4-CHANNEL PLANAR FEM FOR HIGH-POWER MM-WAVE GENERATION

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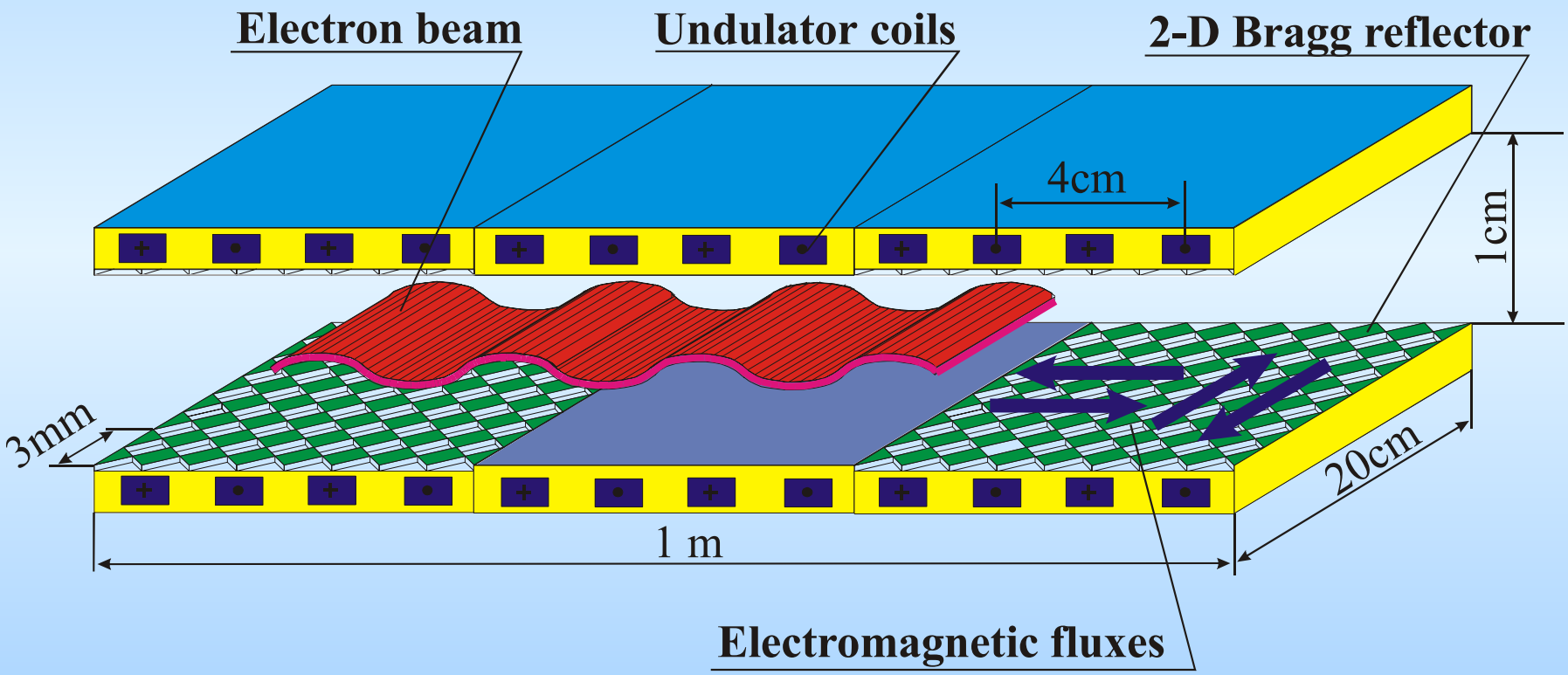
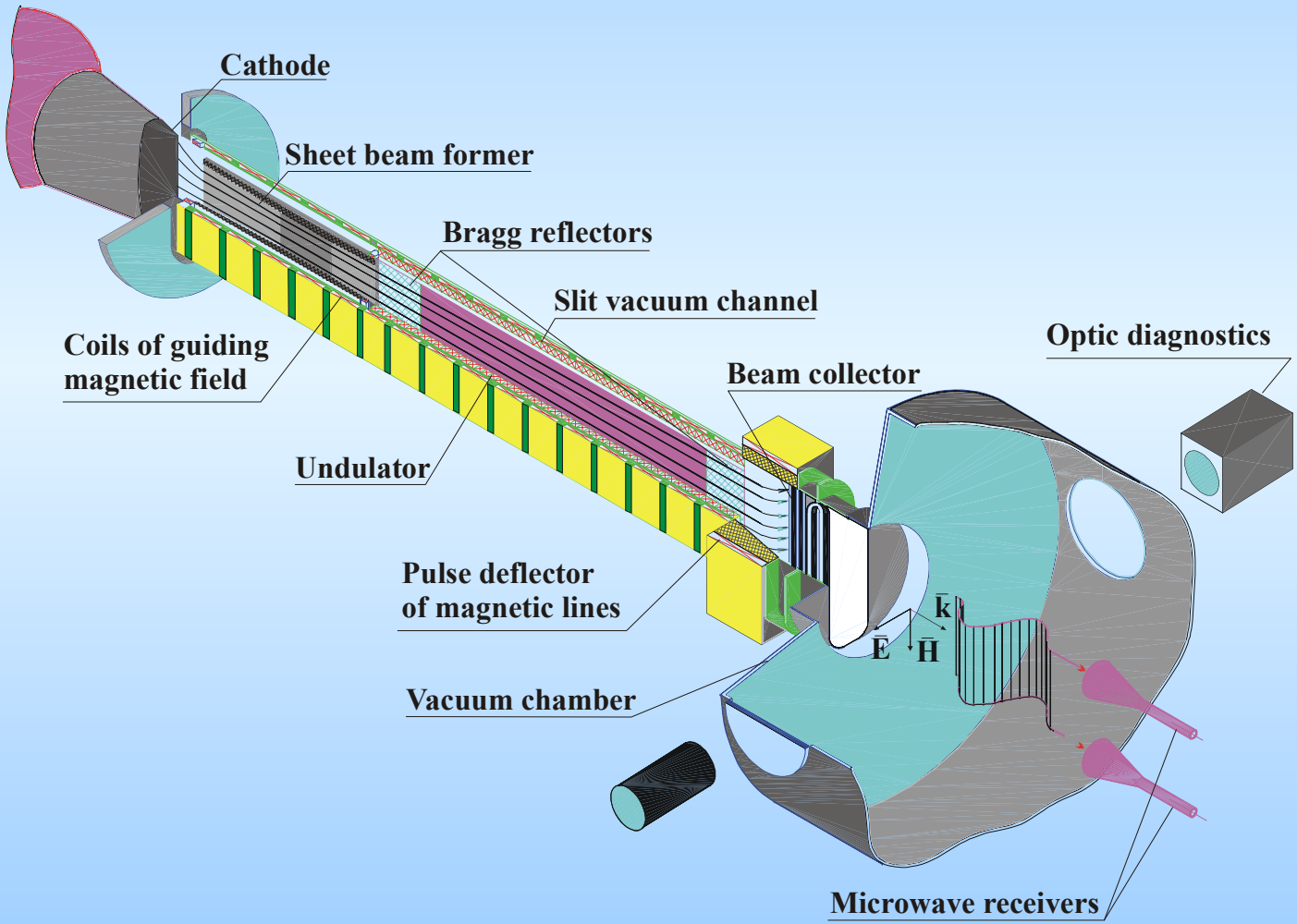
OUTLINE

- PLANAR FEM WITH 2D-DISTRIBUTED FEEDBACK, THE FIRST OPERATION, FEL 1999
- MULTI-CHANNEL PLANAR FEM, CONCEPTUAL DESIGN OF 4-BEAM OSCILLATOR
- SIMULATION OF MULTI-CHANNEL FEM
- CURRENT STATUS OF EXPERIMENT
- SUMMARY

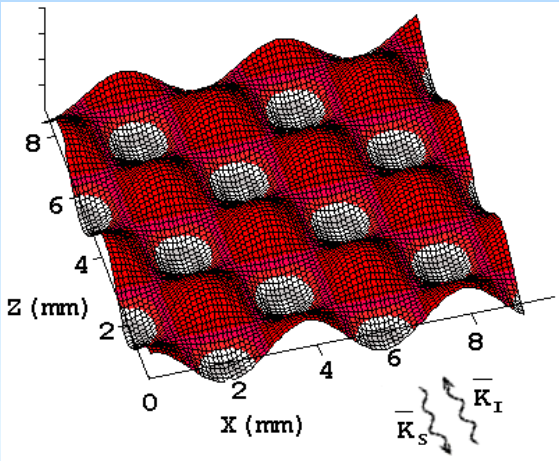
CONCEPT OF
PLANAR FEM DRIVEN BYA SHEET BEAM



