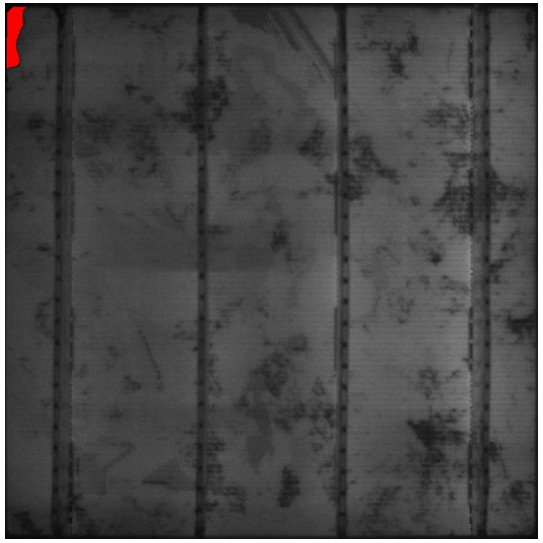
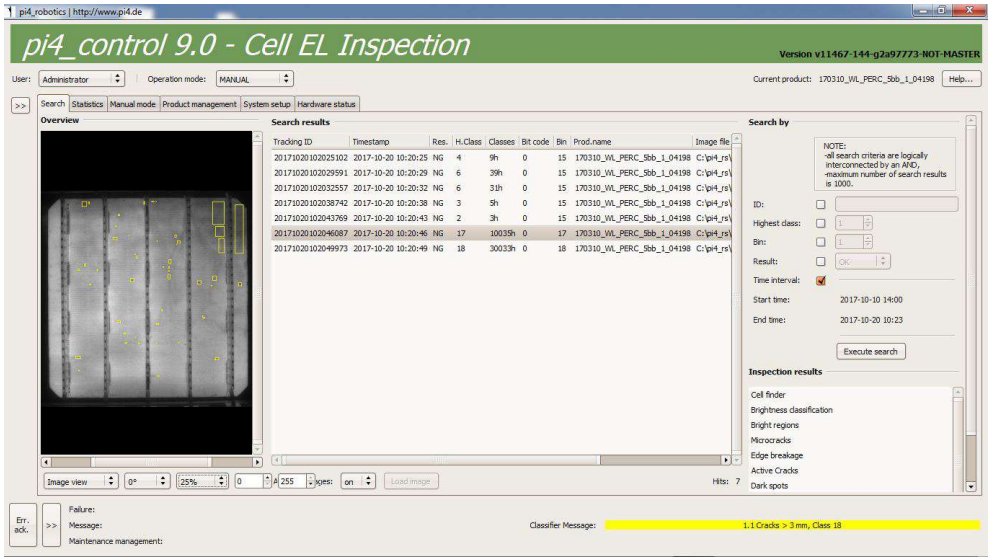
