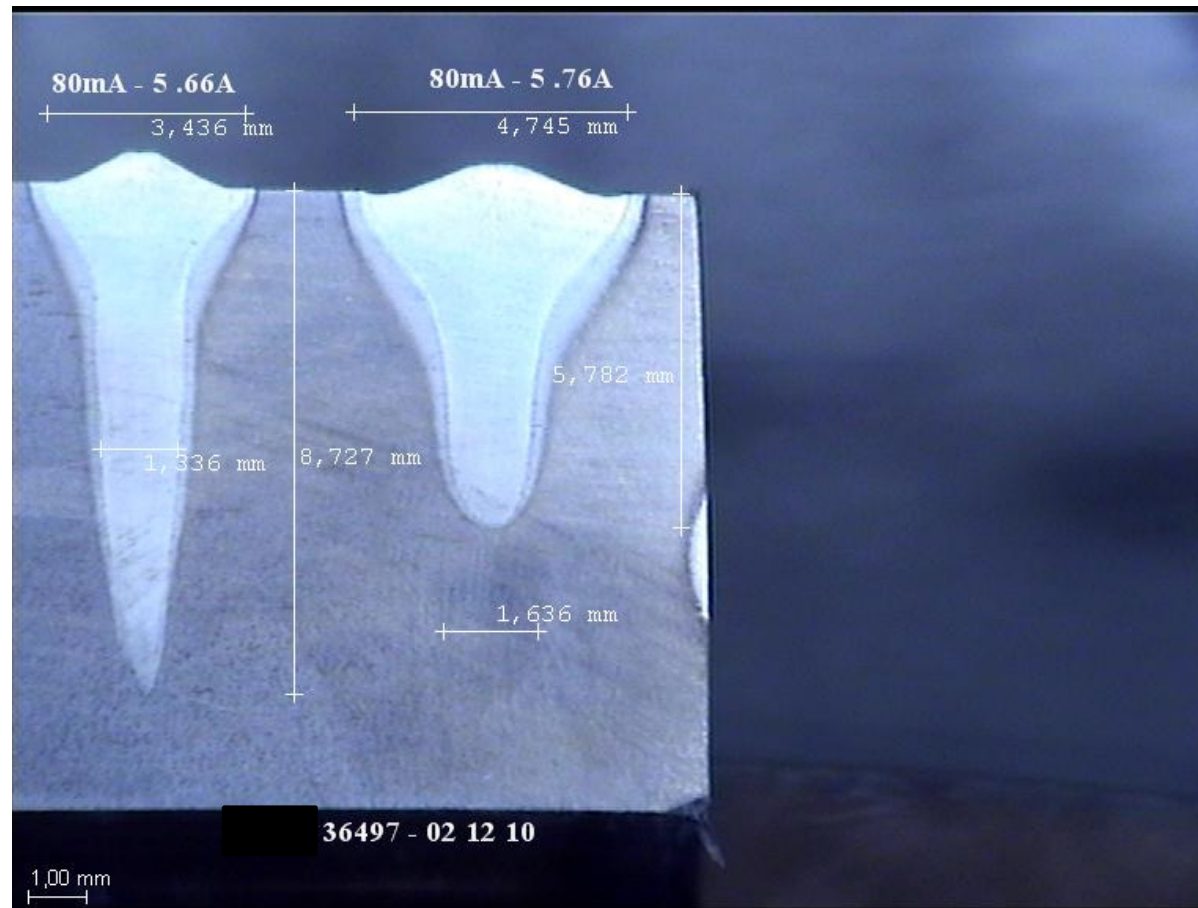
# High energy beam welding principle



# Electrons beam depth of field

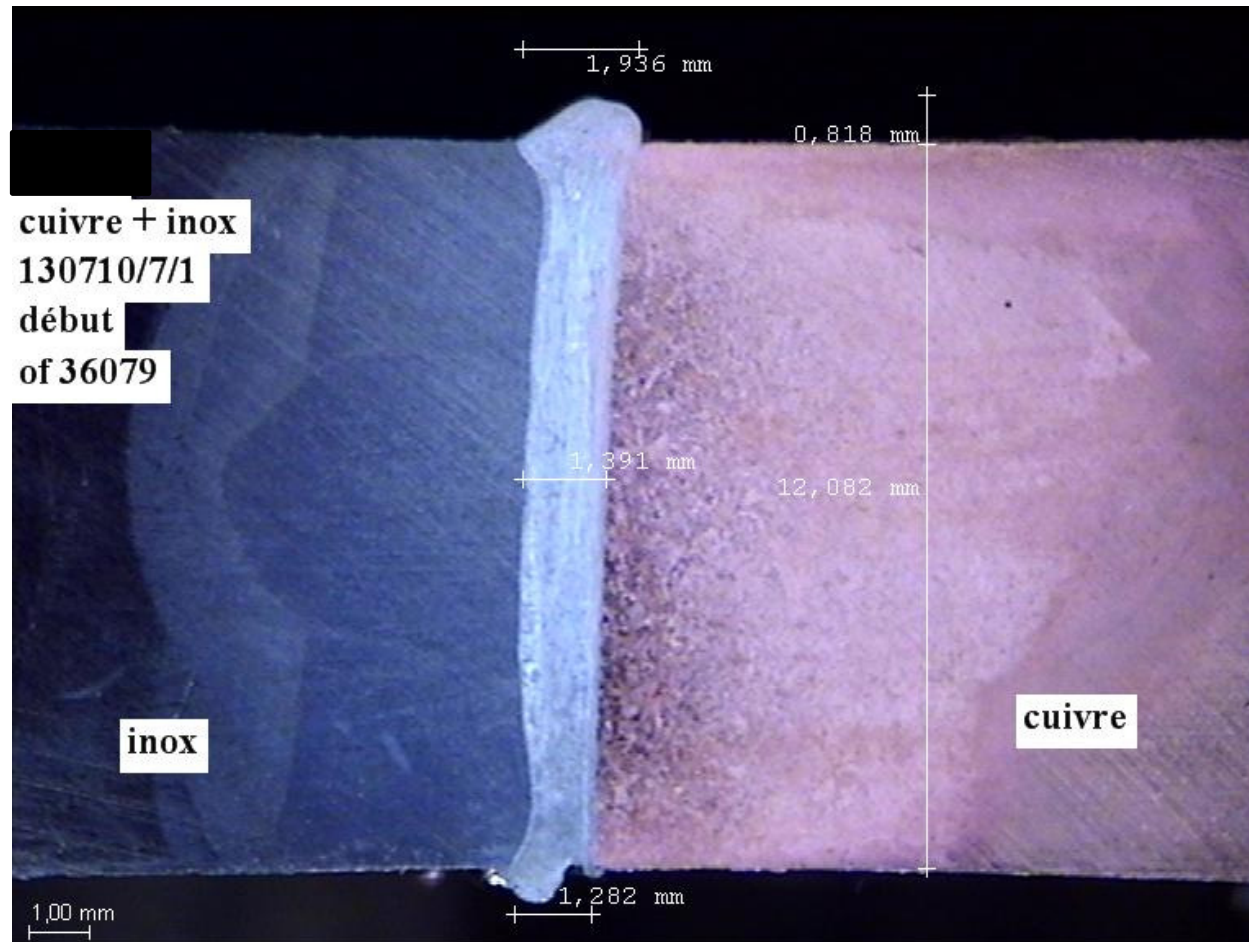


# Focusing lens current effect on weld

