



60 GHz Pulsed Gyrotron Complex for ECR Ion Source of New Generation

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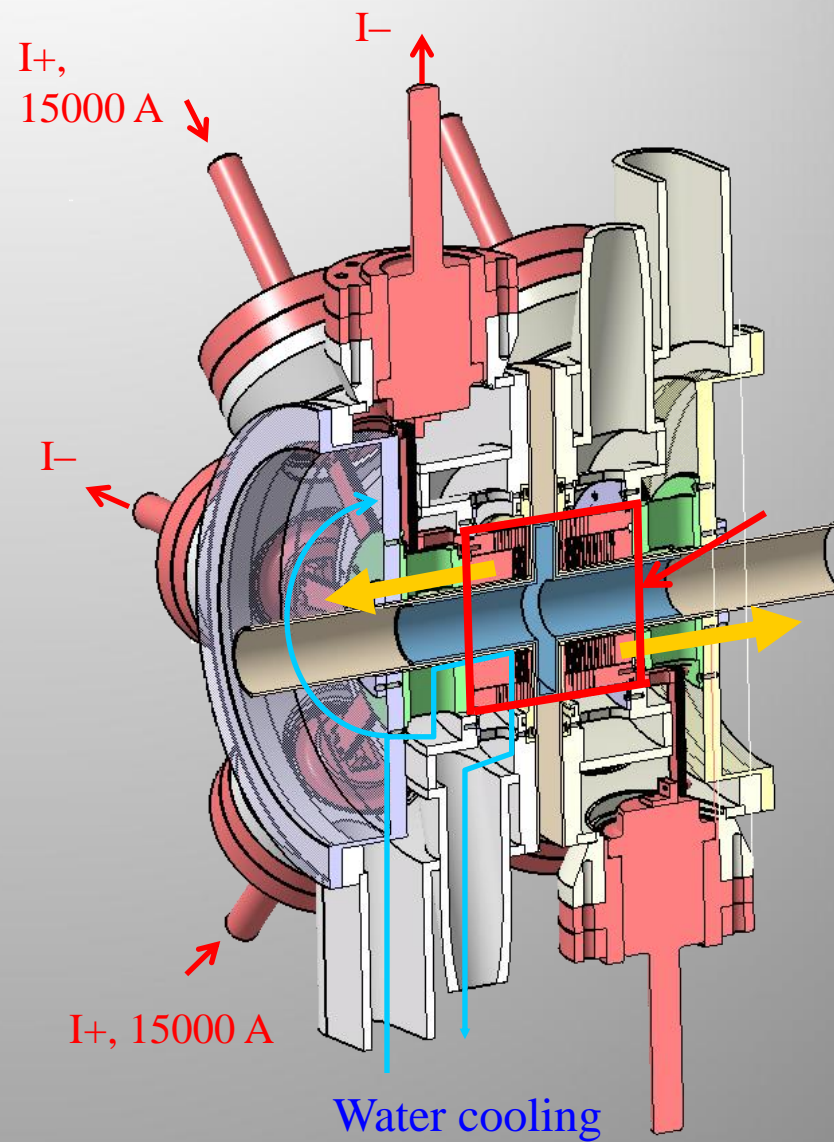
60 GHz ECR ion CAD



60 GHz ion source



Magnetic cusp





Parameters of gyrotron complex (contractual)

Operating frequency	60 GHz
Output power	≤ 300 kW
Regime of gyrotron oscillation	pulse
Accelerating voltage	< 60 kV
Anode voltage	< 20 kV
Beam current	< 18 A
Maximum pulse duration	10 ms
Max freq. of pulse repetition	10 Hz
Efficiency	$> 45\%$
Output mode	waveguide operating mode
Number of harmonic	1
Type of the magnet	cryomagnet

Components of gyrotron complex

-gyrotron	-matching optics unit
-cryomagnet	-RF quasioptical tract
-bench	-power supplies
-calorimetric load	-control system



Gyrotron design

Design features:

