

Compact Class-1-Laser-Setup for Beamtime-preparation and Pre-Tests

Gefördert durch:



Bundesministerium
für Wirtschaft
und Klimaschutz

Hannes Zöllner, Jonas Gruner, Burkart Voss

aufgrund eines Beschlusses
des Deutschen Bundestages

GSI-MAT Collaboration Meeting 23.-25.9.2026

We have 2 prototypes

- **Many investigations done**
- **Helped us for beamtime-preparation**

Benefit for others?



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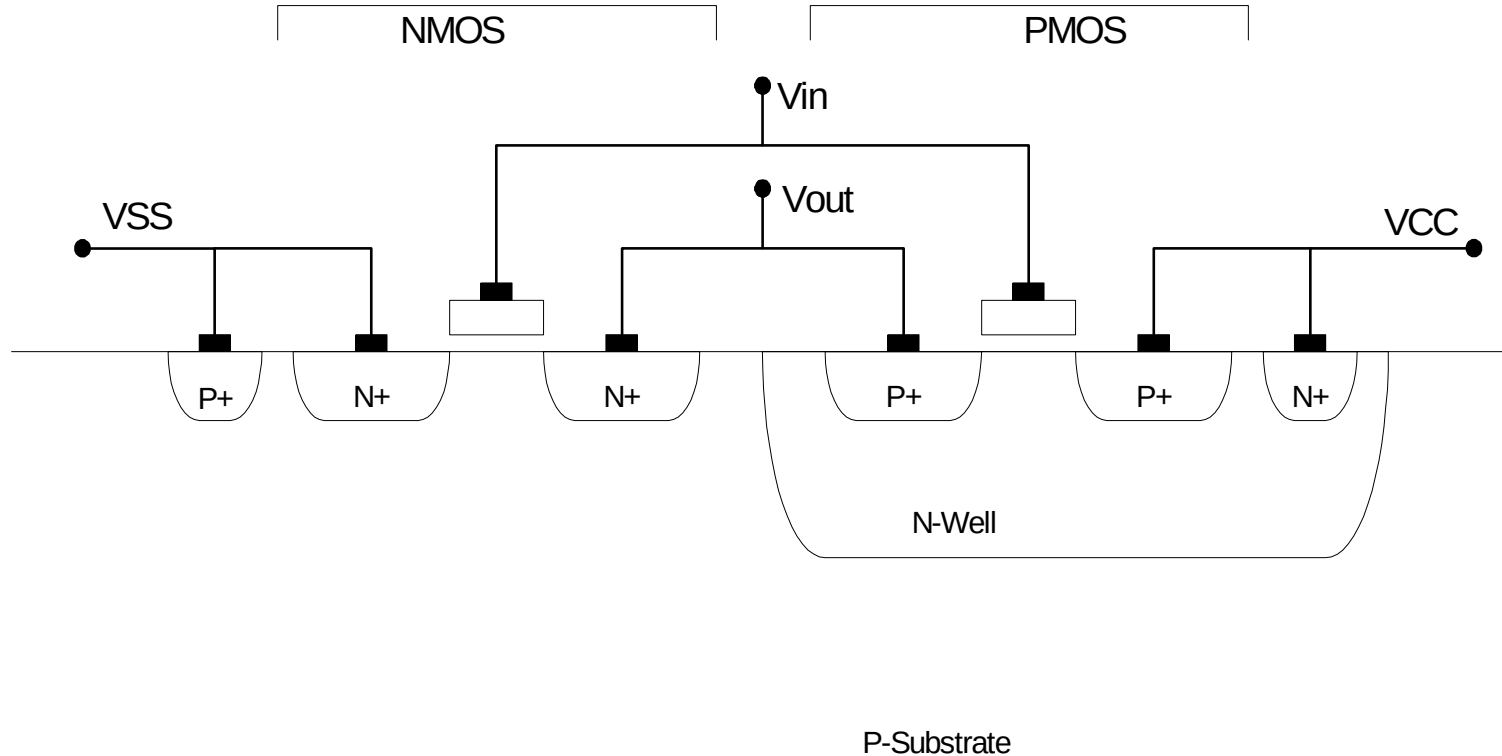
Benefit for others?

→ **Optimize setup for easier use**

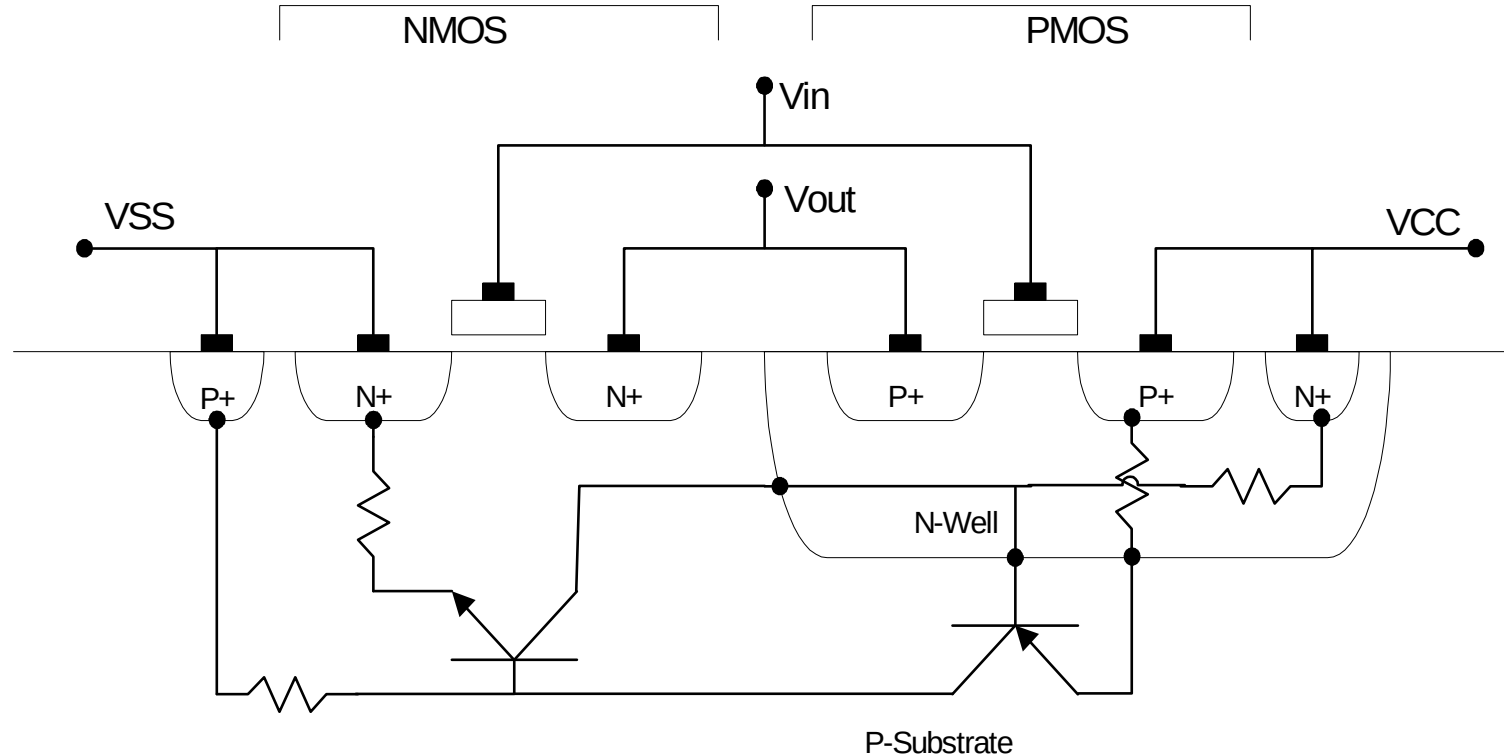
- **More robust prototype**
- **Improve usability**
- **Find common interfaces (e.g. GSI Microprobe)**
- **Find further use-cases & helpful extensions**



