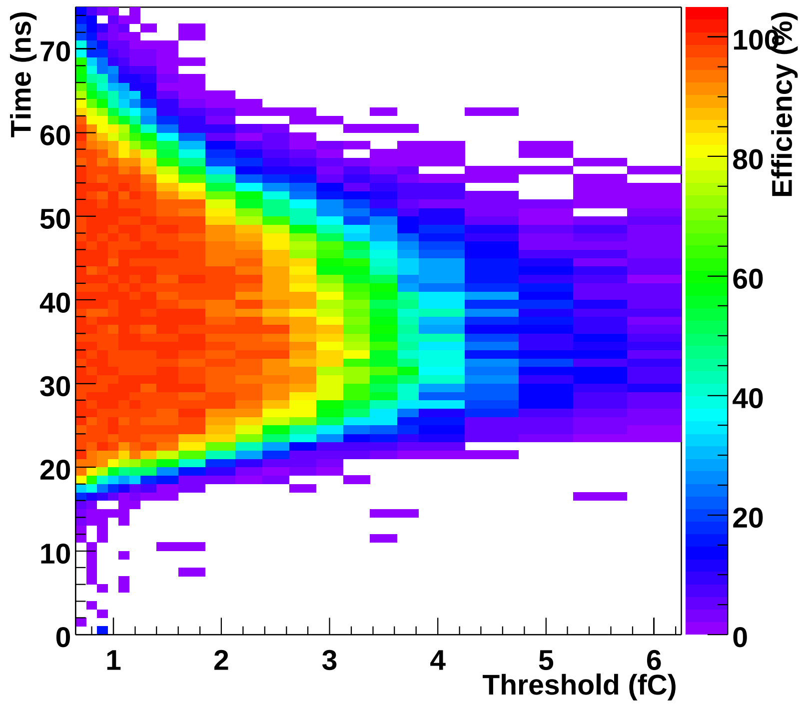
PULSE SHAPE RECONSTRUCTION

The full time and hit information obtained in the test beam can be used to reconstruct the efficiency as a function of trigger phase and discriminating threshold. Fitting the 50 % point in small time slices one obtains the median charge dependence on time. Thus, one can study the pulse output by the shaper/amplifier in a range of detector bias voltages.

The results will be compared to a simulation the detector signal, coupled to a model of the ABCD shaper/amplifier (thanks to Y. Unno).

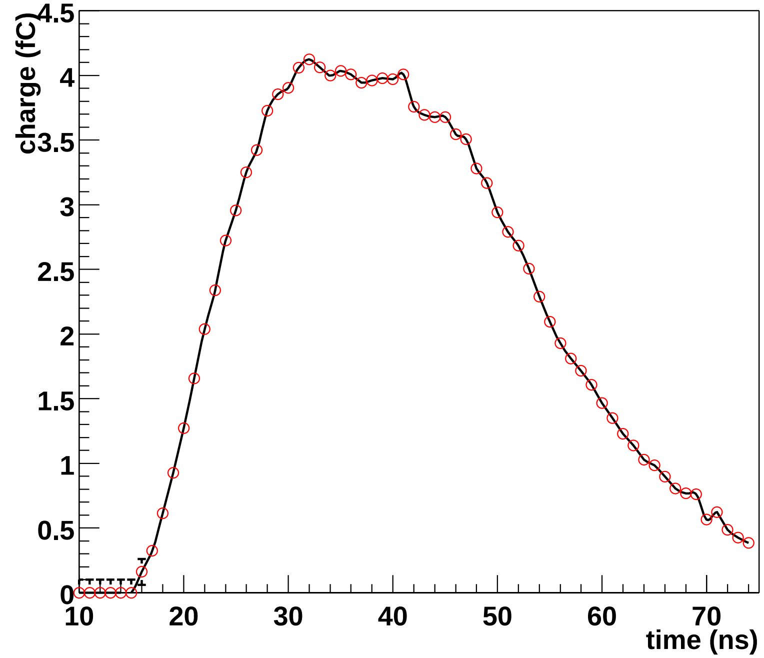
IMPORTANT: Only events where the track points close ($< 40\mu m$) to a strip are used for the reconstruction.

PULSE SHAPE RECONSTRUCTION



Efficiency as a function of threshold and time. Hit information from three time bins has been combined to form a 75 ns range.