- diode-type electron gun with high temperature LaB₆ cathode
- stainless steel body cooled by water
- boron nitride output window with diameter 66 mm
- recuperation of the residual energy of the electron beam
- quasi-optical converter with Gaussian wavebeam output

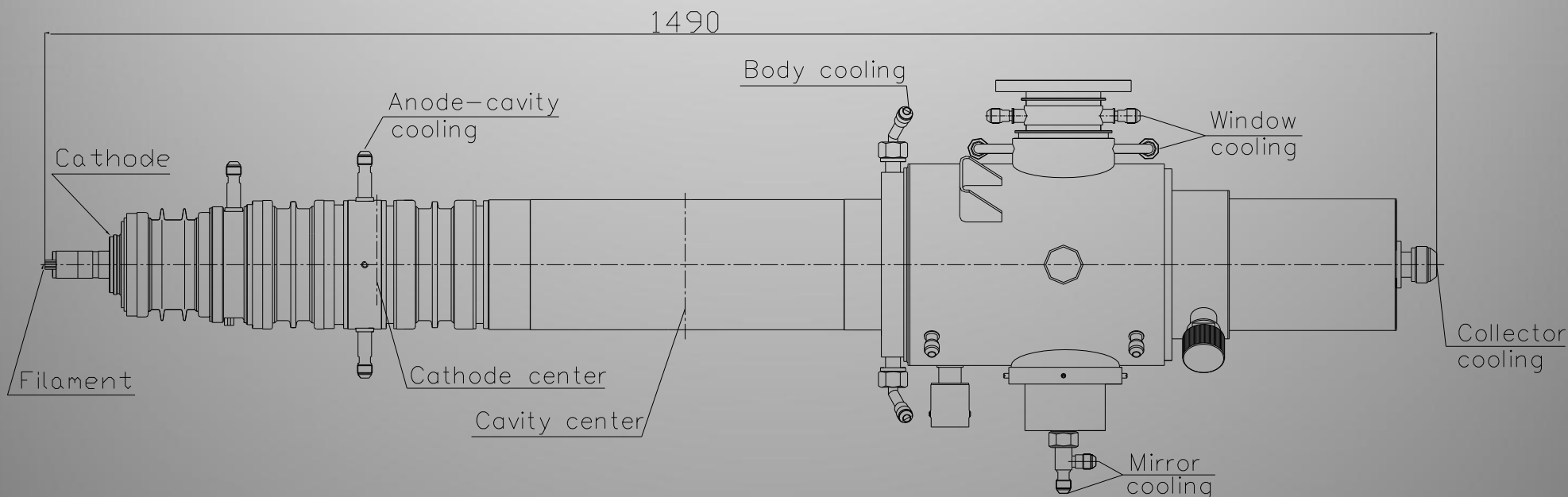
Design parameters:

Operating mode
Cathode diameter
Beam current

H7,3
45mm
18 A

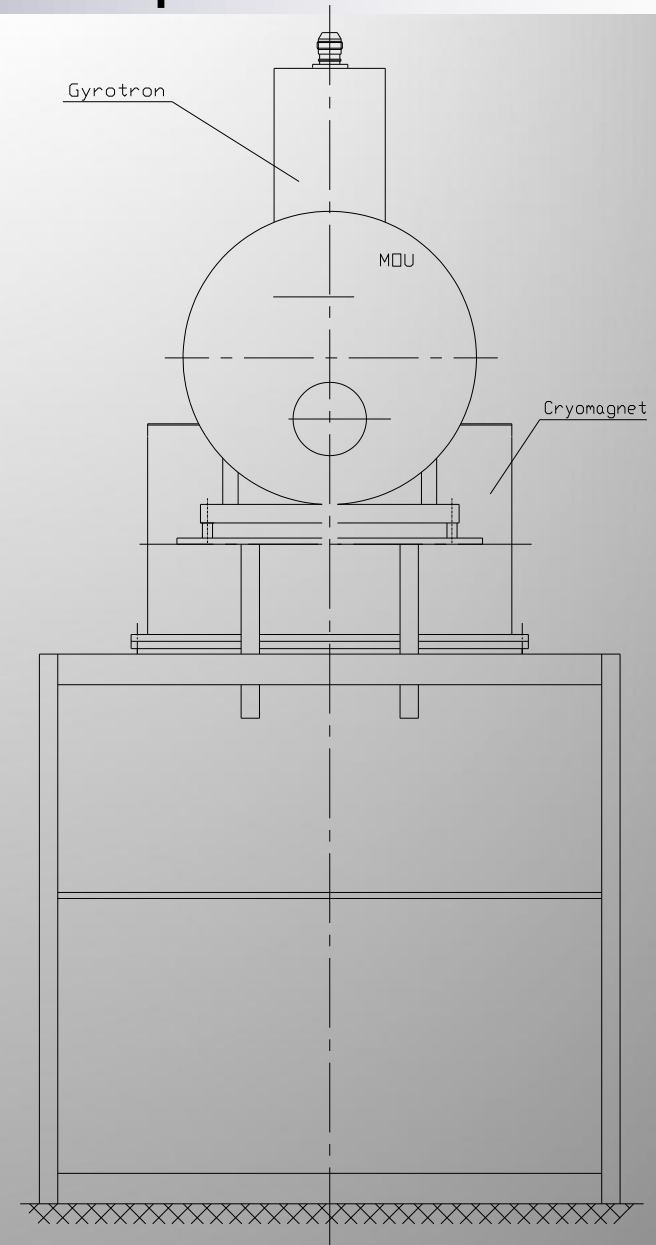
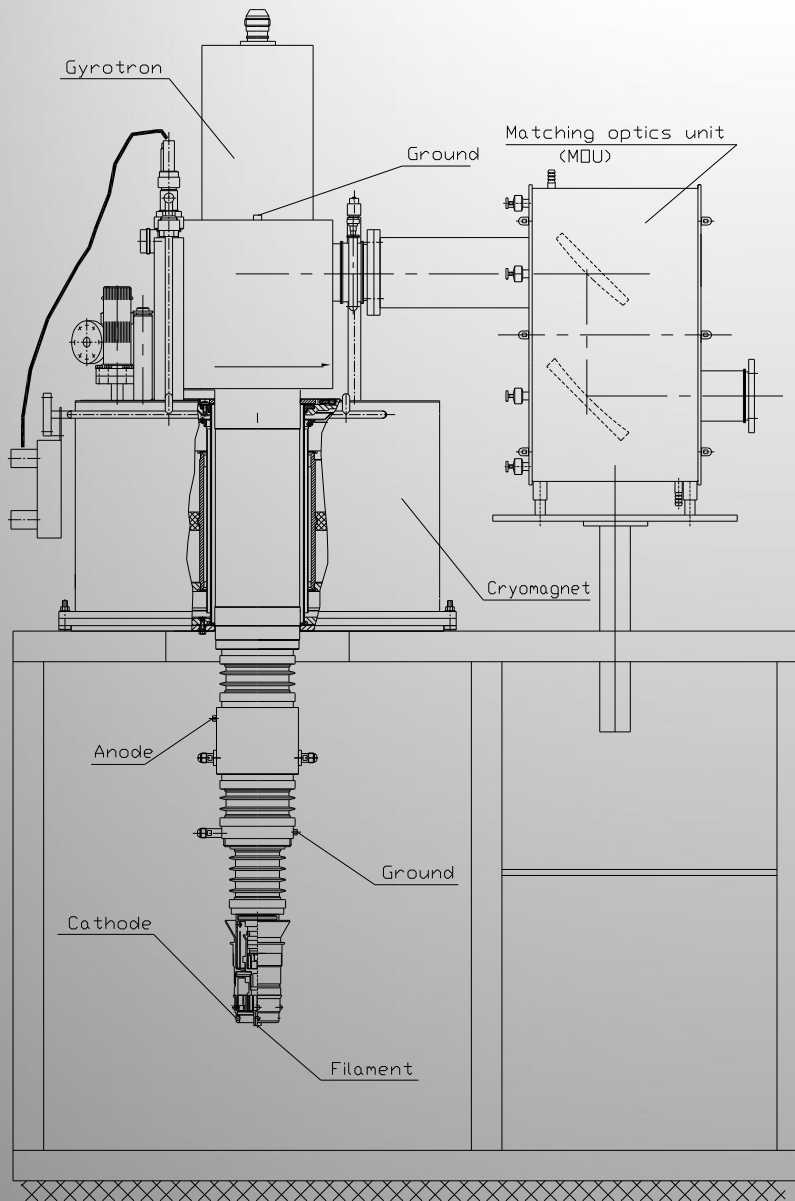
Cathode voltage
Anode / cavity voltage
Magnetic field

