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innovative Solarsysteme für Schule und Ausbildung
innovative solar- systems for school, college, technical education

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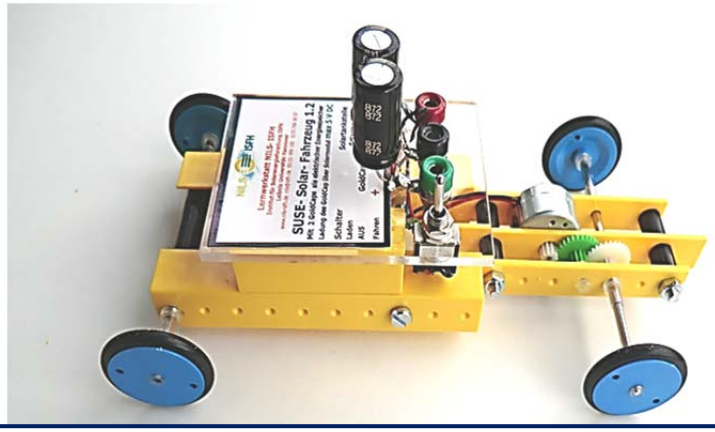
The SUSE solar vehicle 1.2

Solar vehicle with 2 GoldCap energy repositories (without own solar cell) to be charged at a solar filling station
V_{max} = 5 V, drive through SUSE solar motor and two-step gear



Dimensions: length 190 mm, width 95 mm, height 70 mm

Top view:

Up front the solar motor with the two-step gear on the front axis is visible.

At the top the electronic circuit board with the two electrical energy repositories (2 GoldCaps in series connection), the operating switch, and the 3 jacks. To the red-black jack pair lab wires can be connected to charge the GoldCaps, the green jack is a test jack for the voltage applied at the GoldCap.

The SUSE solar vehicle 1.2 with 2 Goldcaps for V_{max}= 5 V DC

(The solar **vehicle 1** has just **1 GoldCap** and a maximum voltage of 2.5 V.)

Often solar modules deliver higher voltages than 2.5 V, the maximum voltage of one GoldCap to 'refuel' the GoldCap energy repository. E.g. solar modules of the SUSE 4.3 series deliver 3.6 V of voltage. To be **charged** with up to **8 solar cells in series connection** the vehicle is equipped with 2 GoldCaps connected in series, so they can be charged with up to 5 V of voltage.

Thereby the vehicle also is twice as fast and stores up to **20 J of energy**. The vehicle does not have an own solar cell, but is 'refueled' at a solar filling station before driving, in the process the electrical energy repository GoldCap is charged with up to 5 V DC and an electric energy of up to 20 J is stored. With one filling the car drives **more than 100 m with high velocity**.

Depending on the light's intensity = irradiance S the charging process takes just one minute ore a few minutes.

This way the vehicle can be charged under a very cloudy sky, a pure solar cell vehicle would not drive under these light conditions. With this vehicle extensive experiments (e.g. capacitor charging/discharging) can be conducted.

To charge the GoldCap lab wires, that lead to the solar module, are plugged into the jacks. The **operational switch has 3 positions**: **1. Charging** (switch to the back), **2. OFF** (middle position), **3. drive** (switch to the front).

The charging and discharging process at the GoldCaps can be observed and measured through a voltage measurement at the green jack (GoldCap+) or through a current measurement in the supply line of the solar module. The vehicle can also be charged with a 4.5 V lantern battery.

The solar vehicle 1.2 at the **solar filling station** (solar module SUSE 4.49), a solar module with 5.0 V output voltage, ideal for charging the solar vehicle

The operation manual of the SUSE solar vehicle 1.2

1. Function:

The GoldCap capacitor is the electric energy storage of the vehicle, from it the electric motor obtains its energy for driving, the capacitor discharges in the process, with real electrically powered vehicles a rechargeable battery is used. An advantage of the GoldCap is the rapid charging, with bright sunshine the charging with a solar module (= solar filling station) takes just about 1 minute. In contrast to the rechargeable battery the GoldCap also doesn't need charging electronics with specific charging currents. The range of the vehicle with fully charged GoldCap and smooth track is 50...100m.
With clouded sky or low irradiation the charging takes longer, the charging can be observed/measured with a voltmeter.

Suitable solar modules for charging: SUSE 4.3RB, SUSE 4.35, SUSE 4.49

Maximum charging voltage: 5.0 V, with higher voltages the GoldCap is destroyed.

The vehicle has **3 jacks for 4mm lab wires:**
Jack red: Positive pole of the supply line from the solar module (solar filling station)
Jack black: Negative pole of the supply line from the solar module and negative pole of the GoldCap
Jack green: Positive pole of the GoldCap and test jack for measuring the voltage

Function of the switch:
The switch has 3 positions:
a in driving direction to the front: driving mode, the electric motor is connected to the GoldCap
b middle: OFF Neither driving nor charging mode
c to the back: charging mode, the GoldCap is connected to the red jack for charging

2. Operation of the vehicle

2.1 Charging

As visible in the photo on page 1, the positive pole of the solar module is connected to the red jack of the vehicle with a lab wire, the negative pole of the solar module to the black jack with another wire. Now the switch is switched to the back on „charging“, the charging process begins. Depending on the light intensity the charging process takes just about <1 up to about 3 minutes. With a voltmeter at the red-black jack pair (measurement range 20 V DC) the charging process can be observed. The voltage increases slowly while charging and reaches the module voltage of the solar module. After a successful charging process the switch is switched to OFF (middle position).

2.2 Driving

The pair of lab wires is removed from the jacks, the vehicle is placed on the ground on a smooth and flat surface. Then the switch is switched to the front on “Drive”, the vehicle drives away. While driving the GoldCap discharges, the speed decreases, at about 0.3 V the vehicle stops. If the discharging of the GoldCap while driving is to be observed, the vehicle gets jacked up, so the wheels run freely in the air, a voltmeter is connected to the green-black jack pair (measurement range 20 V DC), the gradual decline of the GoldCap voltage is noticeable.

2.3 Experiments

With the extensive experimentation manual for the solar vehicle 1.2 extensive experiments with the vehicle can be conducted:

- Driving operation with varying charging voltages, measurements of the speeds and ranges
- Driving operation with varying light intensity, measurements of the speeds and ranges
- Analysis of the GoldCap charging with varying irradiances
- Analysis of the GoldCap discharging, determination of the half-life
- Energy storage and energy conversion processes