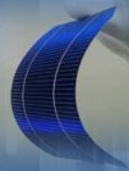


Industry day SUPSI

## Interaction of two accredited test labs



INSTITUT FÜR  
SOLARTECHNIK

Christof Biba, Evelyn Bamberger

Canobbio  
6th Oct. 2017



**HSR**

HOCHSCHULE FÜR TECHNIK  
RAPPERSWIL

FHO Fachhochschule Ostschweiz

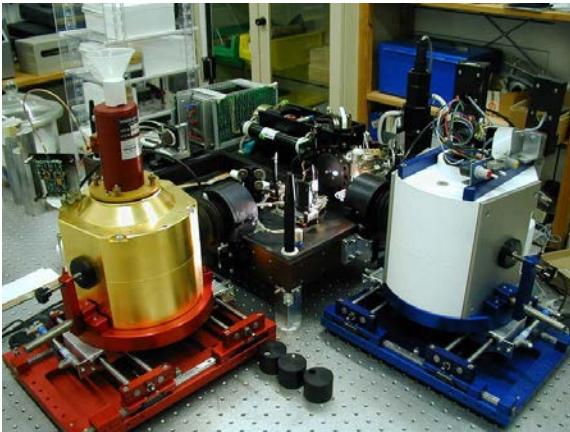
# Portrait SPF



Solar Tracker



Optics laboratory



## ■ Accredited Lab

- Solarthermal and heat in buildings
- Thermal and optical characteristics of the building envelope
- Competence center for solarthermal (BFE)

