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ICSC Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing

AstroVisio

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Spoke 3 Progetti Bandi a Cascata, 29/05/2025

Project Overview

Main Topic
Scientific Visualization with Artificial Intelligence support

Specific Topic
Implementation of interfaces aimed at visualization and analysis through systems of virtual reality of scientific big data from the astrophysical nature both observational and theoretical.

The main goal of this project is the research and development of dedicated tools to the analysis of astrophysical data by making use of immersive technologies such as Virtual Reality (VR), the Extended Reality (XR), and Spatial Computing (SC), in order to efficiency and enhance the research.

Project Overview

Consortium:

Auticon Srl (Milan),
Alkemy SpA (Milan)
Net Service (Cagliari, Cosenza, Lecce)

Consultants:

University of Cagliari, Department of Physics
MetaVerso

Timescale, Milestones, SAL

WP	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 - Literature search on the latest advances in the field of Immersive Visualization / VR / XR / Spatial Computing and analysis of existing software and ecosystems			M1.1											
2 - Interview sessions with researchers on the state of the art in astrophysical data visualization, with the goal of defining the most relevant visualizations to be included in the MVP. PoC and MVP definition.						M2.1								
3 - Definition of data structures. Selection of technologies best suited for the defined data structures						M3.1								
4 - Implementation of multi-user immersive visualization VR software and documentation									M4.1			M4.2		
5 - Release of the software and documentation in Open format and dissemination of the results									M5.1					M5.2

We are here

Timescale, Milestones, SAL

DELIVERABLE	WP	Milestone	Month	SAL
D1 Libraries and technologies for VR/XR rendering and visualization of astrophysical big data	WP1	M1.1	3	1 (3 months)
D2 PoC and MVP features list, with description of UX and UI	WP2	M2.1	6	2 (6 months)
D3 Definition of the data architecture for VR/XR processing of astrophysical data	WP3	M3.1	6	
D4 Release of PoC (Partial Release)	WP4	M4.1	9	3 (9 months)
D5 Report on dissemination activities	WP5	M5.1	9	
D4 Release of MVP (Final Release)	WP4	M4.2	12	4 (12 months)
D5 Final Open Source release and Report on dissemination activities	WP5	M5.2	14	5 (14 months)

Collaborations

During the last months, we established contacts with different stakeholders and we are trying to make the integration of Astrovisio with the broader INAF ecosystem as smooth as possible:

- **VisioLab Project (UniPG)**: we offered to host one of their visualization in our tool. This activity could start soon, given the recent progresses with Astrovisio;

- **iDavie (INAF)**: we evaluated different options for a joint development of Astrovisio and iDavie, also considering the possibility of making Astrovisio a spin-off of iDavie. Due to practical reasons, we opted for continuing the development independently, but with the intention and committment to make future integrations of Astrovisio features in iDavie as easy as possible, thanks to specific technical choices (e.g. using Unity 6);

- **Webinar and workshops for INAF**: we proposed a 45’ minutes webinar to talk about our design-based approach and how it could help INAF members for their activities and research. About the same topic and in more depth, we proposed specific workshops to learn our methodology.

- **In-house all-hands meetings**: we hosted two all-hands meeting, in Alkemy and DGI (Milan), with all the team members of Astrovisio, Astrotool and Astrodata, members from INAF and partners, fostering a spirit of sharing and collaboration.

WP3: Progress Update

A3.1: Selection of Technologies/Libraries for Implementation

- Analysis of files in scope: HDF5, FITS
- Definition of data filtering and transformation operations
- Technologies/libraries selection: Python, PyNbody, AstroPy, FastAPI

A3.2: Definition of Data Schemas (JSON) and Export Methodology from HPC Systems

- Design and development of APIs
- Performance testing of data processing

A3.3: Definition of Data Import Methodologies into Visualization Tools

- API for communication between desktop application and data processing
- Integration of WP3 and WP4

M3.1: Partial Release of System Architecture and Data Management

- In progress

WP4: Progress Update

A4.1: Development of 3D Scene and interactions

- Partial integration between 3D Scene and Front End in Desktop mode.

A4.2: Development of users and interactions between user and Scene/Data

- Single user mode.
- Partial interaction with data in Desktop mode and view-only in VR mode.