-39 kV
+19 kV
~2.3 T





Components of gyrotron complex



Gyrotron – bench – cryomagnet - MOU



Components of gyrotron complex

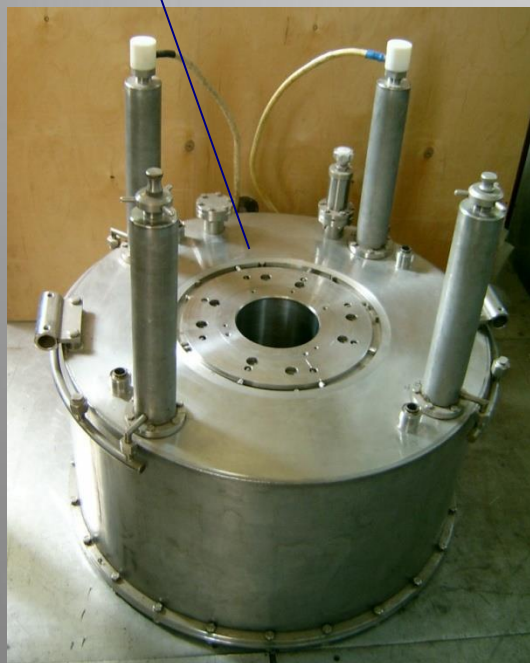


Cryomagnet

Gyrotron

