REANA workflow for dark matter searches

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Project Description

Reproducibility and reusability of analysis is crucial for advancement and improvement in physics research. The particle physics community has had experience in building reproducible data analysis tooling and reinterpreting physics results from the LHC for new physics hypotheses (recasting). The solutions that have been developed are not fundamentally tied to particle physics and have application across science. Having other scientific fields, like astroparticle physics, leverage these solutions can provide benefit to the broader scientific community and also offer opportunities for the tooling to become more robust for all users.

This project aims to leverage Linux container technology and the REANA data analysis platform to implement a galaxy rotation-curve fitting (RCFM) analysis as a reproducible workflow that can be deployed at scale on REANA. By doing so, we aim to improve replicability and provide a solid starting point for future applications in dark matter searches.

The primary objective of this project is to implement a REANA workflow specifically tailored for conducting galaxy rotation-curve fitting analyses. The galaxy rotation-curve fitting analysis involves studying the rotational velocity of galaxies and inferring the distribution of mass within them. Implementation as a reproducible workflow in REANA will allow for possible reinterpretation for future models. The project will be conducted under the mentorship of Matthew Feickert, Lukas Heinrich, Giordon Stark, and Amy Roberts.

Deliverables

At the conclusion of the project the following deliverables will be publicly available:

- **REANA workflow for RCFM**: We will publicly develop a comprehensive workflow that incorporates the necessary steps for conducting a reproducible galaxy rotation-curve fitting analysis. Researchers will be able to easily deploy and execute the workflow on REANA clusters, enabling reproducible and scalable analyses of galaxy rotation curves.
- **Documentation**: We aim to provide comprehensive documentation and user guides outlining the setup, execution, and interpretation of the REANA workflow for RCFM. The documentation will also include step-by-step instructions, example use cases, and best practices for configuring and running the workflow.

- **Summary presentations**: Presentations will be given on the status of the work to the IRIS-HEP collaboration at various meetings as part of the IRIS-HEP Fellow program.

Timeline

Weeks	**Goals**
1-3	Literature review on galaxy rotation-curve fitting analysis techniques, and familiarization with the REANA platform and Linux container technology (e.g. Docker). The various accounts for use of computing resources and access to data and simulation will be acquired.
4-6	Containerize all analysis software necessary for running the selected RCFM analysis.
7-8	Get started on REANA workflow framework. Conduct initial testing to ensure functionality and compatibility. Begin writing documentation concurrently with software development.
9-10	Refine and optimize the workflow to enhance its performance, scalability, and reproducibility. Identify and address any potential issues or improvements.
11-12	Prepare final presentations and finalize the documentation with the setup instructions, workflow execution, and interpretation of results.