



USER MANUAL

Version 7.0 · Scientific Visualization & Analysis Suite

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Web Portal: www.altaiplot.com

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This manual covers all core mechanics of ALTAI PLOT 7.0. Follow these sections to master scientific data visualization and analysis.

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1. Introduction & Installation

1.1 What is ALTAI PLOT?

ALTAI PLOT is a high-performance scientific data visualization and analysis desktop application built on Electron. It provides a spreadsheet-based workspace for importing, processing, fitting, and plotting large scientific datasets — with dual-mode Python/JavaScript scripting, 39 2D chart types, 15 3D visualization modes, 100+ curve fitting models, and publication-ready export.

1.2 System Requirements

COMPONENT	MINIMUM	RECOMMENDED
Operating System	Windows 10, macOS 11 (Big Sur), Ubuntu 18.04+	Windows 11, macOS 14+, Ubuntu 22.04+
RAM	8 GB (V8 heap allocates up to 8 GB)	16 GB+ for datasets > 1M rows
GPU	Any (CPU fallback for <1M points)	WebGL2-capable GPU (Intel UHD 620+) — activates automatically at 1M+ points
Disk	~230 MB (packed)	~470 MB with full Python runtime
Network	Not required (offline mode available)	Internet for license validation (auto-checked every 3 days) & manual update checks

Note: Electron 39 dropped support for Windows 7/8 and macOS 10.x. The embedded Python sidecar reserves 512 MB of memory independently from the Electron heap.

1.3 Tech Stack

1.4 Installation

LAYER	TECHNOLOGY	VERSION
Desktop Runtime	Electron (Chromium)	39.8
UI Framework	React	19.2
Language	TypeScript	5.9
Build System	electron-vite + Vite	5.0 / 7.3
2D Plotting	uPlot (canvas)	1.6
3D Plotting	Plotly.js (WebGL2)	2.35
State Management	Zustand	5.0
Code Editor	Monaco Editor	0.52
JS Scripting	QuickJS-WASM sandbox	0.29
Python Scripting	Embedded CPython 3.12 sidecar	3.12
Animation	Framer Motion	12.38
Math Rendering	KaTeX	0.16
Crash Reporting	Sentry (opt-in)	7.13
OCR (Digitizer)	Tesseract.js (WASM, client-side)	—
Testing	Vitest	4.1

Download & Platform Installers

The installer bundles the full CPython 3.12 runtime with NumPy, SciPy, and Pandas. No separate Python installation is needed.

First Launch Flow

PLATFORM	FORMATS	NOTES
Windows	NSIS Installer, MSI, Portable (.exe)	NSIS: standard install wizard; MSI: enterprise deployment; Portable: no install required
macOS	DMG	Drag-to-Applications; notarization not yet configured
Linux	ApplImage, Snap, DEB	ApplImage: universal; Snap: sandboxed; DEB: Debian/Ubuntu native

- Telemetry Consent:** On first launch, a privacy dialog asks whether to opt in to anonymous crash reporting (default: OFF). Compliant with KVKK/GDPR. One-time only.
- License Gate:** The app verifies your license. Without a license, it runs in **Viewer Mode** (restricted functionality, badge in bottom-right corner).
- Activation:** Enter an online license key, import an offline .lic file, or start a **30-day free trial** (opt-in, client-side).
- Auto-Update Check:** After license verification, the app checks for updates once (downloads disabled by default — user triggers manually).

1.5 Licensing & Activation

FEATURE	DETAIL
License Tiers	Monthly, Yearly, Perpetual, Educational, Offline
Trial	30-day full trial, opt-in, client-side (no server required)
Offline Grace Period	14 days without internet
Activation Limit	2 devices per license key
Validation	Ed25519 cryptographic signatures with tamper detection
Offline Activation	Import .lic file for air-gapped lab setups
Watermark	"A-Plot Trial" watermark on exports during trial/restricted mode

The license system uses Ed25519 public-key cryptography. License data is stored in the user data directory with HMAC tamper detection. The app communicates with `api.altaiplot.com` for online validation (every 3 days) — a separate endpoint from the `releases.altaiplot.com` update feed (§1.8).

1.6 Security Architecture

- **Sandboxed renderer:** `nodeIntegration: false, contextIsolation: true, sandbox: true`
- **Custom protocol:** `app://` scheme instead of `file://` for CSP/COOP/COEP compliance
- **IPC verification:** All IPC messages validated via sender trust system
- **File path guards:** Allowlisted paths prevent directory traversal
- **Single instance:** Only one app instance allowed; second launch focuses existing window
- **Crash recovery:** Crash-loop protection shows a Reload/Quit dialog after 2 crashes within 60s (no silent auto-relaunch)

1.7 Embedded Python Runtime

A trimmed CPython 3.12 runtime (~230 MB packed) is bundled as an extra resource. It runs as a separate sidecar process communicating via JSON-RPC over stdio. Pre-installed packages: NumPy, SciPy, Pandas. The sidecar enforces a 60-second timeout and 512 MB memory limit per execution. Additional packages (e.g., scikit-learn) can be installed via the bundled pip.

1.8 Auto-Update

ALTAI PLOT checks for updates via `electron-updater` against `releases.altaiplot.com/updates`. Updates are **not** auto-downloaded — the user sees a modal with version info, release notes, and a manual download button. The update feed URL can be overridden via the `APLOT_UPDATE_URL` environment variable for enterprise deployments.



Click to upload `First_Launch_Flow.png`

(Show the telemetry consent modal, then the license gate with Viewer Mode badge and trial activation button)

2. Workspace & Interface Overview

2.1 Main Application Layout

ALTAI PLOT uses a **floating window workspace**. All panels — spreadsheets, plots, fit results, pipelines — are independent, draggable, resizable windows that can be arranged, tabbed, minimized, or maximized. The layout consists of:

- **Top Bar:** Three text menu dropdowns — **File, Tools, View** (there is no separate "Edit" menu) — plus quick-access icon buttons (Zoom/Pan mode, Import, Fit, Composer, Workbook, Results, New Plot, Layouts, Arrange), Undo/Redo, Autosave indicator, Theme toggle, Focus Mode, and License Status badge. Full menu contents in §2.11–2.12 (visual tour) below. "Arrange" is a quick toolbar button, not a peer of File/Tools/View — its 5 auto-layout options also live inside the View menu (see §2.12).
- **Floating Sidebar (left):** Entity Explorer tree with toggle button — can be hidden entirely
- **Workspace (center):** All panel windows float freely over the workspace background
- **Script Console Dock (bottom):** Collapsible REPL dock for JavaScript/Python scripting, inset to clear the sidebar

2.2 Panel Types

Additional panels (not in the floating window system): Script Console Dock (bottom), Notebook Panel, Results Log, Results Manager (grouped-by-curve results browser, distinct from the Results Log), and Welcome Screen.