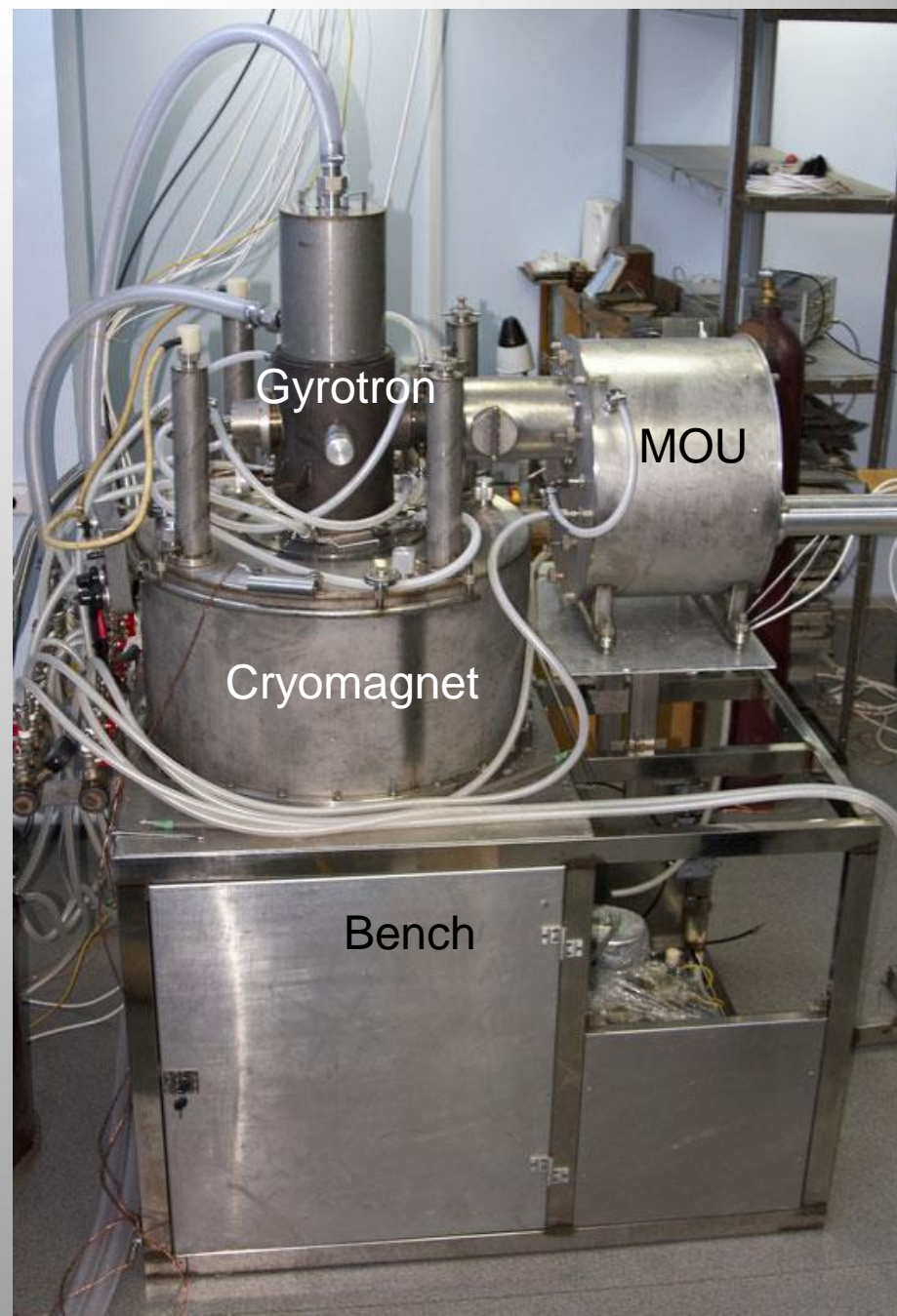
MOU

Bench





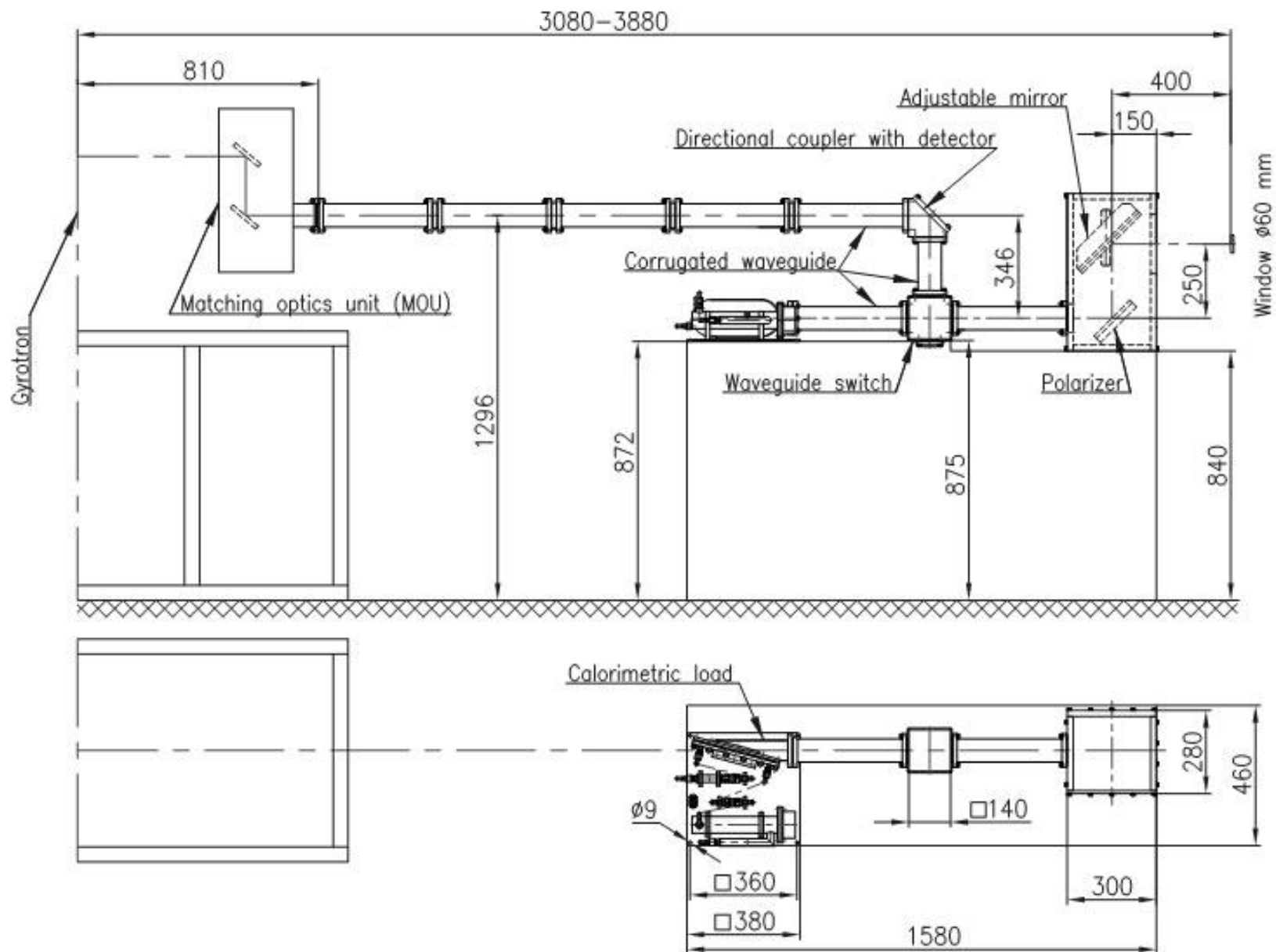
Components of gyrotron complex



Gyrotron complex assembled



Scheme of RF quasioptical tract





Components of complex

Cathode power supply