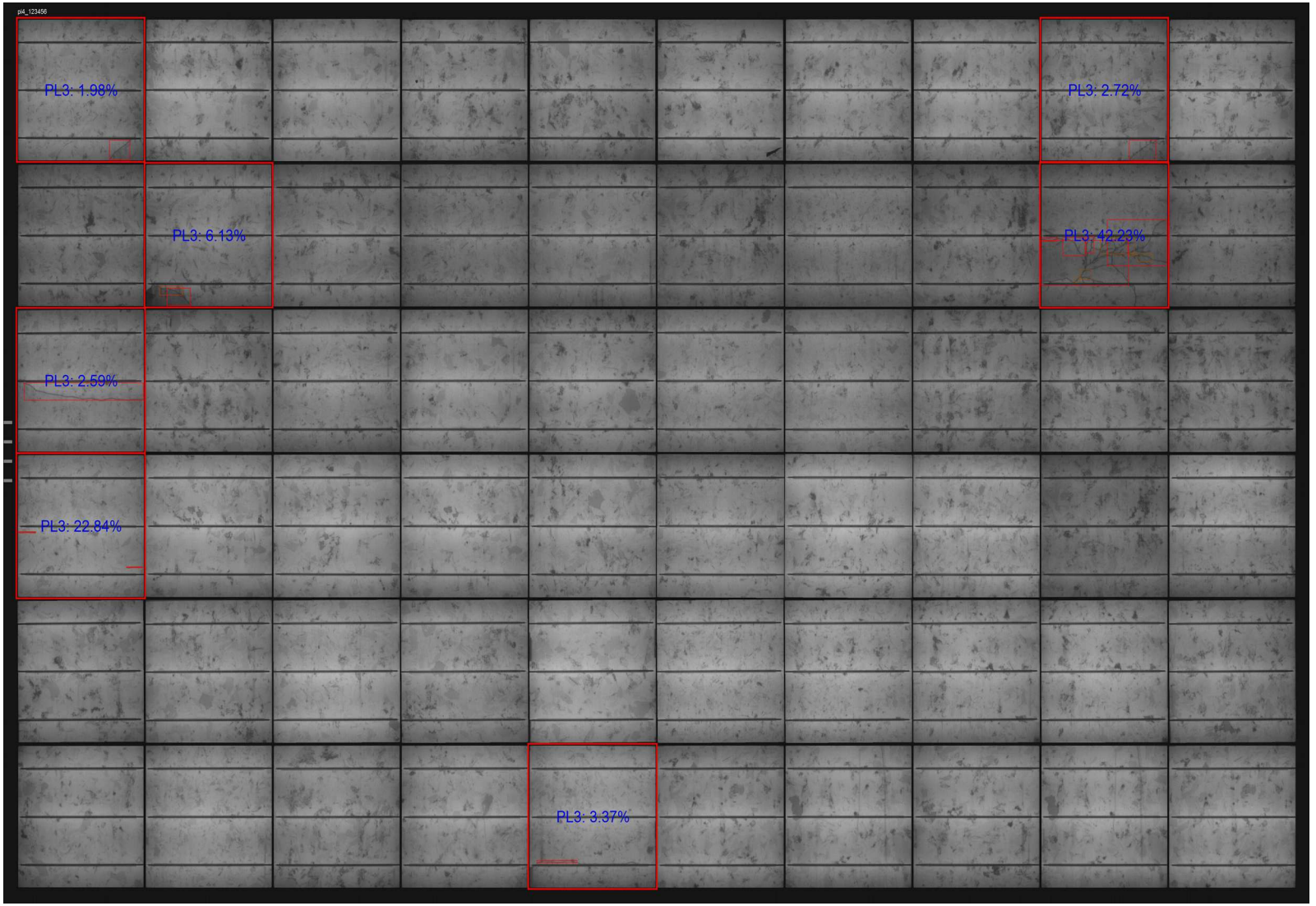