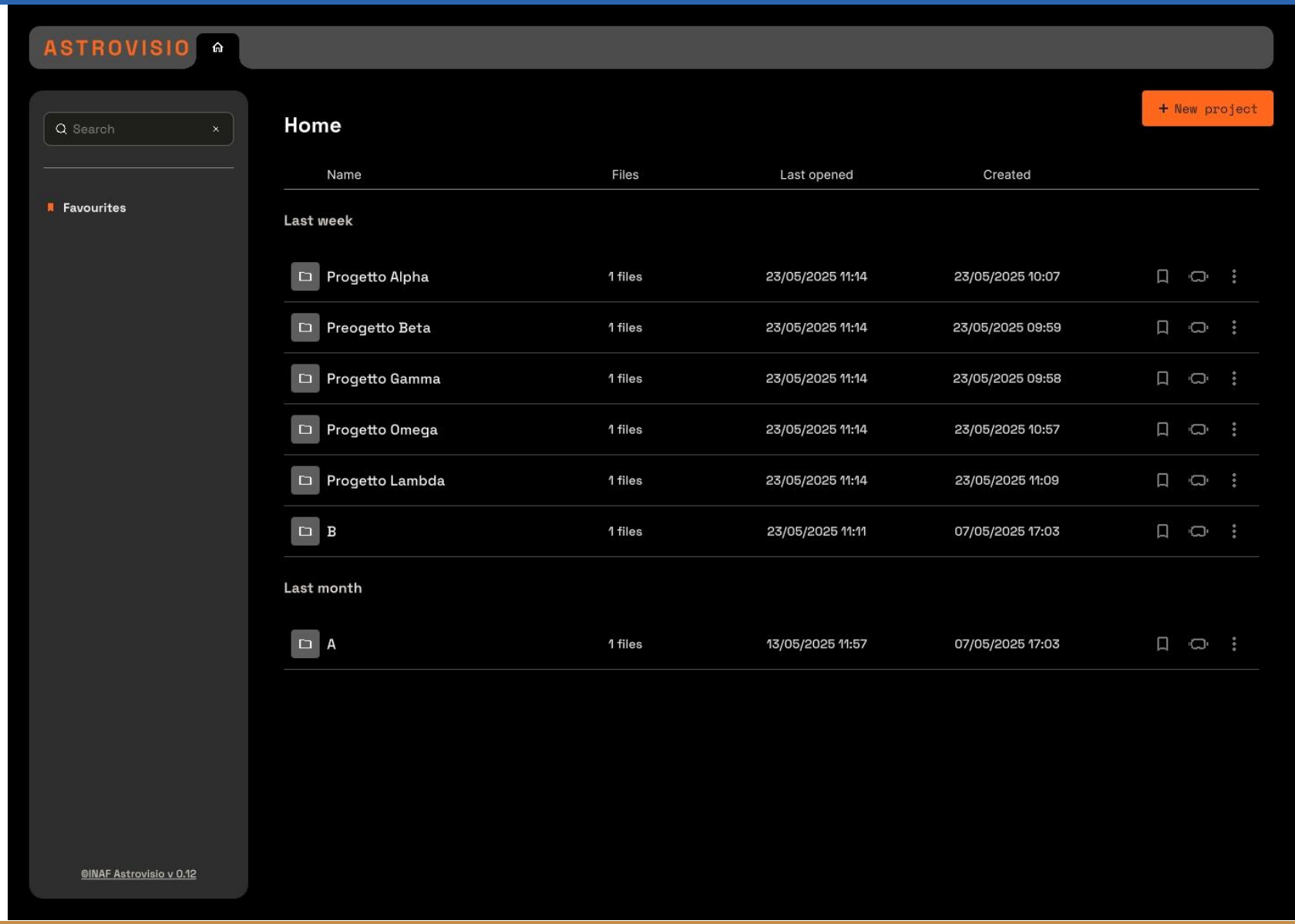
A4.3: Development of data import forms and subsequent graph visualization

- Full integration with Local Back End for data import and processing.

