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Modernizing ESA Science Archives: Reusable Components and Automated HiPS Generation in a VO-Aligned ecosystem

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Recent developments at the ESAC Science Data Centre (ESDC) significantly enhance how the scientific community accesses, explores, and exploits mission data. Two key innovations will be highlighted in this talk: the automatic HiPS generation pipeline for XMM-Newton and the set of widgets deployed within a modernized infrastructure, to be integrated seamlessly within the different Science Archives. Together, these tools demonstrate the commitment to interoperability, reusability, and rapid application development, while strengthening alignment with Virtual Observatory (VO) standards. The introduction of reusable pipelines and widgets has significantly streamlined application development across ESA science data services. This eliminates the need to develop the same component for different missions again and again, reducing both development time and long-term maintenance effort. By centralizing optimisation in a single shared component, any enhancement will benefit all missions simultaneously. The new automatic HiPS generation for XMM-Newton science data, based on HipsGen, enables continuous production and updating of sky maps in accordance with the HiPS standard. This ensures that high-level data products remain fully compatible with a wide range of visualization applications (e.g., Aladin Lite, ESASky). As a result, users have faster access to up-to-date XMM data through an interactive sky view linked to the XMM Science Archive (https://nxsa.esac.esa.int). The ESDC Search Panel widget introduces a mission-agnostic, reusable component for data discovery. Its design, based on the common TAP protocol, provides the Science Archives with the capability of executing searches by any of the filters available in the table provided, eliminating the need for large forms and extensive scrolling to locate specific filters. This widget allows the user to select a column to filter, choose a comparator and define a comparison value (in some cases from a set of predefined values). It also supports the creation of condition groups: filters within the same group will be concatenated using “OR” clauses, while different groups are combined with “AND” clauses. Additional metadata (column name, description, type, UCD…) are provided to support users through the TAP. This approach allows for flexibility and for virtually any search request to be constructed and executed. Complementing this, the ESDC ADQL Console widget provides an interactive TAP/ADQL query environment. Within this component, all tables available through the TAP, including the associated metadata, are provided in a tree. Using this information, users can create their own ADQL query, based on the information available, removing limitations set by pre-defined filters provided in a form. Requests across different tables are now possible, limited only by the users’expertise. By embracing these standards and a common development workflow, ESDC enables faster delivery of high-quality applications across missions. This not only strengthens long-term maintainability for developers, but also empowers the scientific community with more responsive tools, richer data-exploration capabilities, and a consistent experience across archives. Together, these advances mark a significant step forward in ensuring that ESA’s expanding data holdings remain accessible, discoverable, and scientifically impactful for years to come.

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