

Updates to DABAM: an open-source DataBase of Metrology for x-ray optical simulations.

call for contribution



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Since its release in 2016, the database for metrology **DABAM** has been an **important tool** for accurate **beamline design** and tolerancing providing **metrology profiles** of mirrors for **optical simulations** [1]. Its **success** is due to the **collaborative efforts** of various authors and laboratories using an **open-source platform**. We propose to create the **DABAM2D** database by **extending DABAM** to include **2D maps of mirrors, refractive lenses** or any **free-form optics**. We expect to populate the database with profiles coming from both *ex-situ* and *at-wavelength* techniques. We invite x-ray optics **community to contribute with profiles** to this database.

1. In line with modern **open-source practices**, the **new database** is **not tied** to a specific **web repository**, allowing for the use of multiple **local** or **private repositories**. The **height profiles** are stored in a **HDF5 file** and a supplementary metadata **json file**:

```
<url-prefix>/data/dabam2d-XXXX.h5  
<url-prefix>/data/dabam2d-XXXX.txt
```

The data is in SI units. Each surface and its corresponding info file are sequentially numbered:

- 0xxx – single x-ray lenses;
- 1xxx – stacked lenses (CRL);
- 2xxx – mirror profiles;

The structure of the h5 file as well as the contents of the metadata file are described in detail in the GitHub repository (see QR code).