Anode power supply





Components of complex

Control system



Operator workplace

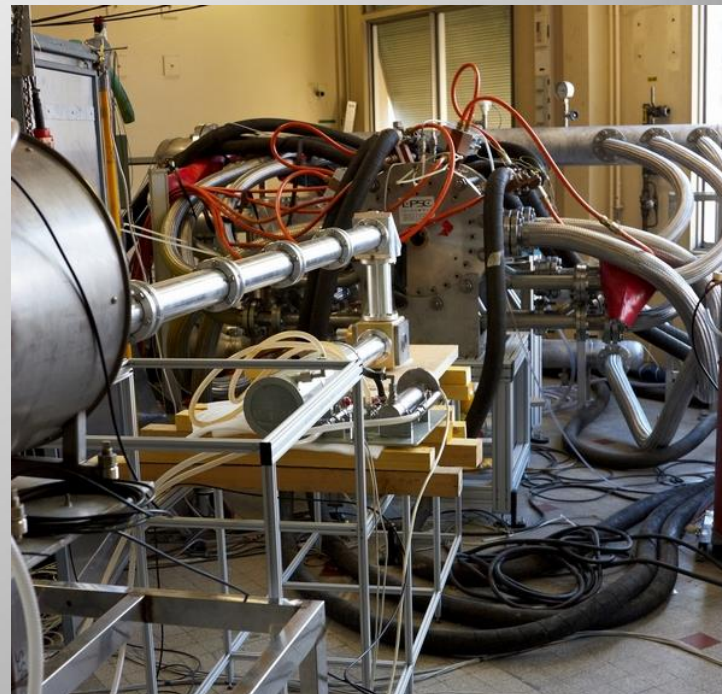
Control rack





Components of complex

Gyrotron complex in Grenoble (France)