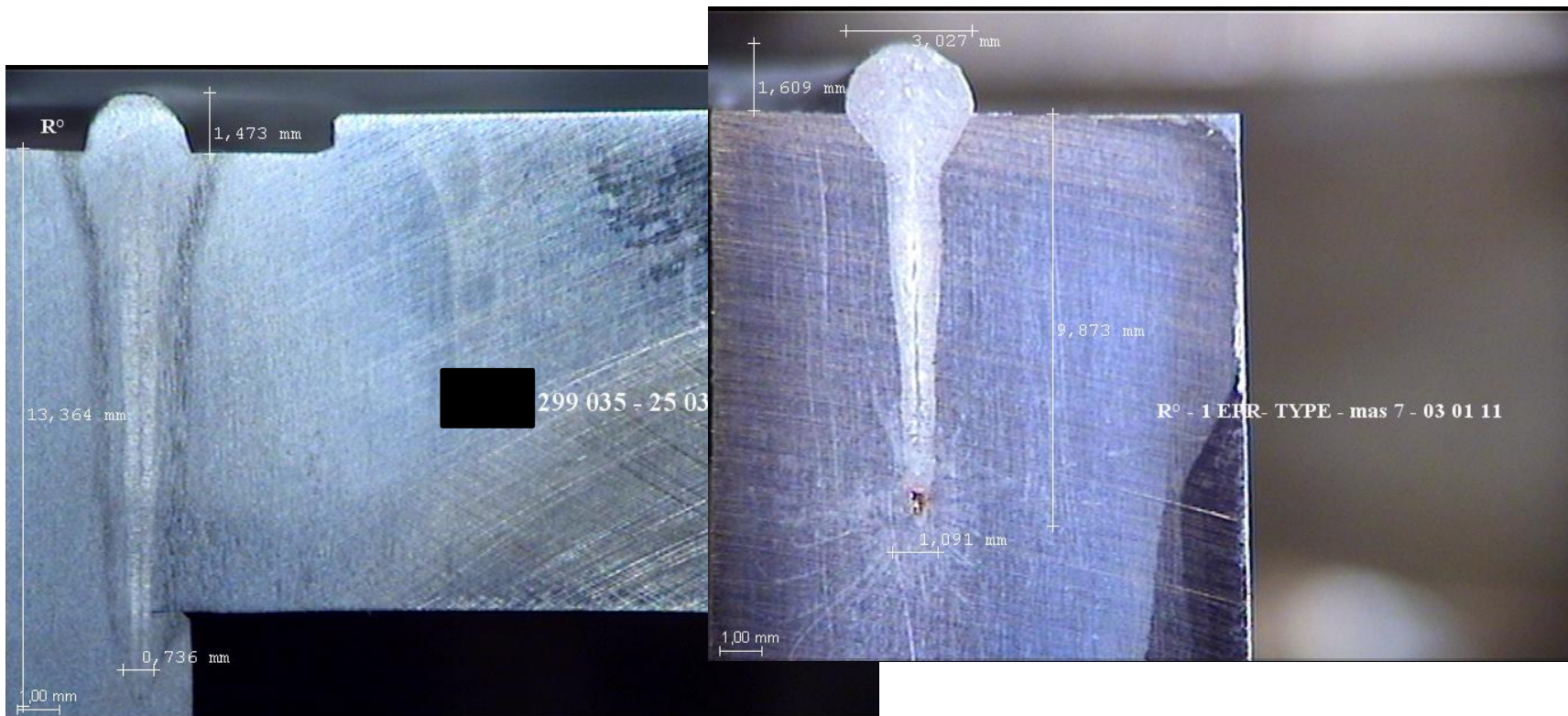




# Deep heterogeneous E-beam weld



# E-beam wobbling benefits on welds



# Electrons beam specificities

## INCONVENIENTS

- Needs vacuum
- Generates X-Rays
- Sensitivity to magnetism
- Cycle time (depends on pumping capability)

## BENEFITS

- High efficiency – 95%
- Compatible with all weldable metals
- Power range (up to more than 100kW)
- Focussing flexibility