→



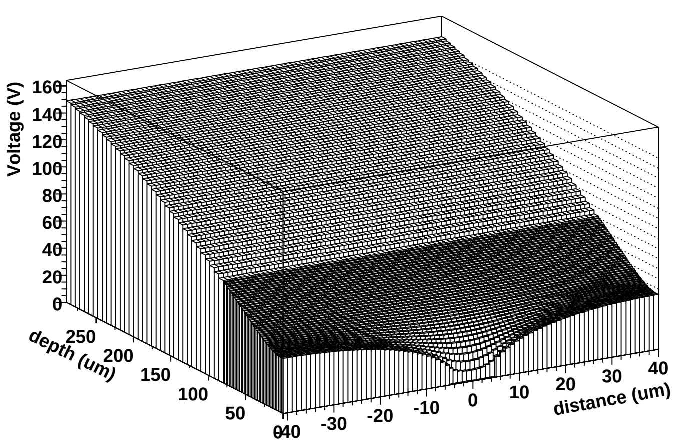
The median charge of each time slice has been found (50 % points) and plotted against time

SIMULATION

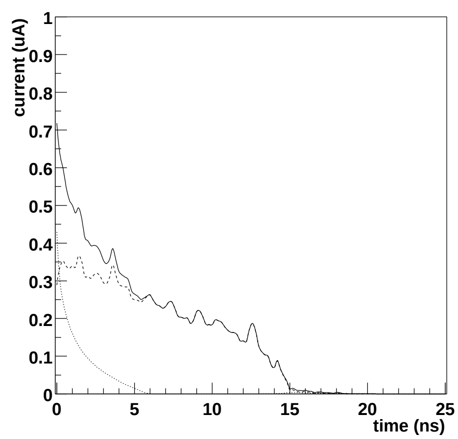
The algorithm was developed by Leslie, Seiden and Unno [*SCIPP 92/61*] Given the Silicon dimensions and the bias and depletion voltage, it determines the field strength on a two dimensional mesh solving Poisson's equation. The weighting field is found by solving the Laplace equation.

Carriers are created according to [*G. Hall, Ionisation energy losses of highly relativistic charged particles in thin silicon layers. Nucl. Instr. Methods 220, 1984(pp. 356)*] and drifted through the field [*R. Muller and T. Kamins, Device Electronics for Integrated Circuits, Wiley, 1986(pp. 32-37)*]

The signal on the strip is convoluted with the shaper/amplifier response function ($CR(RC)^3$ shaper with an extra differentiation step).