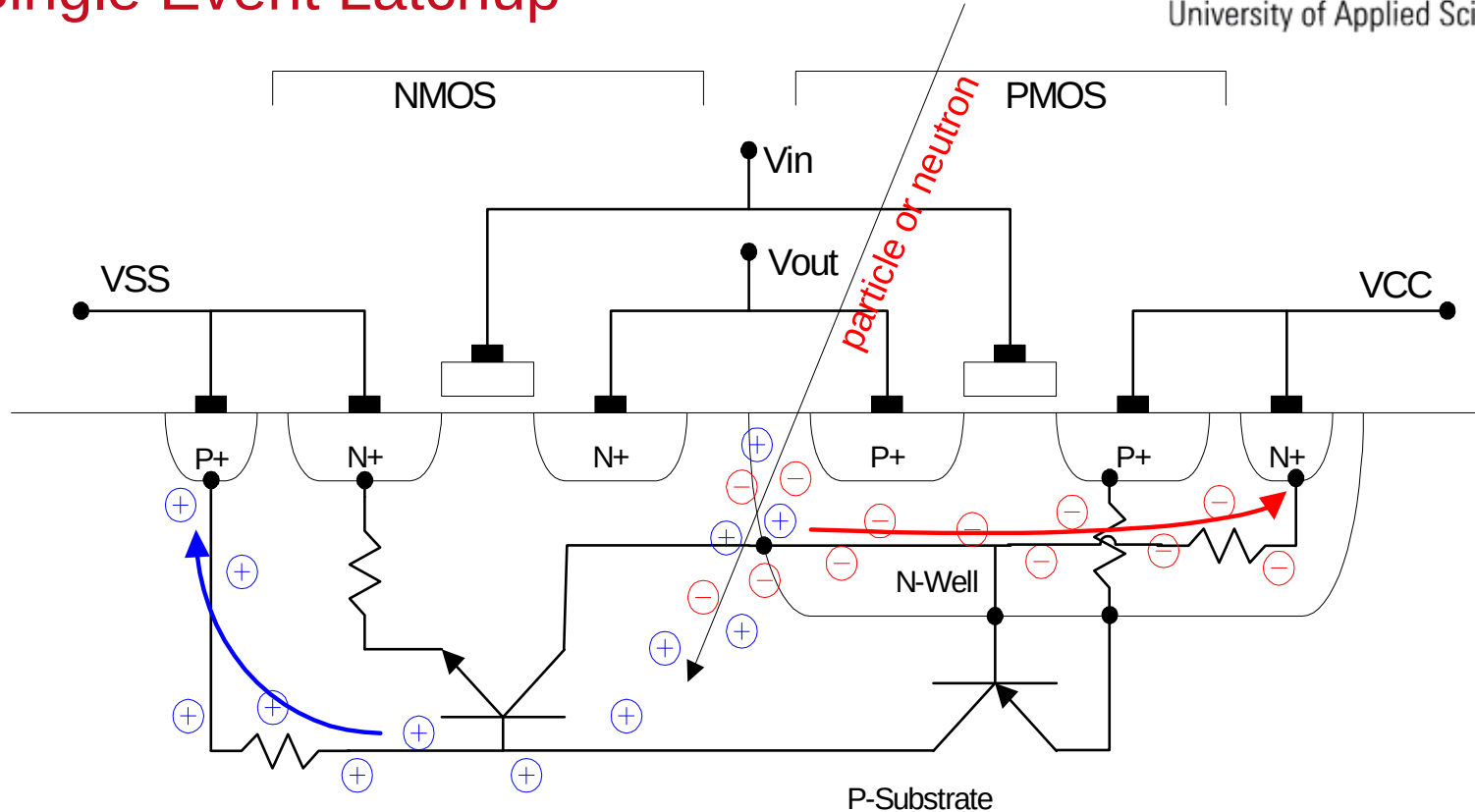
Single Event Latchup



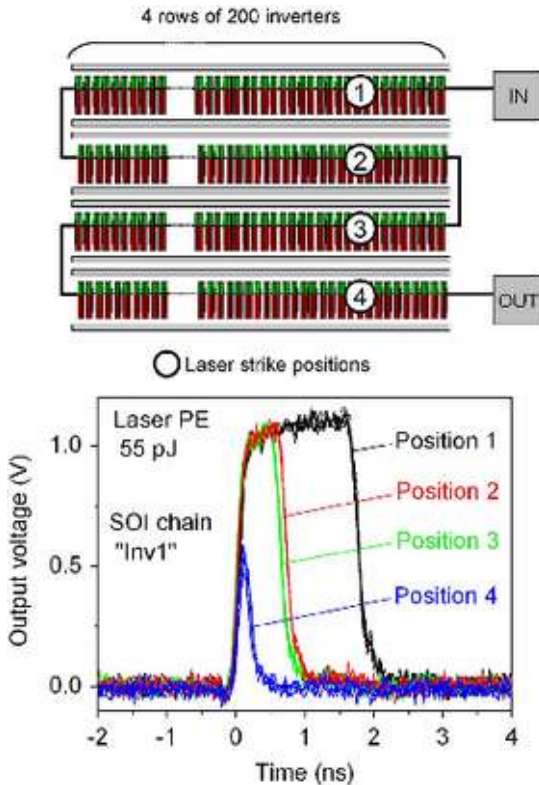
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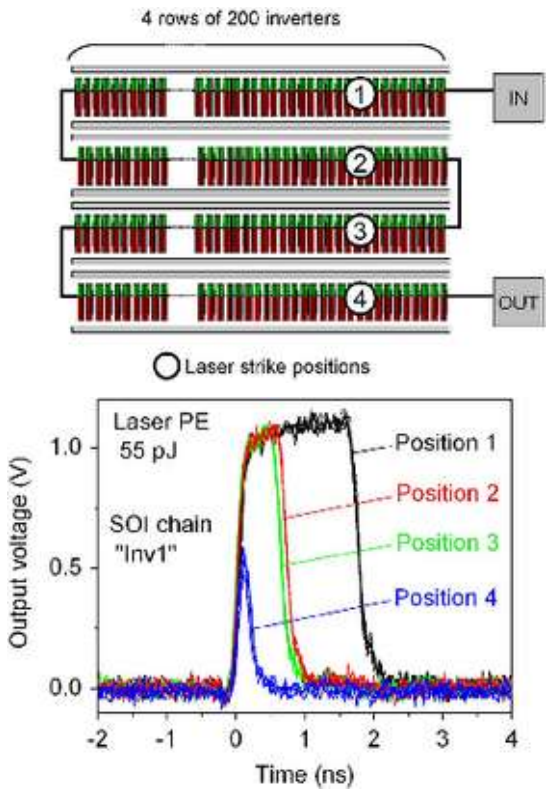