## ■ Energy Systems

- Heat, Electricity & Mobility

## ■ Optical analysis & quality tests

## ■ PV in building envelope

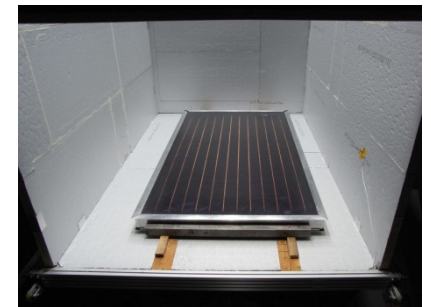
## ■ Academic studies

# Example: Collector Testing



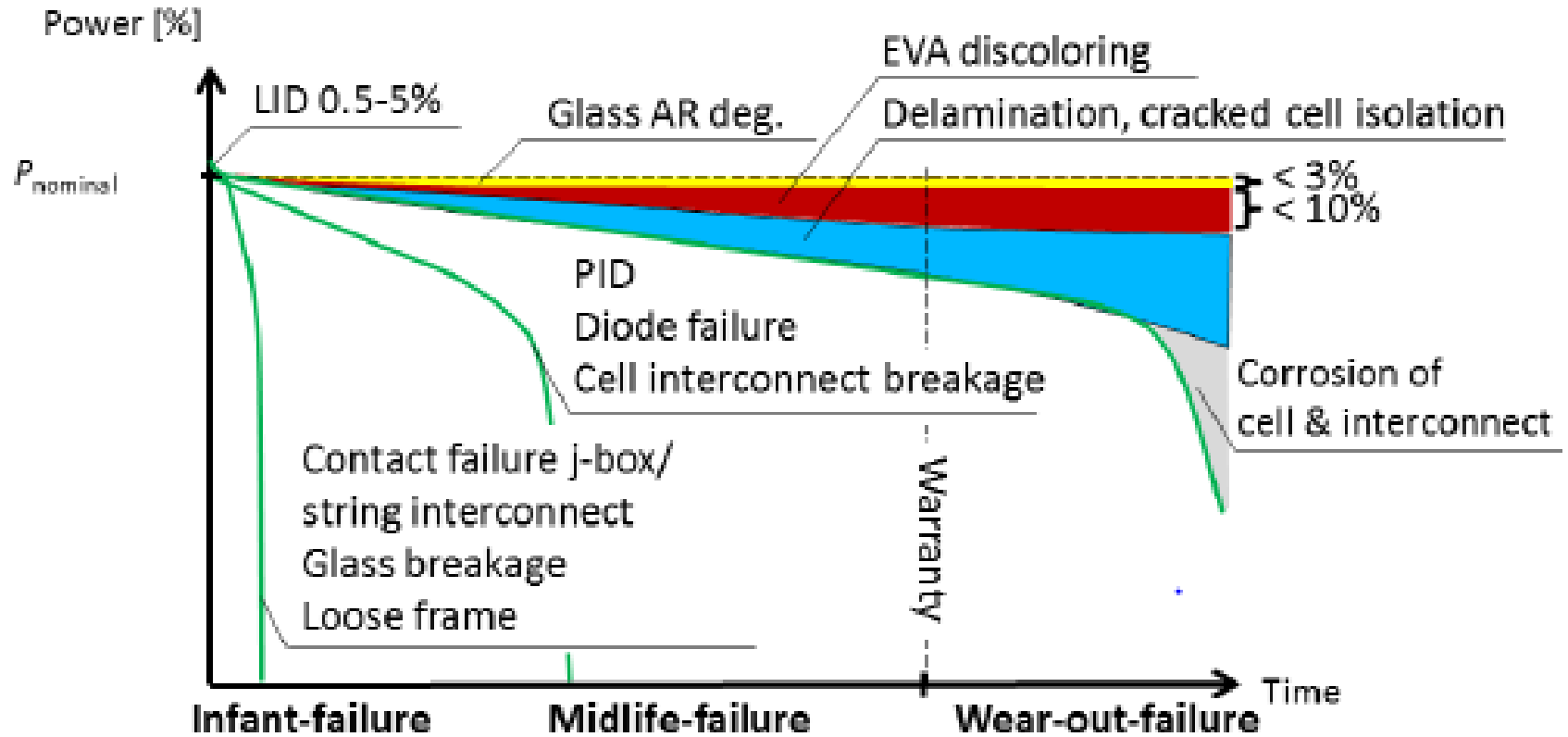
e.g. Solar Thermal / PV Glass

[www.spf.ch/Certification.94.0.html](http://www.spf.ch/Certification.94.0.html)





# Many reasons to lose power after time ...



LID Light induced degradation  
PID Potential induced degradation

# Cooperation SUPSI & SPF via multiple channels



# Snowload Resistance Certificate

- SPF**
- SPF Team
- Products
- Spin-Offs
- Contact
- Research**
- Competencies
- Services
- Projects
- Publications
- Cooperation
- Testing**
- Test reports**
- Collectors
- Systems Hot Water
- Combisystems
- Storage tank stratification
- Glasses
- Snow load**
- Thermal insulation
- Compensators and collector connections
- Stagnation resistance
- Domestic hot water modules

**Snow load resistance – PV modules**

Test date	Manufacturer	Type	Snow load resistance	Certificate
22.06.2015	Eternit (Schweiz) AG	Swisspearl Integral 2 – GG	20 kN/m <sup>2</sup> (0° – 30°) 17 kN/m <sup>2</sup> (30° – 60°)	Certificate

Scuola universitaria professionale della Svizzera Italiana

**SUPSI**

**SPF** Solartechnik Prüfung Forschung

**Schneelastzertifikat**

Handelsname: **Swisspearl Integral 2 – GG**

Firma: **Eternit (Schweiz) AG**

Zertifikat Nr.: **SPF-SUPSI-15-144-SNOW**

Gültigkeit: **06.2015 – 06.2020**

Das PV Modulsystem **Swisspearl Integral 2 – GG** der Firma **Eternit (Schweiz) AG** in **CH-8867 Niederurnen** erfüllt die Anforderungen „SPF-SUPSI Schneelast Zertifizierungsvorschrift und Vertrag Version 1.0“. Als Grundlage gelten die SPF Prüfberichte **L144PV-A, L144PV-B, L144PV-C, L144PV-D** sowie die SUPSI Prüfberichte **14-246-A-REP7-rev1, 14-246-A-REP11-rev1**.