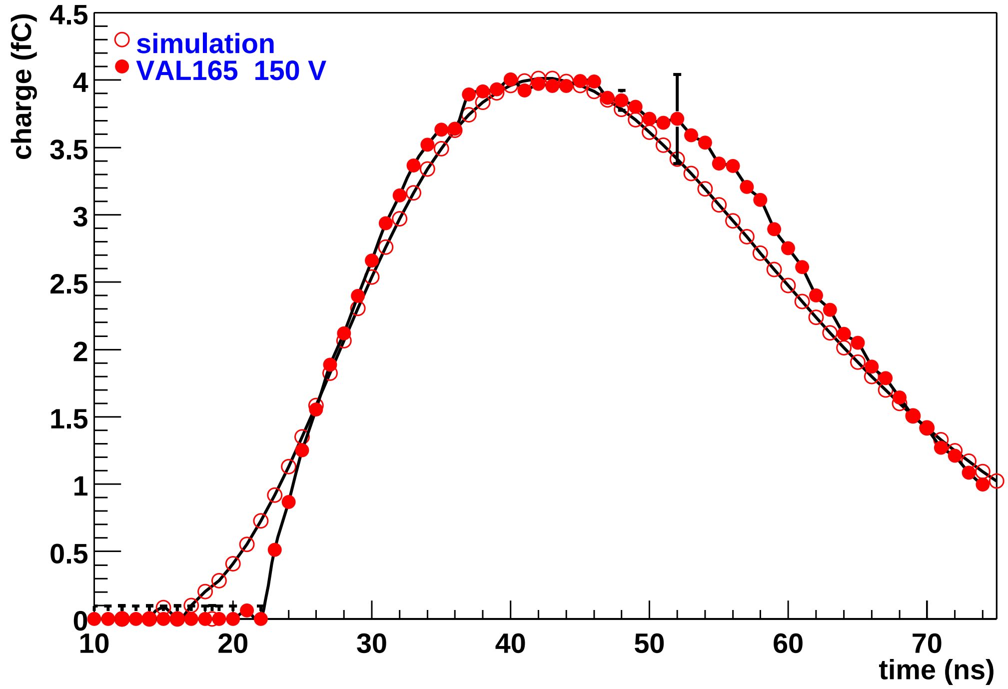


Voltage through the Silicon

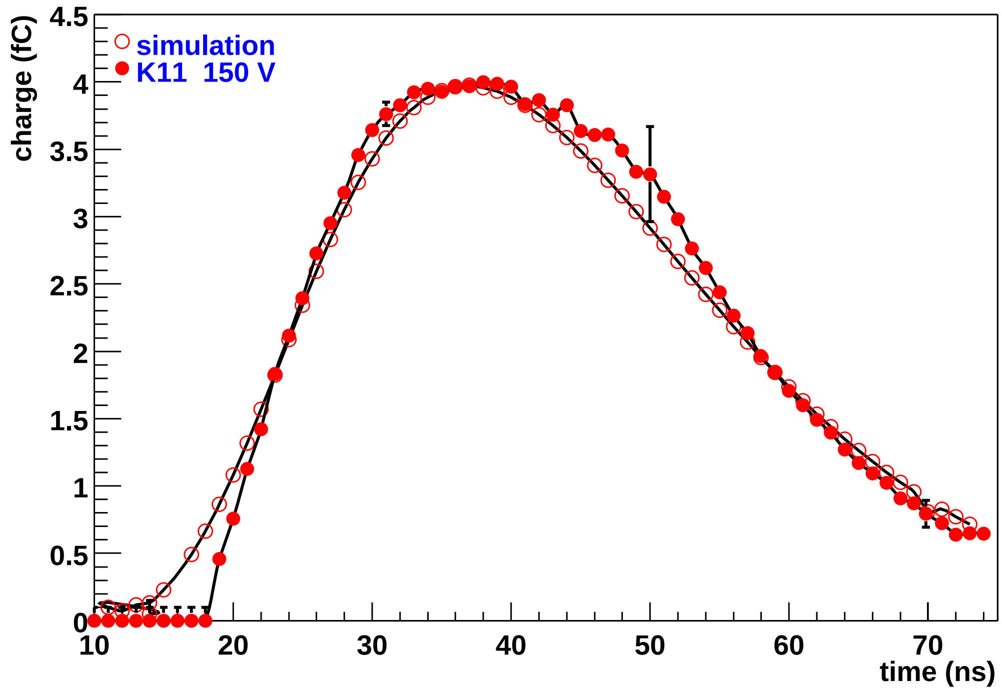


Detector signal

RESULTS

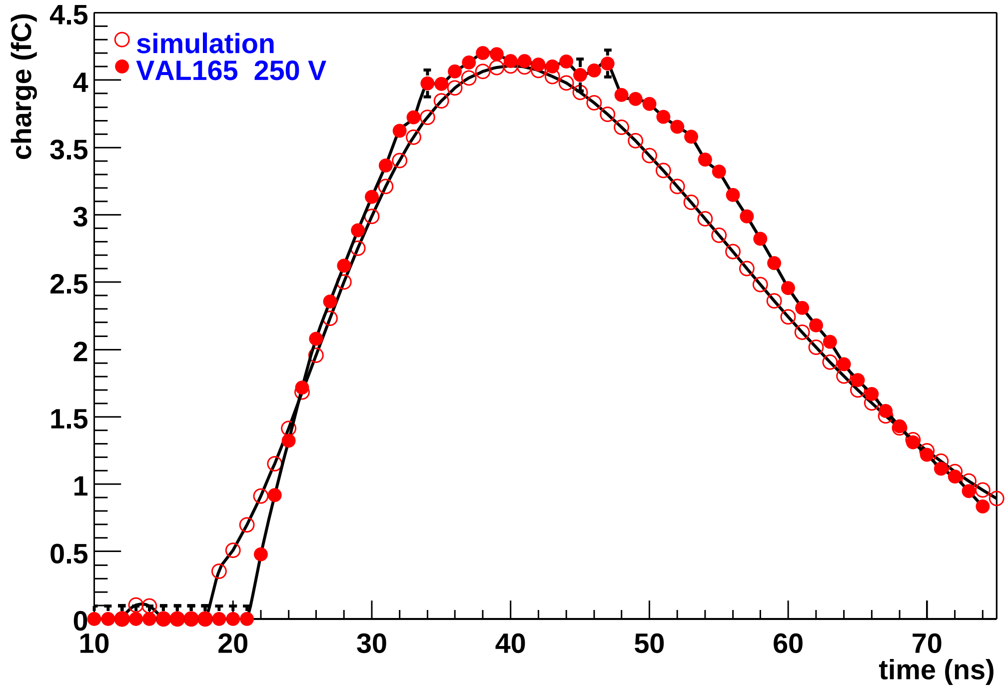


Forward module (VAL165) at 150 V. Simulation: τ = 24 ns.

