# BeamCast – A New Operation Status Display System for the HiSOR Storage Ring

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On the 30th anniversary of the Hiroshima Synchrotron facility (HiSOR) a new operation status display system shall be developed. A preliminary version of this system – called BeamCast beta – has been commissioned in early February 2026. Herewith I report on the project's progress, discuss the system's functionalities contrasted by its physical limitations, and explore some options for HiSOR's future endeavors.

First, we examine the web interface and its dedicated features which are shown in **Fig. 1**. The basic requirements that have been put on this system include automatic measurement functionality, live display of the stored current and correlated beam lifetime, as well as an operator comment window.

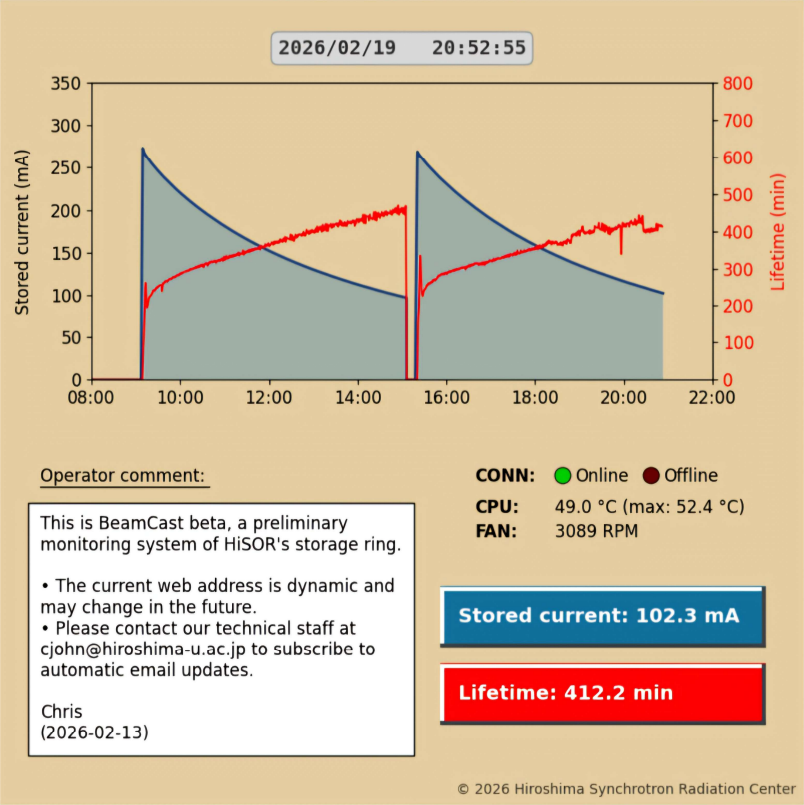


**FIGURE 1.** Web interface showing the preliminary layout of the status display during a live measurement.

The core monitoring capability is twofold: a diagram filling the upper half with a fixed time frame ranging from 8 A.M. to 10 P.M, and framed 24-hours digital displays in the lower right corner – both indicating the stored current in units of mA (blue) and the lifetime in minutes (red). Furthermore, the parameters of the processing unit – essentially a single-board computer (SBC) – are also monitored: the SCPI-handshake between the SBC and the digital multimeter (CONN) is indicated visually by two status lights, the CPU

temperature and max temperature in degrees Celsius, as well as the fan speed in RPM. In addition to that, the operator of the accelerator may leave a short note for the beamline users: up to 10×42 characters plus a bracketed date are hosted by a dedicated comment box in the lower left corner. This technical esemble of live status panels is complemented by a framed date and time window on top of the diagram.

Next, we review this modest status display system on a flow chart (**Fig. 2**). A converter provides an output signal that is proportional to the stored current. A SIGLENT SDM3055 multimeter measures the low-voltage signal and sends data upon SCPI-request to a Raspberry Pi 5 equipped with a 64-bit ARM Cortex-A76 CPU. The SBC logs the measured values for a finite time in a CSV-file, processes them, and generates a PNG-image. Upon browser request, the flask-based server sends the image to the client (pull-principle). This process repeats every 15 seconds via an automatically triggered HTTP request. To ensure secure data transfer, an encrypted communication channel (TLS) is established between server and an HTTPS gateway.

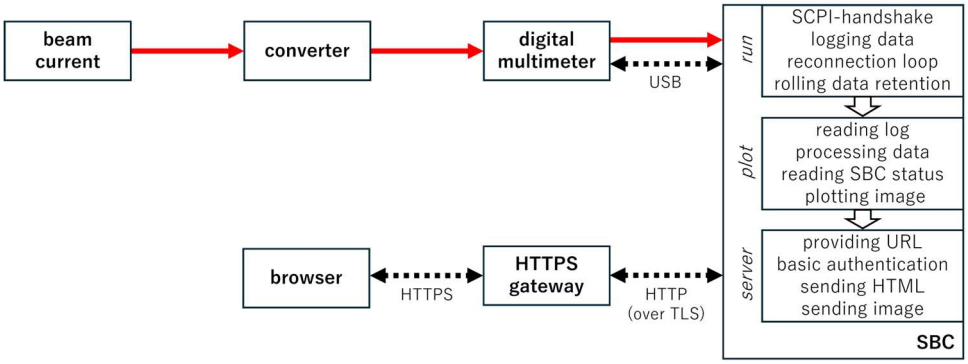


**FIGURE 2.** Flow chart showing the physical signal (red arrow), communication layer (dotted arrow), and data processing (short arrow).

Now, we analyze some of the data processing structures that underpin the entire data output (**Table 1**). To satisfy automation, the Raspberry Pi OS starts service routines on startup to call scripts that carry out various tasks divided into three groups: run, plot, and server.

**TABLE 1.** Some data processing functions. The service files can be found in the directory /etc/systemd/system/.

| Function | Data processing algorithm | Service-file |
|---|---|---|
| Calibration of stored current | current_ma = voltage * 50 | beamcast-run.service |
| Clipping of negative stored current | i.append(max(0.0, val)) | beamcast-plot.service |
| Calculation of beam lifetime over three sampling steps | I1 = i_array[idx]<br>I2 = i_array[idx+3]<br>tau = -dt / (np.log(I2 / I1)) | |
| Averaging of beam lifetime over five samples (window = 5) | kernel = np.ones(window) / window<br>lifetime = np.convolve(lifetime, kernel, …) | |
| Centering of beam lifetime value | t_lifetime = [t[k] + (t[k+3] - t[k]) / 2] | |

A fixed calibration factor relates signal voltage to stored current, while negative values are clipped to zero as they are not meaningful and may arise from signal noise or microampere-order offsets. Logging intervals are 15 seconds long and the CSV-file is truncated after three days. A logarithmic function is used to reflect the exponential decay of the stored electron beam, where the input values of $I_1$ and $I_2$ are separated by three sampling steps to reduce fluctuations in the signal. Then, a moving average filter over five sampling steps is applied and the lifetime value is centered to its corresponding time frame.
Furthermore, health and connectivity of the SBC as well as a dedicated JSON-file containing the operator comment are read out. Ultimately, all the generated data is plotted into a PNG-file (see Fig. 1) which is overwritten every 15 seconds.

Finally, we discuss the limitations and outlook of the presented system. BeamCast beta is based on a dynamic web URL which may change upon gateway reconnection. To compensate for that, an email service has been set up to inform subscribers automatically. When finalized, the system will be transferred to a static domain. Integrating a dedicated user counter or a vacuum readout function is a conceivable option for future extensions.