2.2.1 Macro Recorder

Records a sequence of UI *commands* as you work — not raw mouse coordinates — so a macro recorded against one sheet (e.g. "set column B role to Y, apply Savitzky-Golay filter, run fit") replays correctly against a different sheet or workbook with a different layout. Assigning a custom keybinding to a saved macro is checked against existing shortcuts, and conflicts are flagged before the binding is saved.

2.2.2 Digitizer

PANEL	TYPE ID	DESCRIPTION
Workbook (Spreadsheet)	workbook	Data table with sheet tabs, formulas, column operations, sparkline previews, and drag-drop file import
2D Plot	plot	High-performance uPlot canvas with interactive zoom, pan, annotations, and WebGL2 backend for 1M+ points
3D Plot	plot3d	Plotly.js WebGL2-accelerated 3D visualization (surface, scatter3D, etc.)
Curve Fit	fit	Model catalog, parameter editor, fit results, goodness-of-fit metrics, and residual plots
Pipeline	pipeline	Visual node-based DAG editor for analysis workflows with 34 node types
Macro Recorder	macro	Command-level recording of UI actions with keybinding-conflict detection (§2.2.1)
Formula Debugger	formula	Sandbox for testing spreadsheet formulas with live evaluation
Plugin Manager	plugin	Install, enable, and manage extensions (Ch. 12)
Layout Composer	layout-composer	Multi-panel publication figure layout tool (Ch. 16) — a separate panel from Plugin Manager
Digitizer	digitizer	Extract data points from plot images via axis calibration, color scanning, and OCR (§2.2.2)

Recovers numeric data points from a static plot image — a scanned figure, a screenshot, or a PDF export — in four steps:

2.3 Window Management

Each panel window supports:

Use **View > Arrange** for automatic layouts:

1. **Calibrate** — click two known points on each axis, or let auto axis-frame detection locate the plot border automatically
 2. **Select source** — pick the curve color to scan, or run OCR (Tesseract.js, §1.3) to read the axis tick labels automatically
 3. **Scan** — the tool walks the image column-by-column, extracting pixels that match the selected curve color
 4. **Cluster** — a DBSCAN pass, run off the main thread in a Web Worker, separates overlapping curves and rejects stray noise before the recovered points are written to a new sheet
- **Drag** the title bar to reposition
 - **Resize** from any edge or corner
 - **Minimize** — hides from workspace, accessible via Entity Explorer or Minimized Dock
 - **Maximize** — fills the entire workspace area
 - **Tab groups** — drag one panel onto another to merge into a tabbed group
 - **Z-ordering** — click any window to bring it to front

MODE	DESCRIPTION
Grid	Evenly distribute all open panels in a grid
Horizontal Stack	Side-by-side columns
Vertical Stack	Stacked rows
Cascade	Overlapping diagonal offset
Smart Cascade	Groups related panels (workbook + plot + fit) and cascades each group separately

Three **built-in layout presets** are available via `Ctrl+Alt+1/2/3` or the Layouts menu: Analysis (spreadsheet left, plot right), Fit Mode (plot top, fit results bottom), and Compare (two plots side-by-side). Custom presets can be saved via `View > Save Layout Preset`.

2.4 Entity Explorer Sidebar

The left sidebar shows a hierarchical tree of all entities in the workspace:

- **Workbooks** → expandable to show individual Sheets
- **Plots** — standalone plot panels
- **Fit Results** — curve fitting results linked to their source
- **Trash** — soft-deleted items with restore/hard-delete options

Features: click to open/focus, right-click context menu (rename, duplicate, delete), F2 inline rename, Delete key for soft-delete, search/filter, section collapse, window state icons (open/minimized/closed), orphan indicators, and entity count badges.

2.5 Command Palette (Ctrl+K)

Press **Ctrl+K** to open the global Command Palette. It provides fuzzy search across all available commands organized by category:

CATEGORY	EXAMPLE COMMANDS
File	New Workbook, New Plot, Import Data, Save Project, Open Project
Chart Types	Line, Scatter, Bar, Area, Error Bar, Histogram, Box, Heatmap
View	Toggle Theme, Focus Mode, Settings
Tools	Analysis Pipeline, Curve Fitting, Macro Recorder, Plugin Manager, Digitizer, Layout Composer
Layout	Grid, Horizontal, Vertical, Cascade arrange modes
Axes Presets	Linear, Log X, Log Y, Symlog, Theta, Polar

Navigate with **Arrow keys** and **Enter** to execute. The palette uses a curated subset of the most frequently used chart types (not all 39) to reduce noise.

Press **?** (outside of text inputs) to open the keyboard shortcuts overlay. Key shortcuts:

2.6 Theme & Accessibility

Toggle between **Dark** and **Light** themes via the sun/moon icon in the top bar or via the View menu. Additional accessibility settings (accessible via `Ctrl+,`):

- **UI Zoom:** 0.7x to 2.0x scale (presets: 80%, 90%, 100%, 115%, 130%, 150%) — scales the entire UI via `webFrame.setZoomFactor`
- **High Contrast:** Increases text and border contrast for visually impaired users
- **Focus Mode (F11):** Hides all chrome — top bar, sidebar, dock — leaving only the workspace panels. Press F11 or Escape to exit.
- **Fullscreen (OS):** Native fullscreen via View > Fullscreen

2.7 Keyboard Shortcuts

Note: Plot tool shortcuts (H, Z, M, F, P) only work when a plot panel is focused and no text input is active. Spreadsheet-specific shortcuts (Tab, Enter, F2, Delete) work within the spreadsheet panel.

