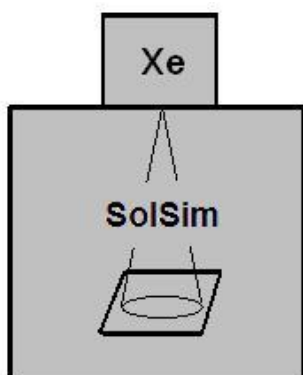

Luzchem Solar Simulator SolSim

Updated Feb 2016

Luzchem's SolSim provides solar simulated radiation based on a powerful 300W ceramic xenon lamp. Enclosed in a standard photoreactor cabinet, the unit produces, under recommended illumination conditions, a circle of approximately 6.0" (15.2 cm) in diameter matching spectrally and approximately in intensity the AM1.5 solar spectrum. The output beam is in a closed chamber, which prevents ambient light from influencing experiments as well as operator exposure to UV. A shutter, a digital timer, a pre-shipment calibration and the filters required for solar simulation are included with the photoreactor.

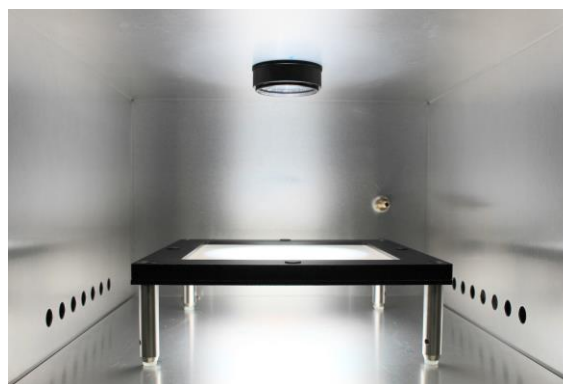


Configuration:



The SolSim utilizes a Xenon lamp placed at the top of the photoreactor chamber along with a custom filter assembly. The solar simulation filters are placed on a stand 3" above the chamber floor, with samples beneath.

For a more detailed diagram see Appendix 1.



Unit Specifications:

| | |
|-----------------------------|--|
| Dimensions: | <i>External:</i> 18" wide, 13.75" deep and 26" high (46 x 35 x 66 cm) <i>Internal:</i> 12" wide, 12" deep and 8.5" high (30 x 30 x 22 cm) |
| Weight: | 31 lbs. / 14 kg |
| Power Rating: | 110 or 220 VAC, 50/60 Hz cycle, 6 Amps |
| Housing Material: | <i>External:</i> Stainless Steel <i>Internal (chamber):</i> Aluminum alloy (highly reflective) |
| Ambient Temperature: | Must be between 0°C and 45°C |
| Chamber Temperature: | Maintained to 6-8 °C above room temperature |
| Humidity: | Must be between 0% and 95% (non-condensing) |

Lamps: The unit uses a 300W Cermax Xenon lamp. A dimmer switch is included so that power output can be optimized to match AM 1.5 intensity. A full-UV, focused xenon lamp (supplied) is required for solar simulation. The full-UV lamp irradiates from 200 nm into the near IR region and requires a safe exhaust system.

See manufacturer's specification sheet for detailed information.

Filters: For solar simulation, Luzchem SolSim proprietary filters are used:

- One 2" circular filter placed at the top of the chamber (in the filter holder)
- One 6" x 6" square filter assembly placed on a stand 3" above the chamber floor.

The filter combination simulates the AM1.5 solar spectrum to within 1% total difference between 280-800 nm.

Lenses: The filter adapter accepts lenses 2" in diameter. This can be used to expand or contract the beam with corresponding changes to output intensity. This option can be either user supplied or a Luzchem supplied option.

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Options Included:

| Option | Specifications |
|----------------------------|--|
| Safe exhaust | <ul style="list-style-type: none">• Material: galvanized aluminum• Exhaust tube provided: 4" diameter, max length: ~ 8'• Built-in fan: 3100 RPM, Airflow: 110 CFM |
| UV protecting goggles | <ul style="list-style-type: none">• Yellow safety goggles, with 420 nm cut-off |
| Shutter | <ul style="list-style-type: none">• Material: reflective aluminum• Manual operation• Automatic operation with use of the digital timer |
| Digital countdown timer | <ul style="list-style-type: none">• Factory preset• Allows unattended exposure times from 1 min to 99 hrs, 99 min |
| Variable Power | <ul style="list-style-type: none">• Range of 175 to 305 Watts |
| Safety Interlock | <ul style="list-style-type: none">• Safety interlock closes the shutter when the door is opened• Can be overridden with interlock key |
| Gas inlet | <ul style="list-style-type: none">• Rear mounted bulkhead gas connector• Only recommended for non-flammable, non-toxic gases• Gas should not dissipate in the chamber, should be used with environmental chamber only. |
| Power Meter | <ul style="list-style-type: none">• Calibrated relative to AM1.5 spectrum• Valid in the Visible region only |
| Accelerated Aging Possible | <ul style="list-style-type: none">• With a new lamp, unit will typically exceed 1.5 (times) AM1.5• Variations between units and lamp aging effects can occur• Power is continuously adjustable to match AM1.5 |
| Hour Meter | <ul style="list-style-type: none">• Built-in to the unit• Keeps track of the number of hours the unit has been in operation |

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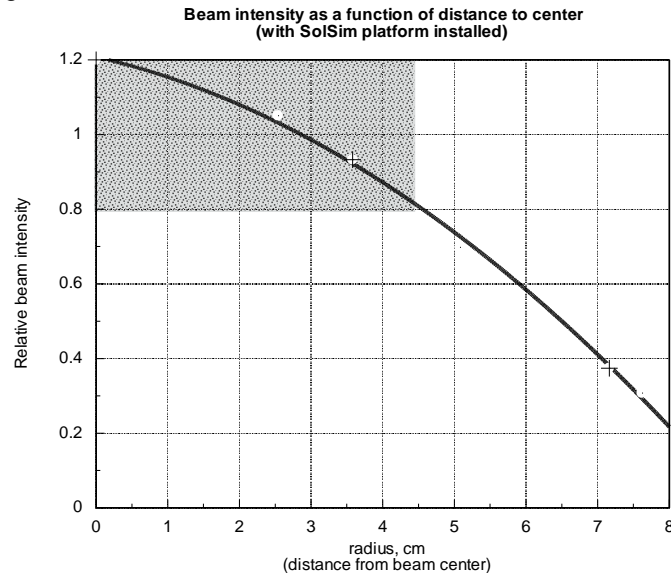
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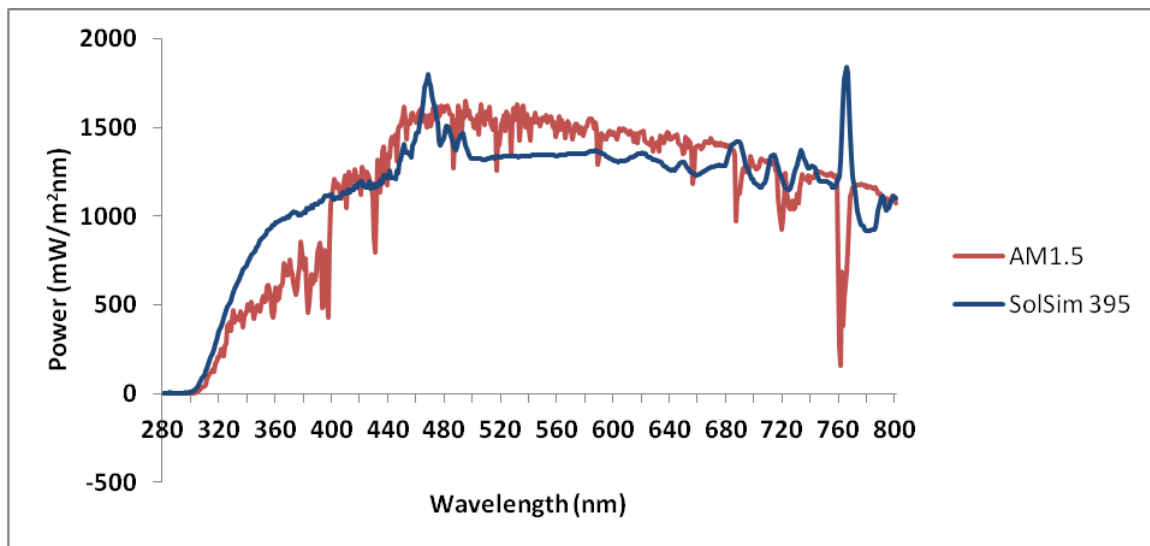
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Beam Homogeneity

The following graph shows the variation of the beam intensity as a function of distance from the beam center. The gray area shows the region with $\leq \pm 20\%$ variation from the normalization value and corresponds to a circle of 8.8 cm diameter with a surface area of 61 cm². Similarly variations of only $\pm 10\%$ can be obtained in a region of 3.0 cm diameter, corresponding to a surface area of 28 cm². Points identified with a + marker correspond to distances in a diagonal line that crosses the center of the stage.