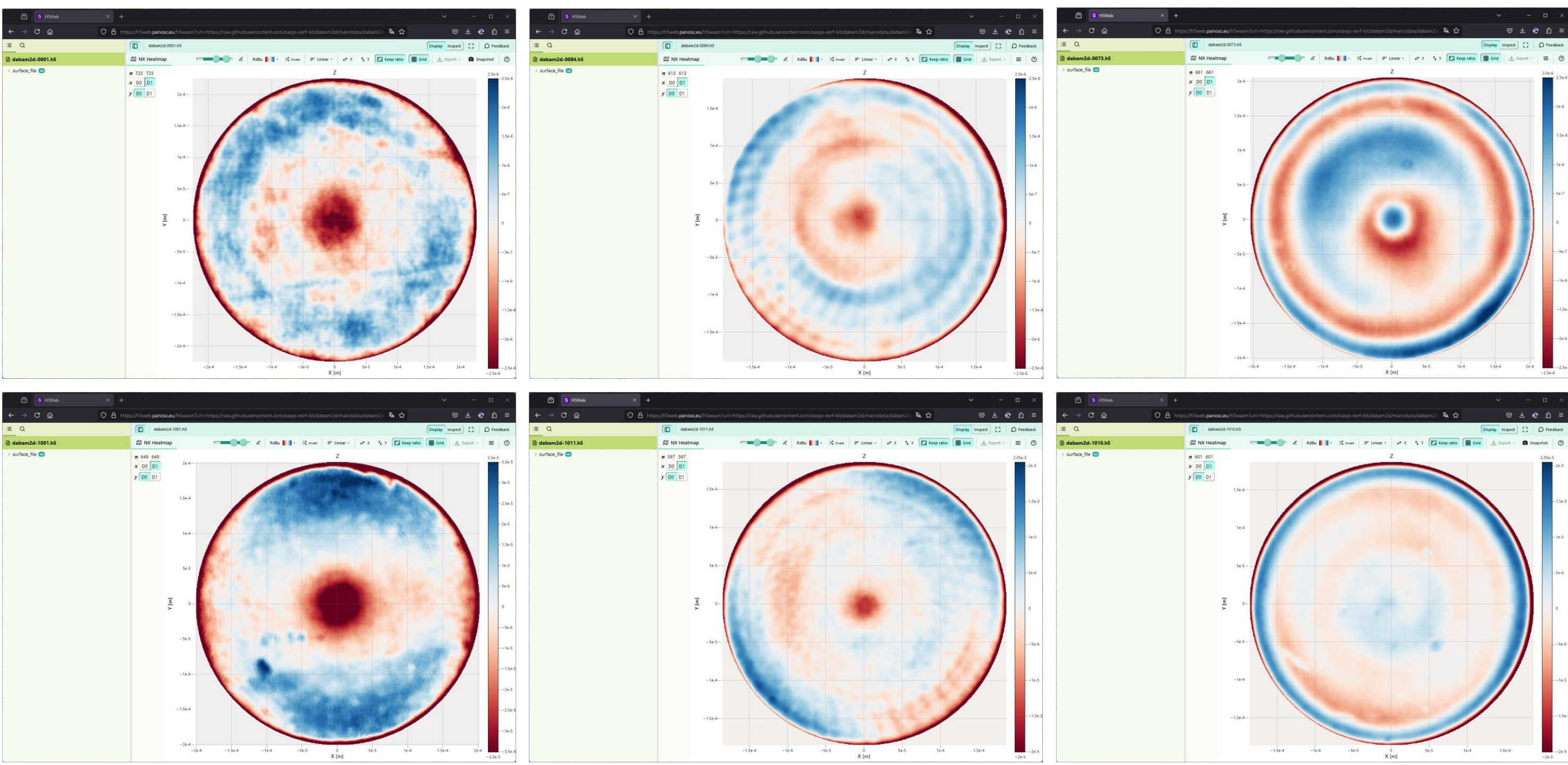


Fig. 1 DABAM2D maps can be visualised using the PaNOSC online H5Wasm viewer in a conventional web browser. Top row: examples of **single lens metrology** (profiles 0001, 0073 and 0084). Bottom row: examples of **CRL metrology** (profiles 1001, 1011 and 1010).

2. DABAM2D is fully **integrated** in the **OASYS** ecosystem [2], which interfaces ray-tracing codes **SHADOW 3** and **4** and wave-propagation packages like **SRW** and **WOFRY**.