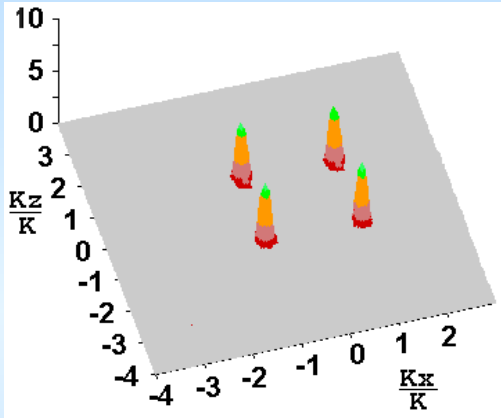
SCHEME OF SINGLE MODULE PLANAR FEM BASED ON THE ELMI ACCELERTOR

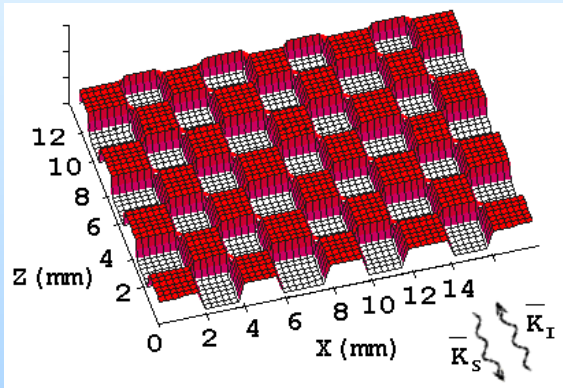


EXPERIMENTAL TESTING 2-D BRAGG REFLECTORS OF DIFFERENT CORRUGATION PROFILES

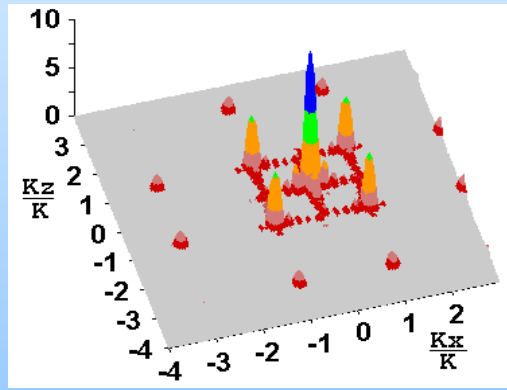


Sine corrugation

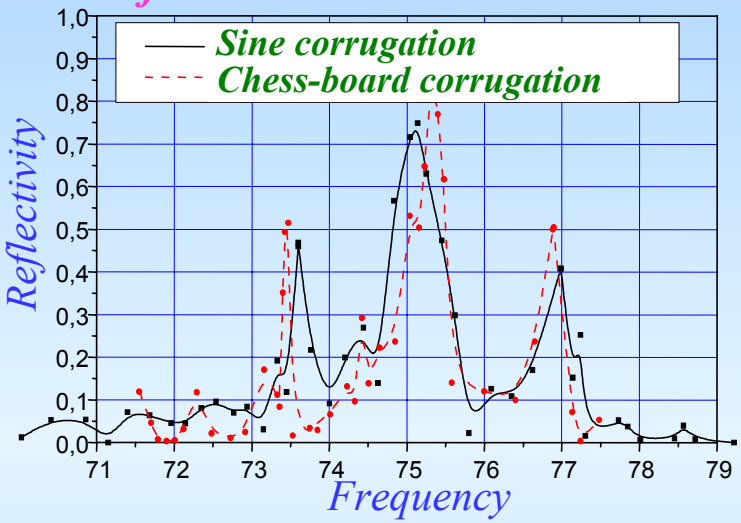




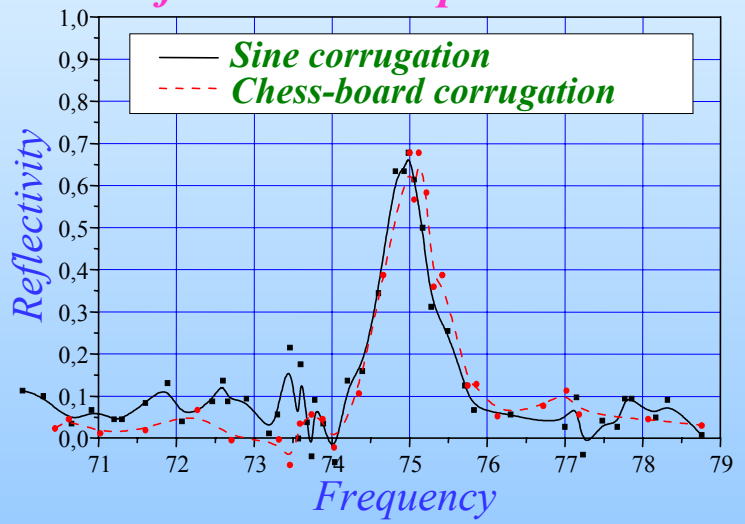
Chess-board corrugation



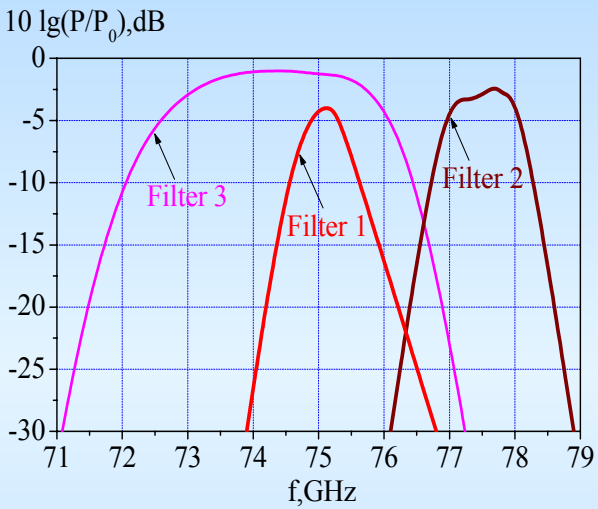
Reflectors with closed sidewalls

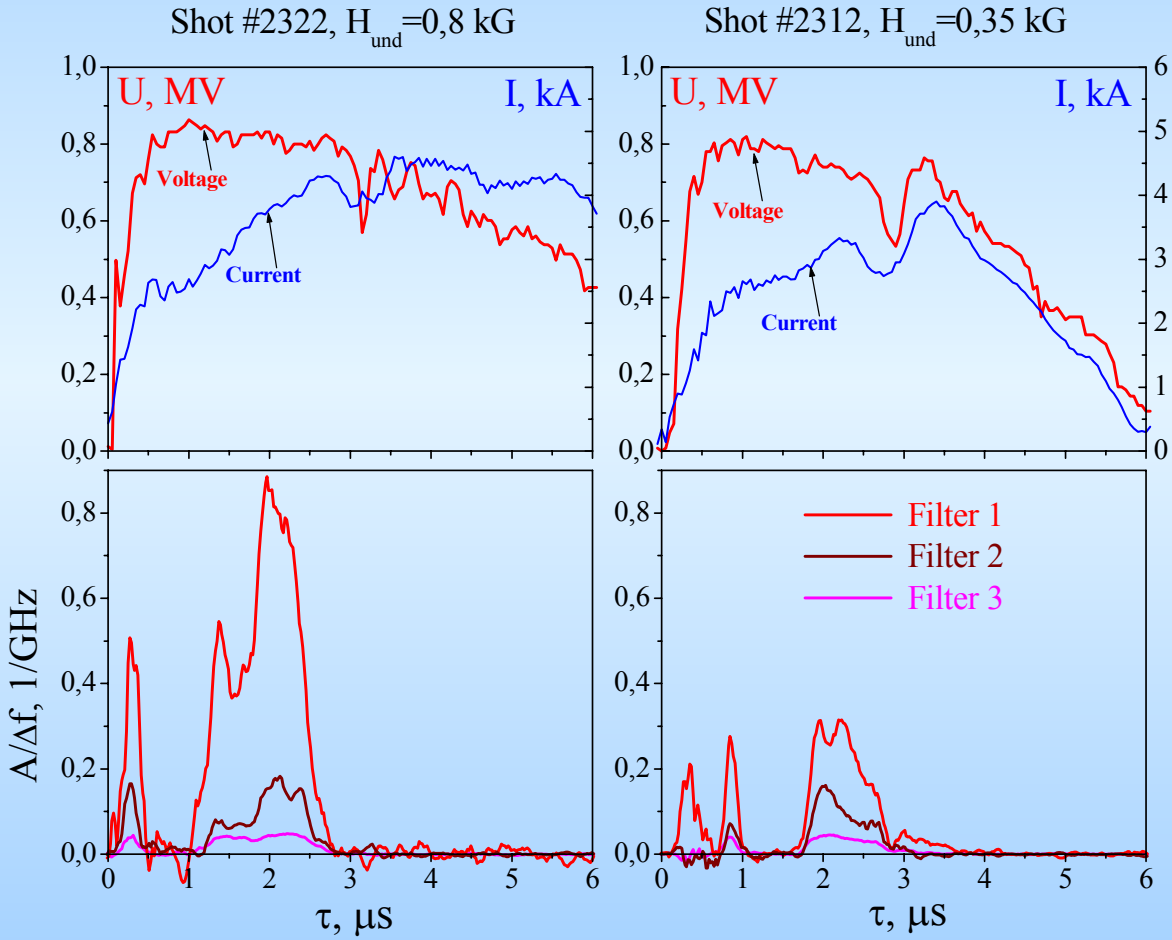


Reflectors with open sidewalls

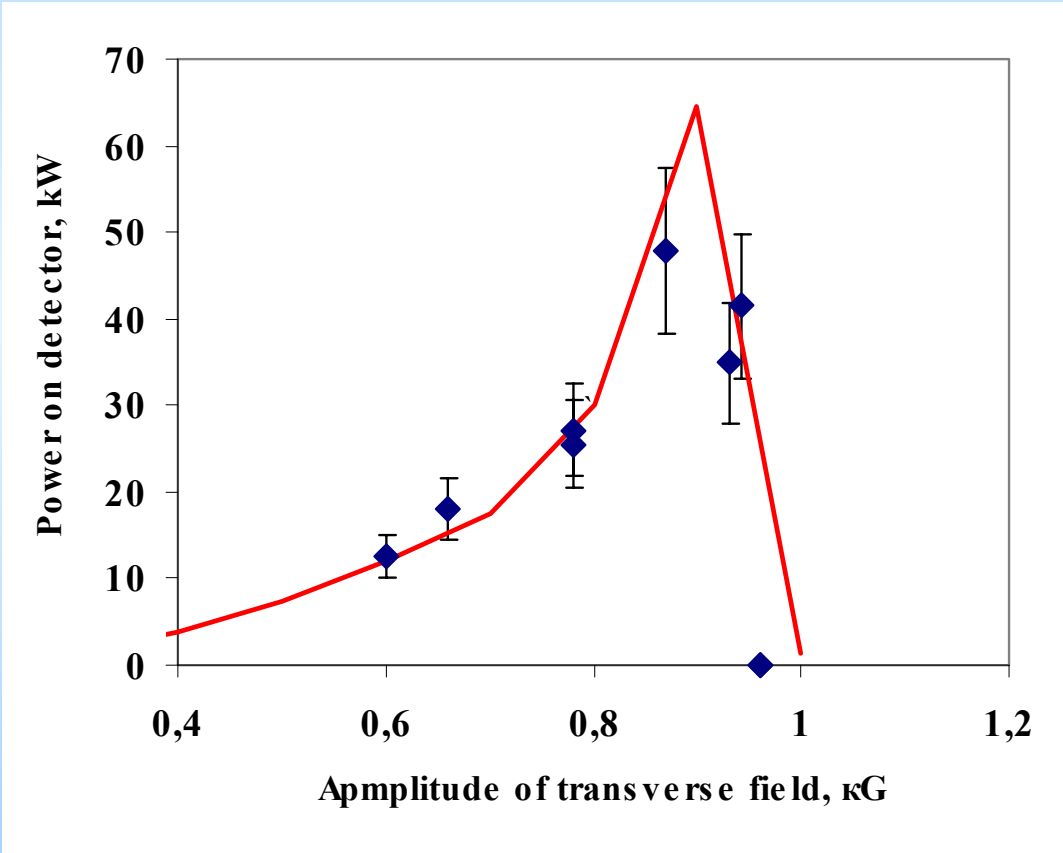