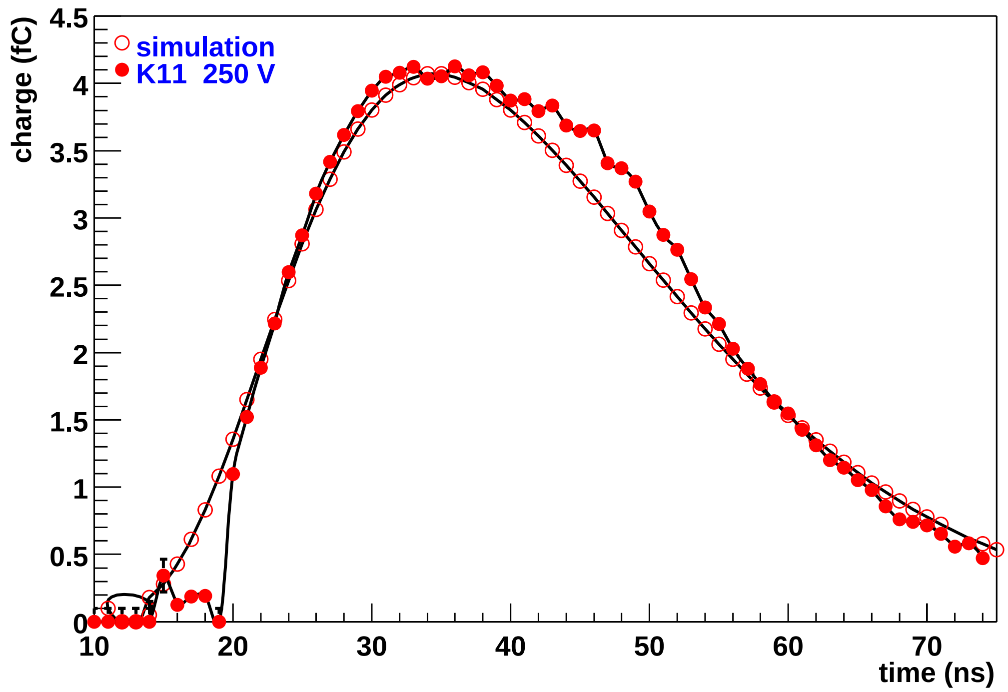


Barrel module (K11) at 150 V. Simulation: τ = 22 ns.

RESULTS

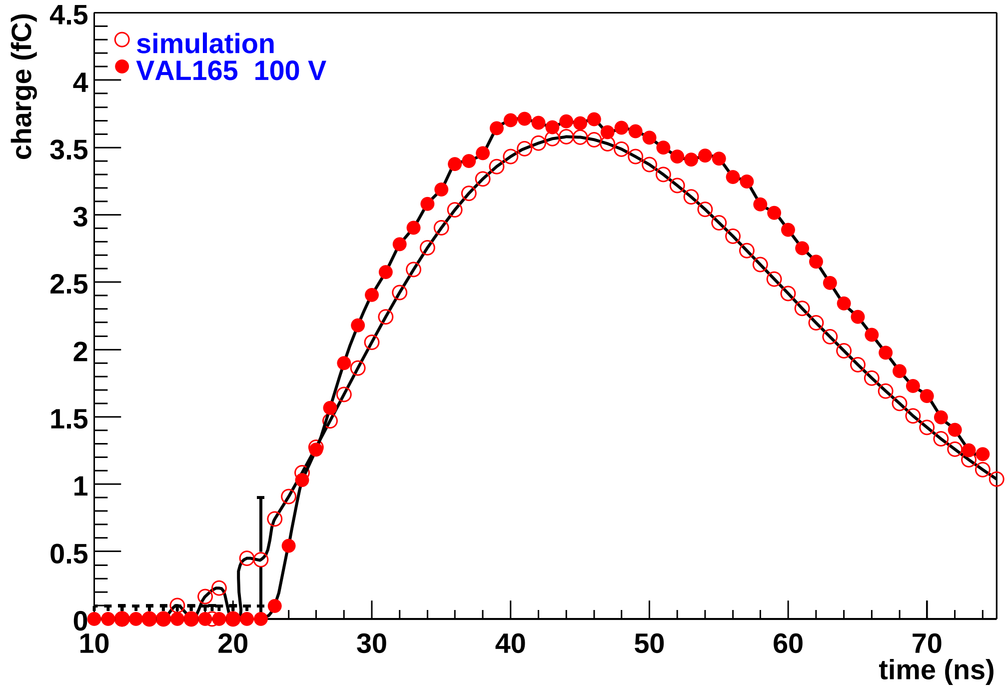


Forward module (VAL165) at 250 V. Simulation: τ = 24 ns.