Cell EL Inspection: Challenges and benefits



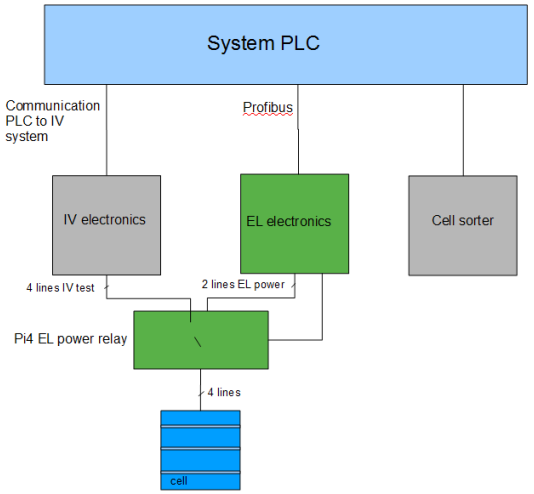
Ralph Schmidt
pi4_robotics GmbH Berlin

You are familiar with the benefits of EL inspection in module production...



pi4 Electroluminescence Systems

Electrical Block Diagram

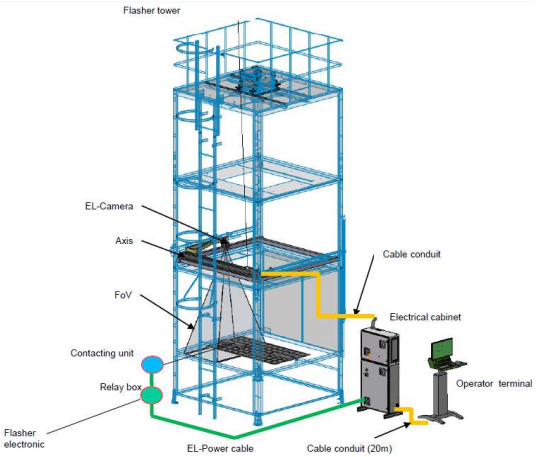


Inline Cell EL-Inspection

Automatic Inline Module EL-Inspection

EL offline systems for Modules

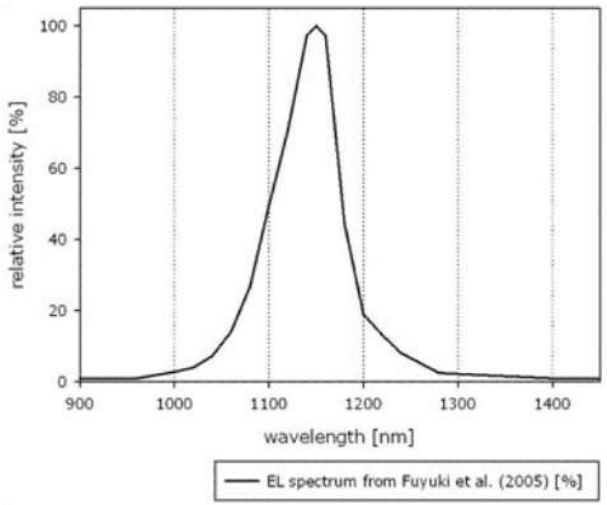
Automatic Inline EL for Thin Film Modules