Single Event Transient

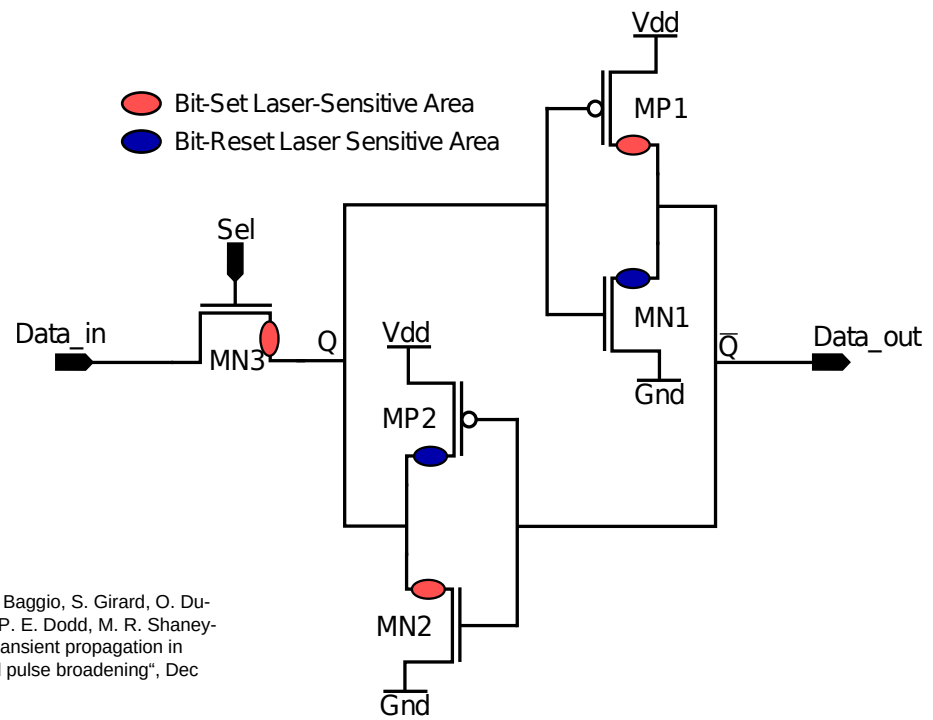


V. Ferlet-Cavrois, P. Paillet, D. McMorrow, N. Fel, J. Baggio, S. Girard, O. Duhamel, J. S. Melinger, M. Gaillardin, J. R. Schwank, P. E. Dodd, M. R. Shaneyfelt, and J. A. Felix, „New insights into single event transient propagation in chains of inverters evidence for propagation-induced pulse broadening“, Dec 2007.

Single Event Transient & Single Event Upset



V. Ferlet-Cavrois, P. Paillet, D. McMorro, N. Fel, J. Baggio, S. Girard, O. Duhamel, J. S. Melinger, M. Gaillardin, J. R. Schwank, P. E. Dodd, M. R. Shaneyfelt, and J. A. Felix, „New insights into single event transient propagation in chains of inverters evidence for propagation-induced pulse broadening“, Dec 2007.



M. Lacruche, N. Borrel, C. Champeix, C. Roscian, A. Saraanos, J. Rigaud, J. Dutertre, and E. Kussener, „Laser fault injection into SRAM cells: Picosecond versus nanosecond pulses“, July 2015

2) Generation of Single-Event-Effects

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2) Generation of Single-Event-Effects