# Laser beam specificities

## INCONVENIENTS

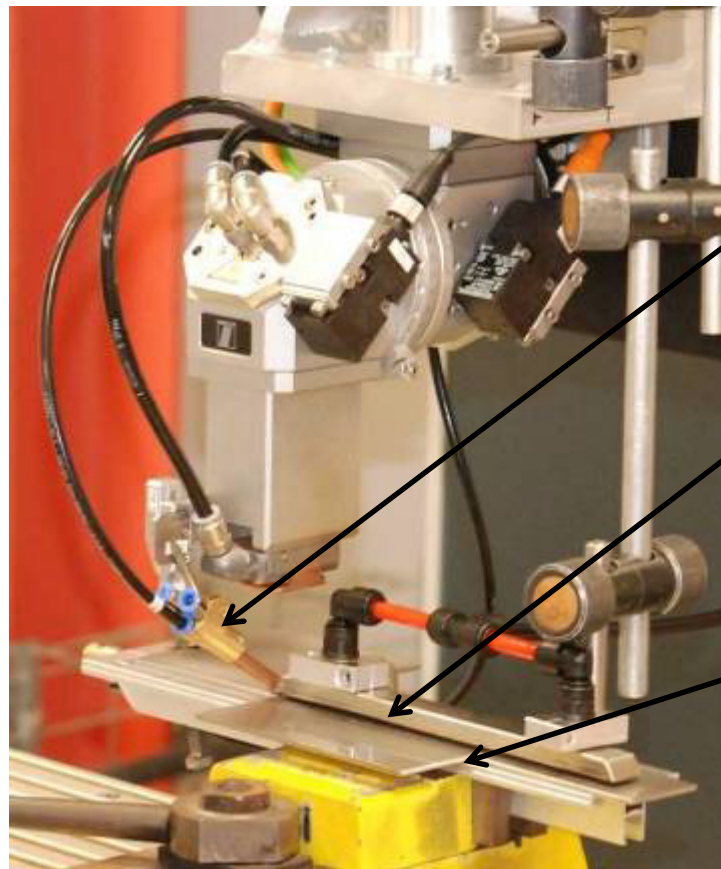
- Needs gas protection
- Efficiency
  - 3 to 10% YAG-CO<sub>2</sub>
  - 20 to 30% Disk-Fiber
- Sensitivity to metal type and surface
- Eyes protection

## BENEFITS

- Works in regular atmosphere
- Flexibility in beam transportation
- Cycle time
- Compacity
  - Specially Fiber lasers