RADIATION SPECTRUM OF FEM





MICROWAVE POWER AS FUNCTION OF UNDULATOR FIELD AMPLITUDE



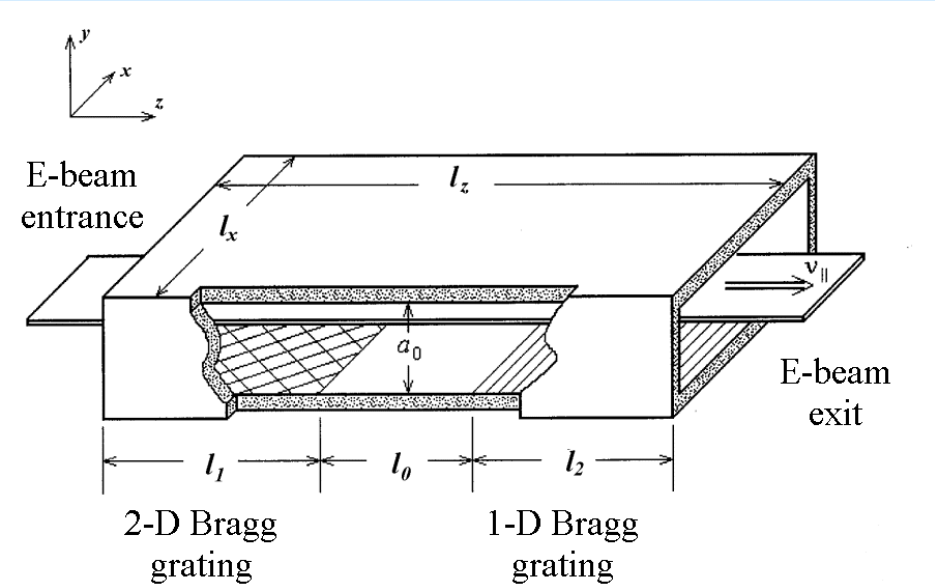
Electron energy - 0.9 MeV
Longitudinal field - 12 kG

Red line *- computer simulations*
Blue points *- experimental measurements within 74.7-75.7GHz (filter 1)*

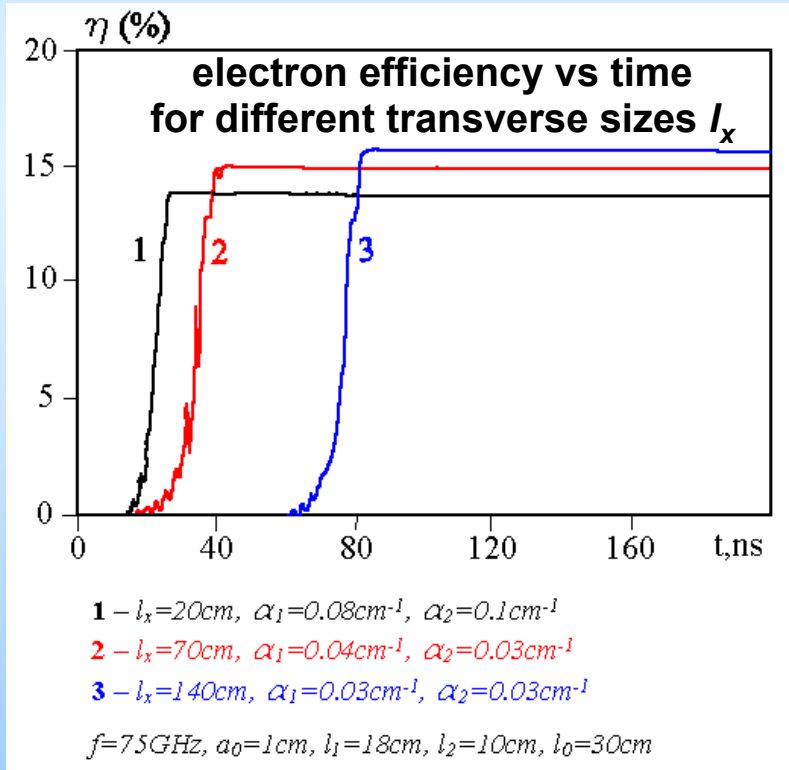
PLANAR FEM WITH

COMBINED BRAGG RESONATOR

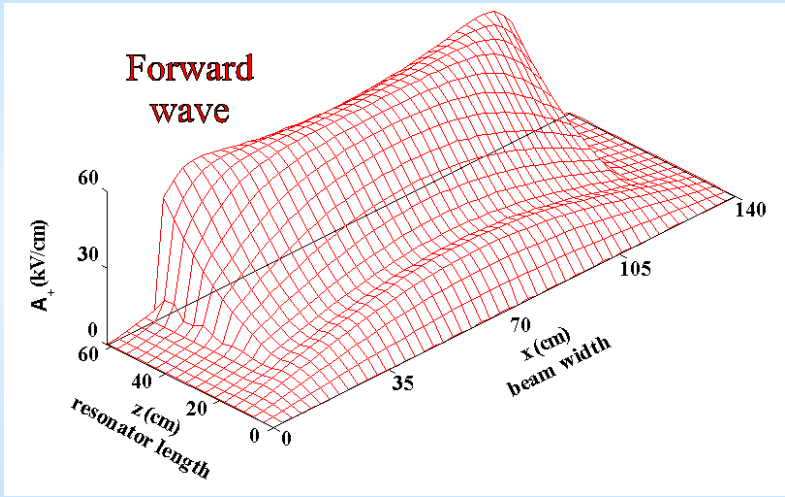
Bragg resonator consisting of 2-D and 1-D gratings

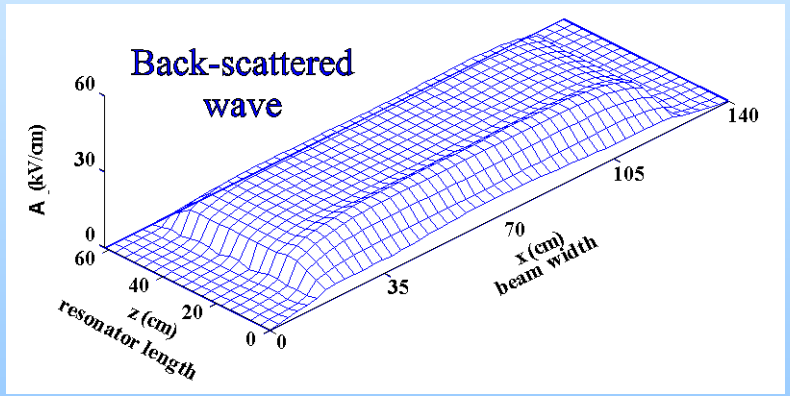


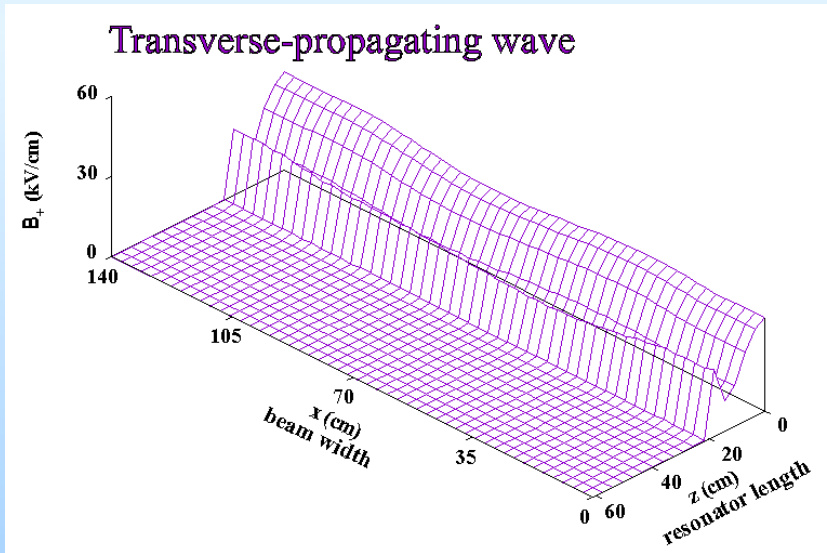
Establishment of the stationary regime of oscillations