GSJ UNILAC



PULSYS

2) Generation of Single-Event-Effects



GSJ UNILAC



PULSYS

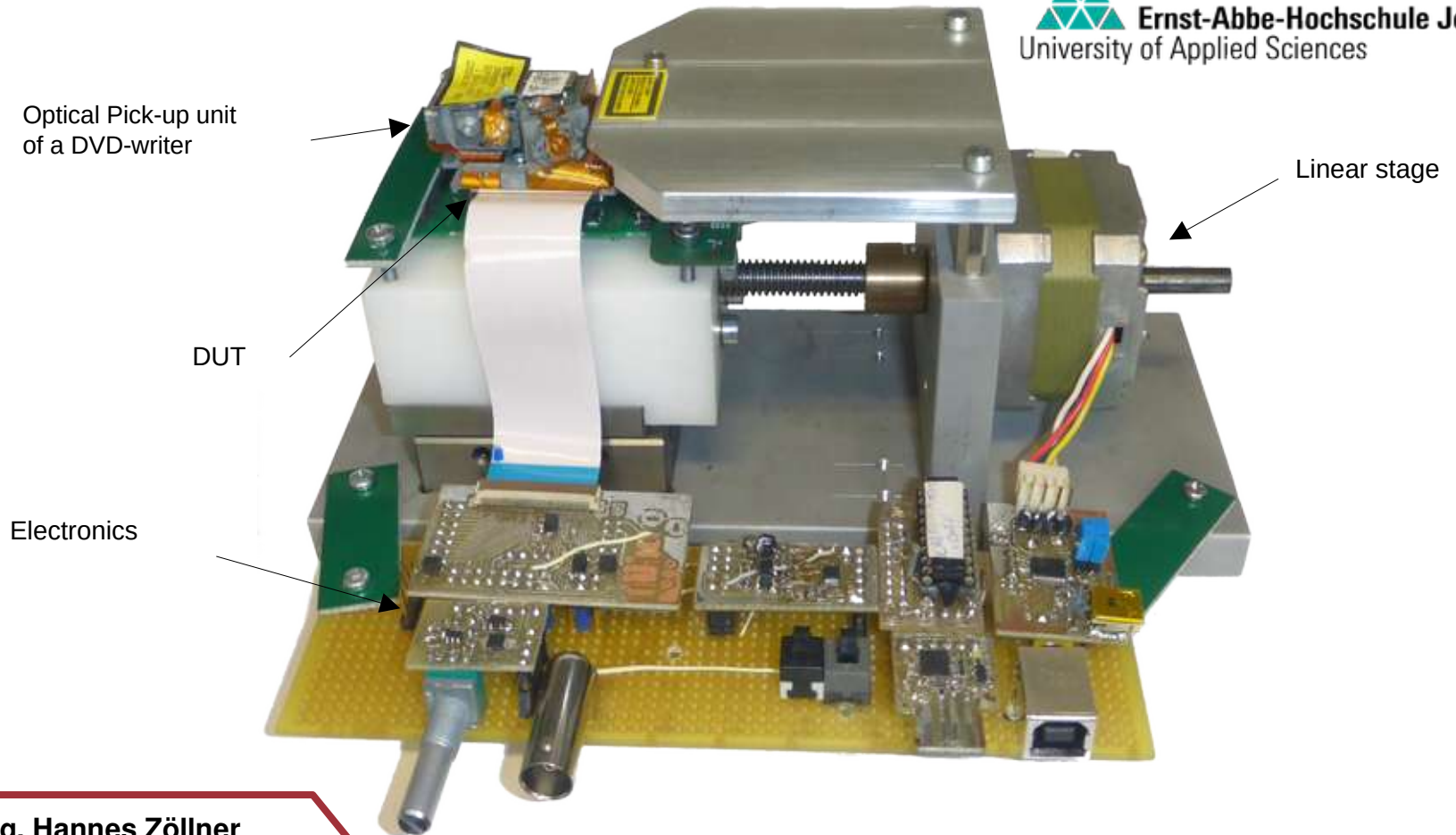


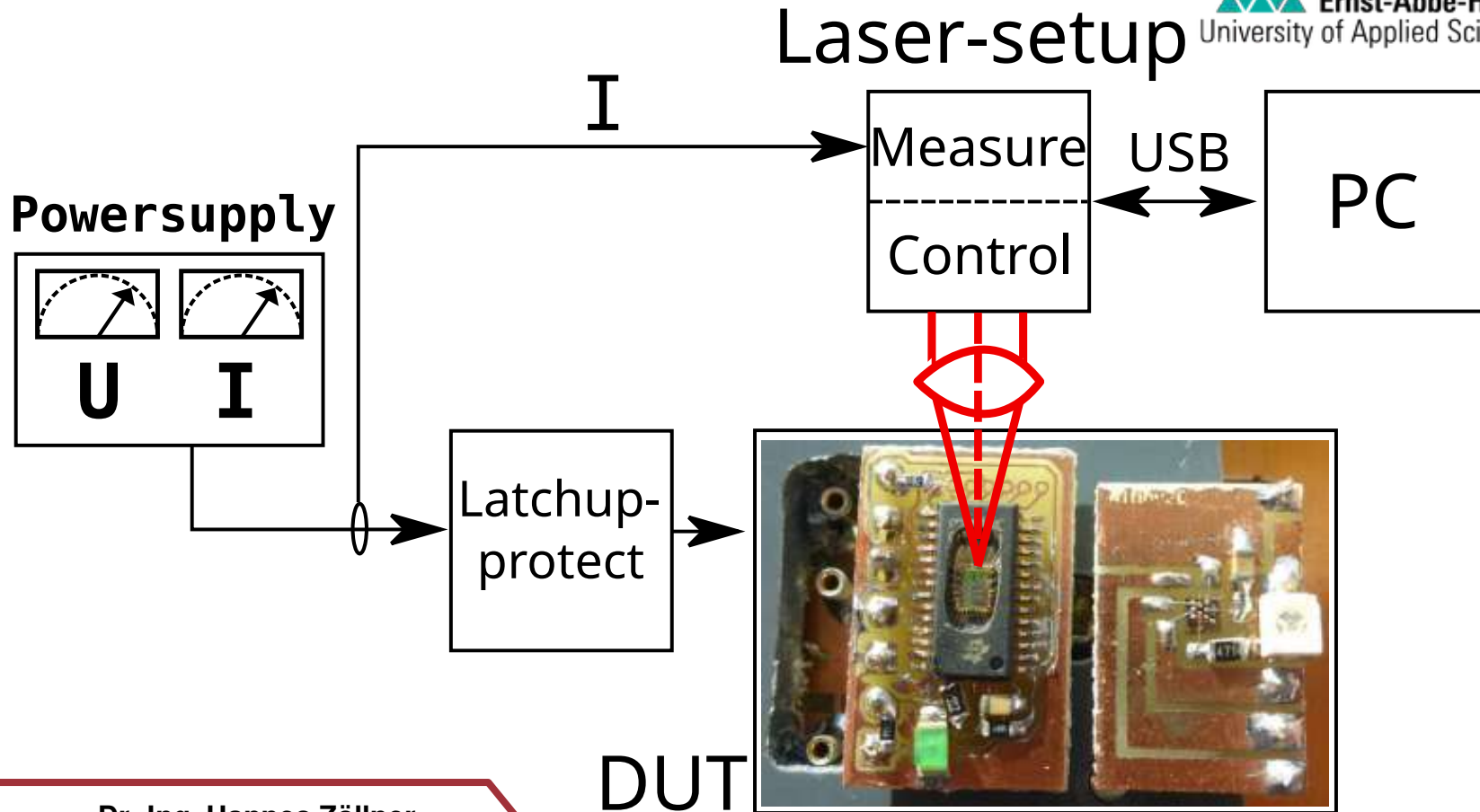
DVD Laser Tag Module

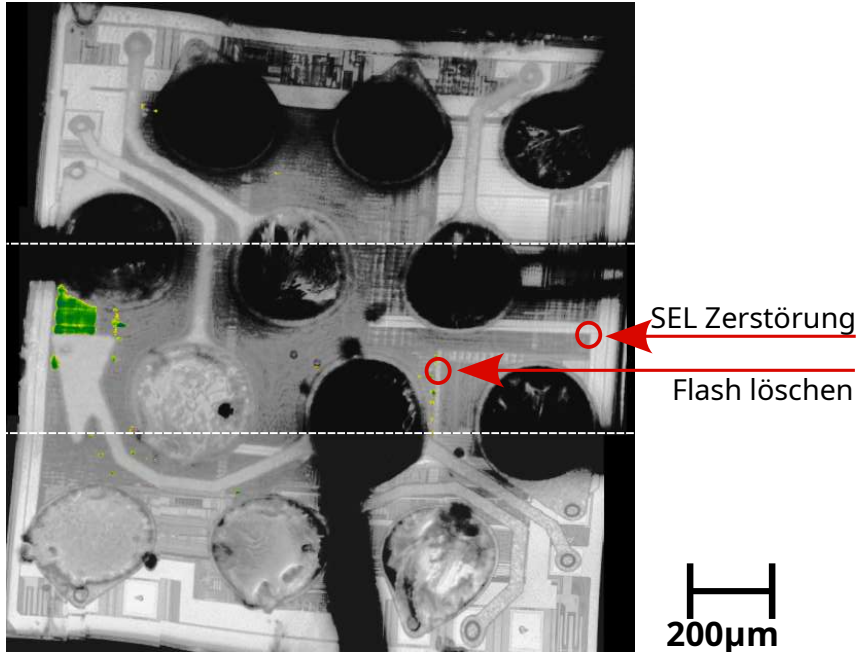