2.8 Undo/Redo System

ALTAI PLOT uses a **tree-based command history** (not a simple linear stack). Each action creates a node in the history tree. Click the **Clock** icon in the top bar to expand the history panel — hover over it to see the full tree. You can jump to any point in the history, including branching paths.

2.9 Autosave & Recovery

The app automatically saves your work periodically. On next launch, if an autosave file is detected (from a crash or unexpected close), a recovery modal offers to restore the last session. Autosave state is cleared after every explicit `Ctrl+S` save. The status indicator in the top bar shows "Saved" with a timestamp.

2.10 Welcome Screen

SHORTCUT	ACTION
Ctrl+K	Command Palette
Ctrl+Z / Ctrl+Y / Ctrl+Shift+Z	Undo / Redo (tree-based history)
Ctrl+S / Ctrl+Shift+S	Save / Save As project
Ctrl+O	Open project
Ctrl+Shift+E	Export modal
Ctrl+,	View Settings (theme, zoom, language)
Ctrl+= / Ctrl+- / Ctrl+0	Zoom in / Zoom out / Reset zoom
F11	Focus / presentation mode
H / Z / M	Pan / Zoom-box / Lasso mask tools
F / P	Open Fit panel / Peak detection tool
?	Show all keyboard shortcuts
Ctrl+Alt+1/2/3	Layout presets: Analysis / Fit Mode / Compare
Ctrl+{custom}	User-defined macro keybindings (via Macro Recorder)

When no panels are open (first launch or after clearing the workspace), a **Welcome Screen** appears with options to create a new workbook, open an existing project, or import data. When panels exist but are all minimized, a watermark with the ALTAI PLOT logo and a hint to restore panels from the sidebar is displayed.

The following pages (§2.11–§2.14) give a visual tour of these areas — the top bar, sidebar, window chrome, and each major panel type — for readers who prefer to orient by screenshot before reading the reference sections above.

2.11 Visual Tour: General Layout



Fig. 2.1 — The main workspace: Top Bar, Entity Explorer sidebar, floating panel workspace, and Script Console dock.

#	AREA	WHAT IT IS
1	File / Tools / View menus	The three top-level text menus — full contents in §2.16–2.17
2	Autosave indicator	"Unsaved changes" / "Saved" with last autosave timestamp (§2.9)
4	Layouts / Arrange / Theme / Focus / License badge	Quick-access cluster: layout presets, auto-arrange, dark/light toggle, Focus Mode, and plan badge (§2.16–17, §2.6)
5	Entity Explorer	Left sidebar tree: Books, Unbound Plots, Fit Results, Trash (§2.4)
7	Fit Parameters table	Inside the Curve Fit results window: parameter value, standard error, and confidence interval per term (§10)
8	Plot window chrome	Standard floating-window title bar shared by every panel type (§2.3, §2.13)
10	Smart Hint banner	Semantic Advisor suggestion — here recognizing a spectroscopy trace and offering Smooth / Find Peaks (§18.1)
11	Minimized Dock	Taskbar-style strip for one-click restore of minimized panels (§2.12)
12	Script Console dock	Collapsible JavaScript/Python REPL docked at the bottom (§14)

Marker numbers follow the original screenshot annotation; 3, 6, and 9 were not used in this particular capture.

2.12 Visual Tour: Top Bar & Minimized Dock

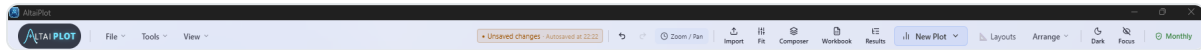


Fig. 2.2 — Top Bar, left to right.

BUTTON	ACTION
Undo / Redo	Tree-based history (§2.8) — not a simple linear stack
Zoom / Pan	Active cursor mode for the focused plot (pairs with the H / Z / M shortcuts, §2.7)
Import	Opens the Universal Import dialog (§4)
Fit	Opens the Curve Fit panel (§10)
Composer	Opens Layout Composer (§16)
Workbook	Creates a new empty workbook
Results	Toggles the Results Log (grouped-by-curve results browser)
New Plot ▾	Dropdown to spawn a new 2D or 3D plot
Layouts	Opens the Layout Presets menu — Analysis / Fit Mode / Compare (Ctrl+Alt+1/2/3)
Arrange ▾	Grid / Horizontal / Vertical / Cascade / Smart Cascade auto-arrange — the same 5 options also live inside View (§2.16)
Dark / Light	Theme toggle (§2.6)
Focus	Focus Mode — hides all chrome (F11)
Plan badge	Current license tier (e.g. Monthly, Trial, Perpetual) — click to open license details

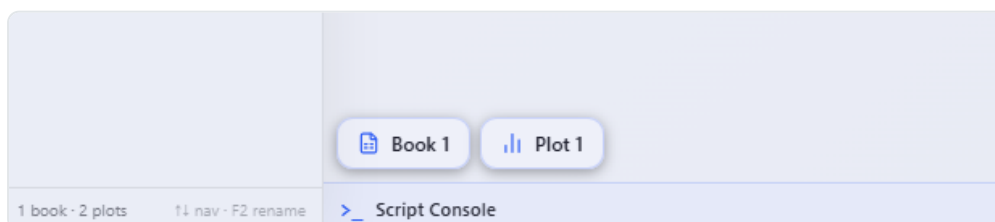


Fig. 2.3 — Minimized Dock: a taskbar-like strip for one-click restore of minimized panels — here holding a minimized Curve Fitting panel and Plot 1.

2.13 Visual Tour: Window Chrome & Command Palette

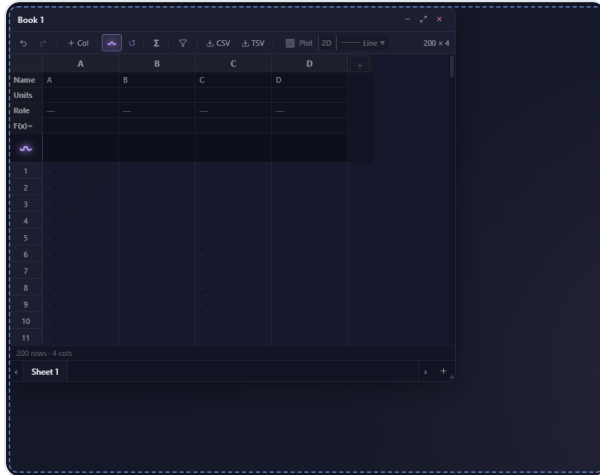


Fig. 2.4 — Panel window chrome: drag handle, resize corner, minimize/maximize/close.