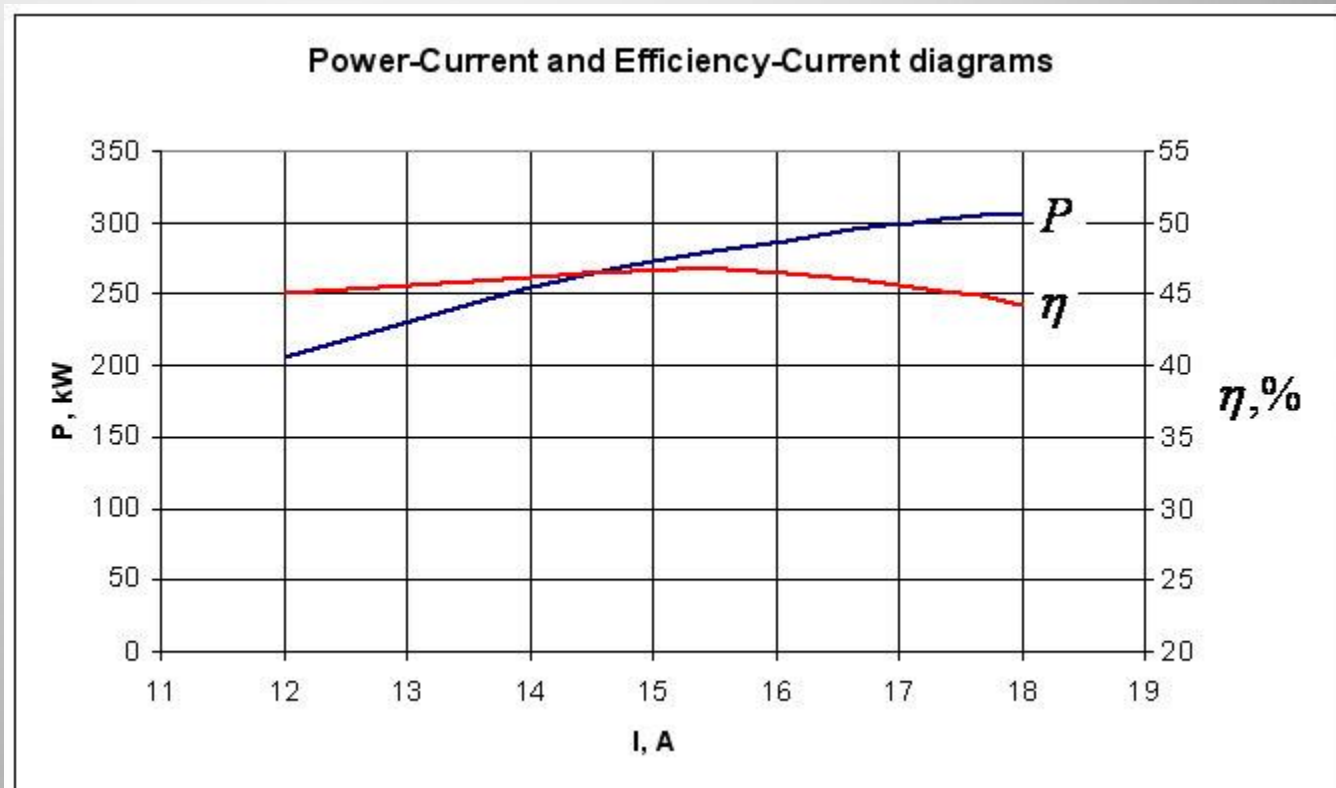




Test results

Output parameters

Power	303 kW
Cathode voltage	39.8 kV
Anode voltage	20 kV
Beam current	17.5 A
Anode current	52 mA
Frequency	60.089 GHz
Efficiency	45%
Pulse duration	50 ms
Magnetic field	2.26T