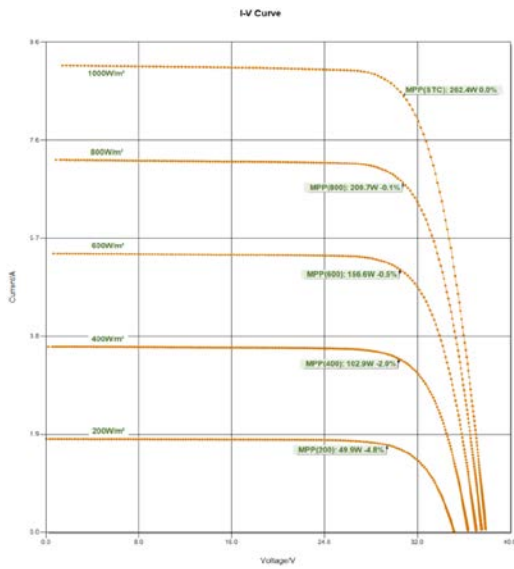


# Mobile PV-Lab since 2016

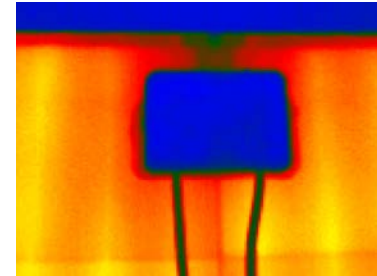


# Which measurements could be done?

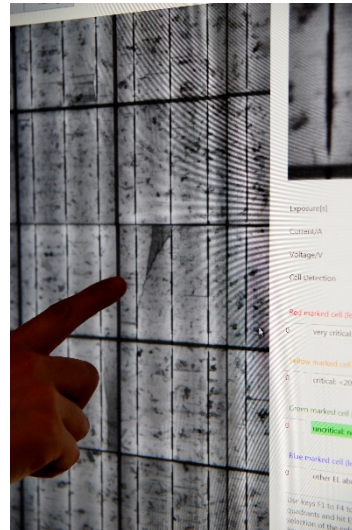
## I-V-Curve



## Infrared



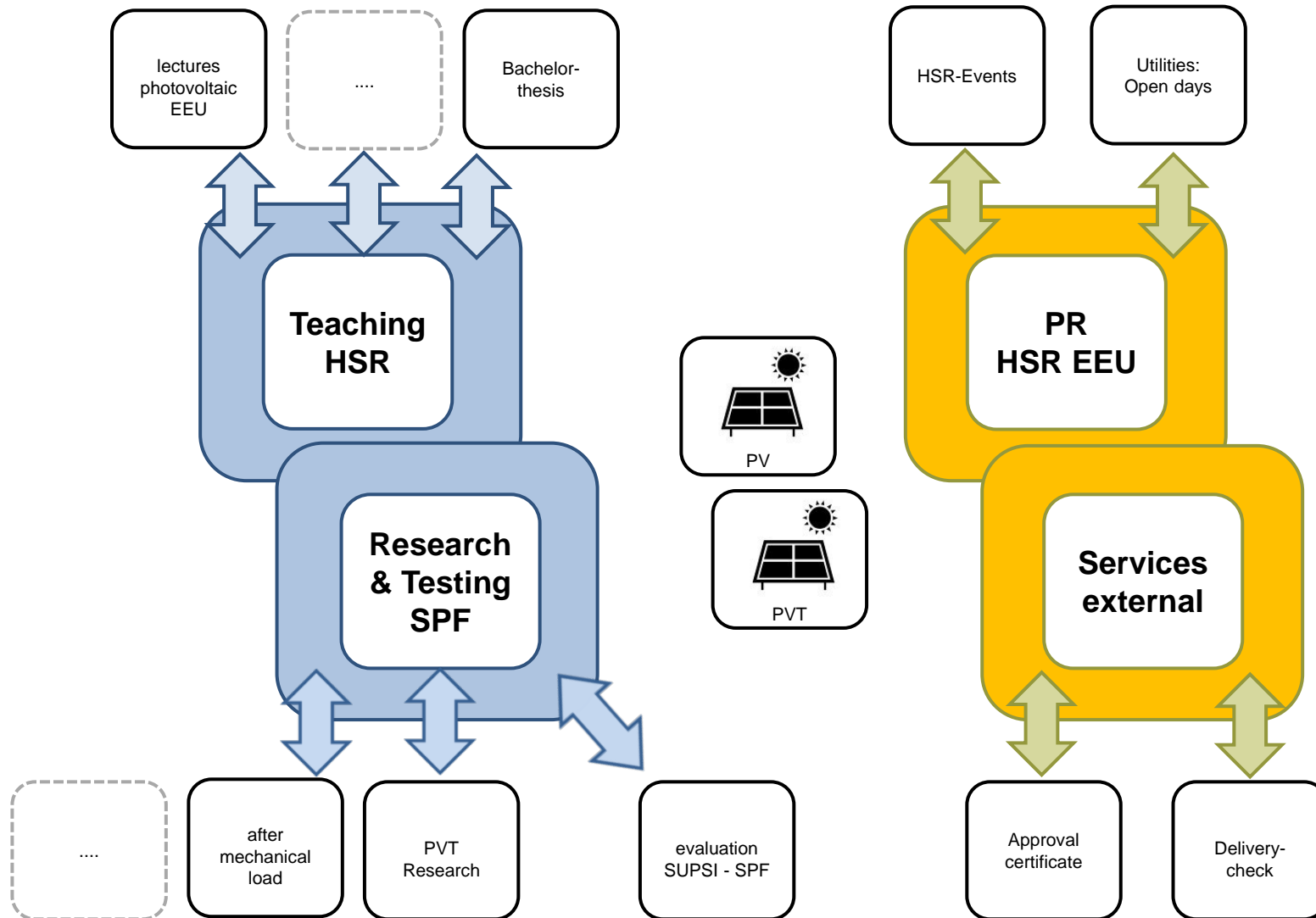
## Electroluminescence



## High voltage / grounding



# Many options ...



# Standardised testing protocol

■ High Voltage-, Isolations-, Diode- Tests

■ EL-measurement

■ I-V-Curve, Power

■ IR-Messung

■ I-V-Curve for irradiation 200 – 1000 W/m<sup>2</sup>

**Prüfprotokoll**

SPF INSTITUT FÜR SOLARTECHNIK

Modul ID: 21503271100145  
 Hersteller: XYZ  
 Modultyp / Beschreibung: Mono  
 Testcenter Seriennummer: 4003\_Queeny