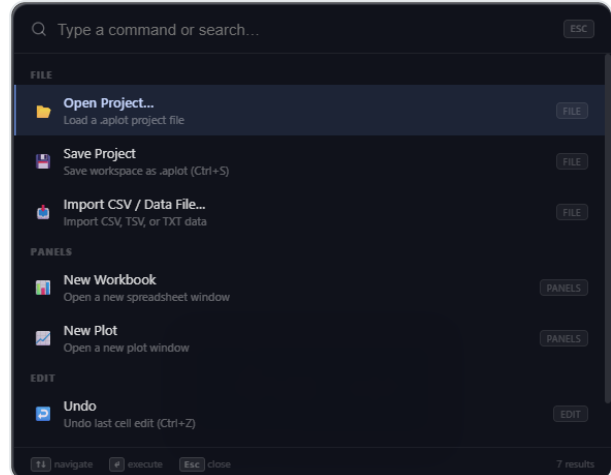


Fig. 2.5 — Command Palette (Ctrl+K) with fuzzy search across command categories.

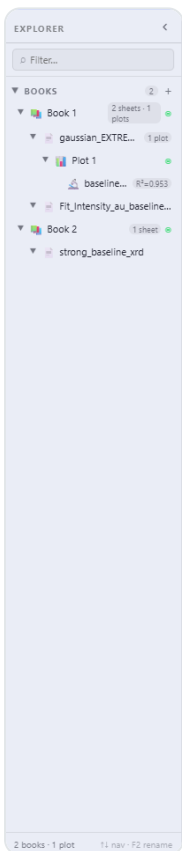


Fig. 2.6 — Entity Explorer sidebar: Workbooks, Plots, Fit Results, and Trash sections, with search, right-click context menu, and orphan indicators (see §2.4).

2.14 Visual Tour: Curve Fit & Plot Panels

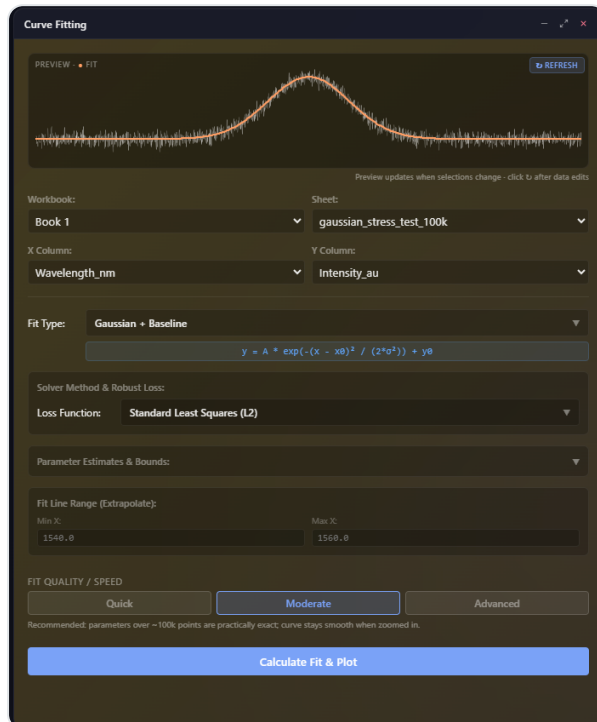


Fig. 2.7 — Curve Fit panel: model catalog, parameter editor, fit results, and residual plot.

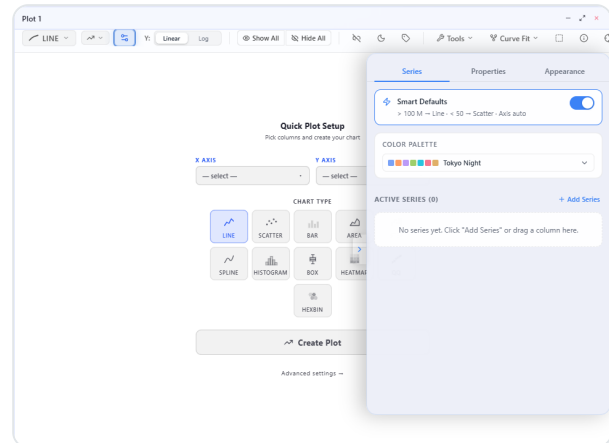


Fig. 2.8 — 2D Plot panel with its own toolbar: pan/zoom/lasso tools, axis presets, legend/grid toggles.

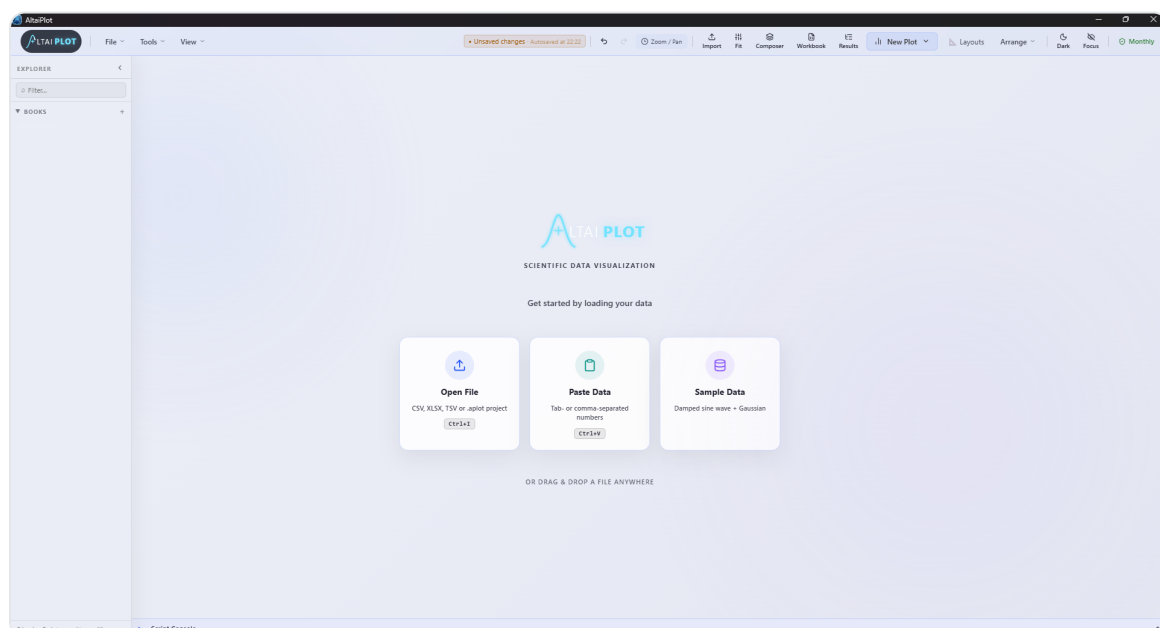


Fig. 2.9 — Welcome Screen, shown when no panels are open: new workbook, open project, or import data.