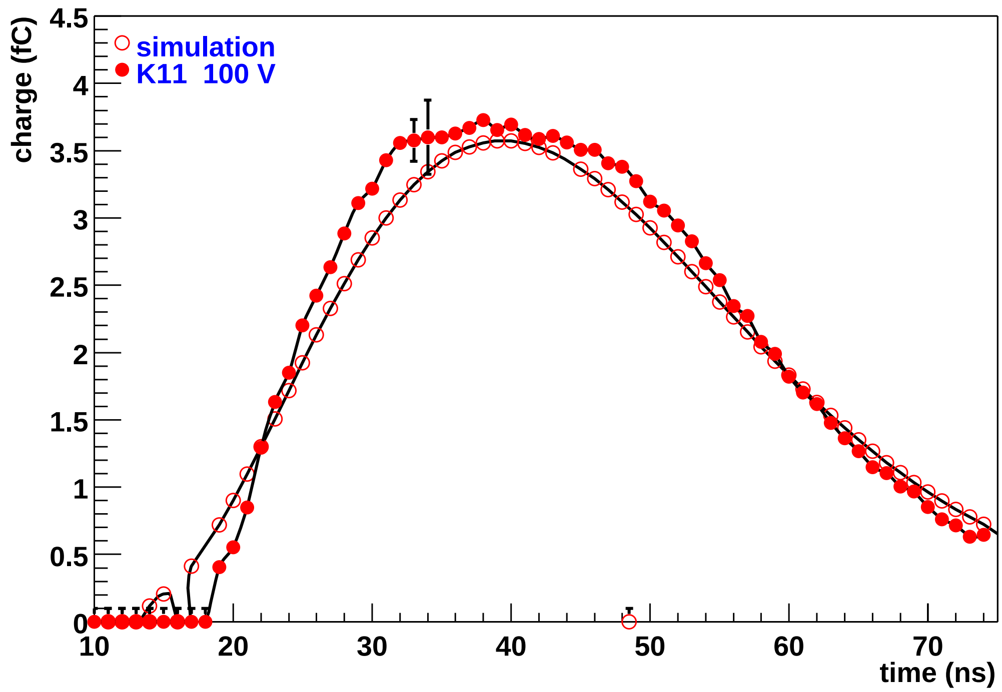


Barrel module (K11) at 250 V. Simulation: τ = 22 ns.