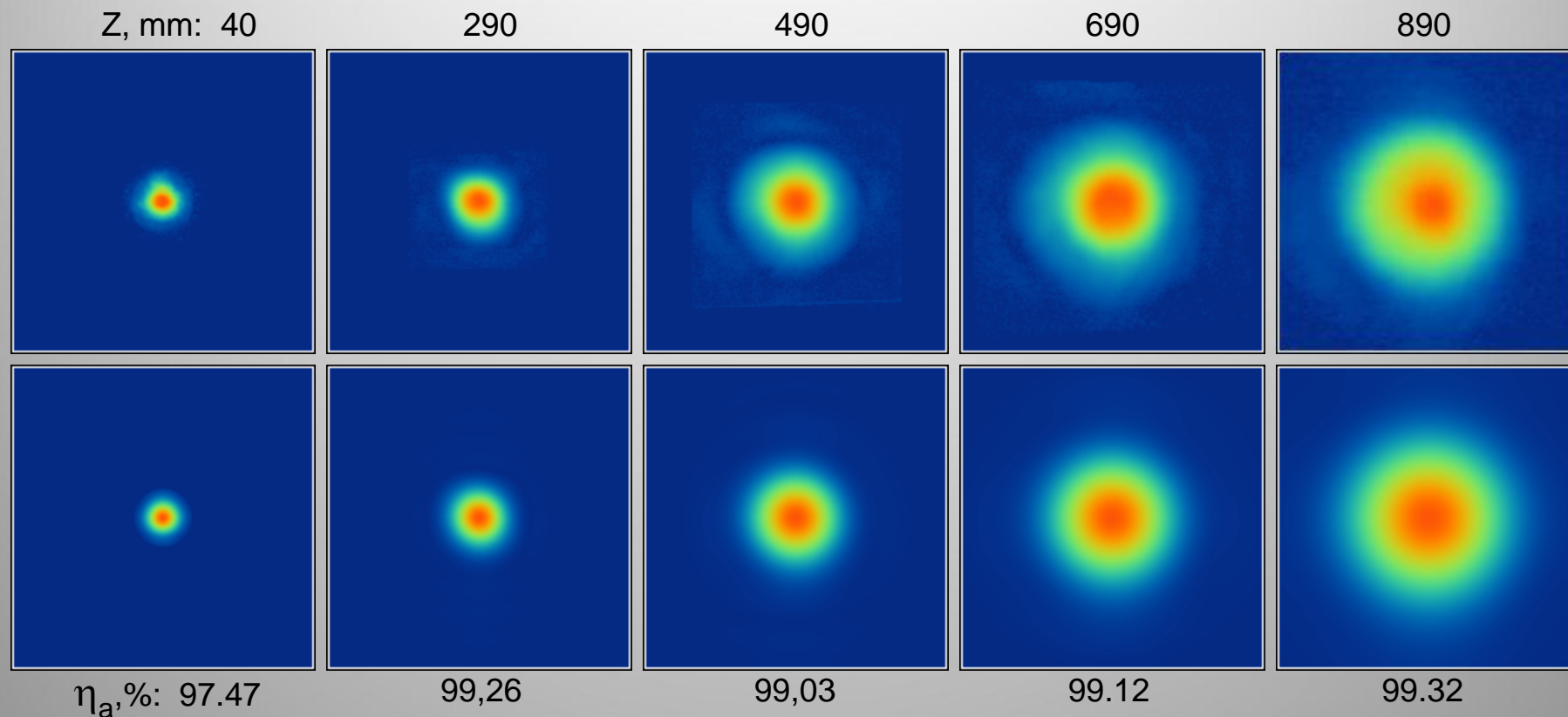




Test results

Experiment vs. Simulations

(field amplitude; aperture 340×340mm²)



TEM₀₀ content in the reconstructed field: $\eta_{a,\phi} = 97,79\%$

Designations:

Z – distance to window

η_a – mutual power between measured and simulated amplitude patterns