THALES

Experience from THALES MIS

Successful collaboration between Technology platforms and industry: conditions, constraints and perspectives

Thales Group

Over **80,000** employees

68 Countries Global presence

1 bn € Self-funded R&D*

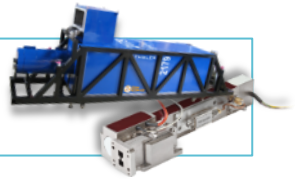
* Does not include externally financed R&D

Sales in 2018 **19** bn €

MIS, Microwave & Imaging Sub-Systems

3 Business Segments

DEFSI



N°1 WORLDWIDE
for scientific and industrial amplification

N°1 EUROPE
for telecom and defence tubes

LONG STANDING PARTNER
with the most prestigious research centres and laboratories

SPACE

N°1 WORLDWIDE
for space amplification

ORBITAL OPERATION
860 million cumulated hours

TUBES IN ORBIT
17 700

RAD

A WORLDWIDE LEADER
for radiological analog and digital imaging

PRODUCTION CAPACITY
OVER 15 000
detectors per year

50% OF ALL
X-ray exams worldwide use a Thales detector

OPEN

THALES

Our global presence

RF & Microwave sources
Production centres

Radiology
Production centres

Sales offices

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THALES

Vélizy (France)

Design and production of Traveling Wave Tubes, klystrons, gyrotrons, space amplifiers, defence amplifiers, energy storage...

29 000 m² of industrial surface, including **2 600 m²** of clean rooms

ISO 9001, EN 9100, AQAP 2110, ISO 14 001 & OHSAS 18001

780 employees
active on January 1, 2019

82 patents

WORLD #1 FOR SPACE AND SCIENCE TUBES
EUROPEAN #1 FOR TELECOM AND DEFENSE TUBES

Thonon (France)

Production of grid tubes, TWTs and various sub-assemblies

25 000 m² of industrial surface, including **240 m²** of clean rooms

ISO 9001, ISO 14 001, OHSAS 18001

270 employees
active on January 1, 2019

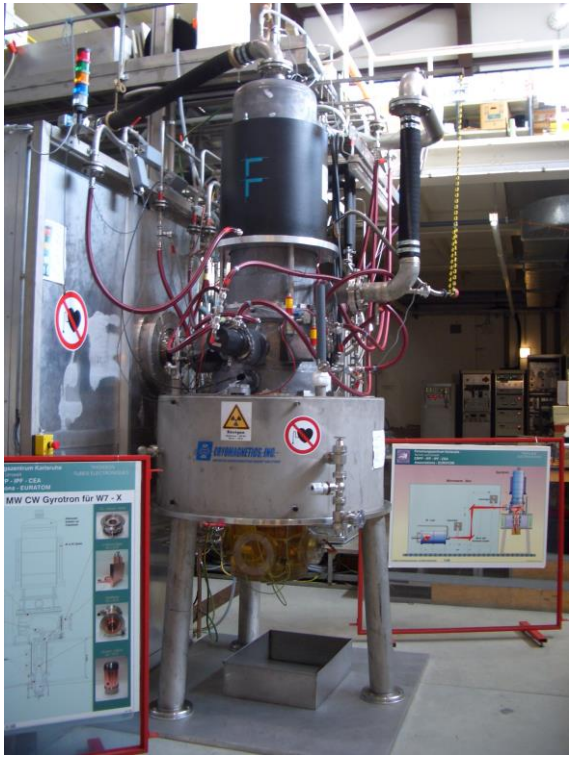
59 patents

WORLD #1
FOR INDUSTRIAL AND BROADCAST TUBES

Experience from THALES MIS: Example Gyrotrons 1/2

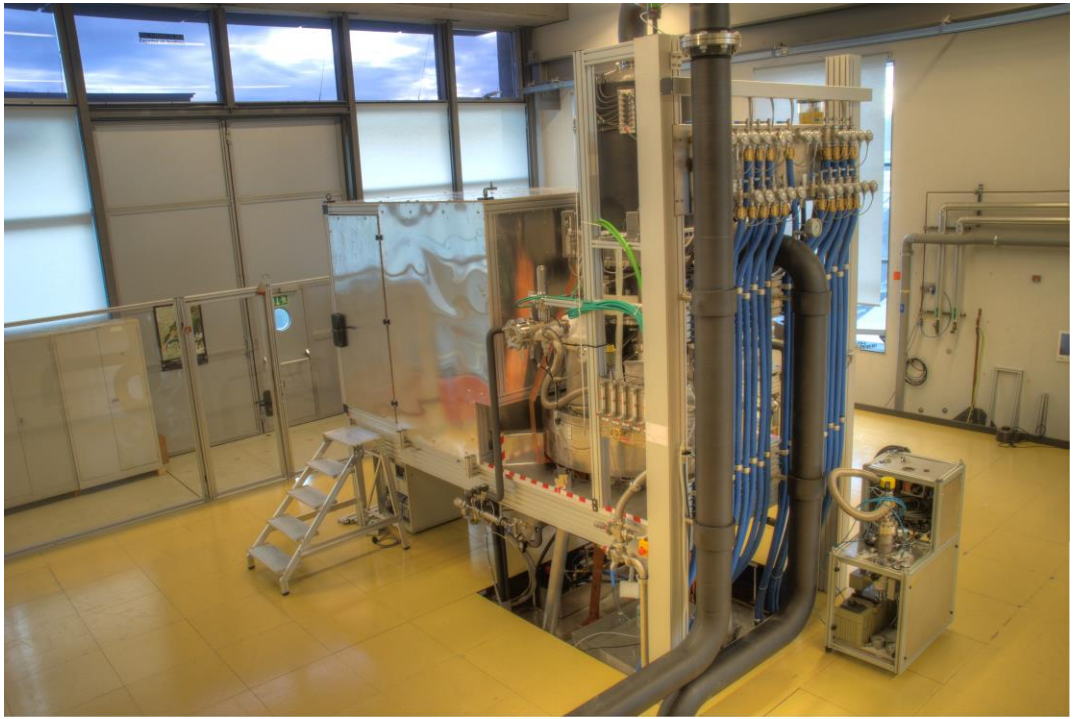
Gyrotrons collaboration (KIT/EPFL):

