

# Status of the irradiation facility at ELSA (Bonn)

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- ELSA facility
- Linac 1 operation point
- Beam characterization
  - Trovidur foils
  - p-i-n diodes
- Dosimetry
  - radFET
  - Aminogray
- Conclusions



Electron Stretcher Accelerator ELSA is operated at the Physics Institute of the University of Bonn. It consists of three stages (LINACs, booster and stretcher ring) and delivers a beam of polarized or unpolarized electrons with variable energy of a maximum of 3.5 GeV.



# **Irradiation facility**





# **Linac 1** 20±2 MeV e<sup>-</sup>

Dedicated room for irradiations



Problems found in the last irradiation campaign:

ELSA runs always in high current, high frequency and small beam size mode

→ Extremely high currents in small areas Dose rates of tens of Mrad per minute!

New parameters with moderate doses

Linac 1
Frequencies: up to 50Hz
Pulses: 1ns, 1-3us
Charge: down to 1nC per pulse

Expected dose at ELSA	entire area	
a (cm)	3,00	cm
b (cm)	3,00	cm
Pulse duration (1ns, 1– 3µs)	1,00E-06	S
Pulse frequency	25,00	Hz
Charge in beam / pulse	1,00E-09	С
Dose per min.	8,61	krad/min

# **Beam characteristics: spot size**





0.4 mm Trovidur foil

0.4 mm Trovidur foil after 4 hours of irradiation

Beam spot size ~ 6x6 cm<sup>2</sup>

# **Beam characteristics: current distribution**





Scan the full beam spot area with a pin diode on XY motorstages

Temperature under control





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#### **Beam spot**





### **Beam current**







4mm Trovidur foil melted in minutes

Linear response in the p-i-n diode at low currents

#### $\rightarrow$ Never tested by the ELSA crew





radFET's are calibrated MOSFETs. The electrons created by the ionizing radiation are trapped in the oxide and shift the value of the gate threshold voltage, required to maintain a given constant drain current through the transistor.

Used in LHC and Belle to measure the TID

 $\rightarrow$  Some pieces available from MPI and KEK



The signal is dose dependent, yet is independent of the dose rate, energy type, and is relatively insensitive to temperature and humidity and can be read more than 70 days after the irradiation. Irradiating the amino acid alanine with ionizing radiation causes the production of radicals (unpaired electrons), of which the number of unpaired electrons is proportional to the dose absorbed over a wide dose range.

The non-destructive readout of the radiation induced measuring signal is performed by the procedure of electron spin resonance (ESR).





Used to calibrate the radFETs in the past

ESR available at KEK for dose measurement.

Many thanks to Tsouboyama-san!

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# **Future plans**



- Bending magnet: Will improve the knowledge of the beam
- Linac 1 will deliver unpolarized electrons to the booster (hopefully more time for irradiations)
- Linac 2 only for polarized electrons
- In July/August a new Interlock system will be installed (ELSA shutdown)
- We will ask for another long time slot in September



- ELSA: Irradiation facility at home
- Stable operation point was found  $\rightarrow$  Low dose rates (~10krad per minute)
- Beam profile in Linac 1 is now under control (Trovidur and p-i-n diode)
- Dosimetry ready for the next period



# Thank you very much!