

An Agentic Tool for Environmental Geophysics

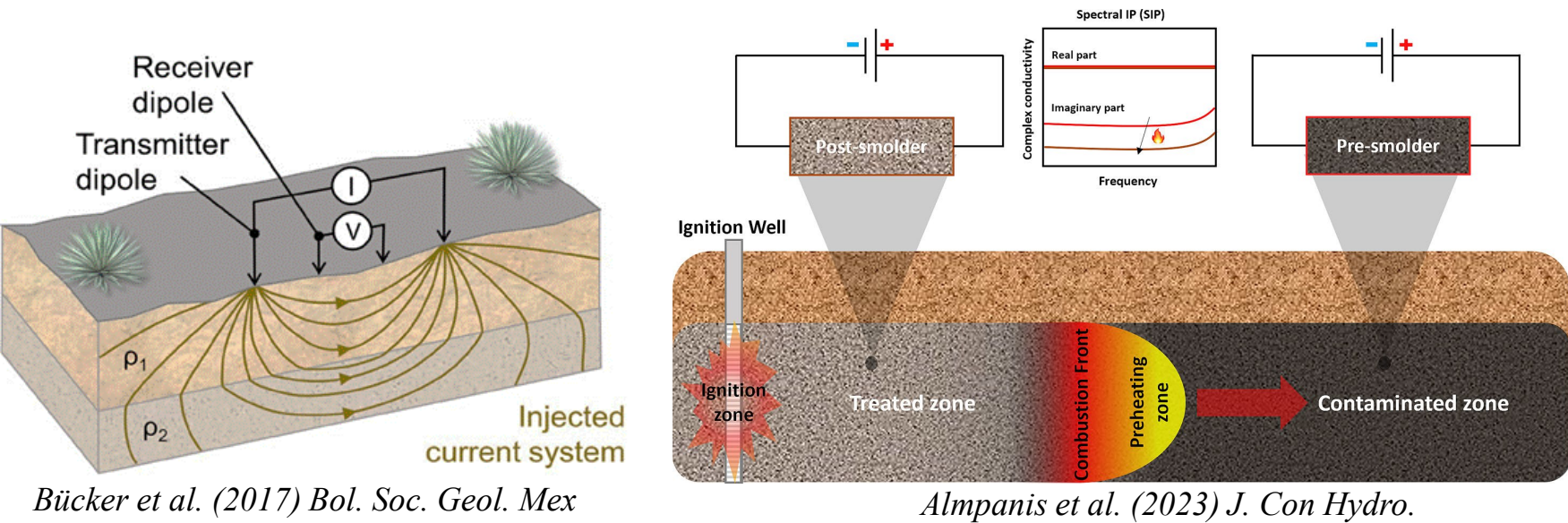
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Backgrounds

Noninvasive geophysics approaches provide indirect measures of geochemical conditions in the subsurface over large spatial extents for environmental monitoring, complementing data from sparsely distributed borehole or core characterization.

Spectral induced polarization (SIP), is a geophysical method that measures complex conductivity and is capable of indirectly measuring mineral properties and mineral-water interfacial interactions.