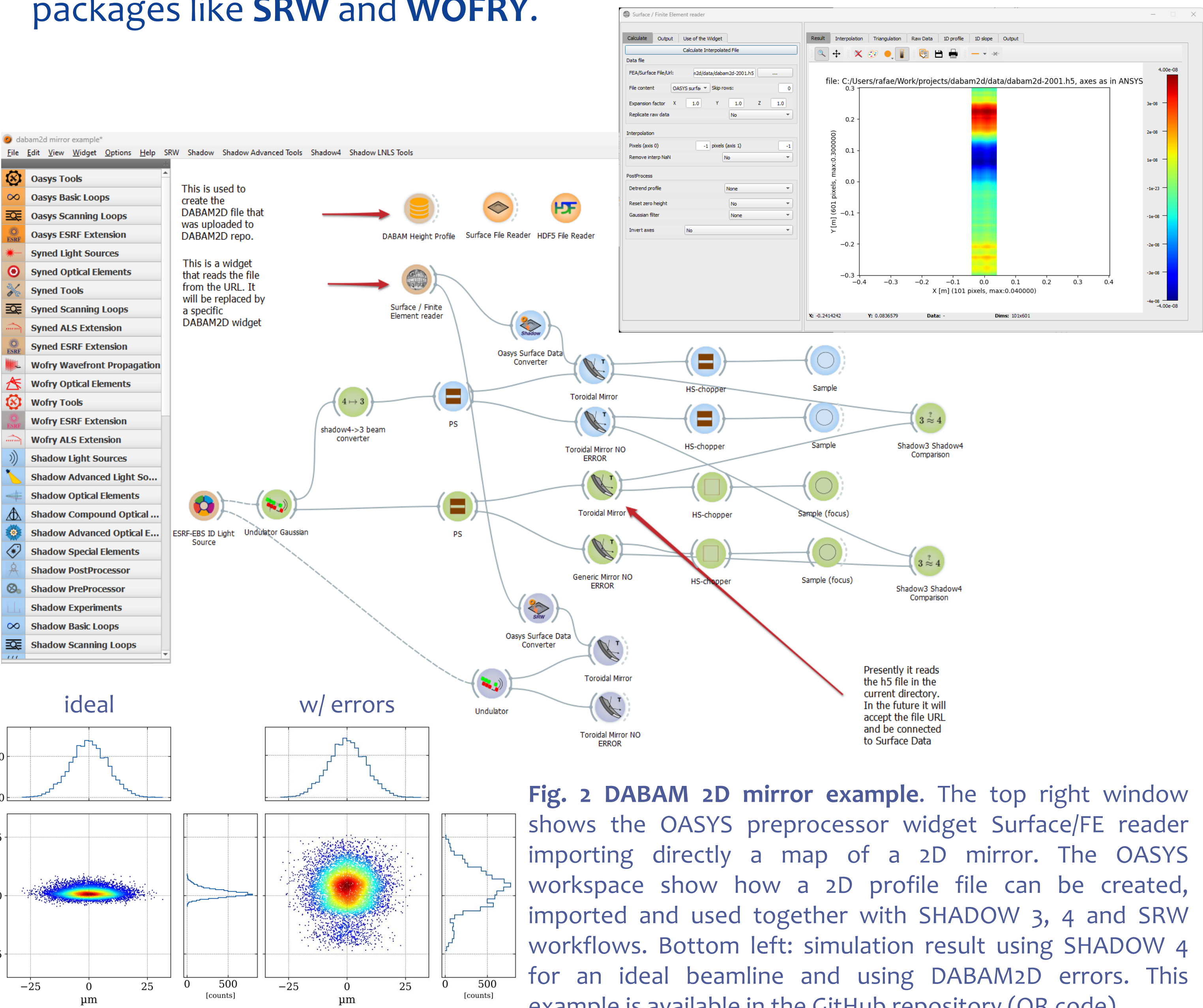


Fig. 2 DABAM 2D mirror example. The top right window shows the OASYS preprocessor widget Surface/FE reader importing directly a map of a 2D mirror. The OASYS workspace show how a 2D profile file can be created, imported and used together with SHADOW 3, 4 and SRW workflows. Bottom left: simulation result using SHADOW 4 for an ideal beamline and using DABAM2D errors. This example is available in the GitHub repository (QR code).

3. Simulations using real **measured error profiles** are able to **reproduce** with high fidelity **what is observed** at the **beamlines**:

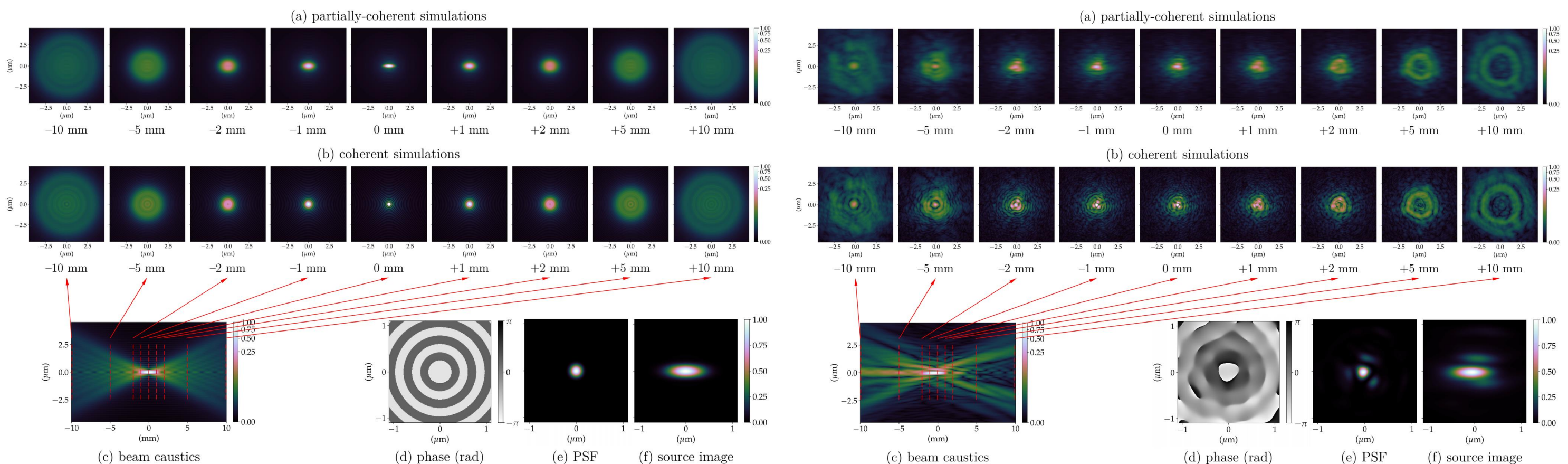


Fig. 4 (left) simulations of an **ideal x-ray lens stack** focusing at 8keV and (right) **aberrated lens stack** focusing using the metrology profiles 0001-0010. Reproduced from Celestre et al, *J. Synch. Rad.* 27(2), 629-643 (2020).