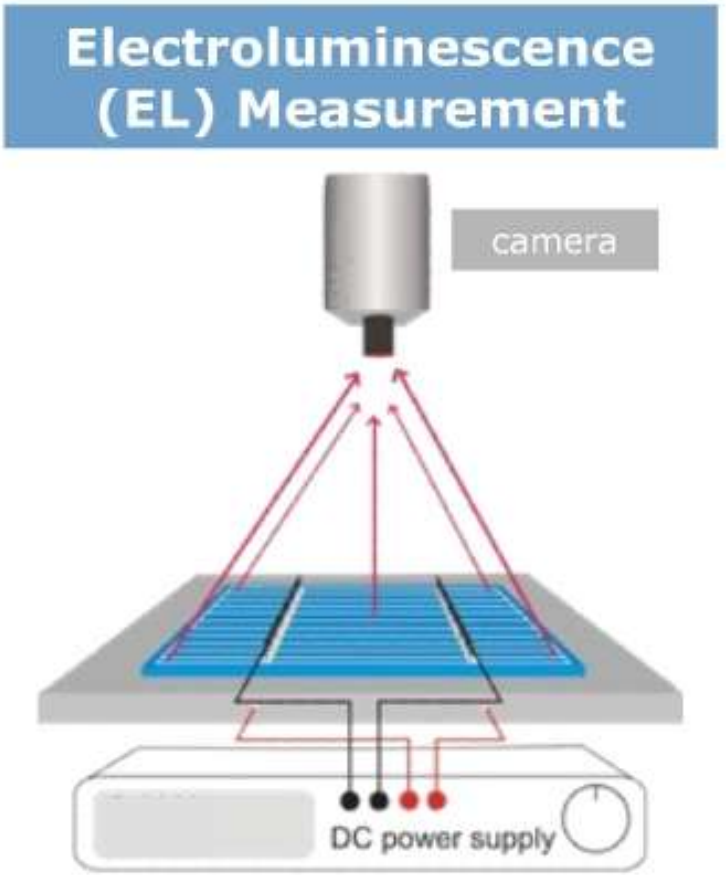
EL-Flasher-Integration

Basic Principle of EL Inspection

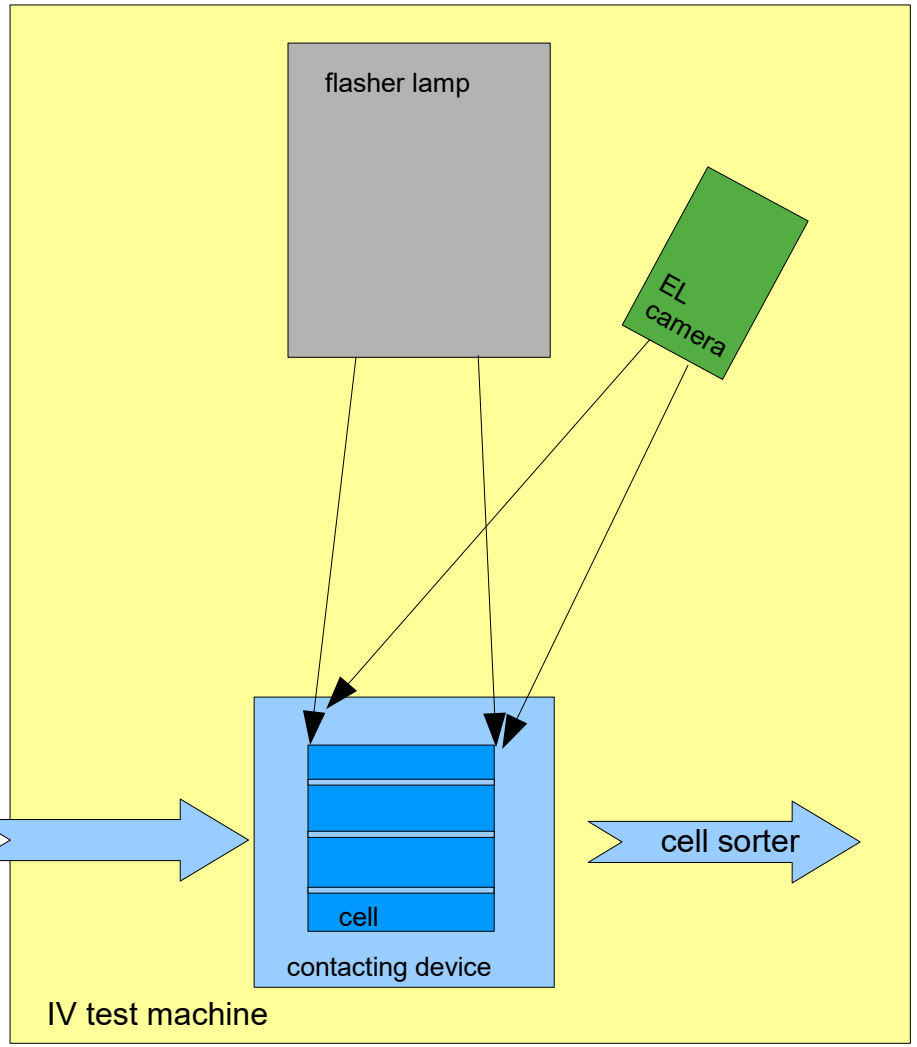
- Feeding a constant current to cells:
  8 A / 60 V DC → 60 x 1 V per Cell



- EL only possible with special NIR-cameras
  (NIR = Near Infrared)
- Usage of NIR optimized lenses
- Absolute darkness necessary
- Inspection in motion not possible (exposure time)