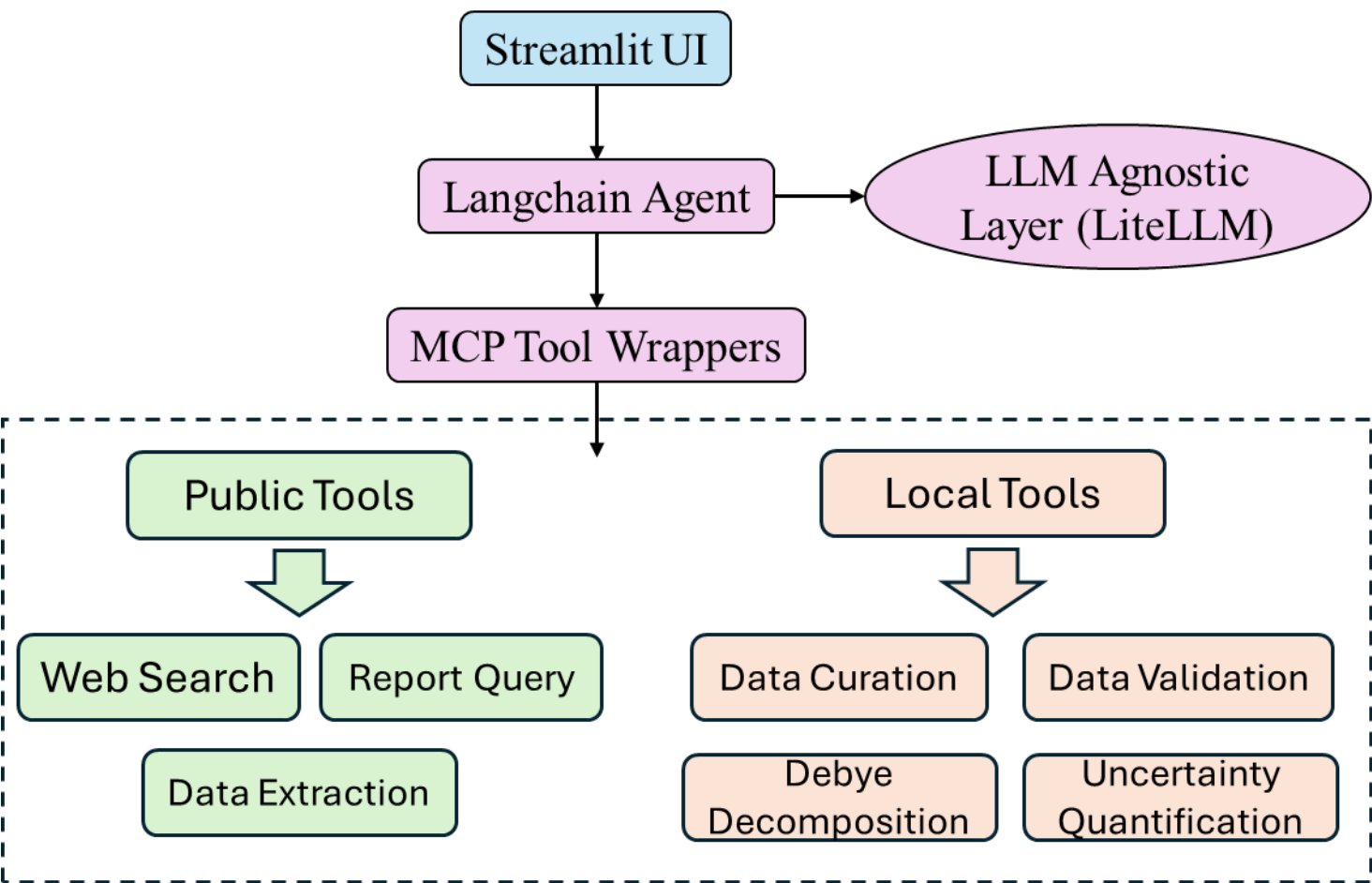
Large language model (LLM) can be used to automate data processing and analysis. This work shows the automatic workflow of experimental SIP data analysis by an agentic tool.