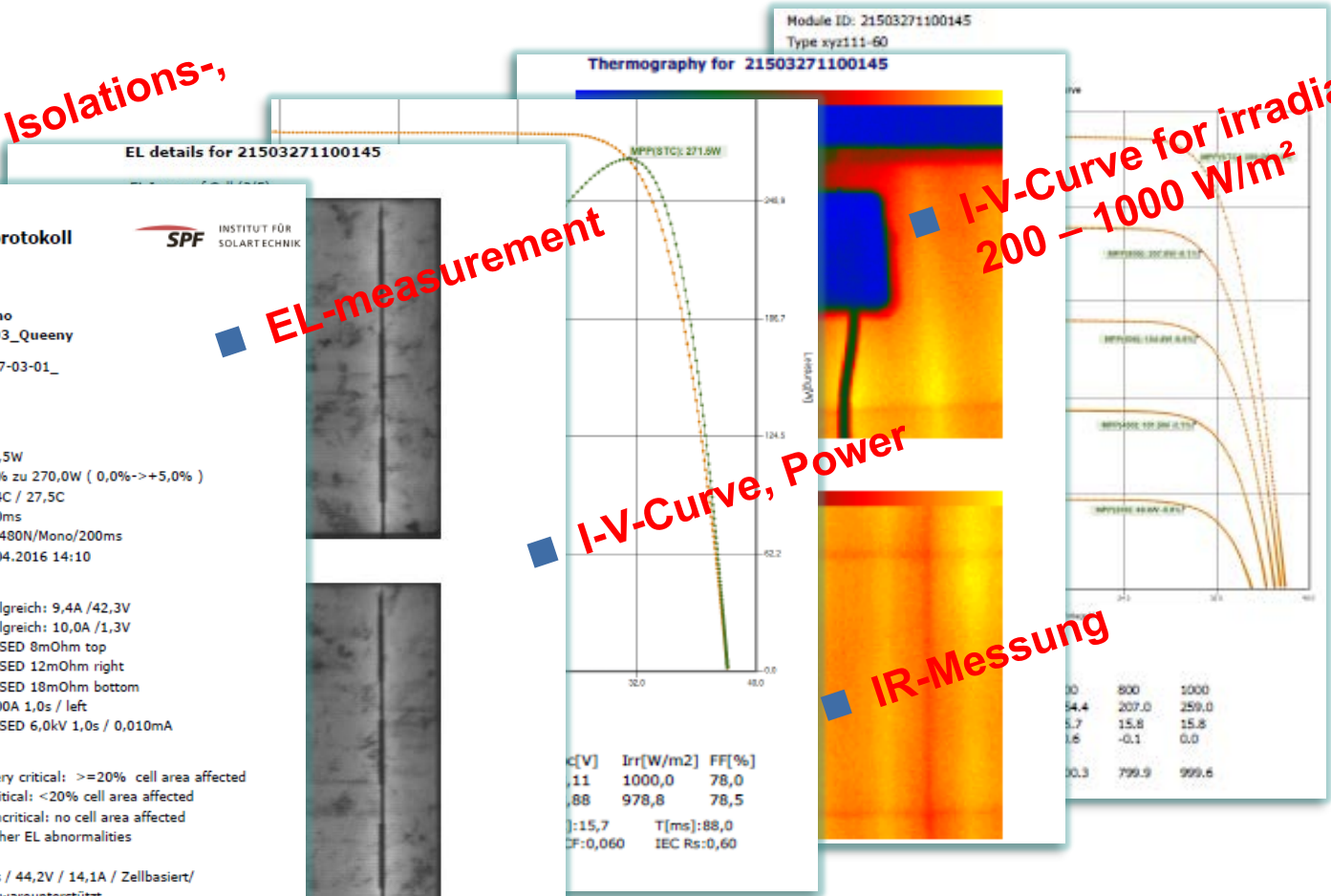
Auftrag ID: 2017-03-01\_  
 Adresse:  
 Ort:

**Leistungsmessung**  
 P<sub>mp</sub> @ STC IEC60891: 271,5W  
 Leistungsabweichung: 0,5% zu 270,0W ( 0,0% -> +5,0% )  
 T<sub>mod</sub> / T<sub>ref</sub>: 18,4C / 27,5C  
 Flash Dauer: 88,0ms  
 Flasher Parameter: C16480N/Mono/200ms  
 Bediener / Zeitpunkt: 15.04.2016 14:10