# Move to laser welding

Protection gas setup, a critical aspect



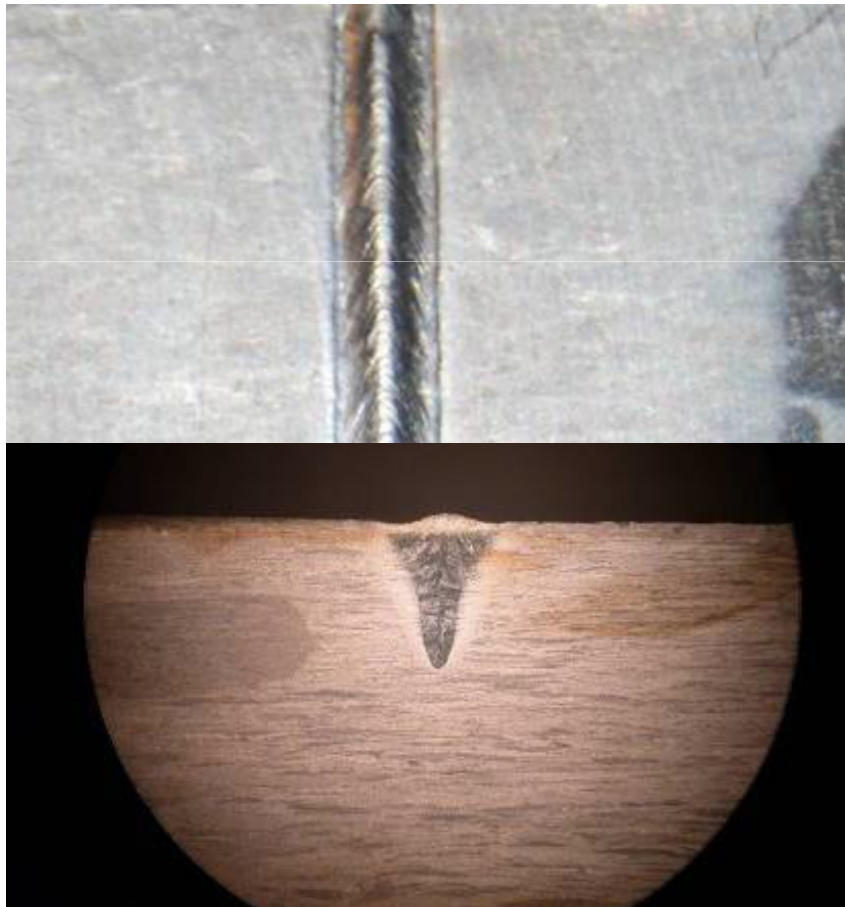
Helium Nozzle

Argon Follower

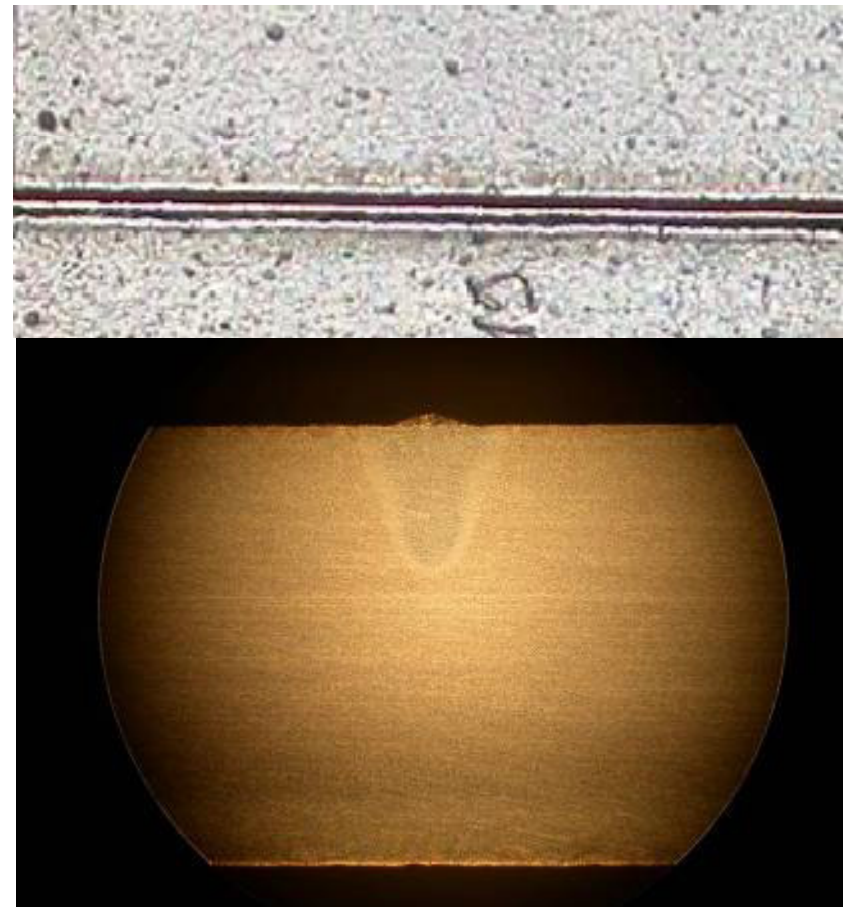
Argon back side

## Move to laser welding

**E-Beam 8kW – P=2.48mm**

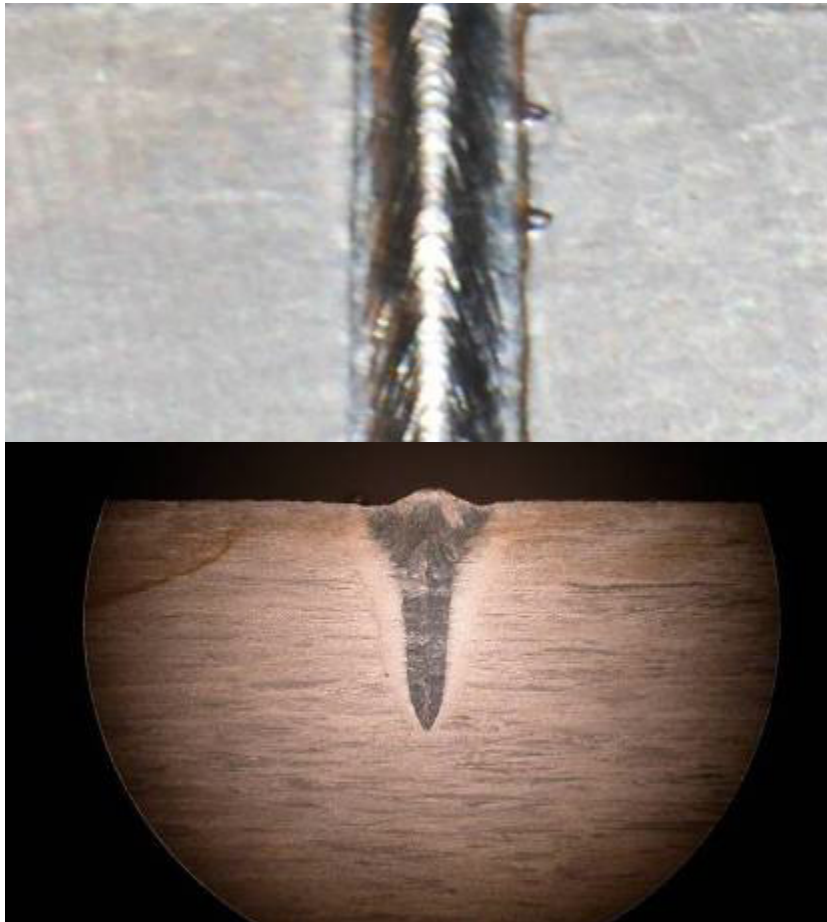