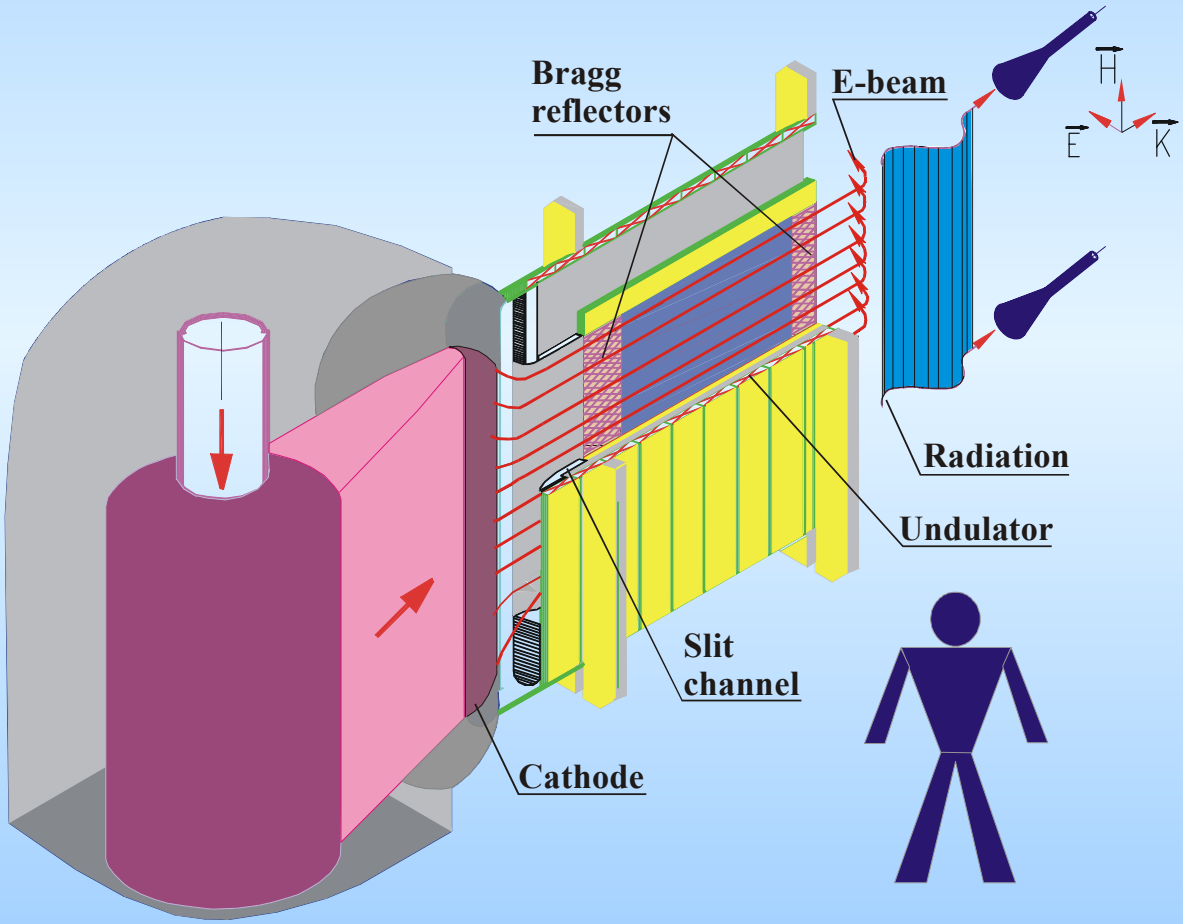
SPATIAL PROFILES OF THE AMPLITUDES OF THE PARTIAL WAVES AT THE STATIONARY REGIME OF GENERATION (COMBINED PLANAR RESONATOR)







PROJECT OF FULL-SCALE PLANAR FEM BASED ON THE U-2 ACCELERATOR



Beam parameters:

E_e=1 MeV

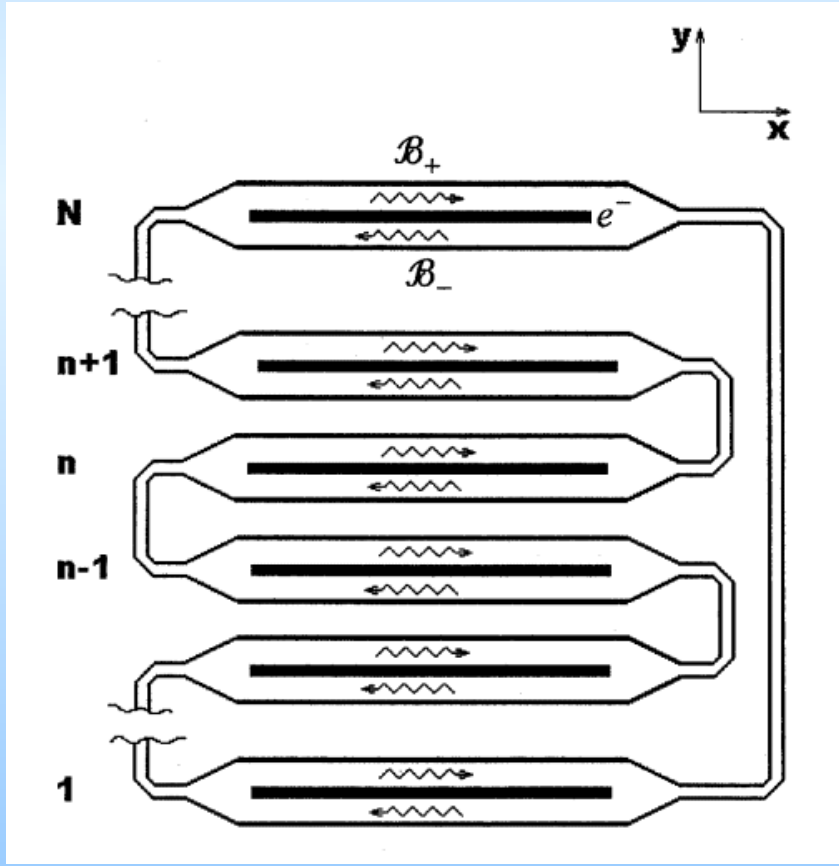
I_b=50 kA

τ_b=8 μs

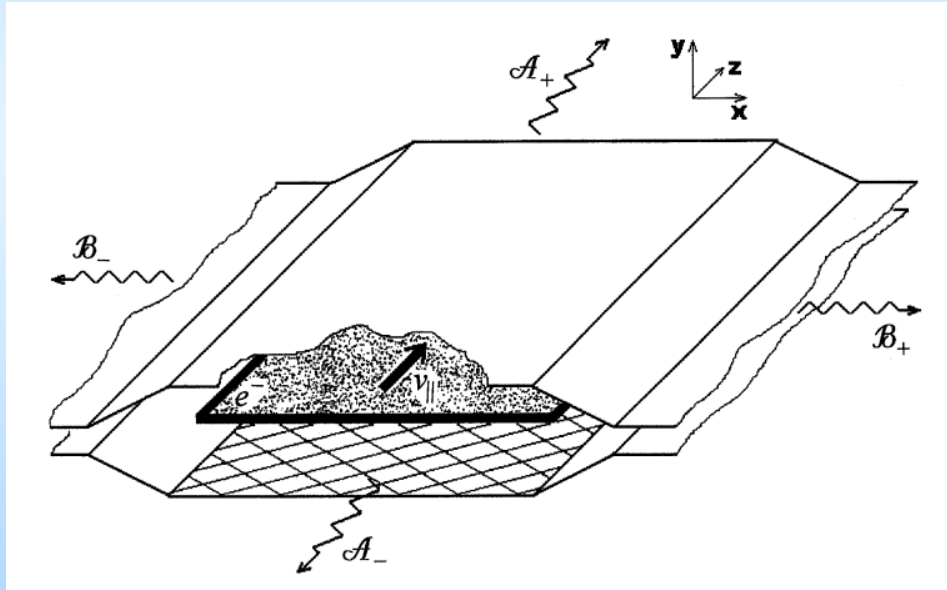
Q_b=0.4 MJ

PROJECT OF MULTI-BEAM PLANAR FEM

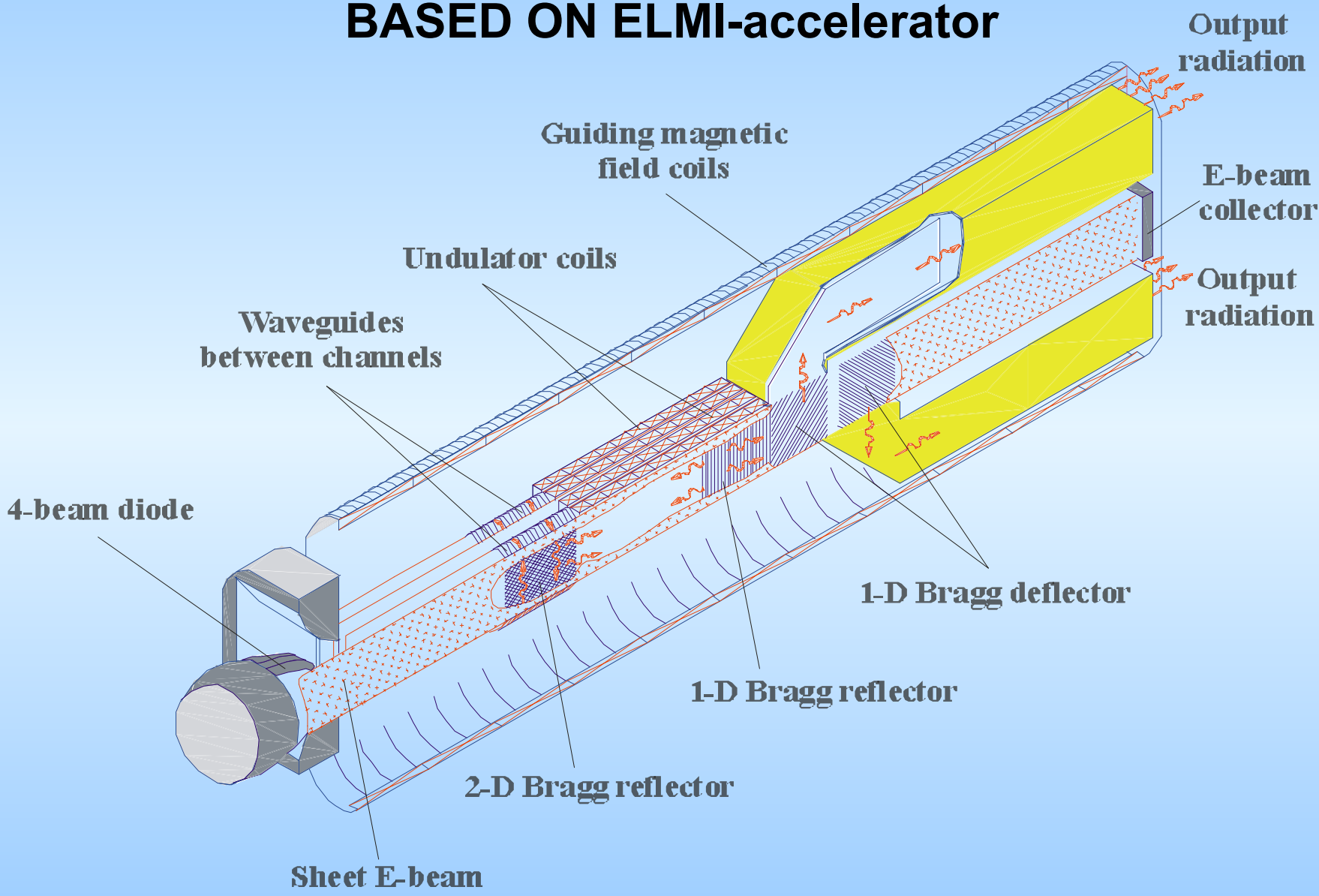
Schematic of FEM consisting of N planar modules connected by transverse electromagnetic fluxes