- Studies:
  - EPFL: RF structure and gun
  - Thales: manufacturing drawing and thermo mechanical studies
  - KIT: mode converter and transport
- Global tests:
  - Thales: assembly of the tube
  - Final high power tests:
    - at EPFL for ITER
    - At KIT and Greifswald for other tubes



Test stand at KIT

Experience from THALES MIS: Example Gyrotrons



Test stand at EPFL

Test stand at IPP Greifswald

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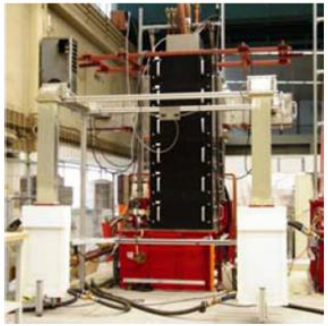
Experience from THALES MIS: Example KLystrons

TH 1801 with DESY

Thales used Desy infrastructure in order to accomplish final RF pulse power at full length for TH 1801

Multi-beam klystrons on DESY programs

- TH1801: 10 vertical MBKs have been built for DESY since 2000
  - 10MWp, 1.5ms – 10 Hz, 63 to 65 % efficiency
  - Klystrons in use at FLASH, PITZ and MBK test stand
  - > 60 000 hours of operation at different conditions
  - Tube stability has been secured thanks to several design improvements



- TH1802 : horizontal L band Multibeam klystron
- 27 RF stations in the XFEL tunnel layout
  - Tunnel components : klystrons, pulse transformers, aux power supplies etc …
  - Horizontal position
  - Waveguide distribution filled with dry air
  - Components are not accessible during accelerator operation

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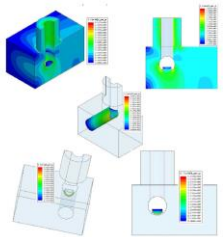
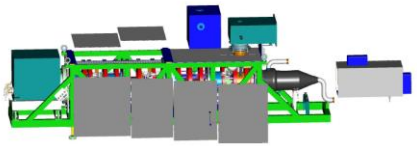
Experience from THALES MIS: Example KLystrons

TH 2179 with CNRS/ IPNO

- Development of a Klystron of 2,8 MW 352 MHz
- collaboration Thales/CNRS specially CNRS worked on:
  - The design of the transition between waveguide/coaxial line (output circuit)



  - Studies and design of RX shielding for the tube



Experience from THALES MIS: Example couplers and test bench

- For manufacturing and tests of XFEL couplers, Thales, Research Instrument, LAL and Desy work in a collaboration spirit in order to deliver couplers.
- We provide the test bench to CNRS , from main up to the exit window of klystron. CNRS provide every thing after : all waveguides en instrumentation relative to the coupler conditioning.

Experience from THALES MIS: others

Thales have a lot of collaboration contracts with laboratories:

- CEA for development of new klystrons at 1 GHz (Kladistron)
- CERN for high efficiency tubes
- CNRS with common Phd thesis
- Material properties investigations with universities etc….

Experience from THALES MIS: general considerations

Some collaboration contracts help us to find/adress new markets/projects

- XFEL couplers and lessons learned were benefit for the obtention and achievement of LCLS2 coupler contract.
- EPFL collaboration help Thales to identify new markets for Gyrotron in NMR domain.

Different type of collaboration occured:

- Studies for the development of Thales products (example TH2179)
- Use of Technical Platform when not available at industrial factory (example Gyrotrons)
- Use of industrial platform for tests of concept for labs (example CEA on Bonding process)

Experience from THALES MIS: general considerations

These general considerations express my personal and only my vision.

An effective collaboration is a collaboration where all parties involved have some benefits, this could be achieved in:

- Prices
- Technical improvements
- Exchange in information on future programs

But:

- Prices: is not only to be at the lowest prices. Lower prices are achievable when involve from the original design (design to cost)

Experience from THALES MIS: general considerations

An effective collaboration is not a collaboration where one party should take the place of another one

- TP is not for taking place of industrial partner
- Industrial have to listen partners
- Every body have to thrust other parties

Obstacles to collaboration:

- One of the main obstacle could be the IP between industry and Labs.
  - When investing in a development, industry is not "happy" if technical data are given in call for tenders or during execution of program to competitor. Sometime even small details could have strong impacts (it happens that some details arrive to competition which have been cost effective, example)