2.15 Visual Tour: Keyboard Shortcuts Overlay

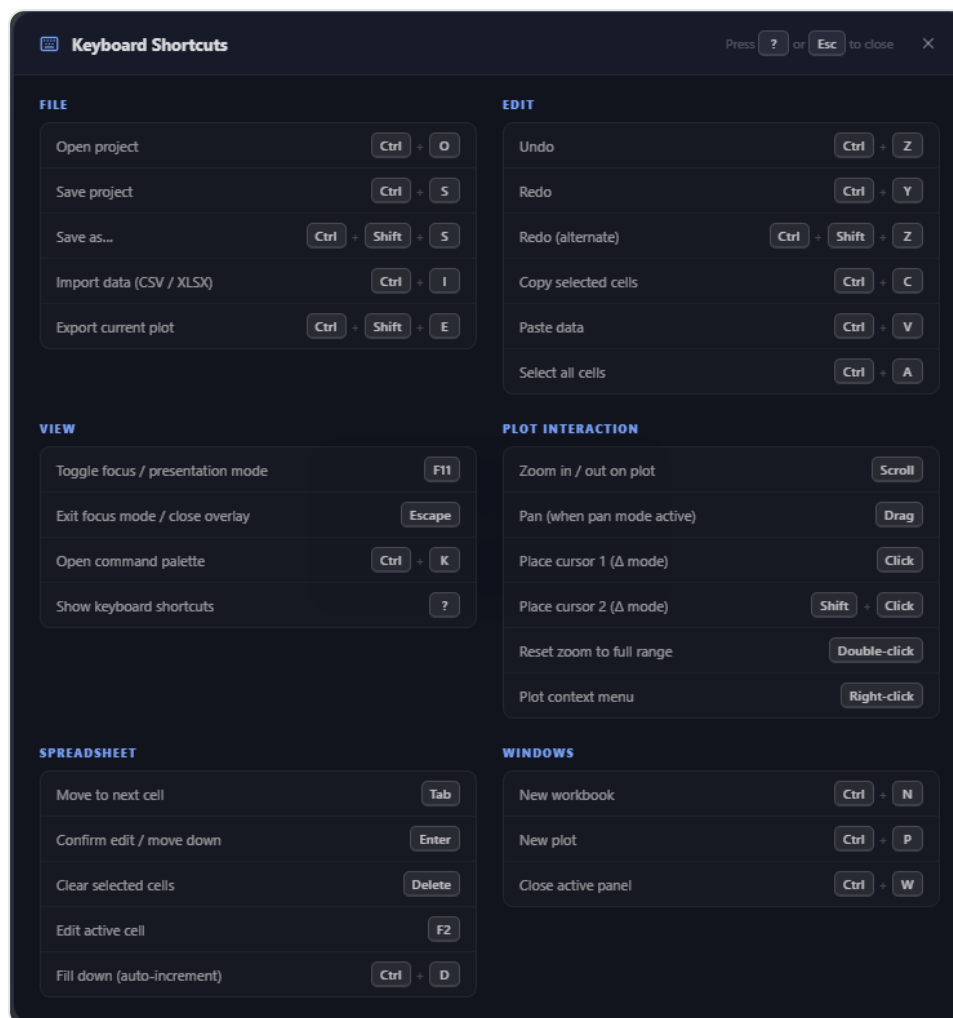


Fig. 2.10 — Keyboard shortcuts overlay, opened with the ? key (see §2.7).

2.16 Menu Bar Reference: File & Tools

Exact contents of the two left-most Top Bar dropdowns, verified against the menu-item labels defined in the source.

File

ITEM	SHORTCUT	ACTION
New Project		Clears the workspace and starts a new project
Open Project	Ctrl+O	Opens a saved .aplot project file
Save Project	Ctrl+S	Saves the current project
Save Project As...	Ctrl+Shift+S	Saves a copy under a new name/location
Import Data		Opens the Universal Import dialog (§4)
Export	Ctrl+Shift+E	Opens the Export Modal (§17) — shows a lock icon instead if the current license is view-restricted

Tools

ITEM	OPENS
Analysis Pipeline	Node-based pipeline editor (§13)
Curve Fitting	Curve Fit panel (§10)
Macro Recorder	Macro Recorder panel (§2.2.1)
Formula Sandbox	Formula Debugger panel — sandboxed live formula testing
Layout Composer	Layout Composer panel (§16)
Plugin Manager	Plugin Manager panel (§12 — preview architecture, not yet functional)
Smart Digitizer	Digitizer panel (§2.2.2)

2.17 Menu Bar Reference: View

The View menu is a single dropdown that bundles theme/window controls with an "Arrange Windows" section and a language switch — it is not split into separate top-level menus.

ITEM	SHORTCUT	ACTION
Light Theme / Dark Theme		Toggles theme (label shows the theme you would switch <i>to</i>)
Focus Mode	F11	Hides all chrome (§2.6)
Fullscreen (OS)		Native OS fullscreen
View Settings...	Ctrl+,	Opens Settings: UI Zoom, High Contrast, language (§2.6)

Arrange Windows (section within View)

The same 5 options as the top-bar **Arrange** quick button (§2.12):

OPTION	EFFECT
Grid Layout	Evenly distributes all open panels in a grid
Horizontal Stack	Side-by-side columns
Vertical Stack	Stacked rows
Cascade Layout	Overlapping diagonal offset
Smart Cascade (grouped)	Groups related panels (workbook + plot + fit) and cascades each group separately

Language

EN / TR toggle buttons at the bottom of the View menu — switches the entire UI's language immediately, no restart required.

