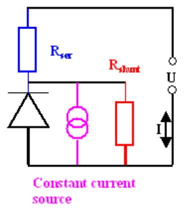
Exercise 3.4.1

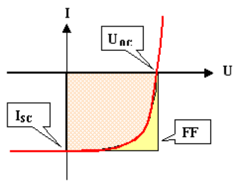
Lets consider a solar cell as an ideal **pn-**junction, for simplicities sake even *without* the current contributions from the space charge region, but *with* a built in **series resistance** R_{ser} and a **shunt resistance** R_{shunt}

- We have the following equivalent circuit diagram (also defining what is meant by a shunt resistance). See also the "Solar Cell Primer" in a basic module



- The shunt resistance takes into account that the huge area of the **pn**-junction of a solar cell might have weak points (locally, e.g. at the edge) which short-circuit the junction somewhat. These defects are summarily described by a *shunt resistor*.
- The constant current source mimics the current generated in the junction by light. it simply defines a current value I_{phot} (not to be mixed up with the terminal current I) that is given by the light and added (with a negative sign) to the junction current, i.e. $I_{junct} = I_{diode}(U) - I_{phot}$. I_{phot} thus simply moves the total characteristics of the diode downwards on the current scale.

- Take the following schematic curve of ***I-U***-characteristics as a reference and for the definition of the following terms



- The fill factor is the relation between the area of the yellow rectangle to the pinkish area under the characteristics.

Derive the complete current-voltage relationship.

Discuss qualitatively the influence of the two resistors with particular respect to:

- The open-circuit voltage U_{OC}
- the short-circuit current I_{SC}
- The fill factor ***FF*** (the degree of "rectangularism" of the characteristics).
- The efficiency η which is proportional to U_{OC}, I_{SC} , and ***FF***, i.e.

$$\eta = \text{const} \cdot U_{OC} \cdot I_{SC} \cdot FF$$

Link to several exercises to solar cells, far exceeding this one, with the solutions.

There, look at chapter 8.