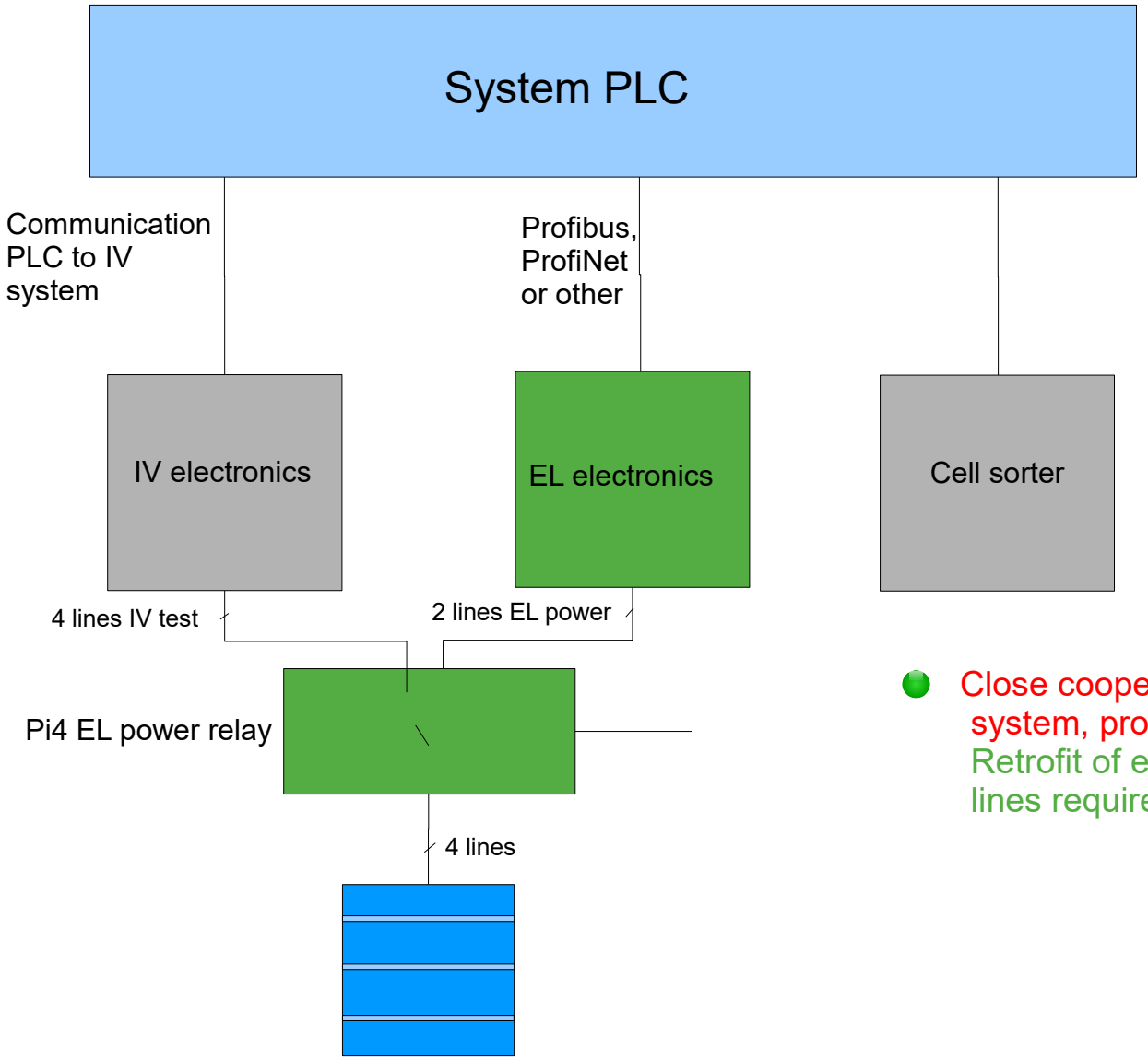


Challenge 1:
Mounting EL camera in IV System Unit



- Camera mounted at non perpendicular angle to cell:
  Geometrical distortion of images must be compensated by software
- Line cycle time must be shared by IV and EL system:
  For fast lines with cycle time <1.5 s, time for image acquisition is < 300 ms
  With silicon cameras cycle times can be realized as follows:
  - Multi crystalline cells <300 ms
  - Mono crystalline cells <150 ms
  - Advanced cells like PERC <20 ms
- Cell Contacting device must be shared:
  IV load and measuring cables cannot be used, EL power supply must be switched to contacting unit