Schematic of single planar FEM module exploiting a 2-D Bragg resonator

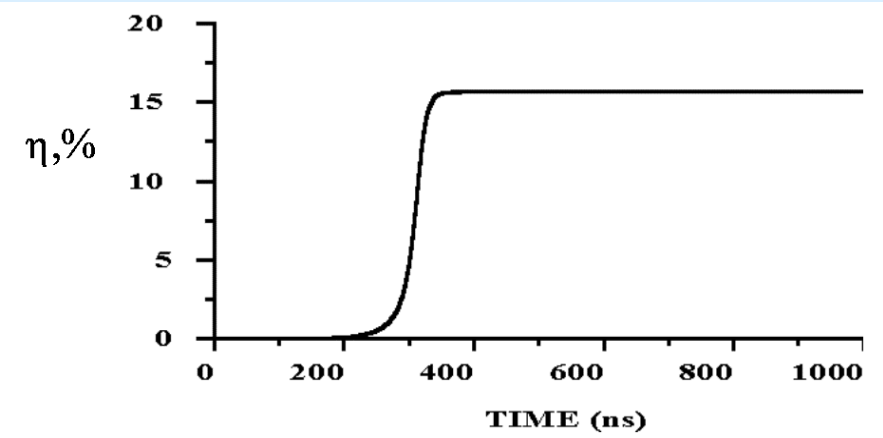


DESIGN OF 4-BEAMS FEM BASED ON ELMI-accelerator

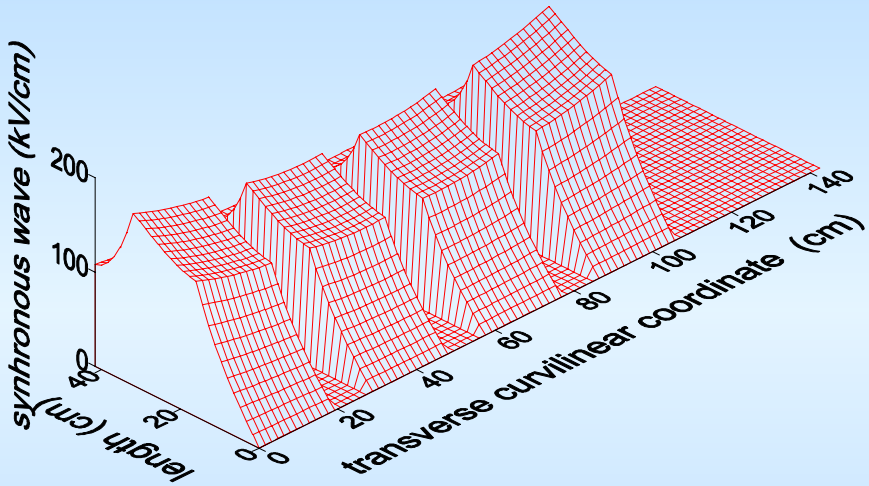


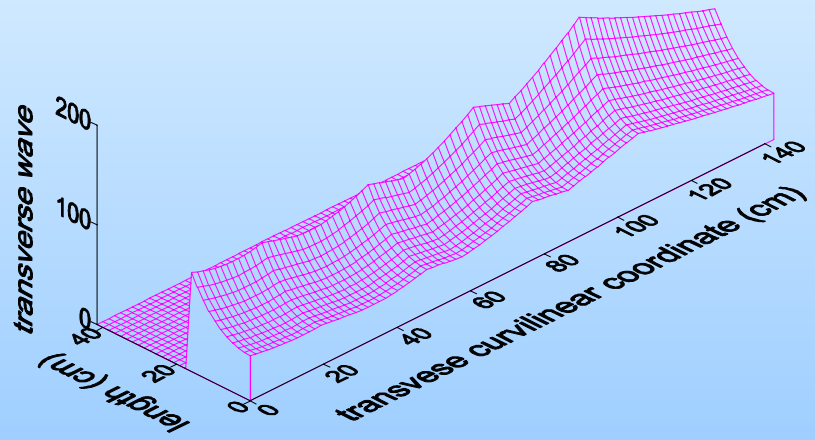
Computer simulations of 4-modules FEM

Oscillation build-up in 4-modules FEM