DVD-Writer as Pulse-Laser-Source



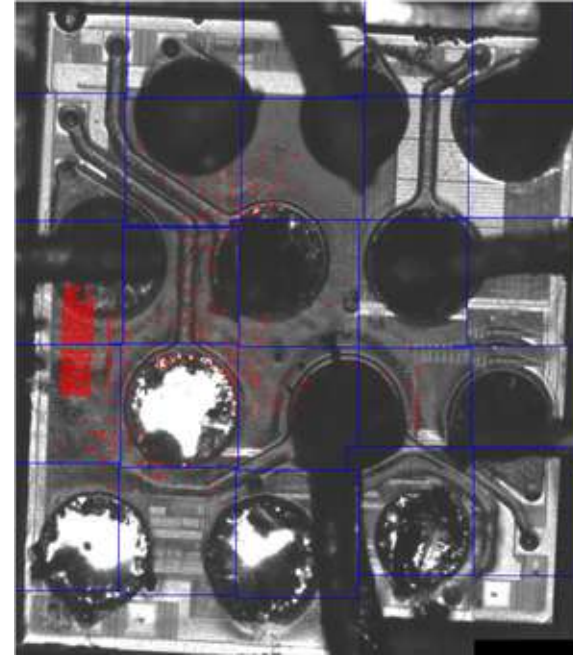
2) Generation of Single-Event-Effects





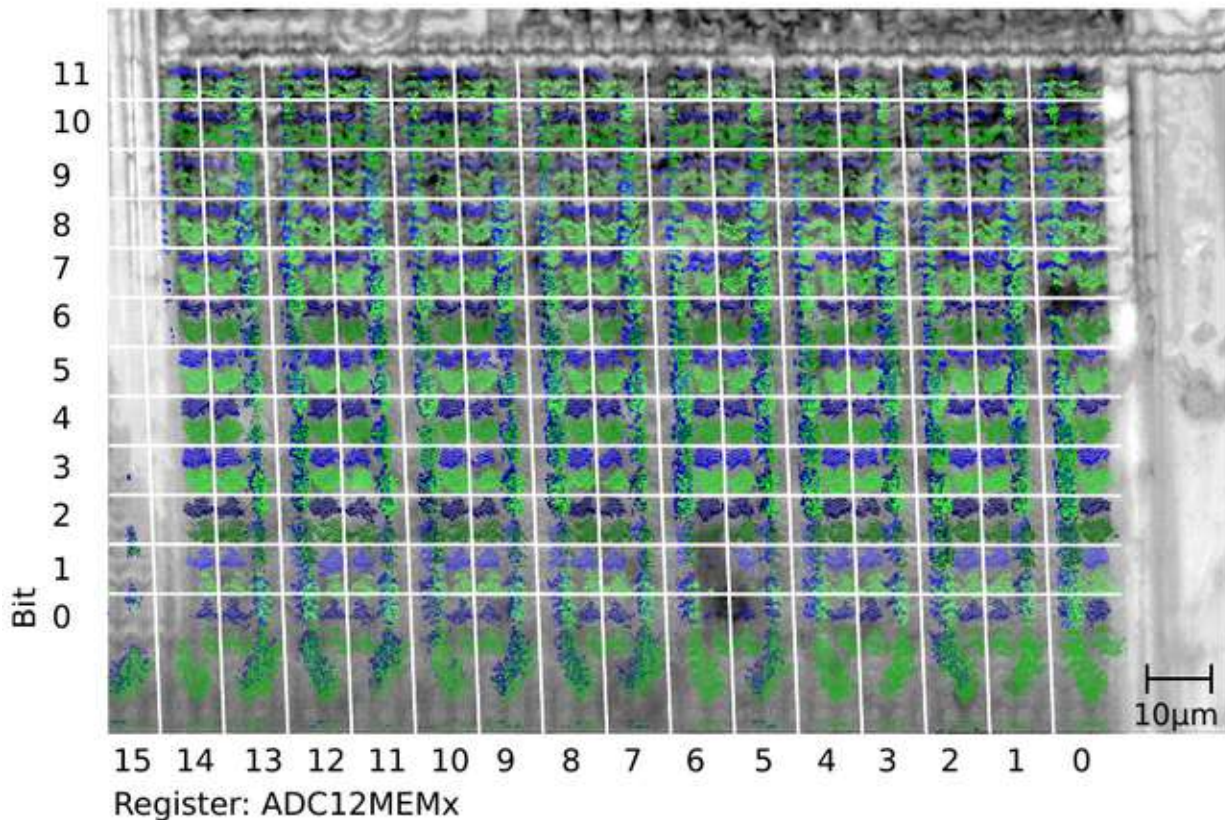
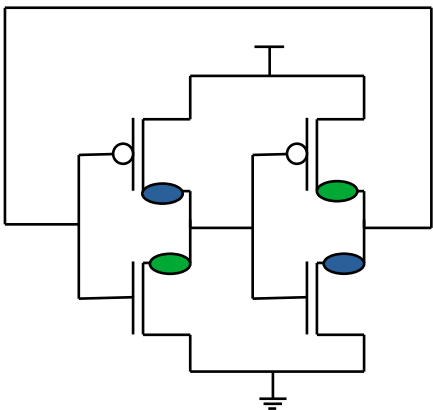


Laser-scan (3 stripes)
With SEL-Threshold (0-1nJ)