3. Data Management & Spreadsheet

3.1 Workbook, Sheet, and Column Hierarchy

Data is organized into a two-level hierarchy:

- **Workbooks** — top-level containers, shown as independent floating panels. Each workbook represents a self-contained data project.
- **Sheets** — tabs within a workbook (shown at the bottom of the spreadsheet). Each sheet is a typed columnar table optimized for scientific data. Sheets can be renamed, reordered, duplicated, and assigned custom tab colors.

Within each sheet, data is stored as **typed columns** (not free-form cells). All values in a column share the same data type. The column header shows the column name, a role badge, and a mini sparkline preview.

The **meta row** section below the header provides four fields per column: *Name*, *Units*, *Role*, and *F(x)=* (formula).

3.2 Supported Column Types

Column types are automatically detected on import. You can also convert types via the column header context menu.

3.3 Column Roles

Each column can be assigned a **Role** that controls how it is used in plotting and analysis:

Quick role shortcuts: When a column is selected (not editing), press x, y, e, f, or n to instantly set the role to X, Y, Error, Fit, or None.

3.4 Column Formats

TYPE	INTERNAL	DESCRIPTION
Float	float64	Default numeric type, 64-bit double precision — used for most scientific data
Float	float32	32-bit single precision (for large datasets)
Integer	int32	32-bit signed integer
Integer	int16	16-bit signed integer
Unsigned	uint8	8-bit unsigned integer (0–255, e.g. image data)
Boolean	bool	True/False values
String	string	Text data (labels, categories, comments)
DateTime	datetime	Date/time values with automatic format detection
Duration	duration	Time interval values
Category	category	Discrete categorical data with finite set of values

Nine display formats are available per-column. Configure via the column header context menu > Format:

3.5 Formula System

Formulas allow computed columns that update automatically when source data changes. Enter formulas in two ways:

- **Cell edit:** Type = at the start of any cell to set a column-wide formula
- **Meta row:** Double-click the $F(x)=$ field in the meta row below the column header

Formulas operate **column-wise** — every row evaluates independently using the same expression. References use Excel-style column letters (A, B, ... Z, AA, AB...).

ROLE	ID	DESCRIPTION
X	x	Independent variable (horizontal axis)
Y	y	Dependent variable (vertical axis)
Y2	y2	Secondary Y-axis (right side)
X Error	xerr	Error bars in X direction ($\pm X$)
Y Error	yerr	Error bars in Y direction ($\pm Y$)
Fit	fit	Curve fit results column
Group	group	Grouping for analysis/binning
Weight	weight	Weight values for weighted fitting
Mask	mask	Boolean mask for data selection
None	generic	No plotting role (unassigned)

```

=A * 2 + 3
=SIN(B) * EXP(C / 100)
=NORMALIZE(D)
=MEAN(E) + 2 * STD(E)

```

3.5.1 Supported Spreadsheet Functions (18 scalar + 5 vector)

Operators: +, -, *, /, ^ (right-associative), parentheses ().

3.5.2 Formula Dependency Graph

Formula computation runs in a **Web Worker** for non-blocking UI. A 3-second timeout prevents infinite loops. Stale results from concurrent edits are detected via version vectors and discarded (up to 2 retries).

FORMAT	EXAMPLE	DESCRIPTION
Auto	1234.56	Automatically choose the best display
Scientific	1.23e+3	Scientific notation
Engineering	1.23k	Engineering notation (powers of 1000)
Fixed 0.00	1234.56	2 decimal places
Fixed 0.0000	1234.5678	4 decimal places
Percent	1234.56%	Percentage with % suffix
Time	14:30	Time display (HH:MM)
Date	18.07.2026	Date display (DD.MM.YYYY)
Date+Time	18.07.2026 14:30	Combined date and time

CATEGORY	FUNCTIONS
Trigonometric	SIN, COS, TAN, ATAN, ATAN2, SINH, COSH
Logarithmic & Exponential	LOG (natural), LOG10, EXP
Rounding	ROUND (optional 2nd arg = decimal places), FLOOR, CEIL
Power & Root	SQRT, POWER
Arithmetic	ABS, MOD, SIGN
Vector (whole-column)	NORMALIZE (min→[0,1]), CUMSUM, DIFF, MEAN (scalar), STD (scalar)

Formulas are managed by a **dependency graph engine** that automatically tracks which columns depend on which. When you change a source column, all dependent formula columns recompute automatically (within 16ms debounce). Circular dependencies are detected and flagged with an error message.

3.5.3 Formula Debugger Panel

Open via **Tools > Formula Debugger** or from the Command Palette. The debugger is a sandbox for testing math expressions independently of the spreadsheet:

- **Expression textarea** — type any expression (monospace, multi-line)
- **Constants bar** — quick-insert buttons for π , e , ϕ (golden ratio), $\sqrt{2}$
- **Live evaluation** — results update with 400ms debounce (green border = success, red = error)
- **Variables** — add custom name/value pairs (e.g. $r = 5$) to use in expressions
- **History** — last 5 unique expressions are saved for quick recall

The debugger supports **33 math functions** including `asin`, `acos`, `tanh`, `cbrt`, `cosh`, `hypot`, `log2`, `log1p`, `expm1`, `trunc`, `ln` (alias for `log`), and the constants π , e , τ , ϕ , $\sqrt{2}$, $\ln 2$, $\ln 10$.



Security: Spreadsheet formulas and the Formula Debugger (§3.5.3) use two separate AST-based expression evaluators — neither calls `new Function()` or `eval()`. The Debugger's parser additionally rejects disallowed characters (e.g. `;`, `$`, `{`, `@`) at parse time.

3.6 Column Operations

Right-click any column header to access the context menu:

Hover stats: Hovering over a column header shows a tooltip with column name, count (n =), min, max, and mean (μ =).

Sparkline preview: Each column header displays a mini canvas waveform (sparkline) showing the column's data shape, with color matching the column's role.