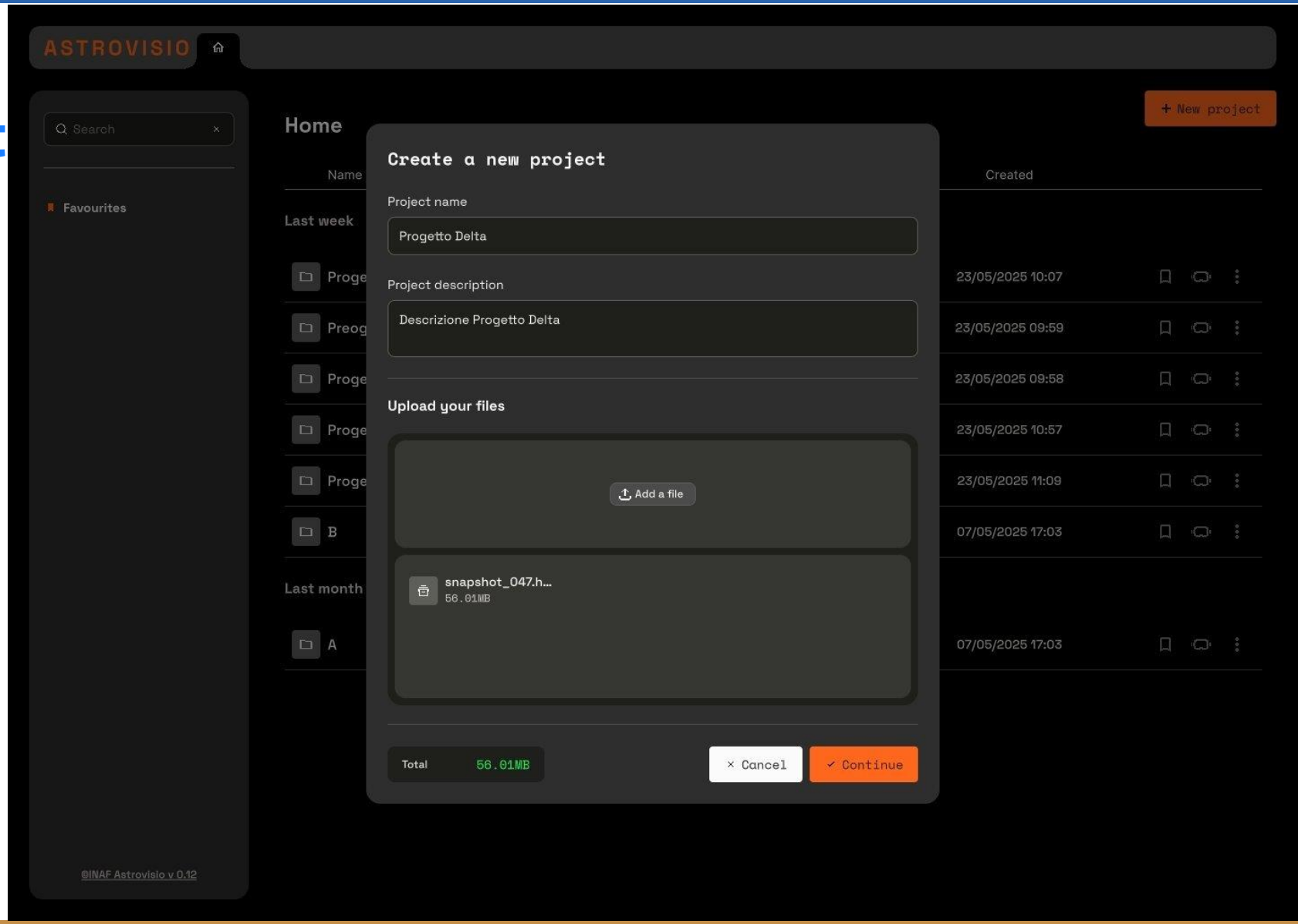
A4.4: PoC release and feedback collection

- PoC release scheduled for week 24 .
- In-person testing session and feedback collection scheduled between week 27 and 28.