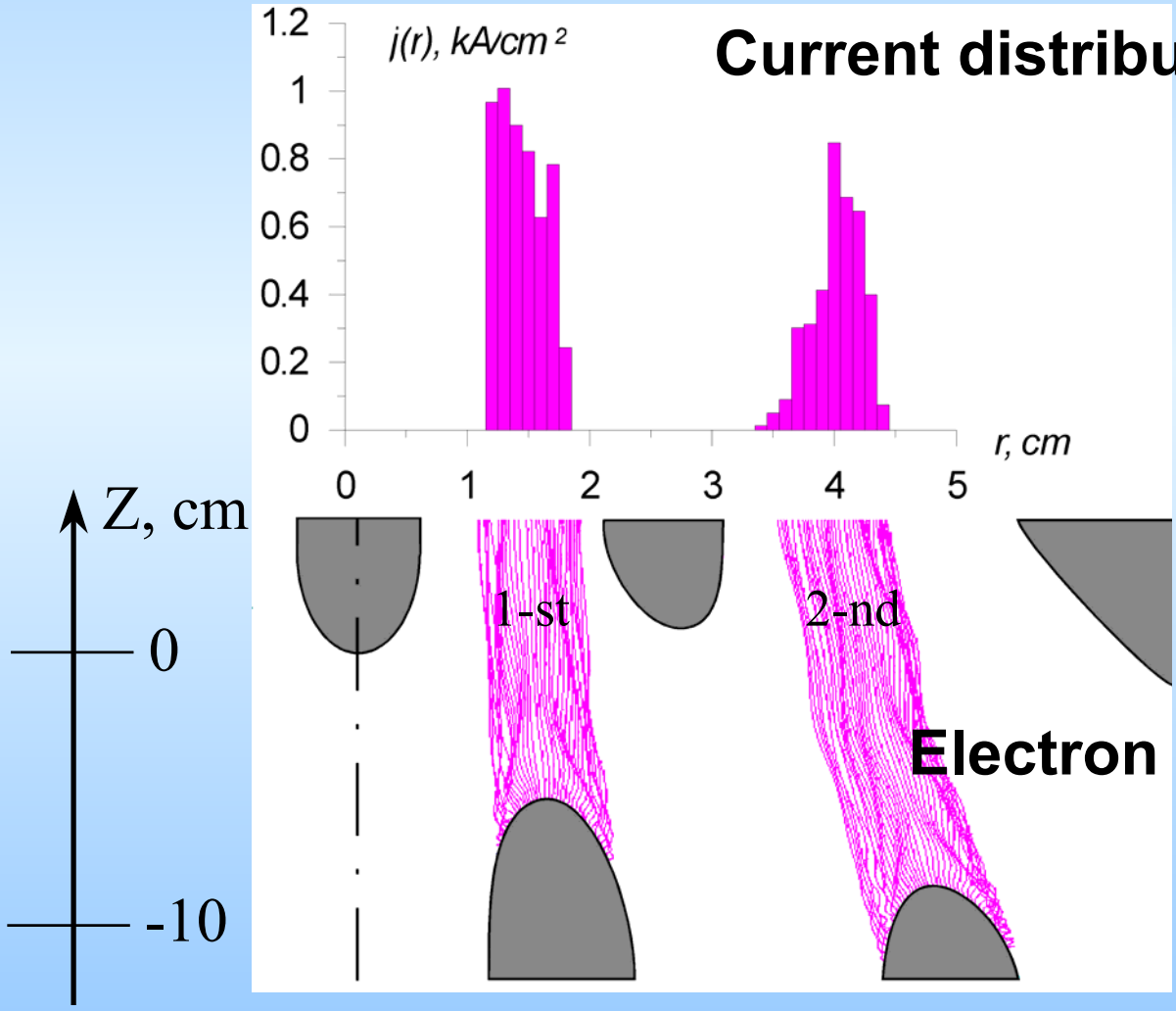


Structure of the partial waves at the stationary regime of generation



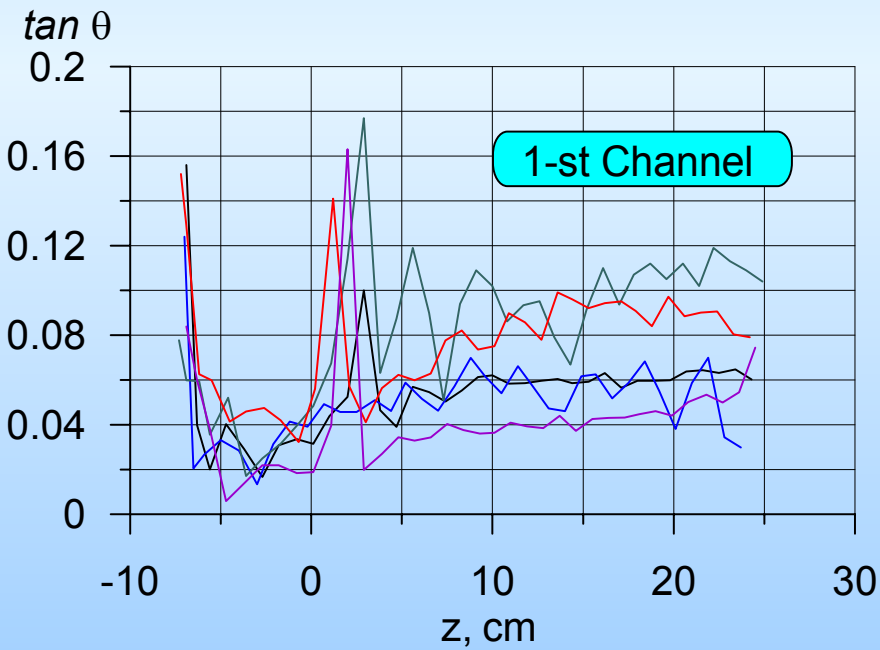


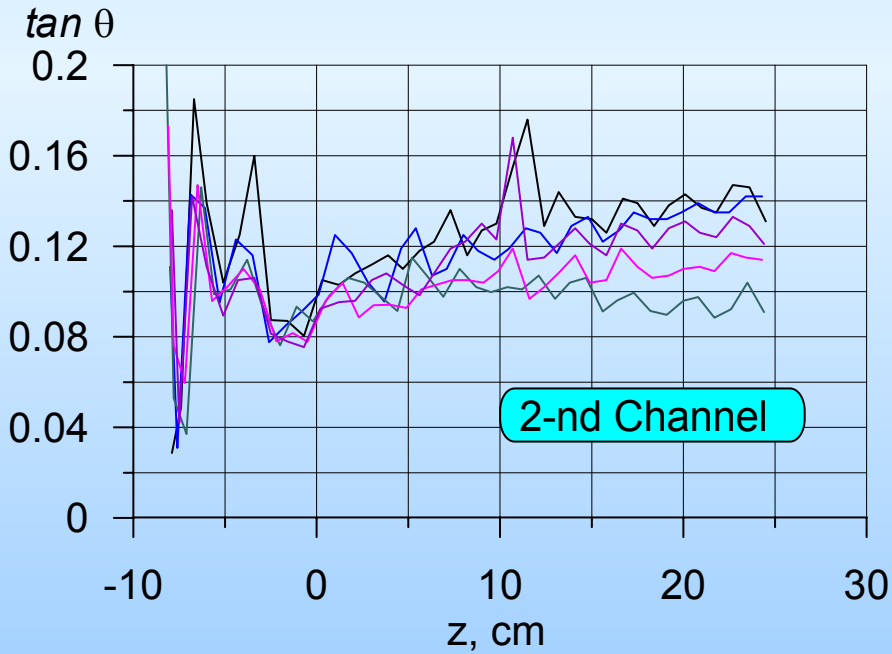
COMPUTER SIMULATION OF 4 SHEET BEAMS FORMATION



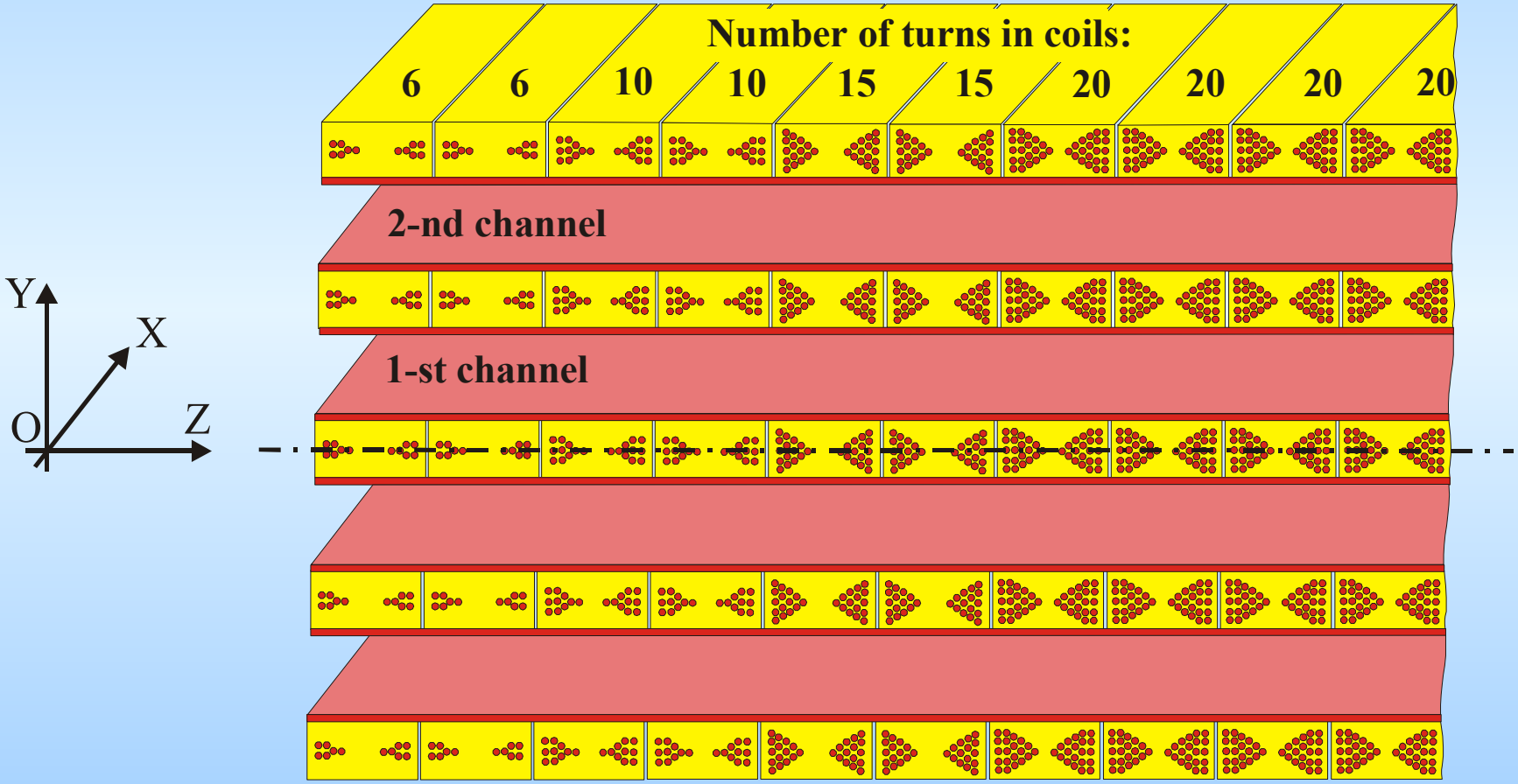
COMPUTER SIMULATION OF 4 SHEET BEAMS FORMATION