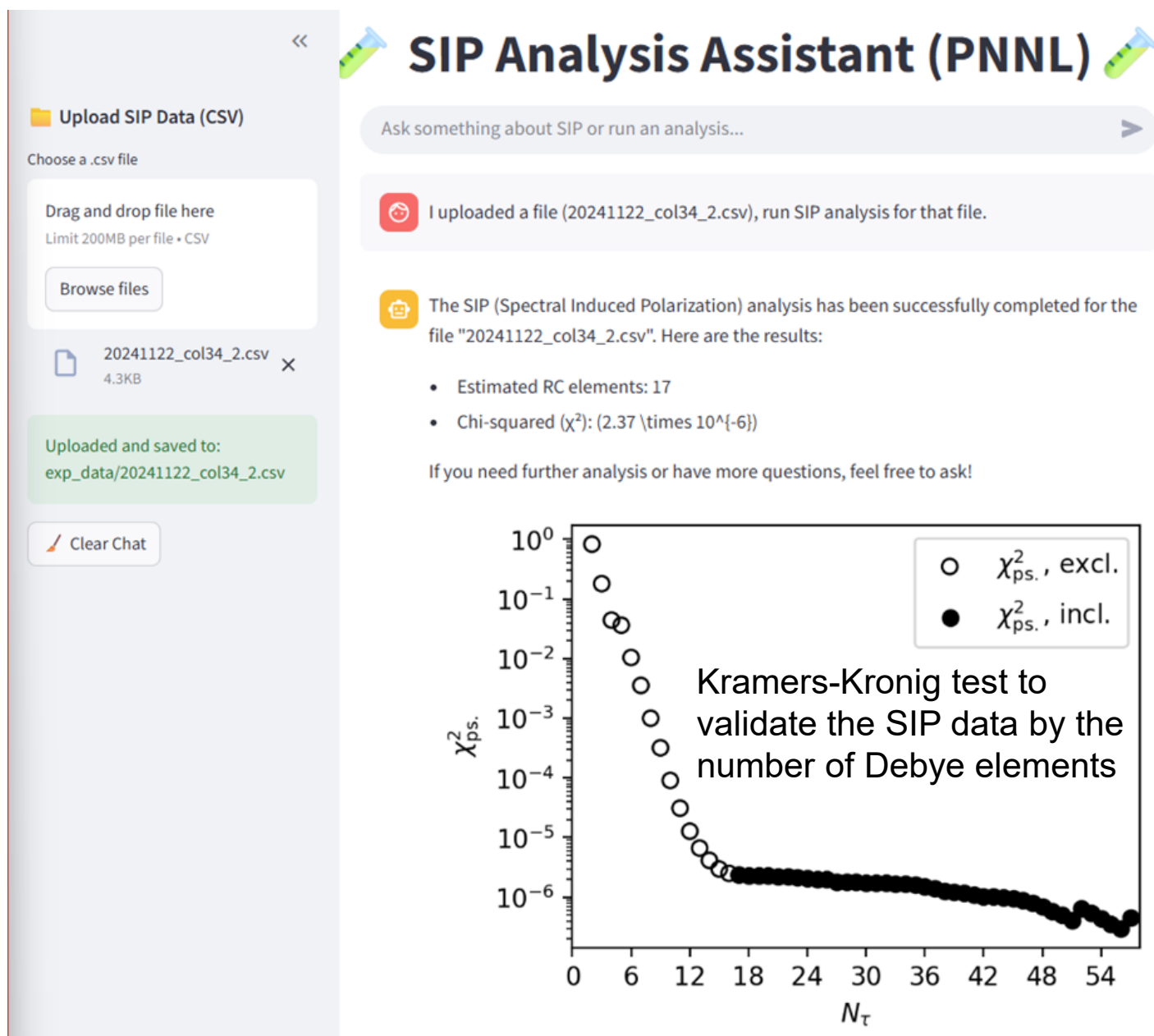
AI Agent Framework

A multi-tool AI agent has the following functionalities:

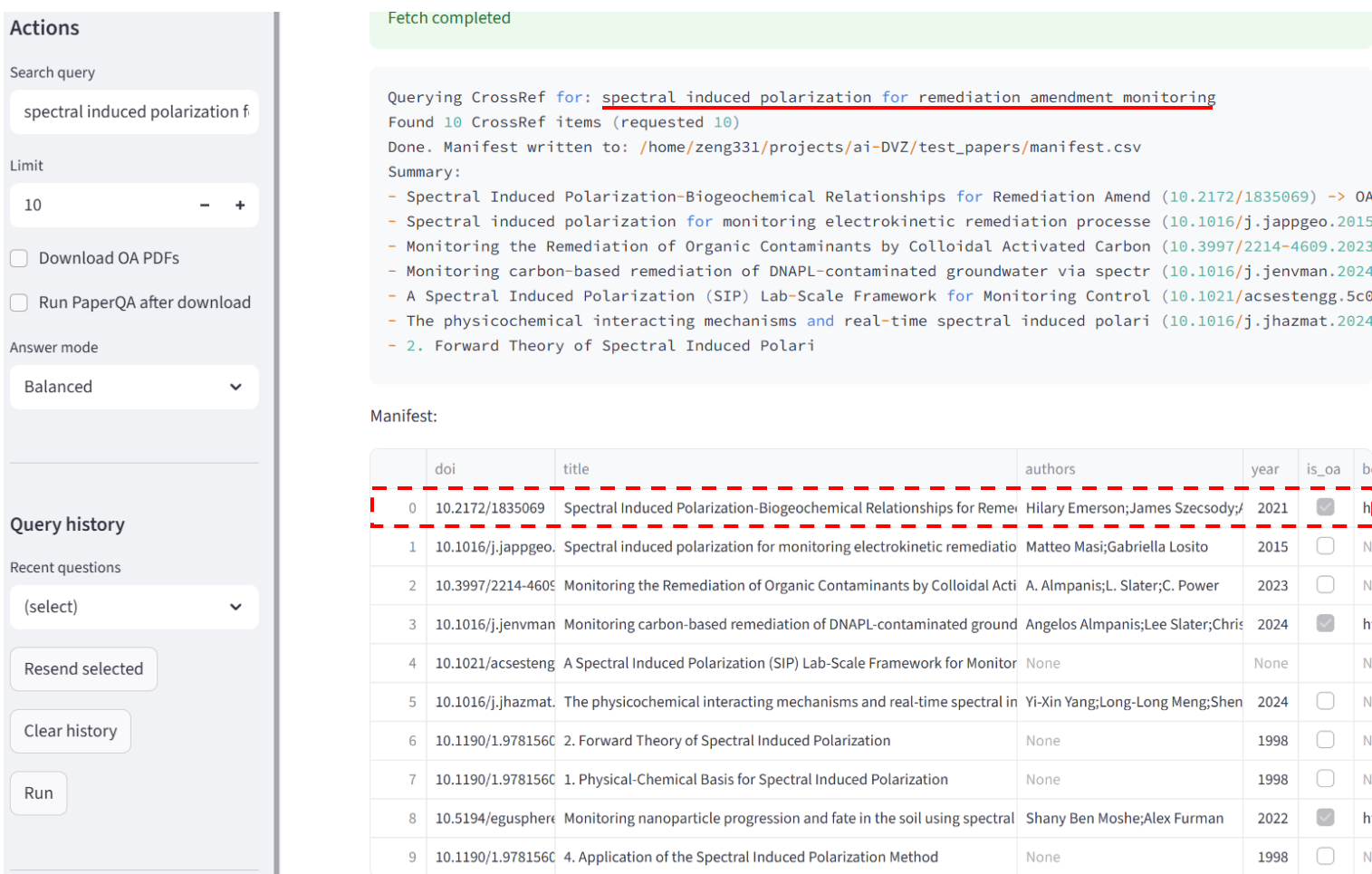
- (1) User interface (UI) by Streamlit UI
- (2) Reasoning by Langchain Agent
- (3) Tool wrapper by model context protocol (MCP)
- (4) Document analysis by retrieval augmented generation (RAG)
- (5) Public tools by application programming interface (API) calling
- (6) Local tools by self development



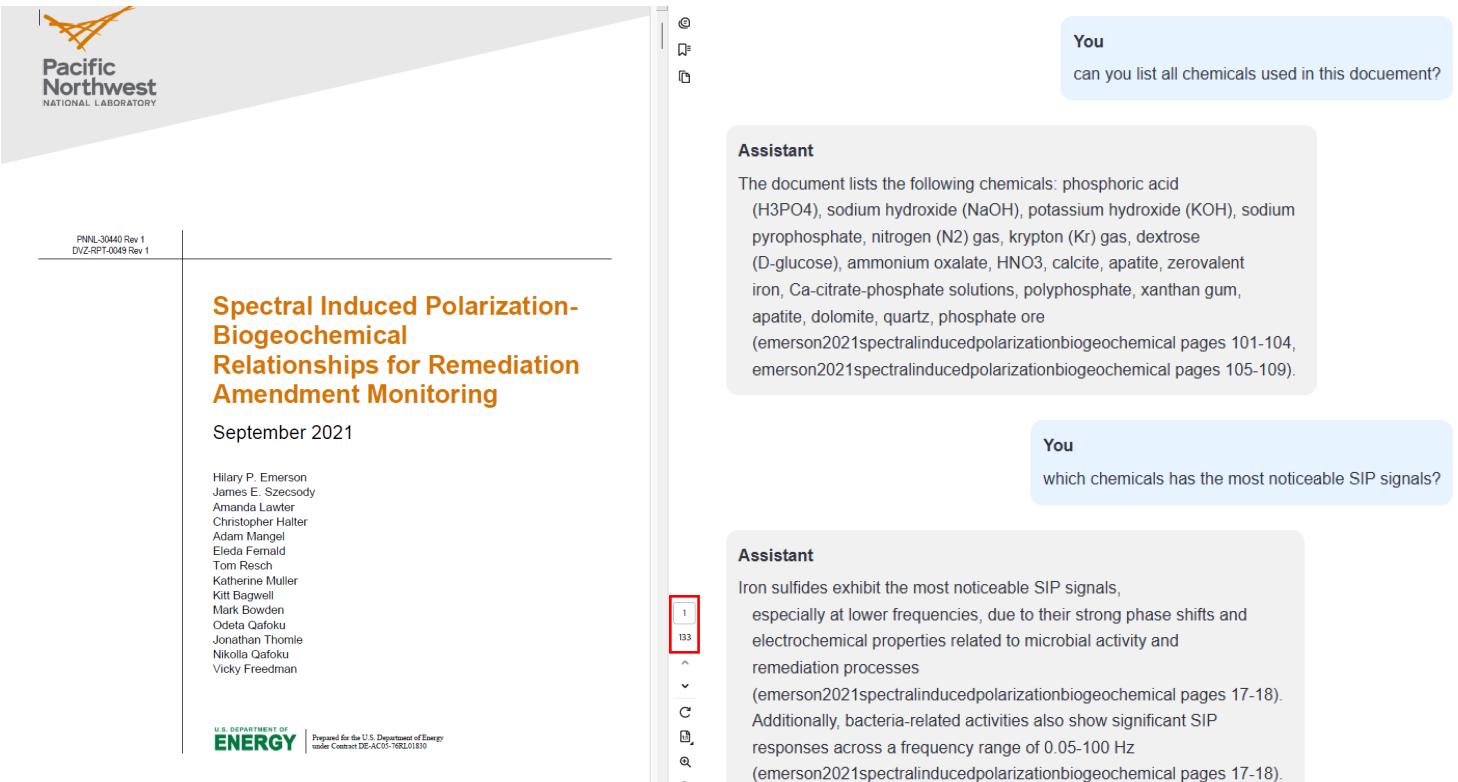
User Interface: Text and image output for user query