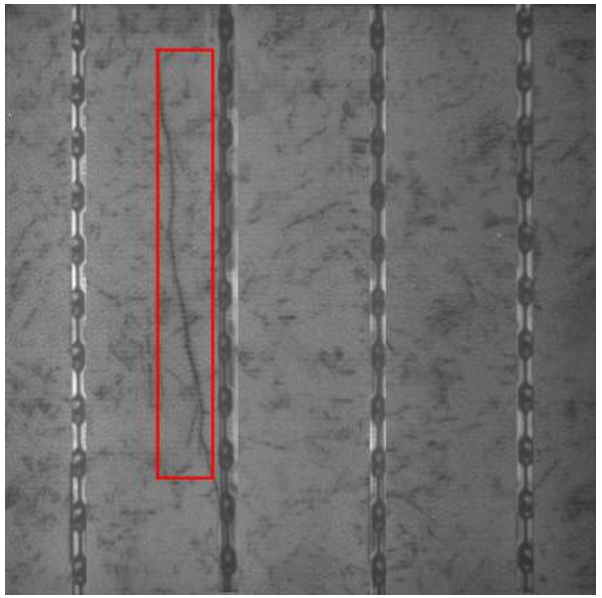
Challenge 2:
Interfacing to existing and new lines



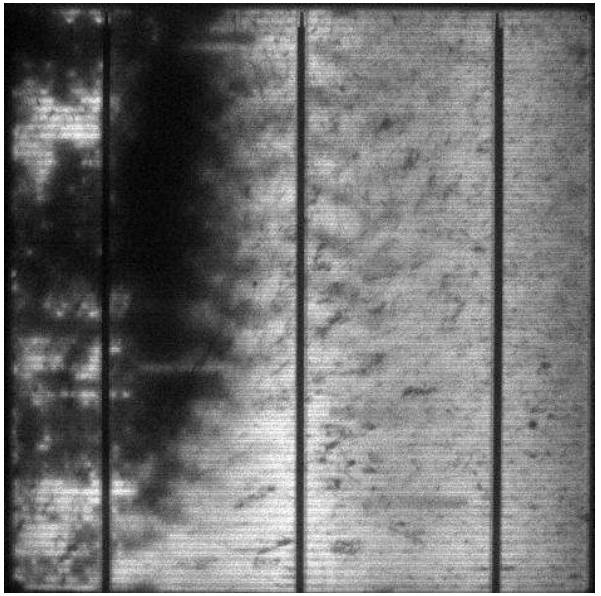
- Close cooperation with producers of IV system, production line and cell sorter:
  Retrofit of existing lines and setup in new lines requires high degree of flexibility

Challenge 3:
Reliable automatic inspection of all typical defects

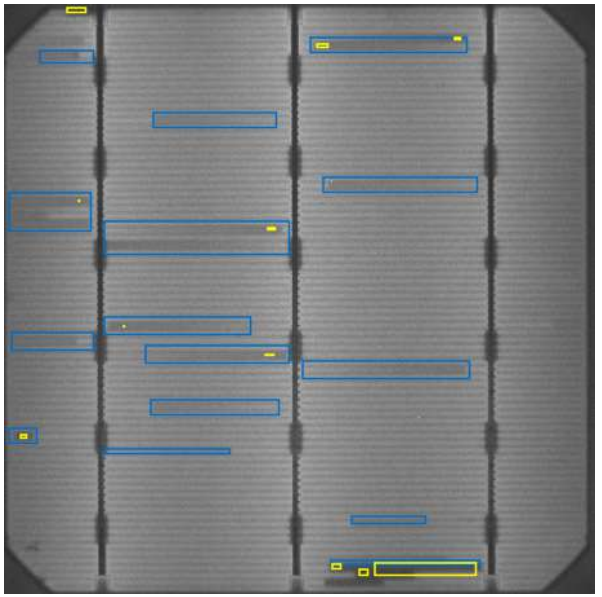
- All types of cell technologies must be processed:
  Monochrystalline, multicrystalline and PERC cells
- No operator intervention possible:
  Due to the short cycle times automatic detection and quality judgement must be very reliable.



