A Web Application for the Photon Strength Function Database

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Abstract. A specialized web application has been developed to manage, query, and visualize photon strength function (PSF) data, compiled as a part of an IAEA Coordinated Research Project. This application significantly advances accessibility and interaction with the data over existing platforms, improving upon the capabilities of the prior resource. Central to this application is the database structure, crucial for efficient data management and retrieval. Built using the Django framework, the Web application's user interface presents queried data and search results in an accessible format. t provides details on basic nuclear properties, including the atomic number (Z), mass number (A), multipolarity, energy range, and the experimental methods used. In addition, the application offers functionalities for searching and sorting data by author names or publication years, facilitating refined navigation through the extensive PSF data repository. A notable feature is the dynamic data visualization tool that utilizes Plotly to create interactive graphs. The platform also features a comprehensive data processing pipeline that ensures data integrity and accessibility.

1 Introduction

Photon Strength Functions (PSFs) are crucial in nuclear reactions, impacting astrophysics, medical isotope production, and nuclear technology applications [1]. They also serve as input for IAEA databases, such as the photonuclear data library [2], RIPL [3], and EGAF [4]. The increasing availability of PSF data necessitated an advanced database for easy visualization and systematic analysis.

Photon Strength Functions (PSFs) are also crucial sources of input information for other databases supported by the International Atomic Energy Agency (IAEA). These include the photonuclear data library [2], the Reference Input Parameter Library (RIPL) [3], evaluated data files such as the Evaluated Gamma Activation File (EGAF) [4] which are integrated into the IAEA's data provision services.

In recent decades, the number of PSF data obtained using different experimental methods has increased significantly. Therefore, it is important to provide users with access to the PSF data in a database that facilitates easy visualization, systematic analysis, and retrieval for various purposes. The IAEA has initiated a coordinated effort to make existing experimental PSF data available through a user-friendly interface. This data spans from the giant dipole resonance region to energies below the neutron separation energy. Previously, the data were accessible only through a static website, which allowed users to download the data files but did not offer any means of direct interaction or visualization.

The IAEA's new interface enables researchers to interact with PSF data, providing enhanced visualization and search capabilities over previous static systems. Figure 1 shows the homepage [5].

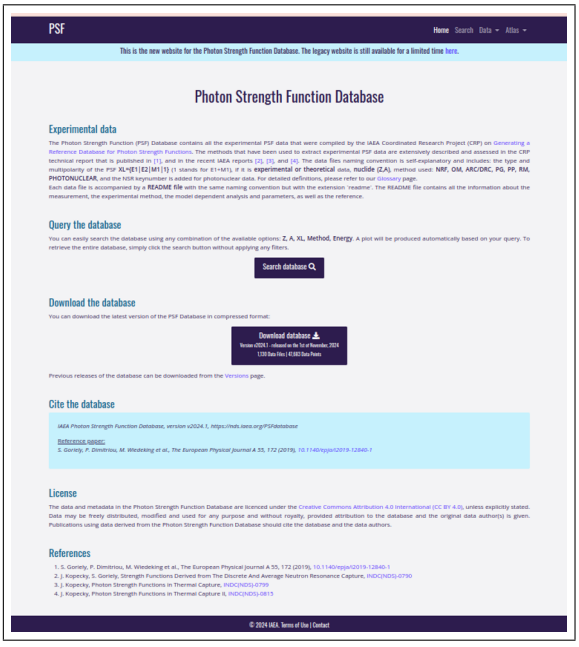


Figure 1. Homepage of the new PSF database interface.

2 Key Functionalities

2.1 Search and Access

The homepage provides a centralized platform for accessing various types of data and information relating to photon strength functions.

The page, as shown in Figure 1, serves as the entry point, offering links to download the database, perform searches, and access additional resources through the navigation bar. The **"Data"** menu item on the navigation bar expands to a drop-down with options such as **"All Versions"**, **"Theoretical Data"**, and **"Glossary"**, each leading to dedicated pages. The **"Versions"** page lists all versions of the database, including previous versions, allowing users to download any version they require. Figure 3 illustrates the versions page. The **"Theoretical Data"** option takes users to a page where they can download all the available theoretical data. From the homepage users can access the search functionality which provides access to filtered PSF data, based on search fields such as atomic number (Z), atomic mass (A), multipolarity, and experimental method. Users can refine queries dynamically, improving search efficiency (Figure 2).

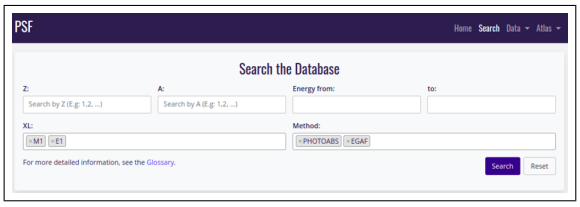


Figure 2. Search interface of the PSF database.