RESULTS

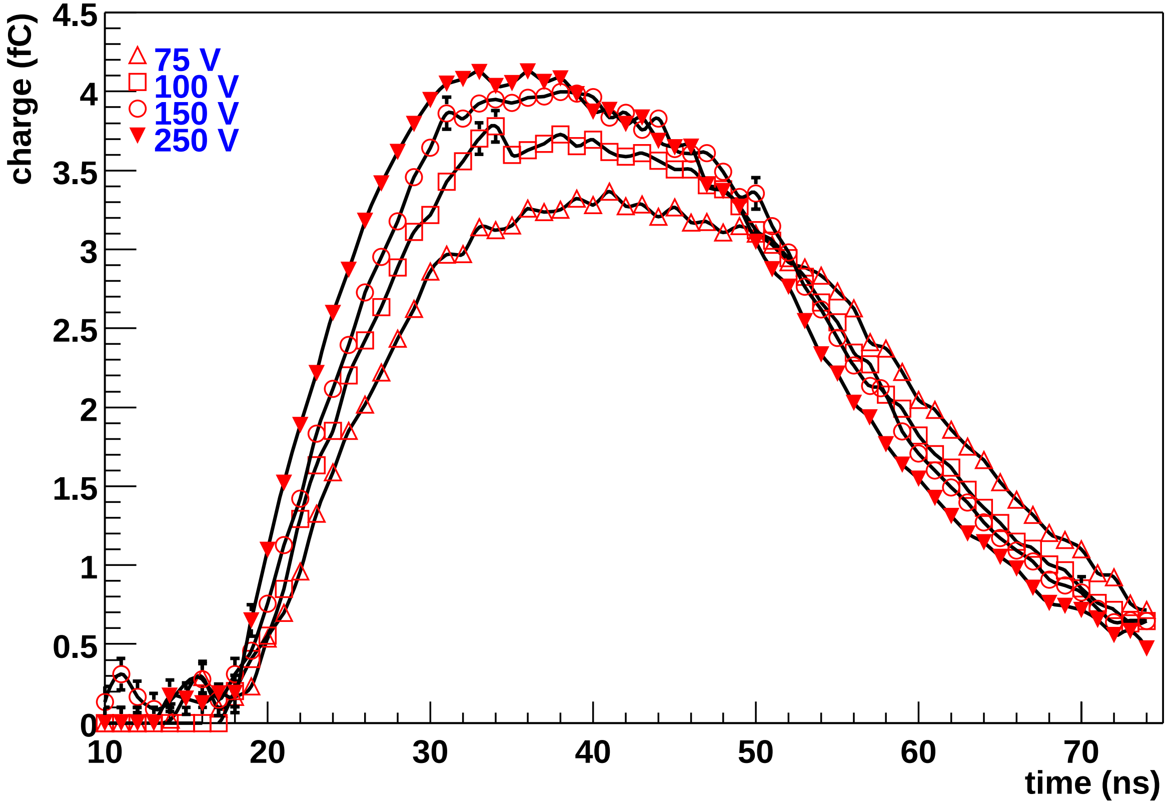


Forward module (VAL165) at 100 V. Simulation: τ = 24 ns.



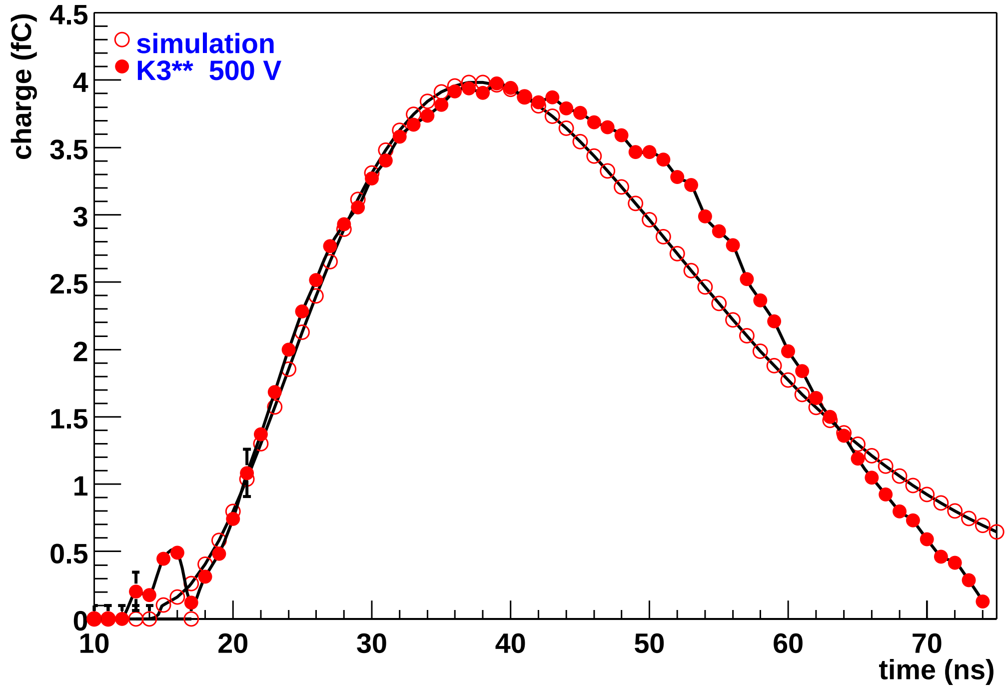
Barrel module (K11) at 100 V. Simulation: τ = 22 ns.