Pitch angles vs longitudinal coordinate for different electron fractions



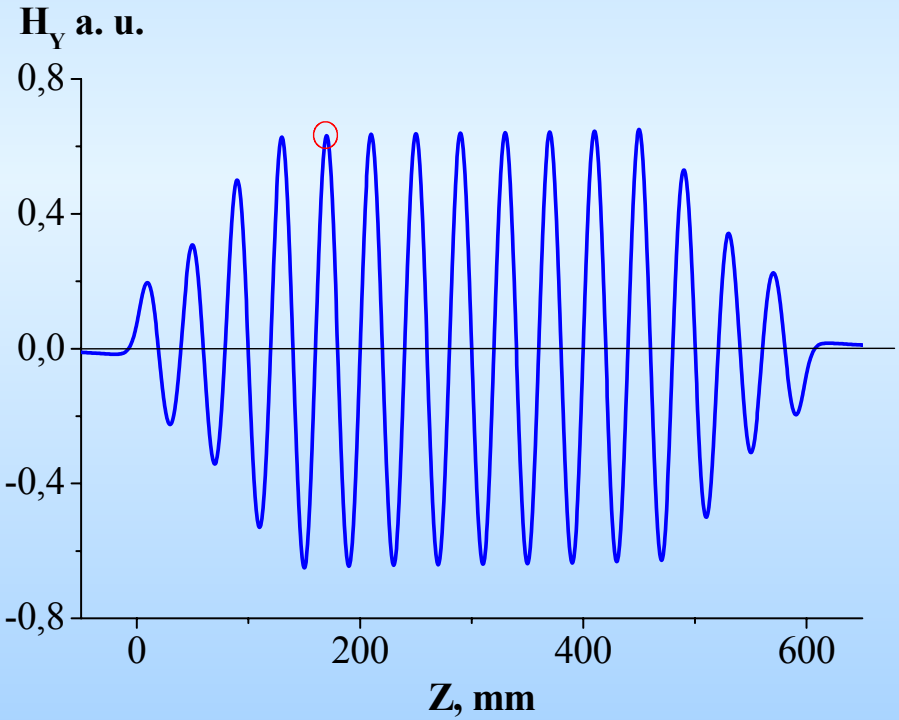


DESIGN OF THE UNDULATOR FOR 4 -MODULES FEM

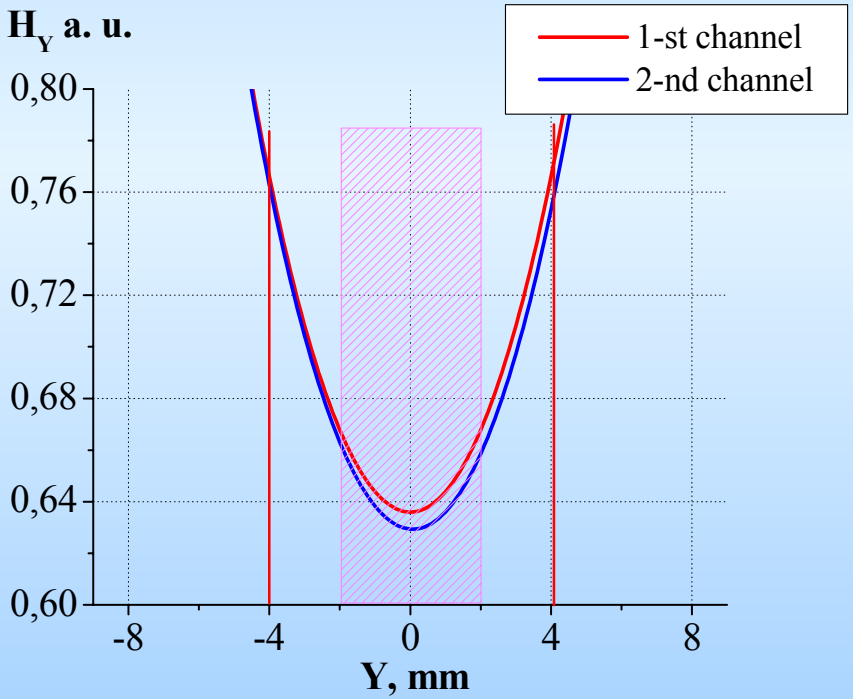


UNDULATOR FIELD DISTRIBUTION

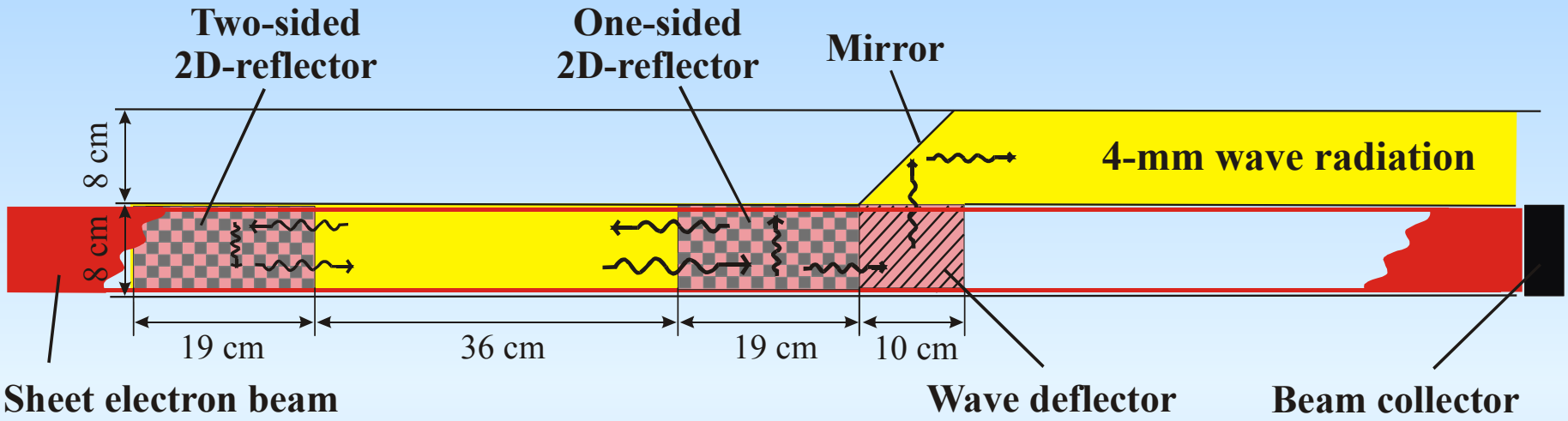
along channels:

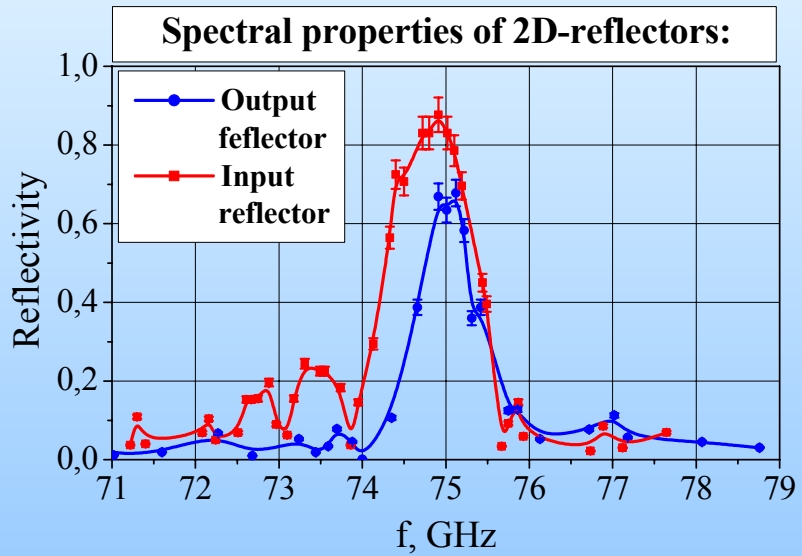


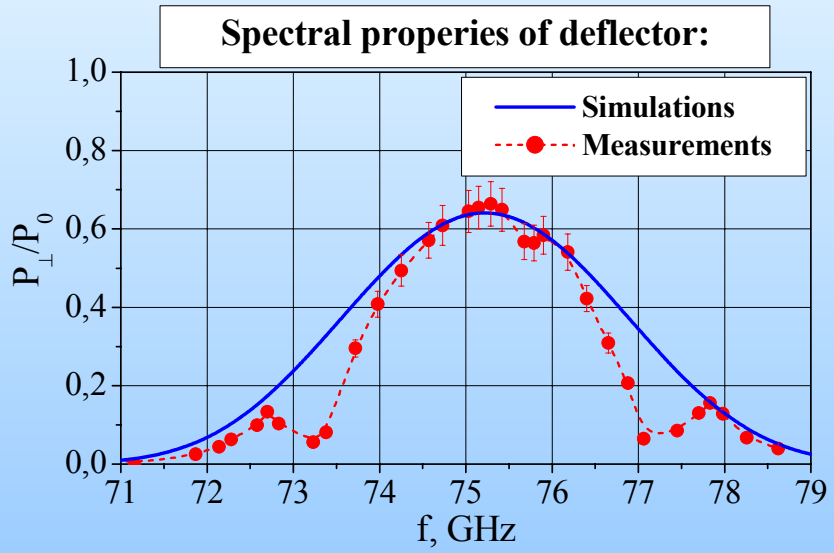
across channels:



RECENT EXPERIMENTS INCLUDING A WAVE OUTPUT DEFLECTOR

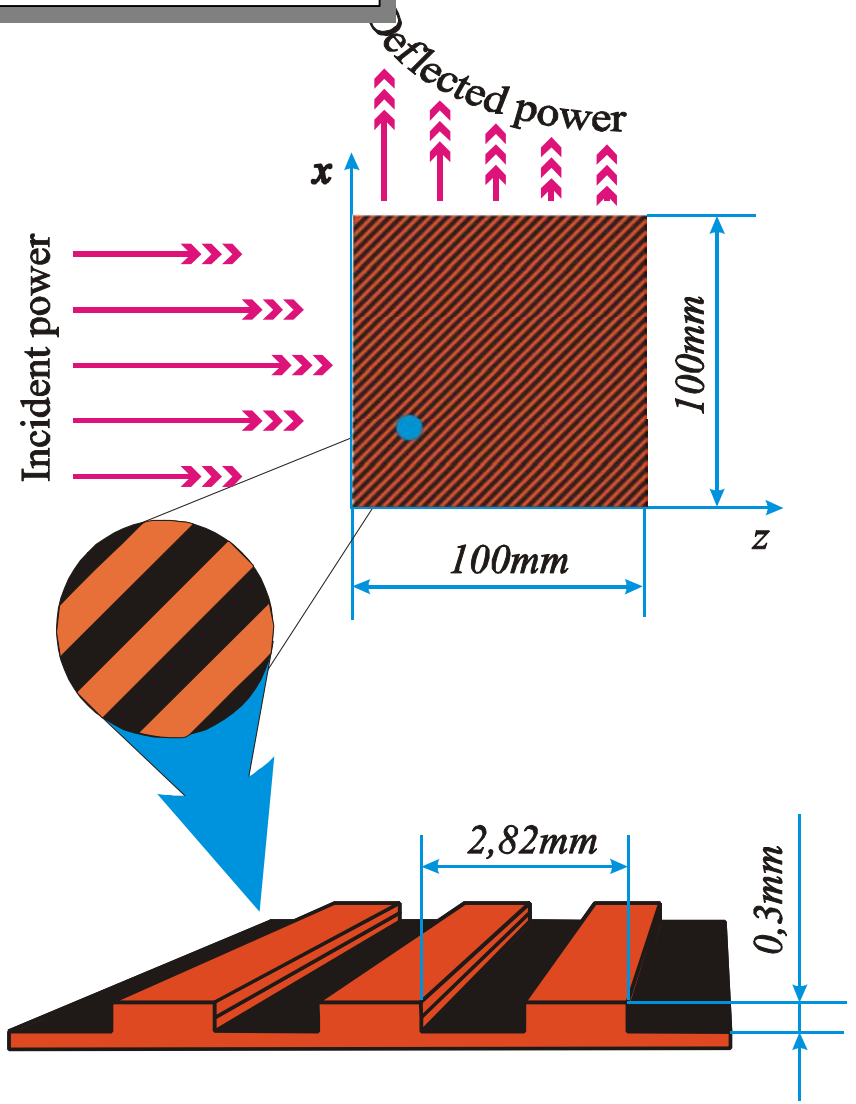




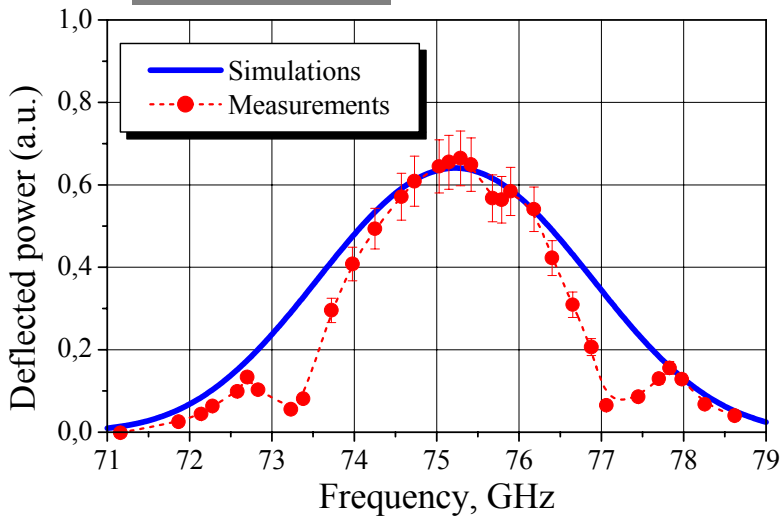


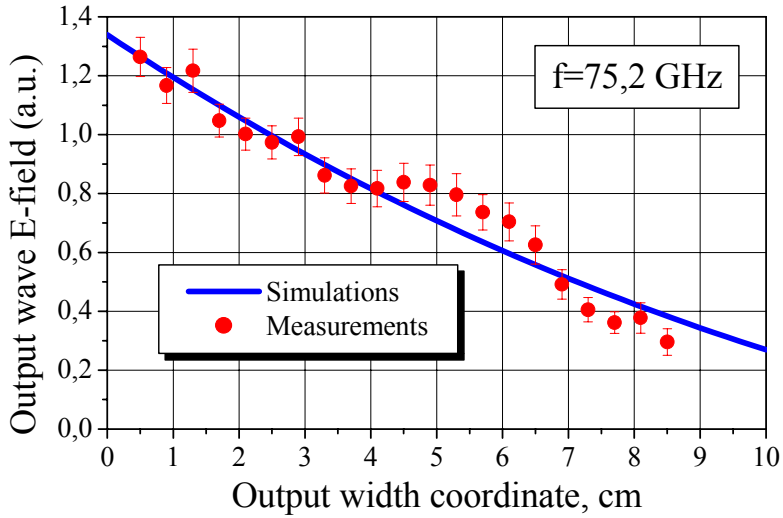
Bragg deflector for 75 GHz radiation

Schematic drawing



Properties

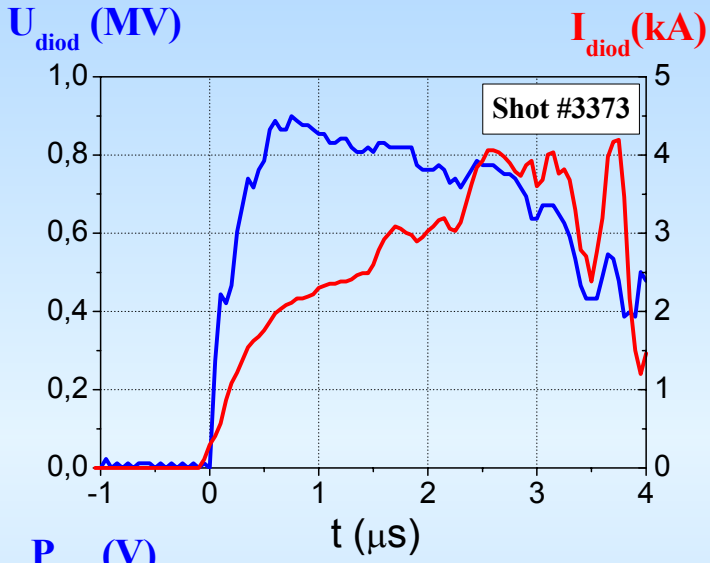


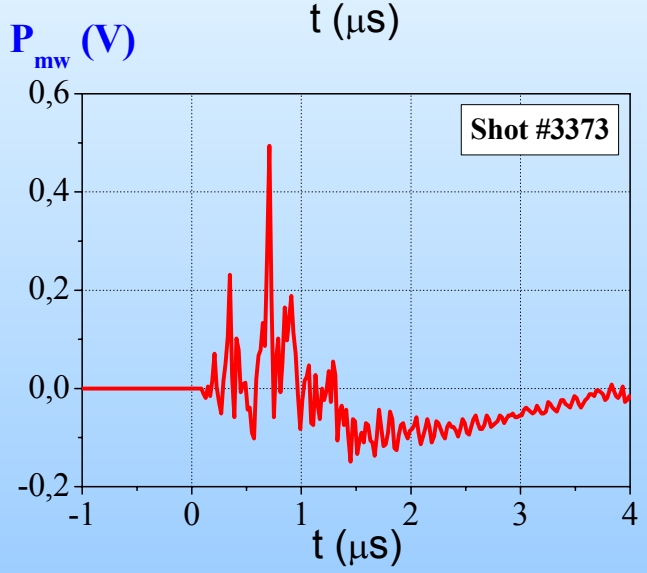


EXPERIMENTAL RESULTS

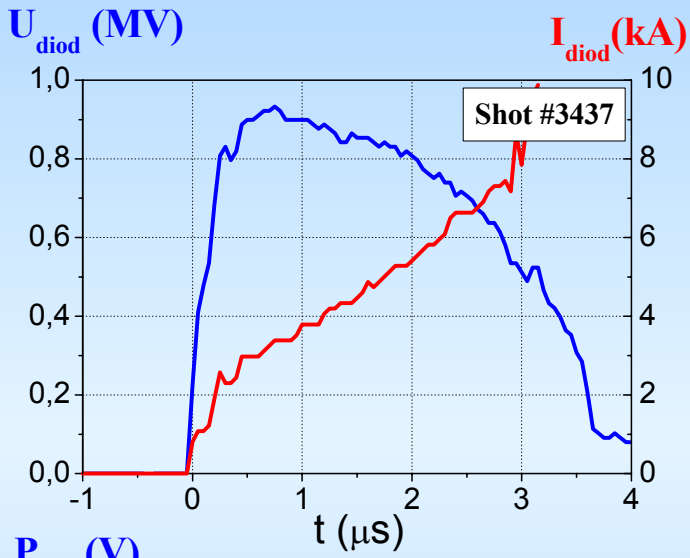
($H_{||}$=10 kG , $H_{\perp}$=0.7 kG)

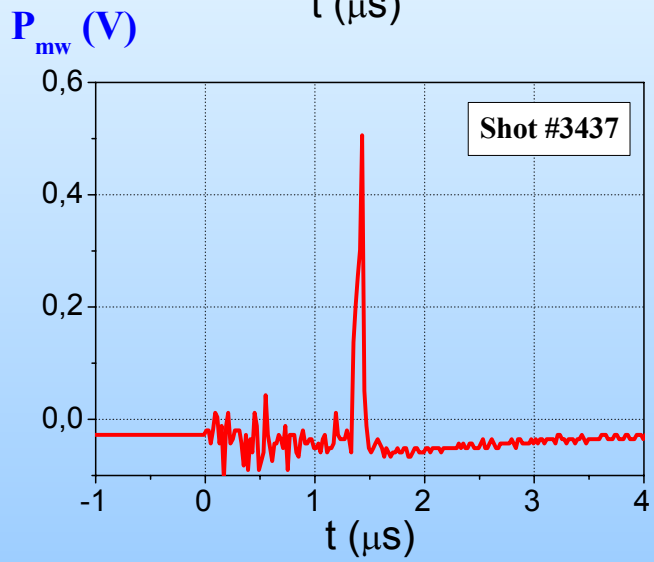
Without absorbers of transverse waves



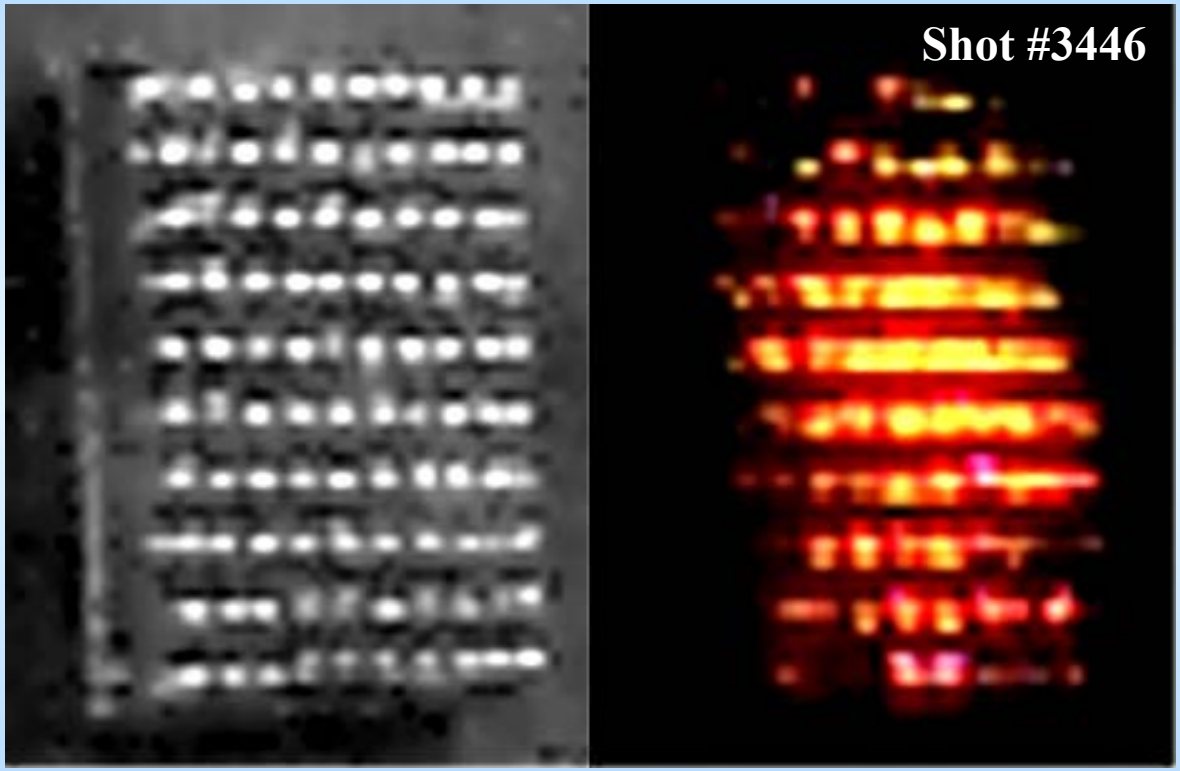


With absorbers of transverse waves





LIGHT EMISSION OF NEON-LAMP PANEL UNDER MM-RADIATION PULSE



Output window sizes - 2x9 cm
Panel sizes - 20x20 cm
Distance from the output window - 0.5 m

Longitudinal magnetic field - 10 kG
Transverse magnetic field - 0.7 kG

SUMMARY

- Operation of planar FEM-oscillator with 2-D distributed feedback was experimentally investigated in the 75GHz frequency band. The 300 ns, 100 MW pulses was generated

- The project of multi-channel FEM to increase radiation power was proposed.

- Theoretical consideration demonstrates possibility of synchronization up to 10 FEM modules using transverse energy fluxes

- Design of 75GHz 4-channel FEM-oscillator carried out and the experimental testing of the basic units at the ELMI-accelerator is under progress