Typical Calibrated Spectral Graph:



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Adjustable Power

Luzchem SolSim simulators have easily controllable lamp power. This is provided so that users can compensate for lamp aging and achieve AM1.5 simulation as the lamp intensity decays with time. If end users want to continue to use an aging lamp, beyond the point where 100% power is required to achieve AM1.5, this can be done by installing suitable lenses in the 2-inch standard lens holder at the top of the chamber. To maintain good spectral matching, the use of lenses made of BK7 glass is recommended.

The following values are given for reference only, since every SolSim system shows variations of as much as 10%. Users should also anticipate variations in this range when they replace the xenon lamp. These values correspond to the AM1.5 units achievable within the power adjustment range provided:

- Power at minimum: $\approx 30\%$ of AM1.5
- To achieve AM1.5 power setting $\approx 77\%$
- Maximum achievable (new lamp, center) ≈ 1.5 times AM1.5

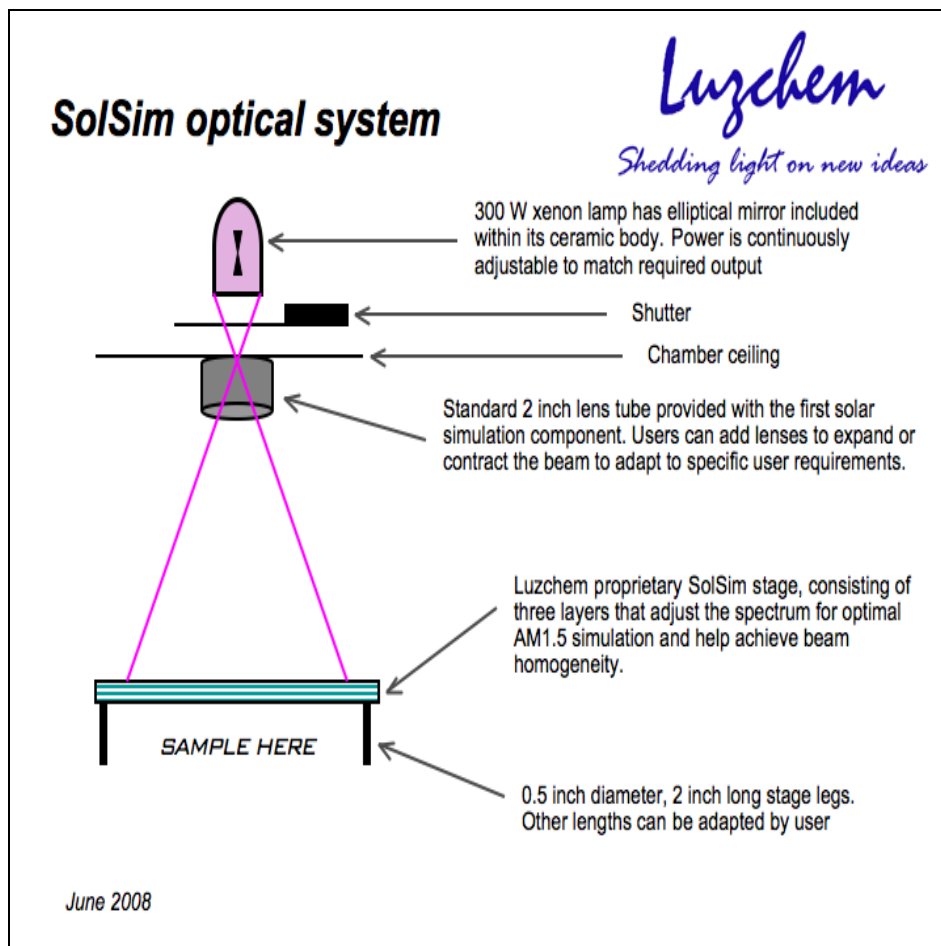
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Appendix 1: System diagram



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