RESULTS

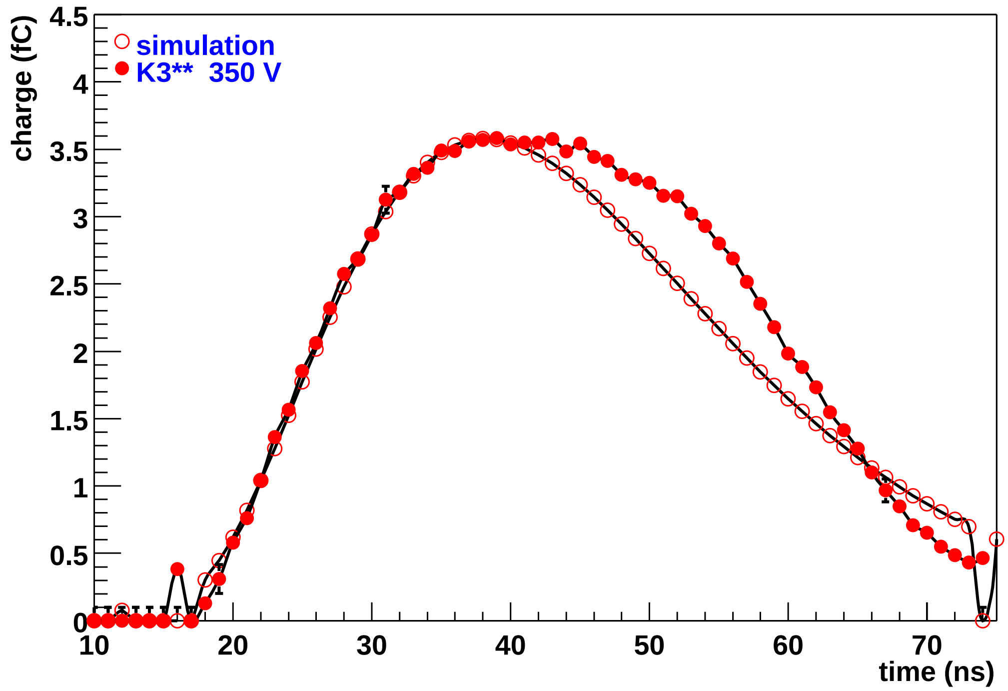


Non-irradiated barrel module (K11)

RESULTS

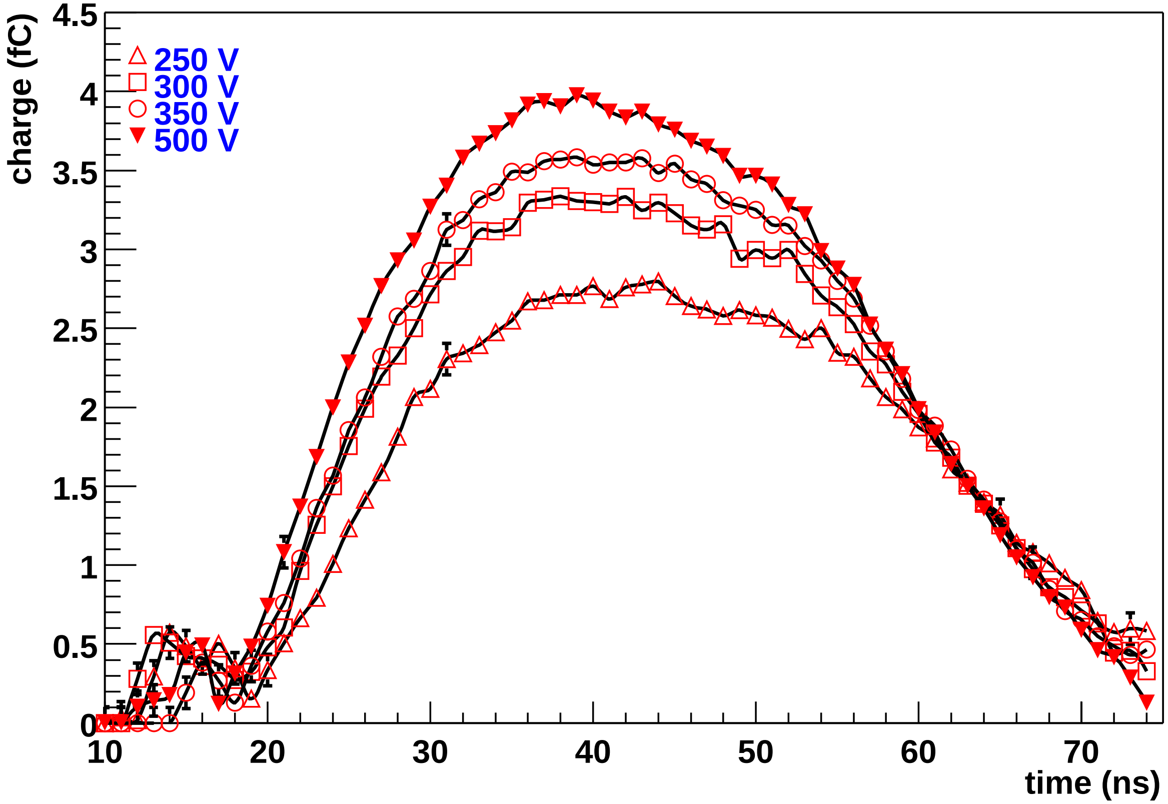


Irradiated barrel (K3) at 500 V. Simulation: τ = 24 ns.



