NPY DATA FORMAT

NPY File Description for MLM-IV System

The `NPY` files generated by the **MLM-IV-SIMPLOT** program store simulated Langmuir probe I-V data in a format optimized for analysis. These files are specifically designed to be compatible with PlasmaPy and our proprietary **MLM-IV-ANALYSIS** program for detailed diagnostics.

File Structure

1. **File Format**: NPY NumPy array format.
    - The file contains a 2D NumPy array with two rows:
        - **Row 1**: Probe voltage values (in volts, `V`).
        - **Row 2**: Corresponding probe current values (in amperes, `A`).
2. **Purpose**:
    - **MLM-IV-SIMPLOT**: Simulates Langmuir probe I-V curves, including physical effects such as electron/ion leakage currents, noise, and plasma temperature. The results are saved in the `NPY` format for consistency and compatibility.
    - **MLM-IV-ANALYSIS**: Processes the generated I-V curves for plasma parameters such as electron temperature (`Te`), plasma potential (`Vp`), and electron density (`ne`), using methods like derivative analysis and curve fitting.
3. **Interoperability**:
    - PlasmaPy can directly read and analyze these files, leveraging its plasma physics functions for extended studies.
    - **MLM-IV-ANALYSIS** enhances the analysis by applying domain-specific diagnostics, such as identifying plasma potential from I-V derivatives or calculating electron densities.

Example Data Usage

1. The first row provides the voltage range of the Langmuir probe experiment, typically spanning a defined range (e.g., -20V to 20V).
2. The second row contains the corresponding measured or simulated current values, reflecting the plasma interaction with the probe under varying bias conditions.

Compatibility

- The `NPY` format's compact structure ensures that both PlasmaPy and custom analysis tools can efficiently load, process, and visualize the I-V data.
- This format supports rapid integration into workflows where raw data from **MLM-IV-SIMPLOT** is directly analyzed, fitted, and visualized for real-time insights or archival purposes.

Generated Files

- **Raw Simulated Data**: Contains the I-V curve with added noise and physical corrections.
- **Processed Data**: May include averaged noisy samples, theoretical curves, or adjusted fits, depending on the operation mode of the program.

Key Features

- **Efficient Storage**: Binary format ensures small file size and quick access.
- **Ready-to-Use Data**: Structured for direct ingestion into PlasmaPy or **MLM-IV-ANALYSIS**.
- **Detailed Metadata**: Captures experimental parameters implicitly via the consistent voltage-current structure.

This format ensures robust compatibility for plasma diagnostics across various tools and platforms, enhancing the reproducibility and reliability of Langmuir probe experiments.