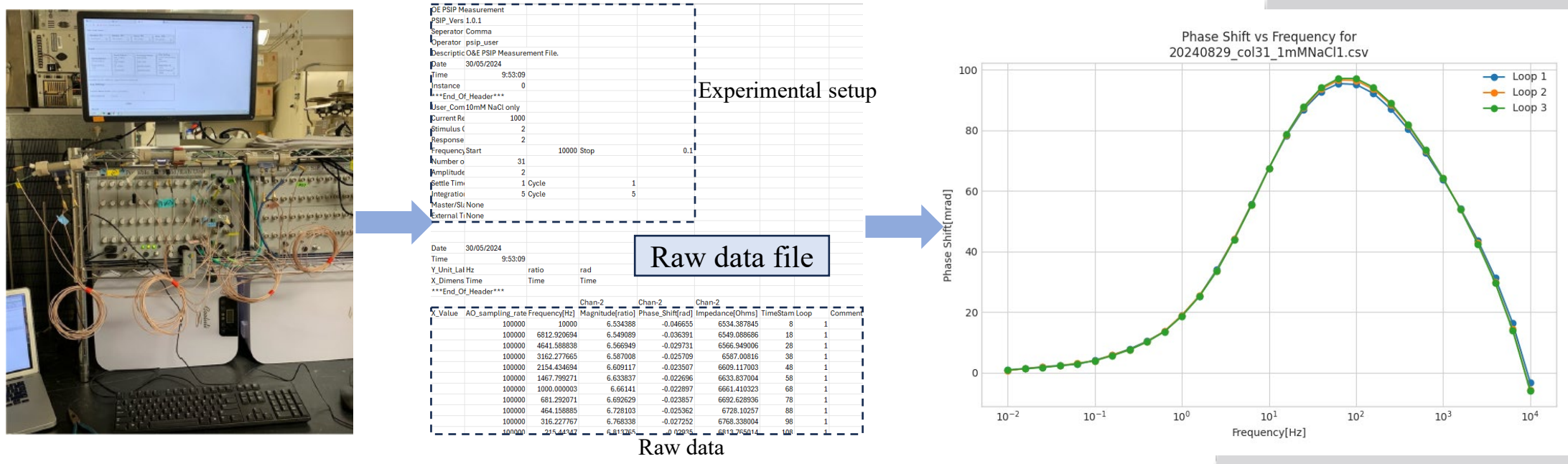
Web browsing: With internet connection and literature search function