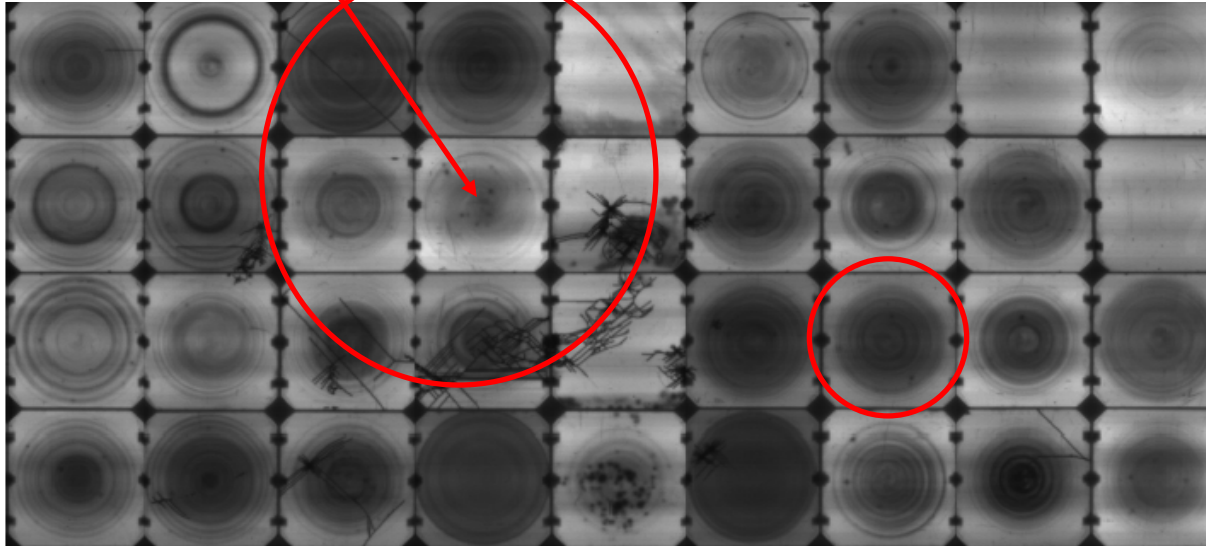
**Elektrisch**  
 Connection Check: Erfolgreich: 9,4A / 42,3V  
 Diodontest: Erfolgreich: 10,0A / 1,3V  
 GND Bound Tests: PASSED 8mOhm top  
 PASSED 12mOhm right  
 PASSED 18mOhm bottom  
 GND Parameter / Return: 30,00A 1,0s / left  
 HiPot Test: PASSED 6,0kV 1,0s / 0,010mA

**Elektrolumineszenz**  
 EL Zellbewertungen: 0 very critical: >=20% cell area affected  
 0 critical: <20% cell area affected  
 0 uncritical: no cell area affected  
 0 other EL abnormalities

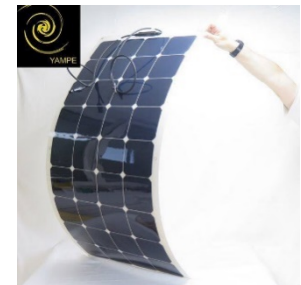
Zellen ohne Bewertung: 60  
 EL Einstellungen: 1,0s / 44,2V / 14,1A / Zellbasiert/  
 Softwareunterstützt  
 Bediener / Zeitpunkt: 15.04.2016 14:10