The **Versions** page lists all database releases with direct download options (Figure 3).

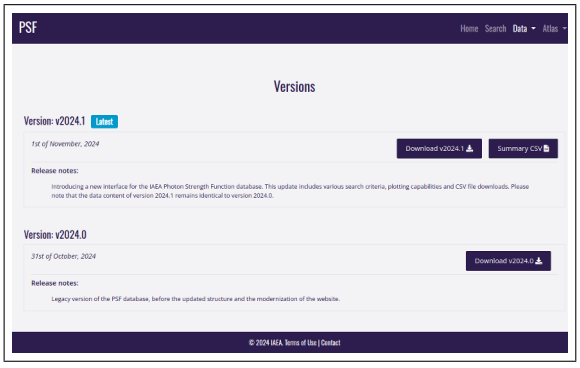


Figure 3. The **"Versions"** page displaying all available database versions.

2.2 Interactive Data Visualization

Using Plotly [6], the application provides interactive plots featuring zooming, axis adjustments, image downloads, and responsive legends (Figure 4).

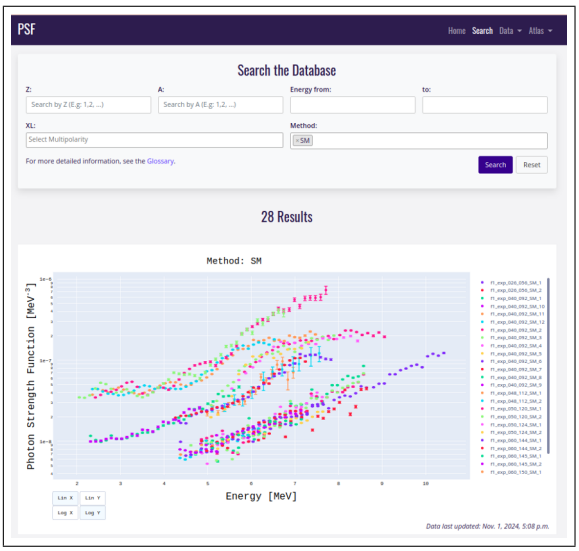
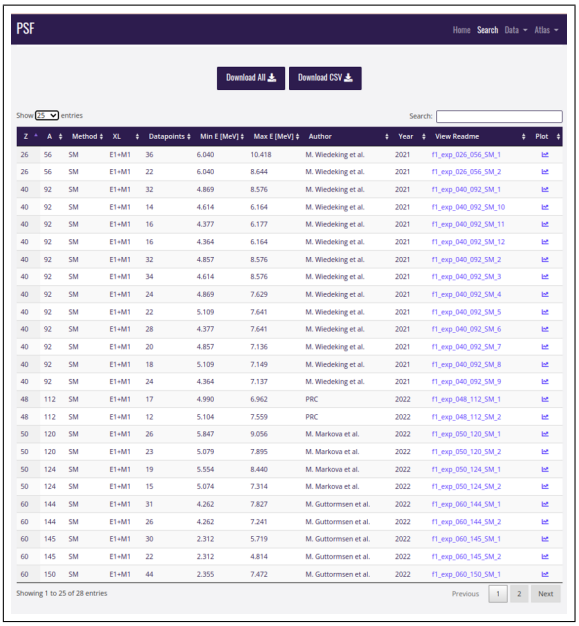


Figure 4. Interactive data visualization of PSF data.

The title content of each plot dynamically corresponds to the selected search parameters, ensuring that users are always aware of the data context. Data updates are time-stamped, ensuring users access the latest information. The plots are designed to be responsive and seamlessly adjusted to various device screens and resolutions to maintain usability and readability.

2.3 Results Table

Below the plots, a table displays search results with sorting, filtering, and quick-access links to additional data sources (Figure 5).