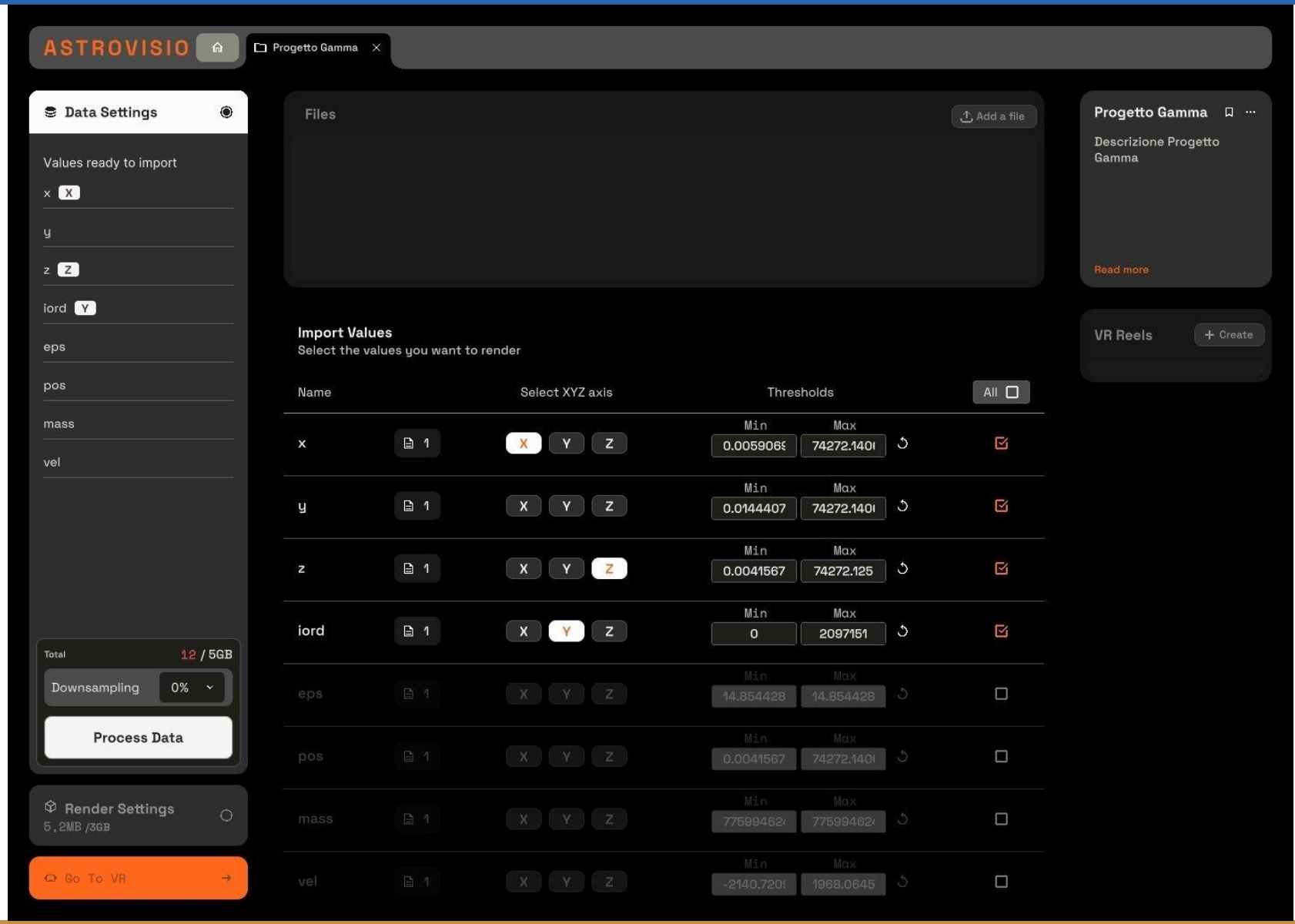
WP4: Progress Update - Home



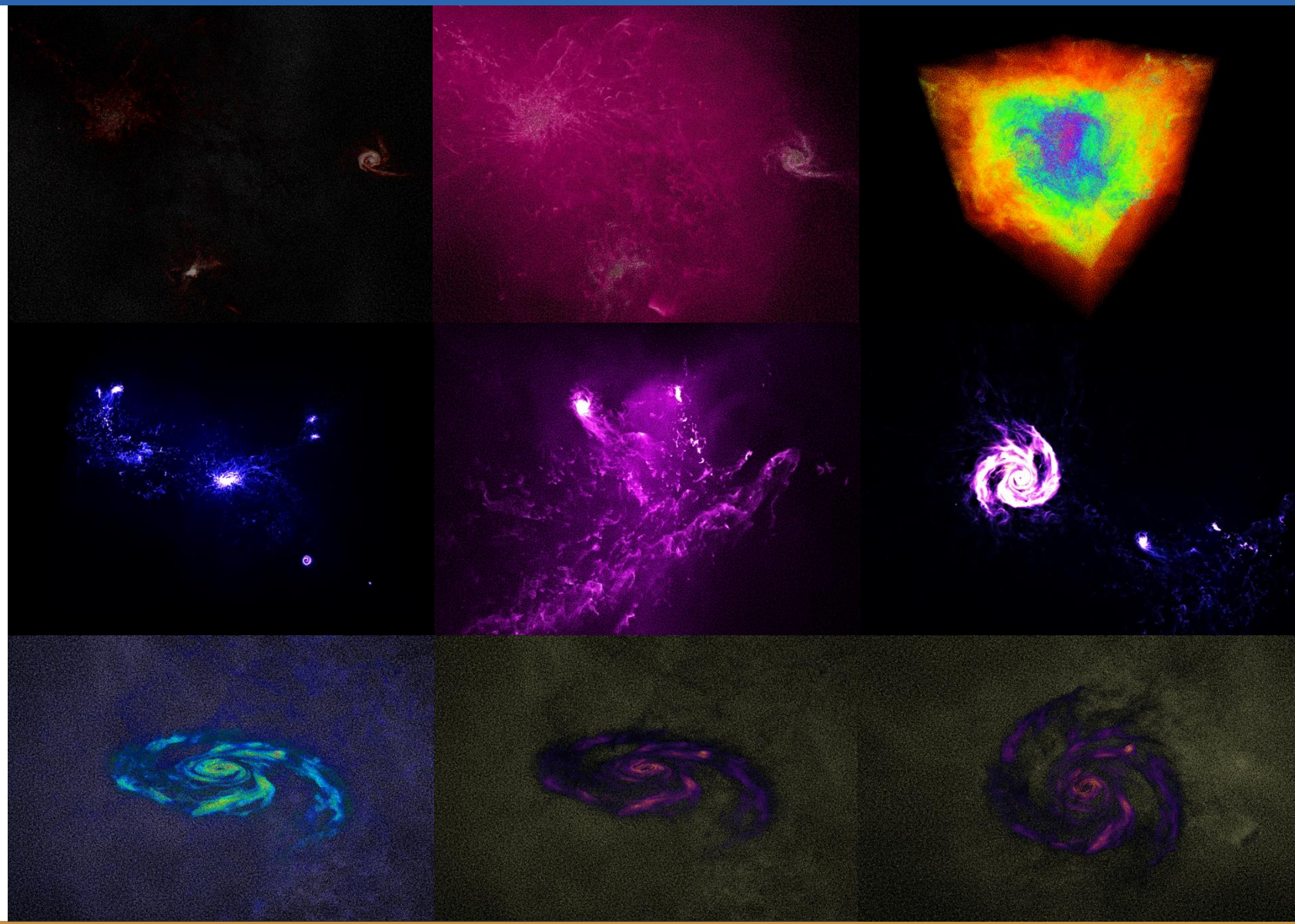
WP4: Progress Update - New Project



WP4: Progress Update - Data Settings



WP4: Progress Update - Data Viz



WP4: Next Steps – From POC to MVP

During the next 4 months, we will focus on the remaining WP4 activities that will bring Astrovisio to the final status of MVP.

Finalization of current features

- **Visualization rendering**
- **Data selection**

New Features

- **Dynamic time-lapse:** Enabling users to observe the evolution of data over time.
- **Image export:** Enabling the export and saving of VR visualizations in image format.
- **Visualization recording and export:** useage of a "physical" tool like a camera to create videos that can be shared or used in presentations.
- **Control toolbar:** Allowing users to adjust parameters within the immersive environment. Examples include linear and logarithmic scales, spatial zoom, and timeline management of simulations.
- **Enhanced visualization expressiveness:** Adding sound and haptic feedback alongside colors to explore data within visualizations.