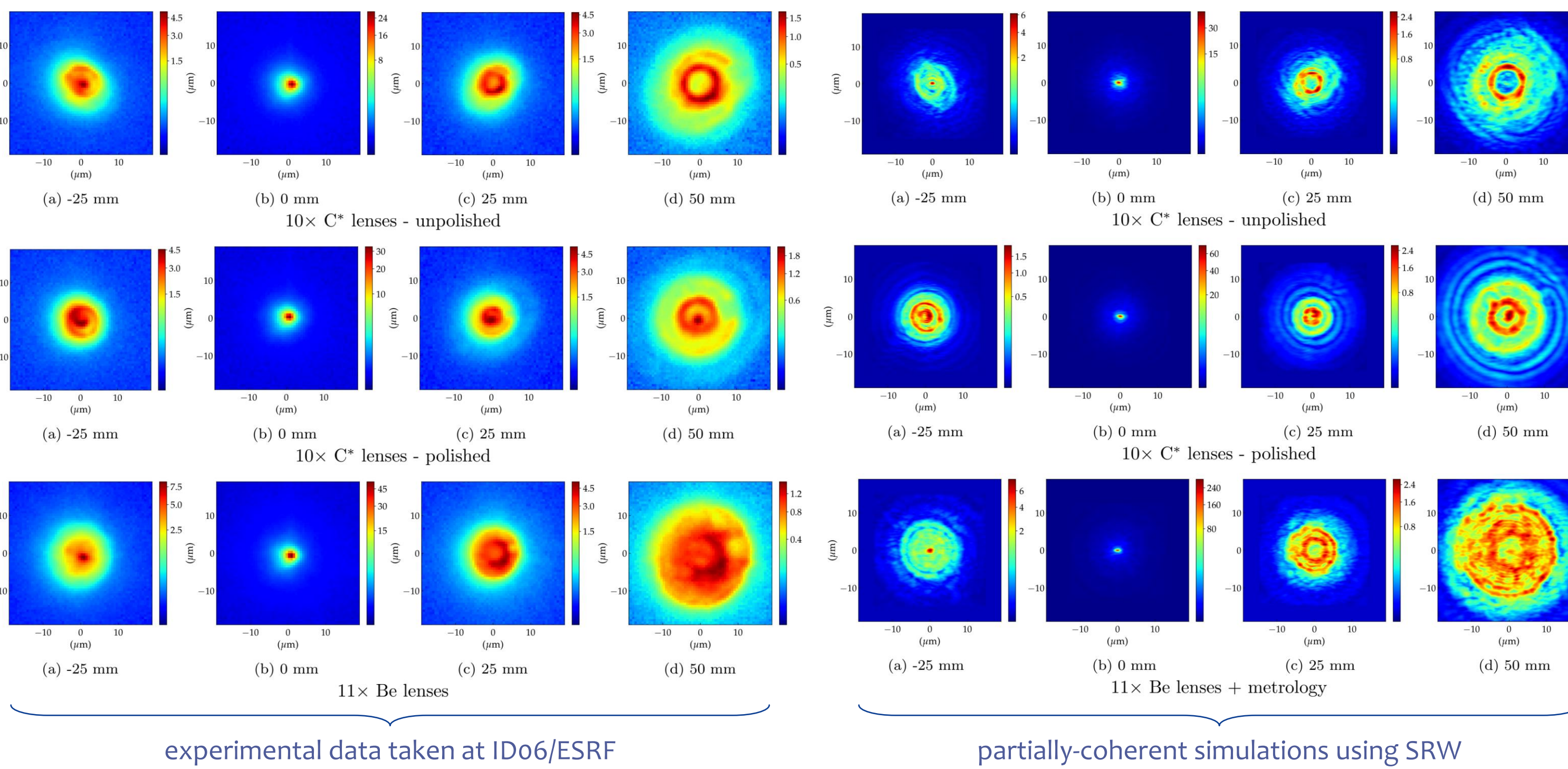


Fig. 5 Example of how the **simulations** are able to **capture the features** of an **aberrated** focused beam from an **x-ray lens stack**. Experimental data was collected at ID06/ESRF and the partially-coherent simulations were done using the CRL metrology profiles 1001, 1011 and 1010 in SRW. Reproduced from Celestre et al, *J. Synch. Rad.* 29(2), 629-643 (2022).

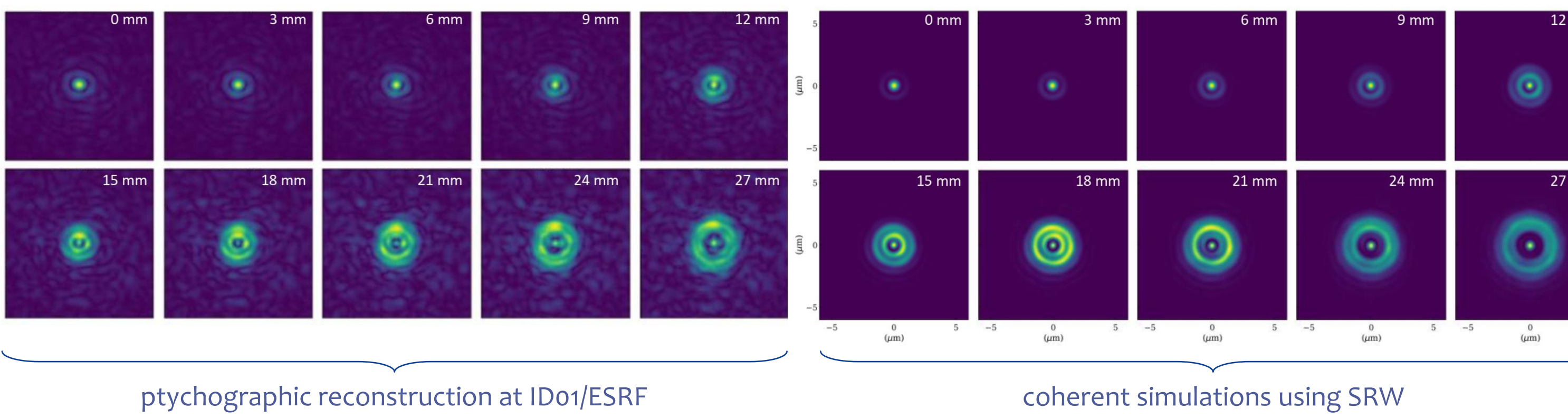


Fig. 6 Example of how the **simulations** are able to **capture the features** of an **aberrated** focused beam from an **x-ray lens stack**. Ptychographic reconstruction based on experimental data collected at ID01/ESRF (courtesy of E. Bellec and S. Leak). The coherent simulations were done using the lens metrology profiles 0022-0025 in SRW.

4. **Contributing to DABAM2D** is simple: prospective collaborators are invited to contact us and **submit** several profiles of **single lens profiles, lens stacks, or 2D mirror maps**, ideally in the DABAM2D data structure, though this is not mandatory. **Contributors** will participate and **co-author** an **upcoming DABAM2D publication**.

5. We aim to collect **profiles** until late **October 2024** and submit a **manuscript for publication** with an extended author list before the end of **November 2024**.

6. The DABAM2D database is currently hosted at:

[GitHub.com/oasys-esrf-kit/dabam2d](https://github.com/oasys-esrf-kit/dabam2d)

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References

- [1] Sanchez del Rio et al, *J. Synchrotron Radiat.* 23 665–678 (2016).
- [2] Rebuffi and Sanchez del Rio, *Proc SPIE* 10388. 05 (2017).