Z	A	Method	XL	Datapoints	Min E [MeV]	Max E [MeV]	Author	Year	View Readme	Plot
26	56	SM	E1+M1	36	6.040	10.418	M. Wiedeking et al.	2021	f1_exp_026_056_SM_1	list
26	56	SM	E1+M1	22	6.040	8.644	M. Wiedeking et al.	2021	f1_exp_026_056_SM_2	list
40	92	SM	E1+M1	32	4.869	8.576	M. Wiedeking et al.	2021	f1_exp_040_092_SM_1	list
40	92	SM	E1+M1	14	4.614	6.164	M. Wiedeking et al.	2021	f1_exp_040_092_SM_10	list
40	92	SM	E1+M1	16	4.377	6.177	M. Wiedeking et al.	2021	f1_exp_040_092_SM_11	list
40	92	SM	E1+M1	16	4.364	6.164	M. Wiedeking et al.	2021	f1_exp_040_092_SM_12	list
40	92	SM	E1+M1	32	4.857	8.576	M. Wiedeking et al.	2021	f1_exp_040_092_SM_2	list
40	92	SM	E1+M1	34	4.614	8.576	M. Wiedeking et al.	2021	f1_exp_040_092_SM_3	list
40	92	SM	E1+M1	24	4.869	7.629	M. Wiedeking et al.	2021	f1_exp_040_092_SM_4	list
40	92	SM	E1+M1	22	5.109	7.641	M. Wiedeking et al.	2021	f1_exp_040_092_SM_5	list
40	92	SM	E1+M1	28	4.377	7.641	M. Wiedeking et al.	2021	f1_exp_040_092_SM_6	list
40	92	SM	E1+M1	20	4.857	7.136	M. Wiedeking et al.	2021	f1_exp_040_092_SM_7	list
40	92	SM	E1+M1	18	5.109	7.149	M. Wiedeking et al.	2021	f1_exp_040_092_SM_8	list
40	92	SM	E1+M1	24	4.364	7.137	M. Wiedeking et al.	2021	f1_exp_040_092_SM_9	list
48	112	SM	E1+M1	17	4.990	6.962	PRC	2022	f1_exp_048_112_SM_1	list
48	112	SM	E1+M1	12	5.104	7.559	PRC	2022	f1_exp_048_112_SM_2	list
50	120	SM	E1+M1	26	5.847	9.056	M. Markova et al.	2022	f1_exp_050_120_SM_1	list
50	120	SM	E1+M1	23	5.079	7.895	M. Markova et al.	2022	f1_exp_050_120_SM_2	list
50	124	SM	E1+M1	19	5.554	8.440	M. Markova et al.	2022	f1_exp_050_124_SM_1	list
50	124	SM	E1+M1	15	5.074	7.314	M. Markova et al.	2022	f1_exp_050_124_SM_2	list
60	144	SM	E1+M1	31	4.262	7.827	M. Guttormsen et al.	2022	f1_exp_060_144_SM_1	list
60	144	SM	E1+M1	26	4.262	7.241	M. Guttormsen et al.	2022	f1_exp_060_144_SM_2	list
60	145	SM	E1+M1	30	2.312	5.719	M. Guttormsen et al.	2022	f1_exp_060_145_SM_1	list
60	145	SM	E1+M1	22	2.312	4.814	M. Guttormsen et al.	2022	f1_exp_060_145_SM_2	list
60	150	SM	E1+M1	44	2.355	7.472	M. Guttormsen et al.	2022	f1_exp_060_150_SM_1	list

Figure 5. Table displaying search results.

The table has multiple columns, namely the atomic number (Z), atomic mass (A), experimental

method, multipolarity (XL), number of data points, minimum and maximum energy range, author, plot, a link to the data file, view Readme, publication year, and a link to a single plot. Each column can be sorted in ascending or descending order, and users can search within the table for specific keywords or values, making it easier to find relevant data. Additionally, above the table there is a functionality to download the datasets specific to the query results and individual data files contained in the form of a zip folder that contains the data in CSV format or the data files as they appear in the database.

Clicking a dataset's plot icon opens a dedicated visualization page containing dataset details, compiler information, and citation references (Figure 6).

Figure 6. Plot for a single entry accessed via the results table.

For Oslo Method and nuclear resonance fluorescence measurements, plots display lower, recommended, and upper values representing model-dependent uncertainties (Figure 7).

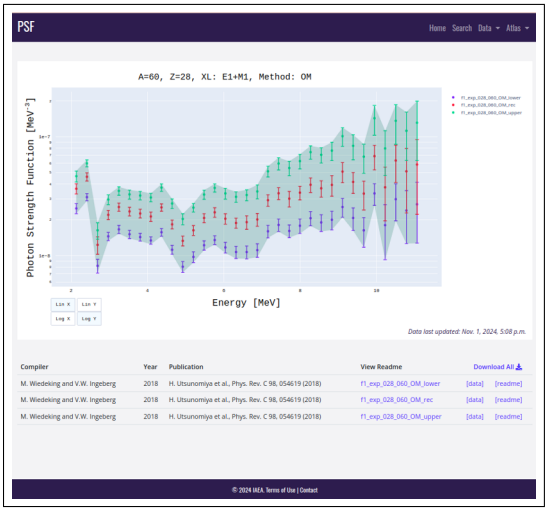


Figure 7. Detailed PSF data for ^{60}Ni using the Oslo Method, showing uncertainties.

3 Conclusion

The PSF database application significantly improves data accessibility, visualization, and systematic analysis, supporting nuclear research. Its interactive capabilities enhance usability, making it a valuable tool for the research community. Future developments include addition of theoretical datasets, plots, linking DOIs to various publications, and additional tools that will prove useful to the user.

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