3.7 Row Operations

Right-click any row number header for row operations:

OPERATION	DESCRIPTION
Rename	Inline edit of column name
Copy / Cut / Paste	Clipboard operations (Ctrl+C/X/V) — paste auto-creates columns if data extends beyond current count
Set Color...	Opens color picker for the column's plot line/bars
Sort ↑ / ↓	Sort ascending or descending (all rows are reordered)
Format	Submenu with all 9 display formats (see §3.4)
Set Role	Submenu: X, Y, Y2, X Error, Y Error, Fit, None
Insert Column ← / →	Add empty column to the left or right
Statistics...	Opens Column Analysis modal (min, max, mean, std, count, histogram)
Normalize [0–1]	Creates a new column {name}_norm with values scaled to [0, 1]
Delete Column	Removes the column (undoable). Disabled when only 1 column remains.

OPERATION	DESCRIPTION
Analyze Row Data...	Opens Row Statistics modal (mean, std, count of numeric cells in that row)
Insert Row Above / Below	Add empty row at the specified position
Delete Row	Deletes all selected rows (or just the right-clicked row if none selected)

Cell context menu (right-click on a data cell): Copy, Paste, Delete, Fill Down (Ctrl+D), Fill Right (Ctrl+R), Insert/Delete Row.

3.8 Keyboard Shortcuts (Spreadsheet)

SHORTCUT	ACTION
Ctrl+C / Ctrl+X / Ctrl+V	Copy / Cut / Paste selection
Ctrl+D / Ctrl+R	Fill Down / Fill Right
Ctrl+A	Select all cells
Enter	Start editing active cell
Tab	Navigate to next column
Arrow keys	Navigate cells (hold Shift to extend selection)
Ctrl+Arrow	Jump to data boundary (like Excel)
Ctrl+Home / Ctrl+End	Go to cell A1 / last used cell
Escape	Clear selection / cancel edit
Delete / Backspace	Clear selected cells
x / y / e / f / n	Quick role set (when column selected, not editing)

3.9 Data Import

Open the **Universal Import Dialog** via Ctrl+I, **File > Import**, or by dragging files onto the spreadsheet. The dialog has four steps:

1. **File Selection** — drag-and-drop zone, file browser, or clipboard paste
2. **Format & Preview** — auto-detected format, sheet selection (Excel), encoding selector, delimiter option (CSV), preview grid with column statistics
3. **Column Configuration** — assign roles (X/Y/Y2/Error/Fit/None), rename columns, set units
4. **Data Reduction** (large files only) — memory budget, chunk size, row sampling/decimation

3.9.1 Supported Import Formats

FORMAT	EXTENSIONS	OPTIONS
CSV / TSV	.csv, .tsv	Delimiter, quote char, escape char, skip rows, header row, encoding, decimal separator
Excel	.xlsx, .xls, .xlsm	Sheet name, header row, start/end row range
JSON / JSONL	.json, .jsonl	Data path (dot notation), header detection
DAT / LOG	.dat, .log, .asc	Comment char, delimiter (auto), skip rows, header lines
MATLAB	.mat	Level 5 format (v5.0–v7.2)
HDF5	.h5, .hdf5	Dataset name
Arrow IPC	.arrow, .feather	Apache Arrow IPC format

Encodings supported: UTF-8 (default), Windows-1254 (Turkish), ISO-8859-1 (Latin-1).

Large file handling: CSV files use streaming import with chunked IPC-based processing. The import dialog offers a memory budget slider and chunk size control for files that exceed available RAM.

Import templates: Save and load import configurations for recurring file formats.

3.10 Data Export

Open via Ctrl+Shift+E or **File > Export**. The export modal has three sections:

Publication presets: Nature (89mm 1-col), Science (55mm 1-col), PNAS (87mm 1-col), and 24 more journal/column presets — see §17.2 for the full table.

CATEGORY	FORMATS	KEY OPTIONS
Data Export	CSV, JSON, Excel (XLSX), HDF5, MAT	Separator, decimal, null text, headers, date format, precision
Plot Export	PNG, JPEG, TIFF, PDF, SVG, EPS	DPI (72/150/300/600), dimensions, background, transparency
Report Export	HTML, Markdown, LaTeX, PDF, DOCX	Full analysis report with embedded plots and tables

CSV injection protection: Exported CSV files automatically neutralize formula injection attempts by prepending a single quote to strings starting with =, +, -, or @.

3.11 Drag & Drop

Two types of drag-drop are supported:

- **File drop:** Drag files from your OS file manager directly onto the spreadsheet panel. Single files import into the active sheet; multiple files are batch-appended as new columns.
- **Column-to-plot drag:** Drag a column header (or multi-selected columns) onto a Plot Panel or 3D Plot Panel. If the plot already has an X axis, dropped columns become new Y series. If empty, the role-aware system assigns X/Y automatically.

3.12 Sheet Management

Right-click any sheet tab for:

- **Rename...** — inline edit of the tab label
- **Duplicate Sheet** — creates a complete copy of the sheet and its data
- **Delete Sheet** — removes the sheet (disabled when only 1 sheet remains). Dependent plots are moved to trash.

Sheet tabs can be **reordered** by dragging, and **colored** via the tab color picker.

3.13 Sparkline Previews

Each column header displays a **canvas-based sparkline** — a mini waveform showing the column's data shape. Sparklines use role-based coloring (blue for Y, orange for X, etc.) and are sampled for performance on large datasets. The sparkline version counter is incremented on data changes to trigger re-renders.



Click to upload Spreadsheet_Column_Mapping.png

(Show the spreadsheet with meta row fields, column role badges, sparkline previews, sheet tabs, and formula bar)

4. Data Import Mechanics

4.1 Supported Formats

ALTAI PLOT supports **7 importers** covering 14+ file extensions, with automatic format detection from file extension and content sniffing.

FORMAT	EXTENSIONS	KEY OPTIONS
CSV / TSV	.csv, .tsv, .txt	Delimiter, quote char, escape char, skip rows, header row, encoding, decimal separator
Excel	.xlsx, .xls, .xlsm	Sheet name, header row, start/end row range
JSON / JSONL	.json, .jsonl	Data path (dot notation), header detection
DAT / LOG	.dat, .log, .asc	Comment char, delimiter (auto-detected), skip rows, header lines
MATLAB	.mat	Level 5 format only (v5.0–v7.2)
HDF5	.h5, .hdf5	Dataset name selection
Apache Arrow	.arrow, .feather	IPC stream/file format



Note: .txt files are claimed by both CSV and DAT importers. DAT wins by priority. The CSV importer explicitly excludes .dat files.