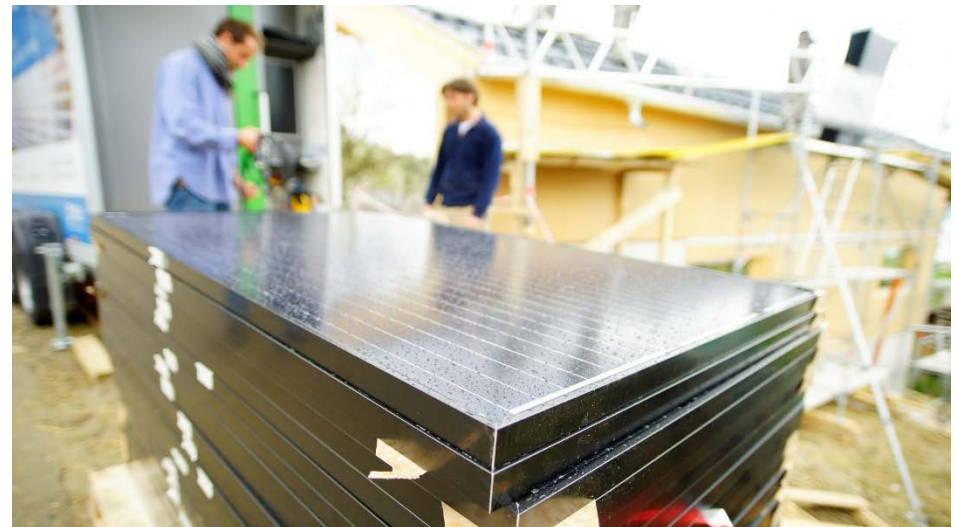
# Use of the PV-Lab within lectures



Quelle: Dominik Trütsch

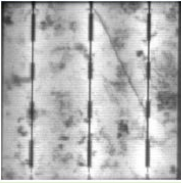
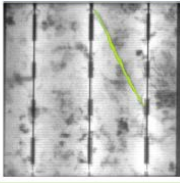
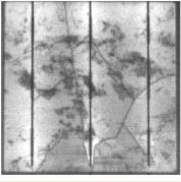
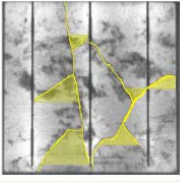
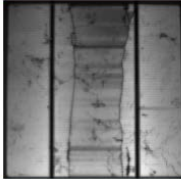
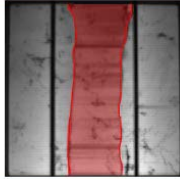


# How to use the mobile PV-Lab for service

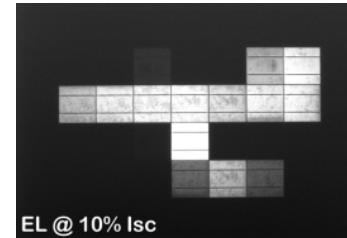




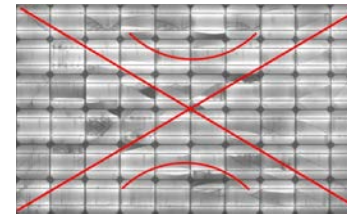
# Assessment & interpretation – e.g. EL

	<p><b>Beschreibung</b> Riss verläuft geradlinig zwischen den 'Busbars'.</p>		<p><b>Bewertung</b> Eine weitere Ausbreitung des Risses ist nicht zu erwarten. Mögliche Zellaabtrennung 0%.</p>
	<p><b>Beschreibung</b> Mehrere Y-Risse zwischen den 'Busbars'.</p>		<p><b>Bewertung</b> Die Mikrorisse können hier potentiell mehr als 10% der Zellafläche von der Stromversorgung abtrennen.</p>
	<p><b>Beschreibung</b> Zwei parallel verlaufende Risse/Brüche zwischen den 'Busbars'.</p>		<p><b>Bewertung</b> Mögliche Zellaabtrennung mehr als 20%.</p>

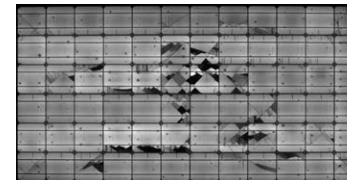
*Source: mbj*



■ → PID



■ → uniform load



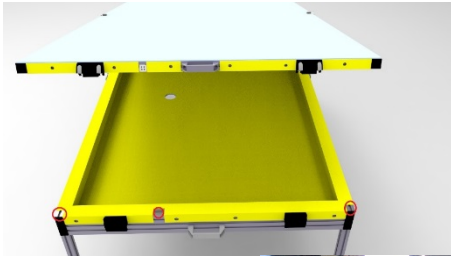
■ → fallen module



- **air conditioning STC 25 C°**
- **long-Pulse LED Flasher**
  - polycrystalline reference cell
  - class triple A: spectrum (A+), stability (A+++), homogeneity (A), according to IEC 60904-9 Ed.2
  - Irradiation 200 – 1200 W/m<sup>2</sup>
- **Power accuracy: +/- 3%, repeatability: < 0.5%**
- **2 MBJ NIR-CCD (cooled) cameras**
  - resolution 300 µm/Pixel (20 MPixel per module)
- **MBJ IR camera 160 x 120 pixel**
- **24'' monitor**