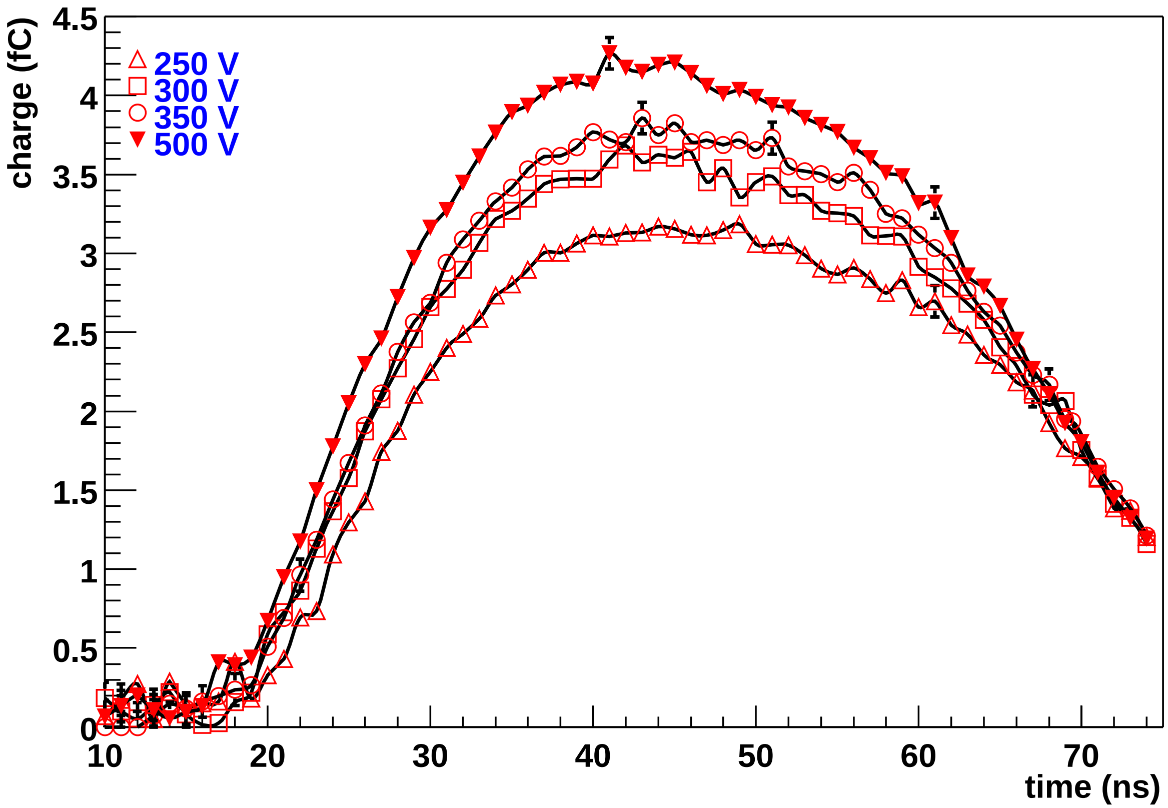
Irradiated barrel module (K3) at 350 V. Simulation: τ = 24 ns.

RESULTS



Irradiated barrel module (K3)

RESULTS



Irradiated forward module (VAL166)

Conclusions

- The dependence of the pulse shape on bias voltage in non-irradiated modules is described reasonably well by the simulation throughout the measured bias voltage range (25 to 275 Volts)
- Non-irradiated modules of the same type have very similar pulses. Forward modules are consistently slower (due to position of the beam?)
- The pulse in non-irradiated modules hardly changes between 150 and 275 Volts. At lower voltages it is stretched due to ballistic deficit of the shaper.
- In the irradiated modules the “shoulder” in the pulse shape has become more pronounced, leading to a longer overall pulse. The simulation does not reproduce this effect.
- The increase in pulse length is much more severe in VAL166 than in K3.
- The pulse shape varies smoothly with bias voltage down to some 300 Volts.