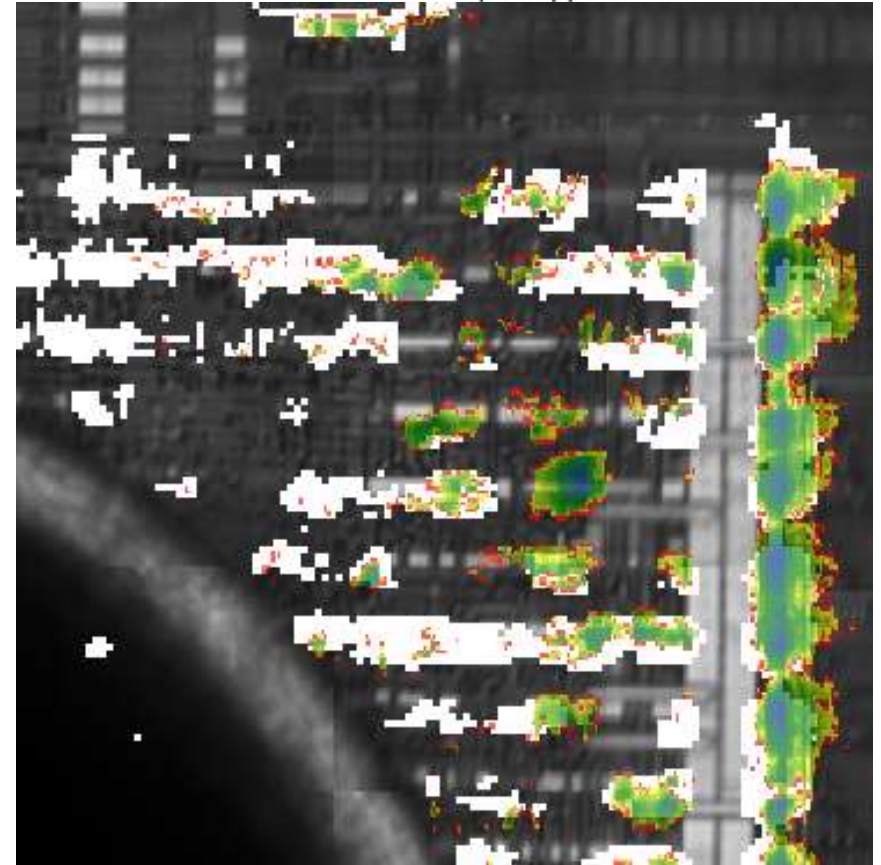
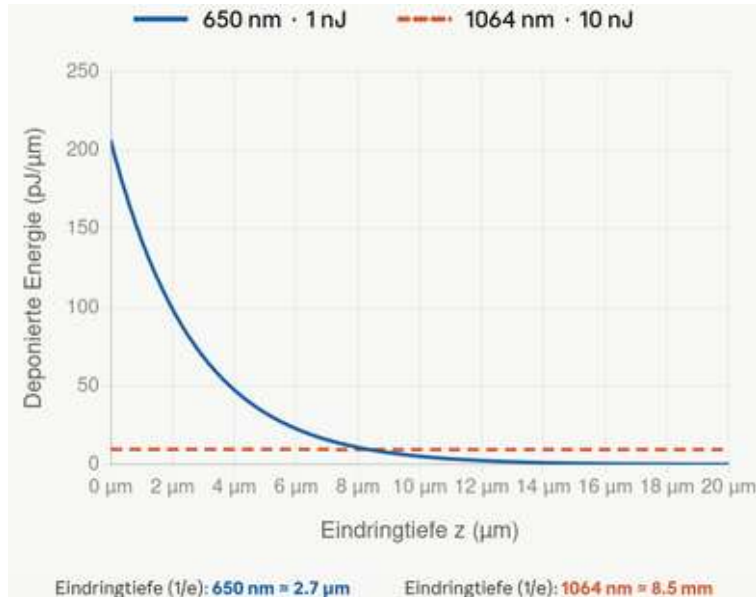
Gold-ions
(6,1MeV/u @ GSI-Microprobe)
Special spots could be verified