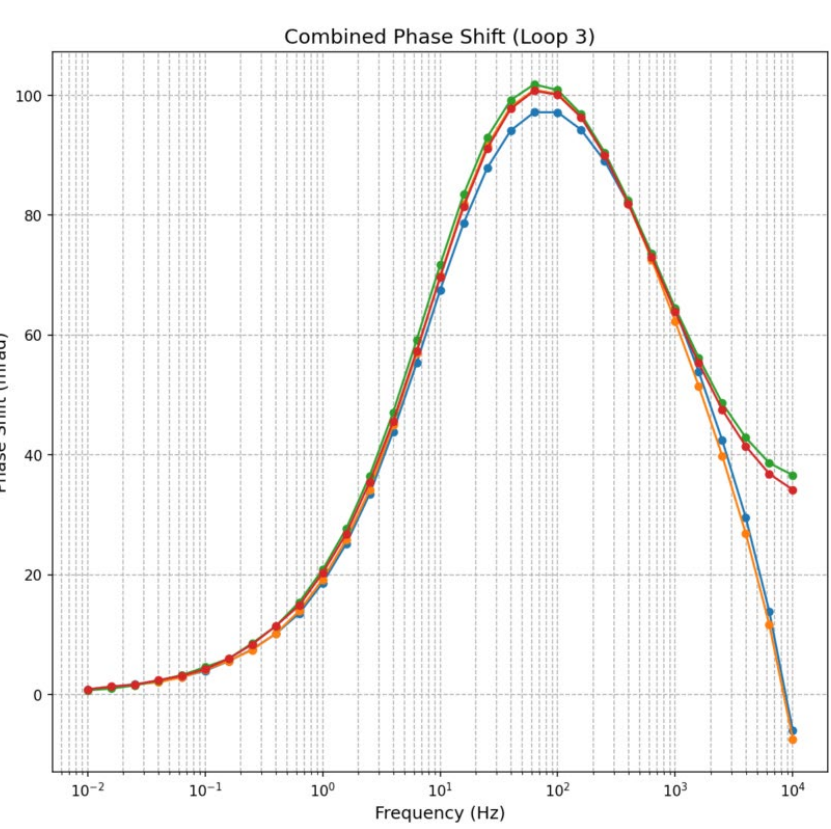
Document query: Data extraction and summary



Experimental Data

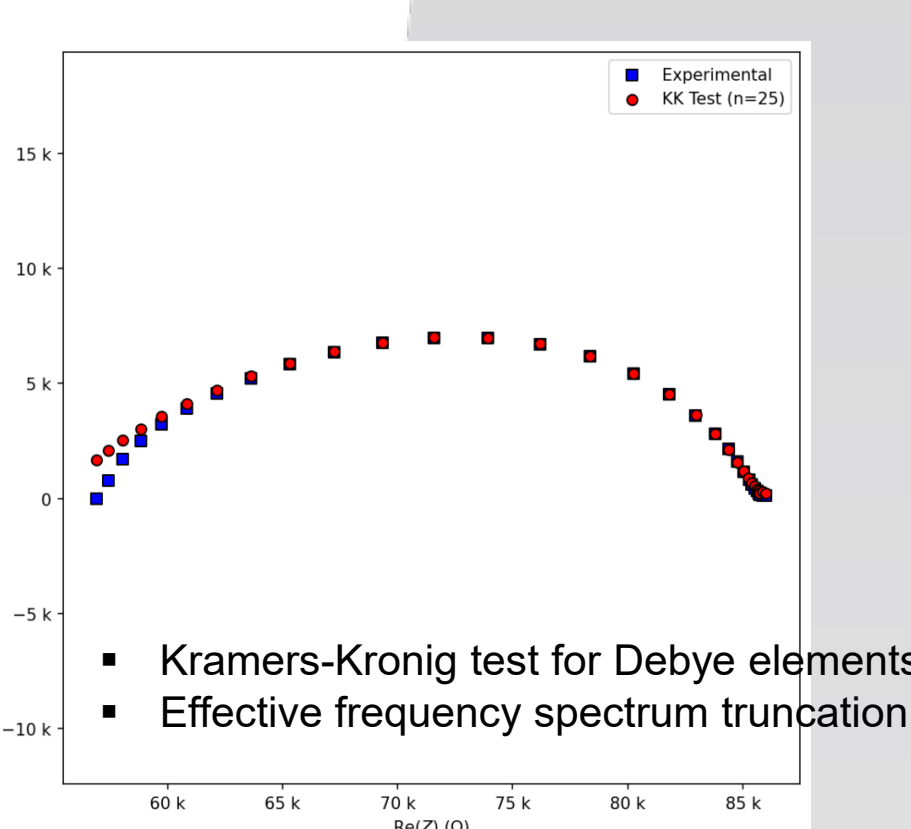


Data analysis and visualization:



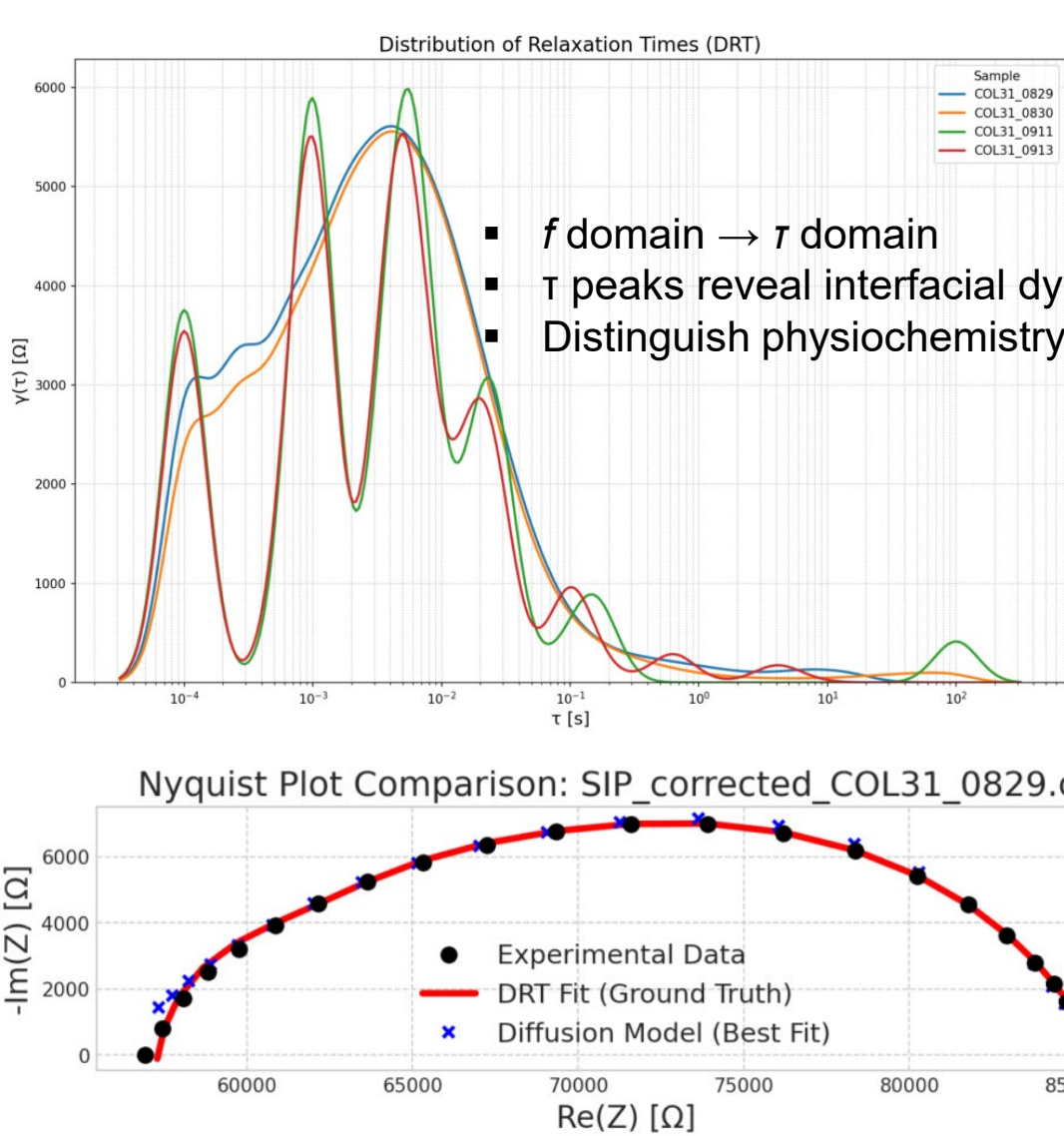
- Compare multiple measurements
- Illustrate trends over time for major parameters

Data validation:



- Kramers-Kronig test for Debye elements
- Effective frequency spectrum truncation

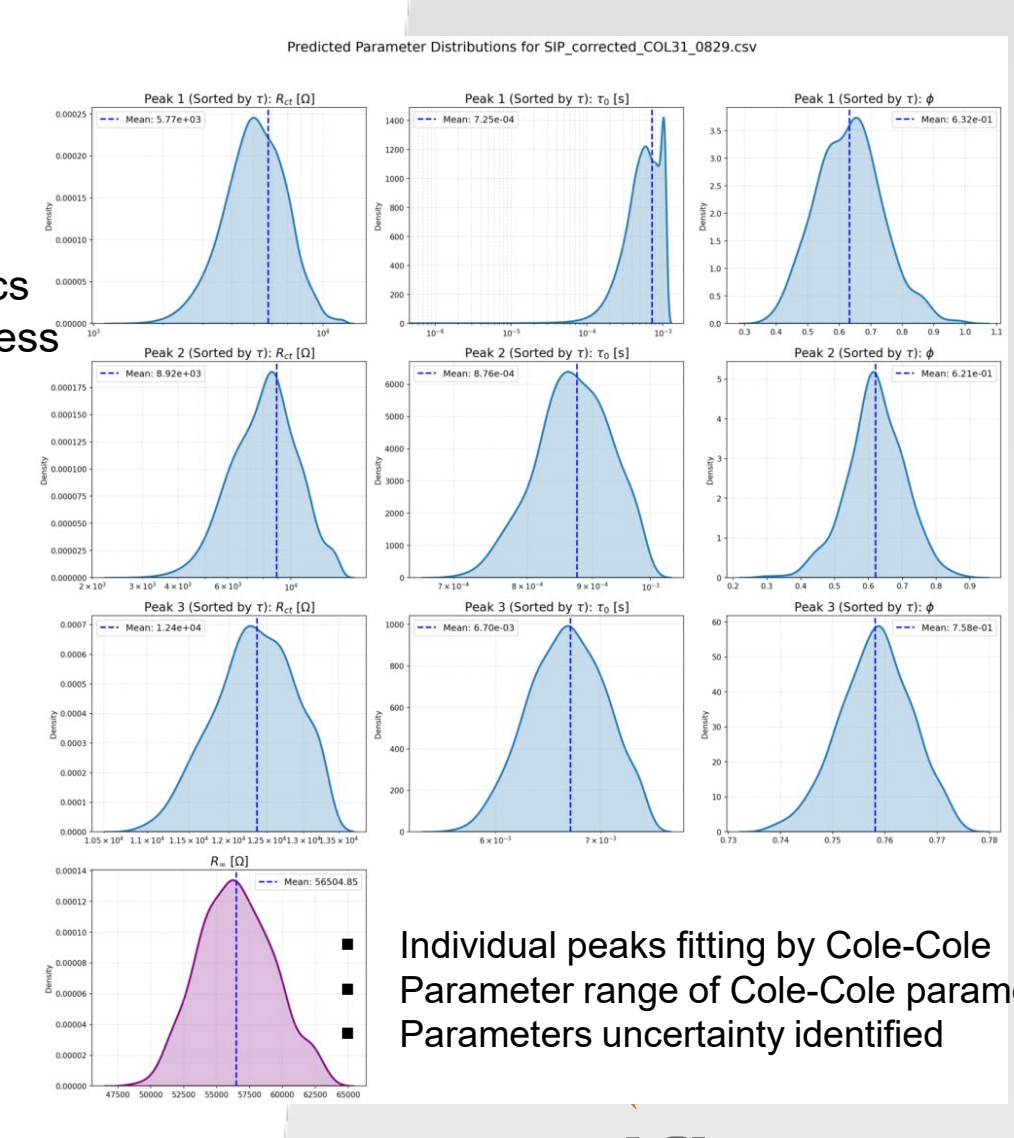
Debye decomposition:



Summary

An AI agent has been developed for data mining, extraction, processing and modeling. This tool is capable of extracting SIP-specific parameters and aiding in the interpretation of results. The tool has flexibility to add new tasks and is potentially scalable to a multi-agent framework. This tool could significantly decrease the time in processing complex SIP datasets.

Uncertainty quantification:



- Individual peaks fitting by Cole-Cole
- Parameter range of Cole-Cole parameters
- Parameters uncertainty identified