Task 4.3 Klystron and Modulator technology

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Recent information from discussion with the companies

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Recent information from discussion with the companies

CPI

no news with respect to last presentation in June

- X-band klystrons
  - Deliveries of 7 MW, 400 Hz tubes for DESY
  - Tests of this tube up to 10MW to start
  - Design of the 20 MW Klystron using GSB/Dakota code
  - High efficiency 50MW tube with CERN
- Preliminary studies of 15MW C-band high repetition rate klystron (5.996 GHz)

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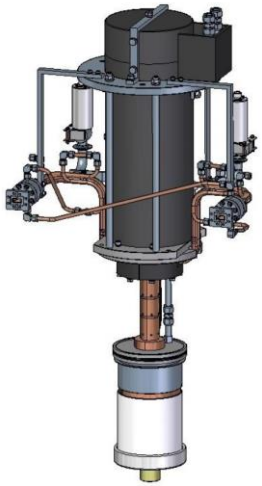
Recent information from discussion with the companies

CANON

- X-band klystrons
  - 8-10 MW high-efficiency (upgrade in collaboration with CERN of existing 6 MW tube)
    - Simulations in CST-3D and FCI show output power of 8.2 MW, at 154 kV and 94A (~56% efficiency)
    - The mechanical design has not been started
    - Prototyping possible in 2021
  - 20 MW klystron, new design
    - Mechanical design of 20 MW tube finished
    - Prototyping to start after Summer with tests possible in 2020

CANON - 20 MW klystron, specifications



Frequency	11424 MHz (±1 MHz)
Peak Output Power	Target 20 MW (>16 MW for test specification of 1st prototype)
RF Pulse Width	1.5 μs max.
Pulse Rep. Rate	400 Hz max.
Beam Voltage	Design 265 kV (290 kV max.)
Beam Current	Design 170 A (195 A max.)
Drive Power	Design 120 W (400 W max.)
Efficiency	44%
Max E field strength in cavity	< 60.4 kV/mm (for 1.5 μs RF)
Height	~1.3 m
Weight	Klystron ~300 kg, Electromagnet ~800 kg

At 1kHz operation the average power of the RF and the beam will be 2.5 times higher
Modifications of the collector, windows and cooling circuits will be required for higher rep rate operation

Currently the frequency of this tube is American X-band, the interaction section design and RF windows has to be changed to match 12 GHz

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Modulator for dual-source operation – **Scandinova, JEMA**

3 alternatives in switching between the 10MW and 50 MW klystrons
(2 klystrons integrated in one modulator)

Alternative	Actions necessary for the switch	Approx switch time	Pricing/feasibility
Reconnection of HV-connector **Scandinova, JEMA**	Remove (part of) oil & open tank Disconnect one klystron and connect other Refill tank with oil Start heating filament Start pulsing	System completely OFF for the switch 3-5 hours	Cheapest option: One pulse transformer and minimal amount of power modules
Reconnection of primary connections **Scandinova**	Disconnect cables from one primary connections and move them to the other pulse transformer primaries related to klystron to be used	System in stand-by (filament heating of both klystrons ON) 1-3 hours	More expensive: two optimized pulse transformers will be used
Remote switching between 2 klystrons **Scandinova**	No need for any reconnections Most practical solution	Few msec	Most expensive: extra power Modules in the same system

System could be based on K500 platform, but klystron tank, control system, internal cooling distribution need to be modified

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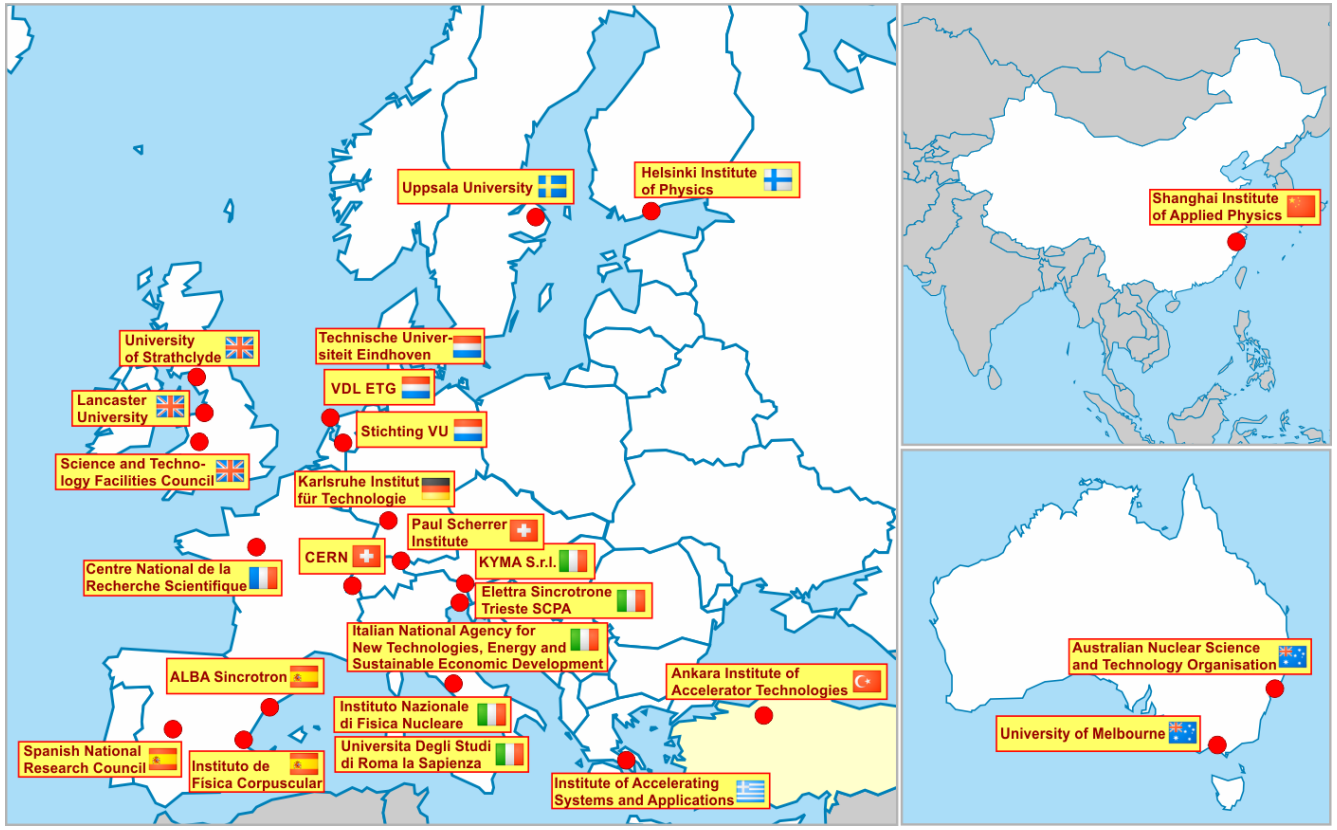
Thank you!

CompactLight@elettra.eu

www.CompactLight.eu



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