# Extension of options: based on a Bachelor-Thesis



Quelle: Joel Barmettler

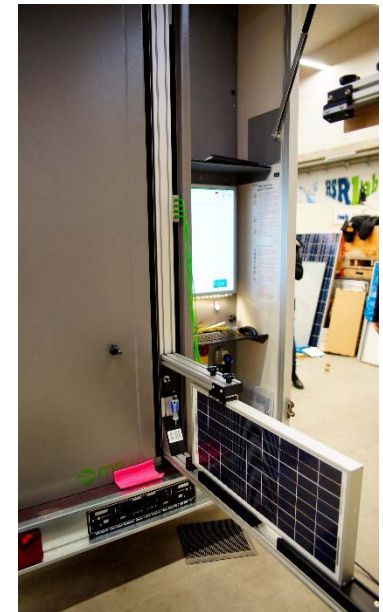


## ■ High-voltage-test

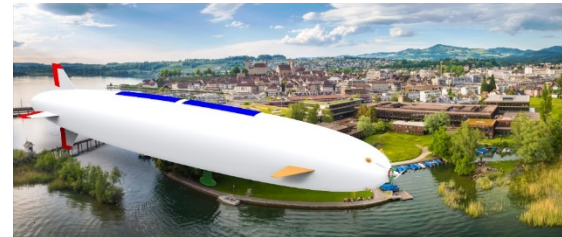
- Grounding consistency (MST 13)
- Leakage resistance (MST 16 based on IEC 61730-2)
- Wet leakage test: leakage current under wet conditions (MST 17)

# Which modules could be measured?

- Si-standard, PVT, amorphous, CdTe, Bifacial, PERC, small
- max. 1 m x 2 m x 0,1 m



# Example: special task

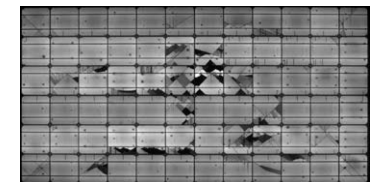
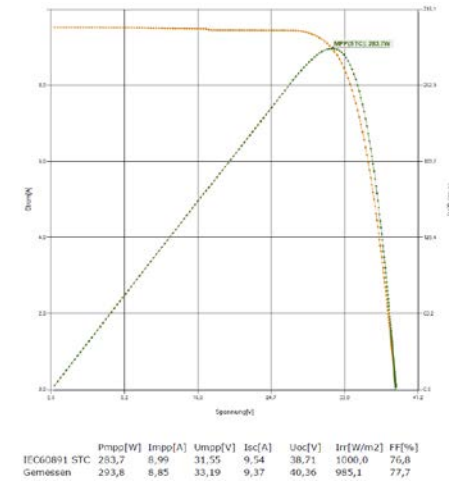


# SUPSI & SPF on work



# results and future projects SPF & SUPSI

- **customer 1 – choice of product**
  - distributor, comparison of rated to measured power
- **customer 2 – incoming quality check**
  - project manager for systems > 50kWp
- **customer 3 - certification**
  - association, swissolar, manufacturer
- **customer 4 – fault analysis**
  - operator of PV-system
- **customer 5 – evaluation**
  - public institution, research



# Come together ....



**SPF** INSTITUT FÜR SOLARTECHNIK



**SOLAR-TESTLABOR**  
QUALITÄTSSICHERUNG VON SOLARMODULEN

**HSR Solar-Testlabor**  
Qualitätsanalyse von Solarmodulen  
I/U-Kennlinienmessungen  
Elektrolumineszenzprüfungen  
Thermografieaufnahmen  
HighPot-Tests

**HSR**  
HOCHSCHULE FÜR TECHNIK  
RAPPERSWIL  
FHO Fachhochschule Ostschweiz

**SUPSI** INSTITUT FÜR SOLARTECHNIK

## Competence together

ISO 17025 accredited labs



- > SUPSI PVlab
- > Photovoltaics
- > SPF Testing
- > Solar Systems

On site testing



- > Quality evaluation
- > Acceptance criteria
- > High precision power measurement
- > Safety checks

Dr. rer. oec. Hans-Joachim  
Dr. rer. oec. Hans-Joachim  
Dr. rer. oec. Hans-Joachim  
Dr. rer. oec. Hans-Joachim

■ **contact:**  
[evelyn.bamberger@spf.ch](mailto:evelyn.bamberger@spf.ch)  
[christof.biba@spf.ch](mailto:christof.biba@spf.ch)