**Laser 100W – P=1000W**

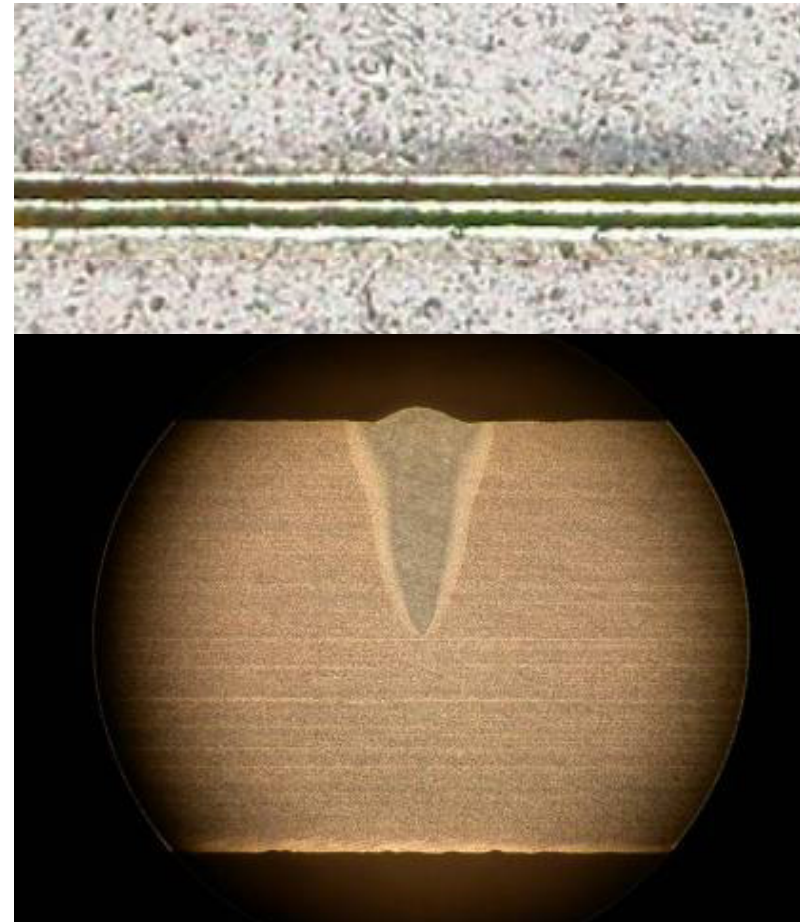


## Move to laser welding

**E-Beam 12kW – P=4.55mm**



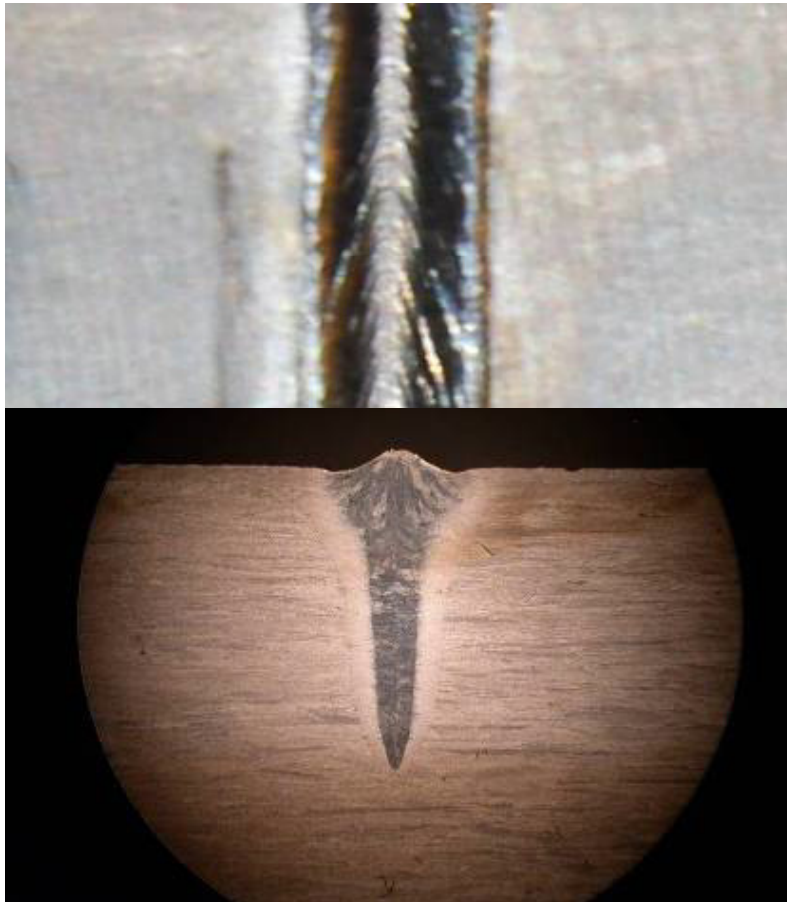
**Laser 1500W – P=3.09mm**



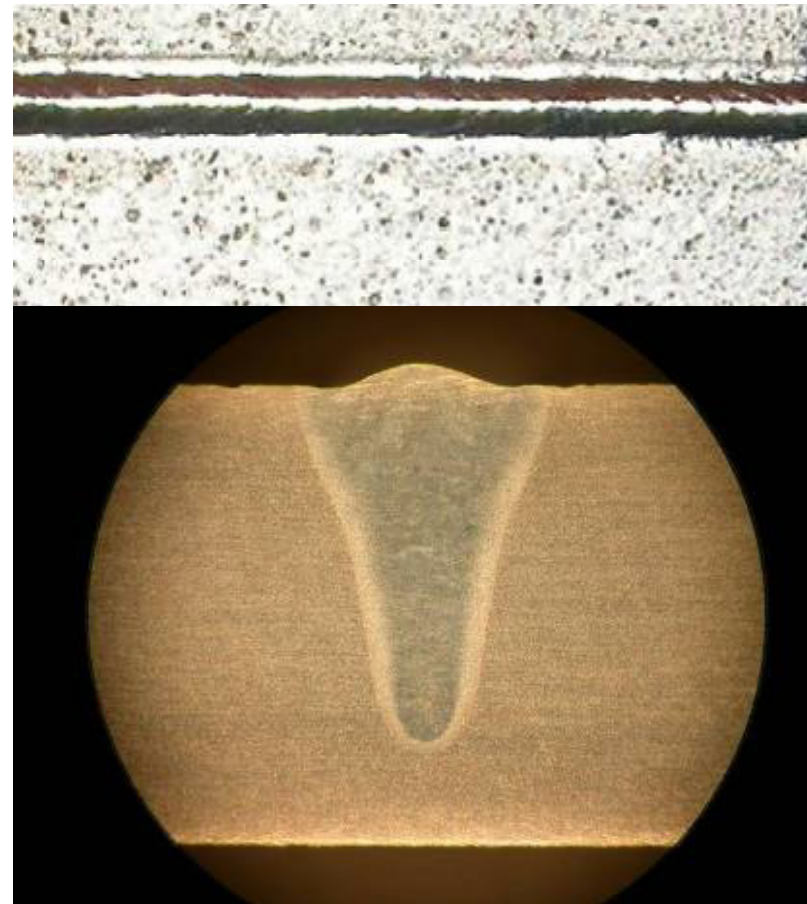


## Move to laser welding

**E-Beam 16kW – P=5.56mm**



**Laser 2000W – P=5.00mm**







# Electron beam installations



## Conclusions

- Replacement of Electrons beam welding by laser welding proven to work for Titanium up to 5mm
- Cycle time X 2
- Costs saving around 45-50%