Cracks and other mechanical cell damages



Cell processing flaws



Screen printing issues

Challenge 4:
Contacting and positioning of cells must be reproducible and reliable

- Poor Contacting:
  Is not a problem for the IV system, but can produce dark areas in the EL image of varying size and position

- Poor Cell Positioning:
  Can result in poor cell contacting

Benefits of Inline Cell EL Inspection

1. Detection of all quality and process related defects automatically

Micro cracks, active and inactive

Gridfinger defects

Dark spots

Chipped edge

Cell brightness classification

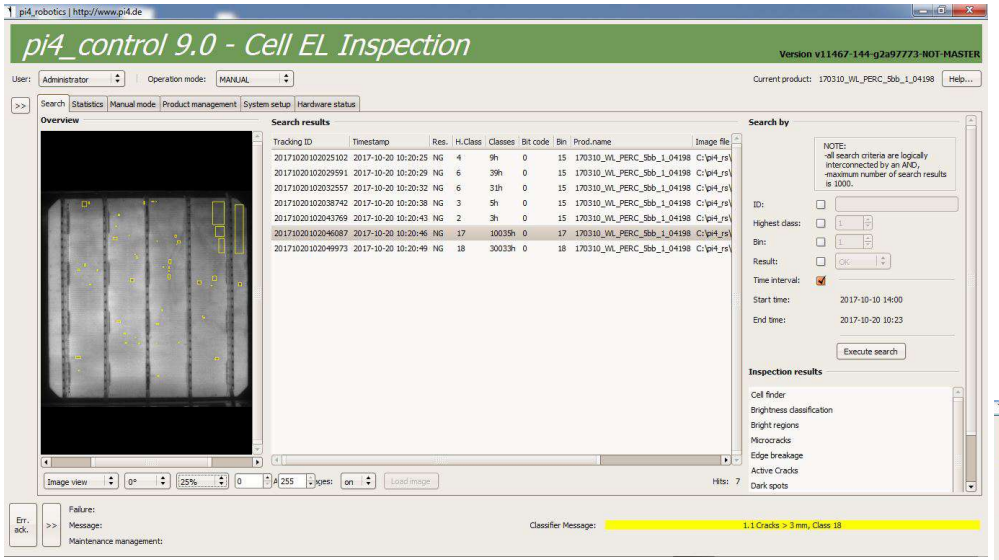
2. Detecting defects not visible without EL:

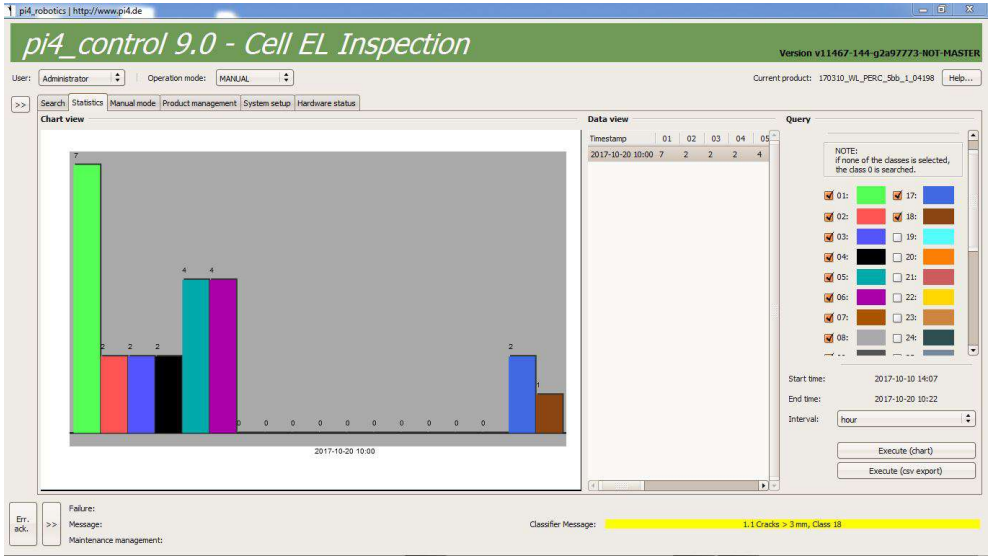
Some process issues are not detectable by visible light AOI systems and cannot be classified by IV system

Benefits of Inline Cell EL Inspection

3. Detecting defects inline:

Immediate feedback about process issues to line operators by inline sorting





Statistics and image data stored in a data base may can be viewed on remote workstations in the network, giving process and quality management full access

Conclusion

A well designed automatic inline Cell EL system can:

- increase consistency of product quality

- detect process issues earlier

- avoid production losses by early process interaction

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