- Bit reset
- Bit set

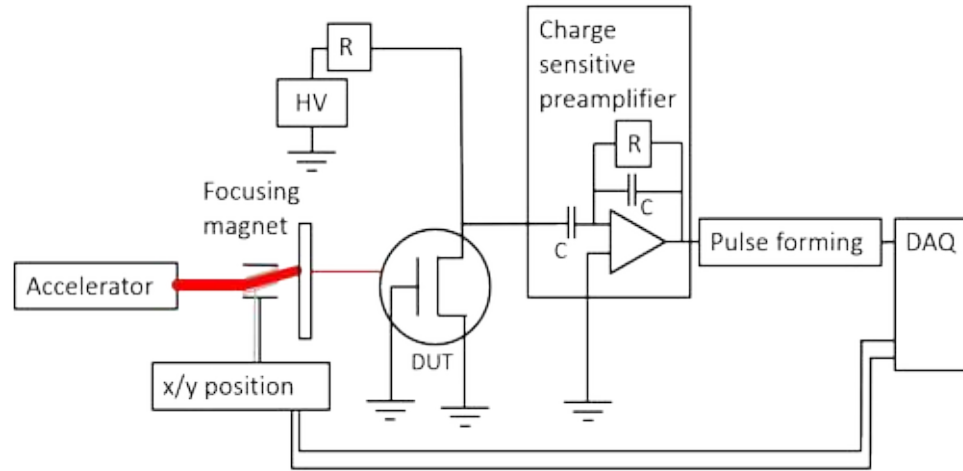


3) Results – Different energy-distribution

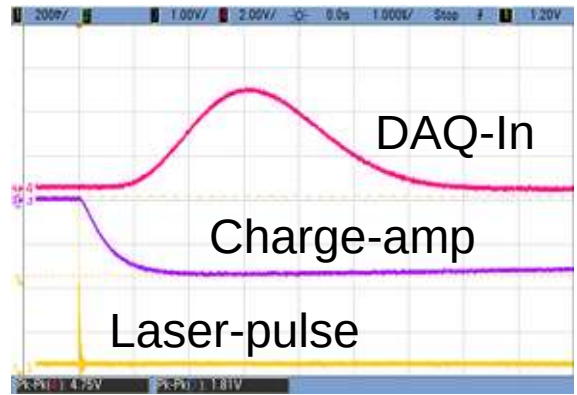
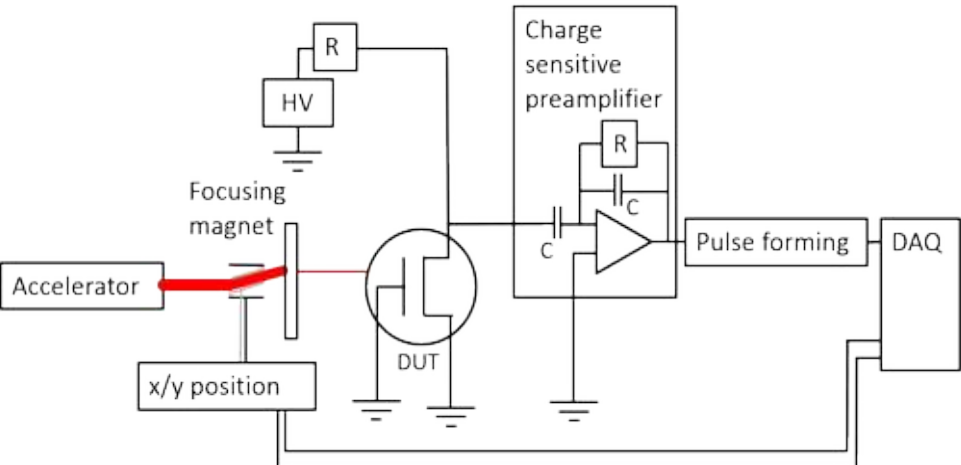
- **White – Latchup-regions @1064nm (FKIE-Euskirchen)**
- **Coloured – Latchup-regions @650nm (DLTM)**



Setup for Accelerator-Measurements:



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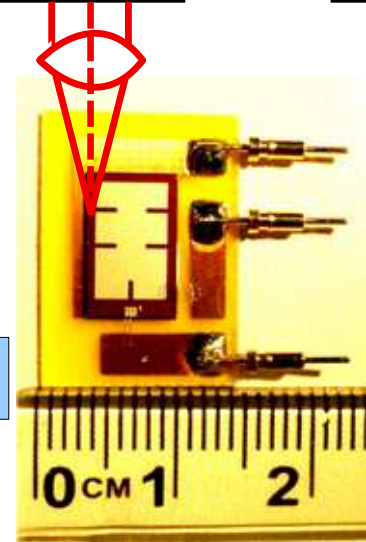
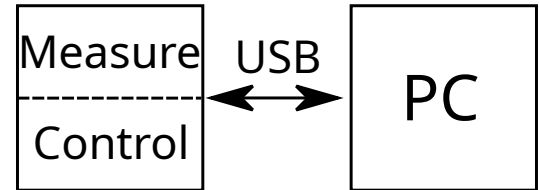


Ernst-Abbe-Hochschule Jena
University of Applied Sciences

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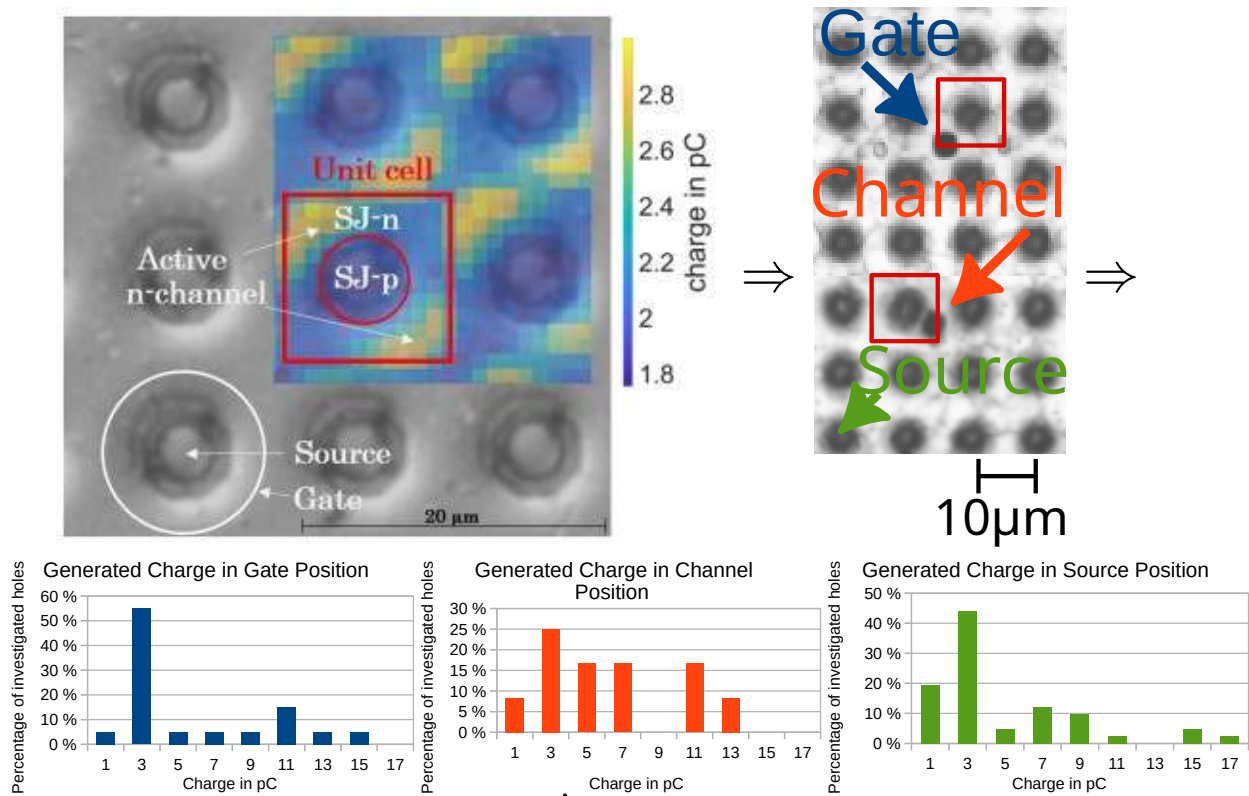
Test & optimize test-setup:

Laser-setup



DUT

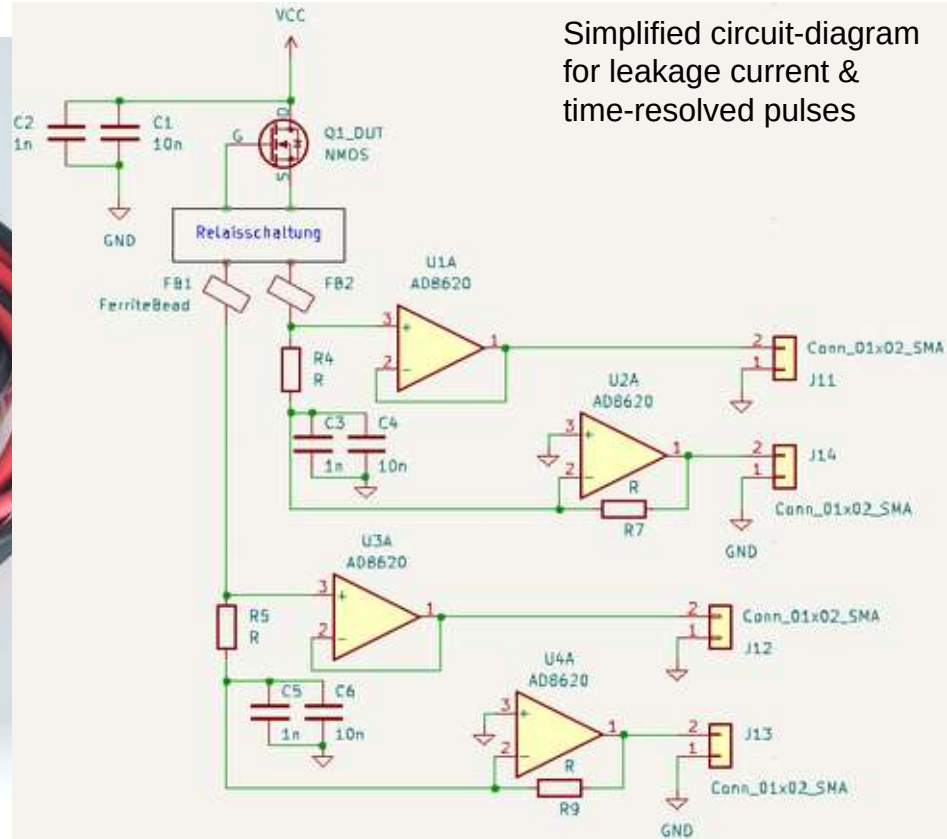
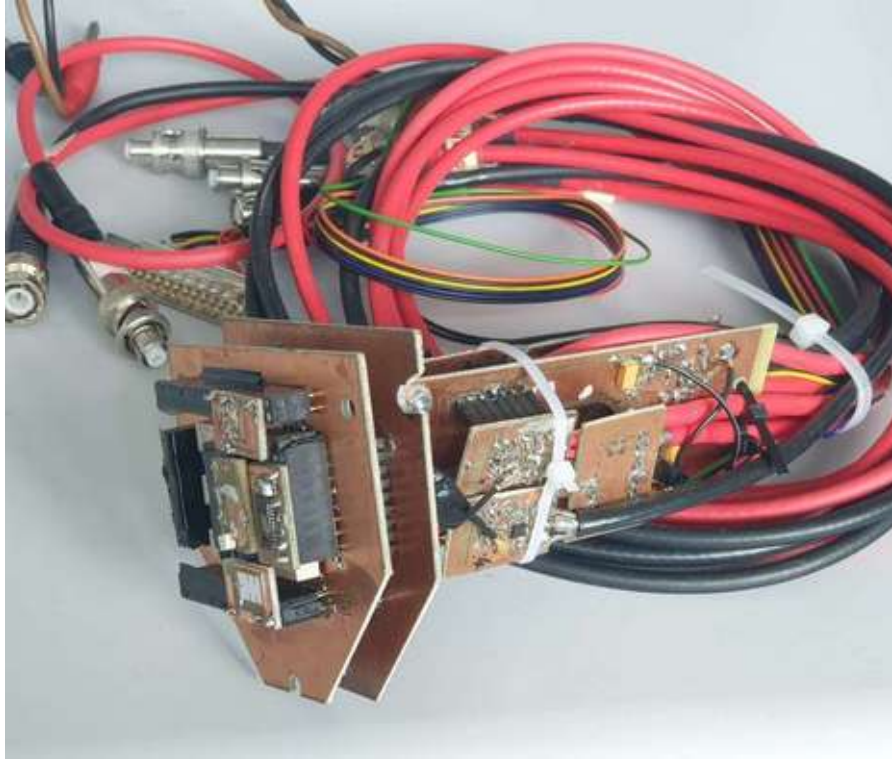
3) Results – Power-Transistors



Transistor-structure and ion-behaviour ⇒ “Drilled” holes into metallized surface by a material processing laser ⇒ Resulting generated charge with laser setup from 70 holes

Probe	Location	Drain-Source voltage at breakdown	Laser energy at breakdown	Drain current after breakdown	Gate current after breakdown
R16	Source contact	600V	330 pJ	0,11 mA	0,34 μ A
R15	Source contact	575V	680 pJ	0,15 mA	10 pA
R12	Gate	575V	1300 pJ	0,14 mA	10 pA
R18	Channel	600V	1000 pJ	0,14 mA	10 pA
R17	Channel	600V	680 pJ	0,14 mA	32 μ A
R2	Channel	575 V	680 pJ	0,14 mA	10 pA

Signal-path has slow low-pass-filter → Modification for RF-Measurements



4) Features of DLTM

- **650nm/780nm wavelength → low penetration-depth (few μm)**
- **Diode-Laser → long pulse-width (ns)**
- **Metallization on wafers limits access**

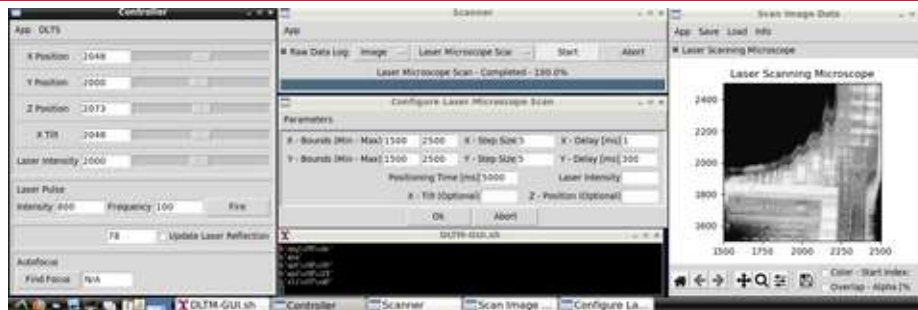
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- **Class-1-Laser → No special safety necessary - Usable nearly everywhere**
 - Preparation of Beam-times
 - For iterative investigations
 - Teaching of SEE
- **Laser-scanning-microscope included**
 - Auto-focus and permanent Beam-control
 - Measurement of reflectivity at every pulse

5) Outlook: Unified Control Interface?



Shared Control GUI

- Consistent user interface logic
- Reduced training effort
- Standardized measurement procedure



**DLTM
Laser Tests**



???



**GSI
Ion Microprobe**

Questions? Wishes?

Unless your brain has suffered a latch-up
due to information overload,
you may ask questions now.

Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages

FKZ 50PS2502

Dr.-Ing. Hannes Zöllner