4.2 Universal Import Dialog

4.2.1 Supported Encodings

Open via `Ctrl+I`, **File > Import**, or by **dragging files** onto the spreadsheet. The dialog guides you through four steps:

1. **File Selection** — drag-and-drop zone, file browser, or clipboard paste
2. **Format & Preview** — auto-detected format with preview grid showing column statistics (min, max, mean, count)
3. **Column Configuration** — assign roles (X/Y/Y2/Error/Fit/None), rename columns, set units
4. **Data Reduction** (large files only) — memory budget, chunk size, row sampling/decimation

Three text encodings are supported for CSV and text-based formats:

- UTF-8 (default)
- Windows-1254 (Turkish)
- ISO-8859-1 (Latin-1)

4.2.2 Import Templates

Save and load import configurations for recurring file formats. Once you've configured a CSV importer with specific delimiters, headers, and column mappings, save it as a template to reuse for similar instrument exports.

4.3 Large File Handling

For files that exceed available RAM, ALTAI PLOT uses **streaming import** with chunked IPC-based processing:

- **Memory budget slider** — control maximum RAM usage during import
- **Chunk size** — number of rows processed per batch
- **Row sampling** — for preview, subsample large files to keep the preview responsive
- **Decimation** — for data reduction, use LTTB (Largest Triangle Three Buckets) or MinMax algorithms

4.4 CSV/TSV Import Details

The CSV importer handles the most common scientific data formats:

OPTION	DEFAULT	DESCRIPTION
Delimiter	Auto-detected	Comma, tab, semicolon, pipe, or whitespace
Quote char	"	Character used to quote fields containing delimiters
Escape char	"	Character used to escape quotes within quoted fields
Skip rows	0	Number of leading rows to skip (metadata headers)
Header row	true	First data row contains column names
Decimal separator	.	Period or comma for decimal numbers

4.5 Excel Import Details

Supports .xlsx, .xls, and .xlsm formats via SheetJS. Options include:

- **Sheet selection** — choose which sheet to import from multi-sheet workbooks
- **Row range** — specify start and end rows (1-indexed) for partial imports
- **Header detection** — first row treated as column names by default

4.6 JSON/JSONL Import

Supports two JSON structures:

- **Array of objects** — each object becomes a row, keys become column headers
- **Columnar/nested** — use dot-notation data path (e.g. `data.values`) to extract arrays

JSONL (JSON Lines) treats each line as a separate JSON object.

4.7 Instrument Data (DAT/LOG)

Designed for scientific instrument exports:

- **Comment lines** — lines starting with #, %, or ; are skipped by default
- **Auto-delimiter detection** — tab, whitespace, or fixed-width formats
- **Header lines** — configurable number of header lines to read
- Handles incomplete lines during write-in-progress (useful with File Watcher)

4.8 Binary Formats (MAT, HDF5, Arrow)

FORMAT	DETAILS
MATLAB Level 5	Supports double, int64, char columns. Only Level 5 format (v5.0–v7.2) — not newer v7.3+ HDF5-based MAT files.
HDF5	Select dataset by name. Supports compression and chunked storage. Common in physics and engineering.
Apache Arrow IPC	High-performance columnar format. Supports .arrow and .feather extensions.

4.9 File & Folder Watcher (Live Streaming)

Enable **Live File Watch** on a sheet to monitor an external file for changes. When an instrument or logger appends new data, ALTAI PLOT automatically detects the delta, parses new rows, and updates the sheet and any linked plots in real-time. Handles incomplete lines gracefully during write-in-progress.



Tip: Combine File Watcher with the Script Console's reactive cells to create live-updating analysis dashboards from streaming instrument data.

4.10 Drag & Drop Import

Drag files from your OS file manager directly onto the spreadsheet panel:

- **Single file** — imports into the active sheet, auto-detecting format
- **Multiple files** — batch-appends each file as new columns in the active sheet

The drop zone highlights with a visual indicator when files are dragged over the spreadsheet.

4.11 Clipboard Paste

Paste tab-separated or comma-separated data directly from the clipboard:

- **Small paste** ($\leq 1,000$ rows) — parsed synchronously for instant feedback
- **Large paste** ($> 1,000$ rows) — parsed in chunks for non-blocking UI
- **Auto-extends** — creates new columns if paste data is wider than current sheet, adds rows if taller
- **Locale-tolerant** — handles Turkish/European commas (3,14), thousands separators (1.234,56), NBSP grouping
- **Date detection** — auto-applies detected date/time formats to pasted columns



Click to upload Universal_Import Modal.png

(Show the universal import dialog with 4 steps: file selection, format preview, column configuration, and data reduction)

5. 2D Plot Types & Visualization

ALTAI PLOT supports **39 distinct 2D chart types** organized into families. Select any type from the Plot Toolbar's chart type selector or the Command Palette (Ctrl+K). The plotting engine uses **uPlot** for high-performance canvas rendering with a WebGL2 backend that activates automatically for datasets exceeding 1 million points.

5.1 Line & Scatter Family

TYPE	ID	DESCRIPTION
Line	line	Solid line connecting data points
Line + Symbol	line_symbol	Solid line with marker symbols at data points
Dashed	dashed	Dashed line style (pattern: [4,2])
Dotted	dotted	Dotted line style (pattern: [2,2])
Scatter	scatter	Markers only (no connecting line)
Spline	spline	Cubic spline interpolation, no markers
Spline + Symbol	spline_symbol	Cubic spline with marker symbols
Step	step	Step function (staircase), no markers
Step + Symbol	step_symbol	Step function with marker symbols
Stem	stem	Stem / lollipop plot (vertical lines to baseline)

5.2 Area Family

5.3 Bar & Column Family

TYPE	ID	DESCRIPTION
Area	area	Filled area under curve (configurable fill alpha 0–1)
Stacked Area	stacked_area	Multiple series stacked area fill
Step Area	step_area	Step function with filled area
Fill Between	fill_between	Shaded region between two series (envelope, confidence band)

TYPE	ID	DESCRIPTION
Bar (Column)	bar	Vertical bars; supports Grouped, Overlay, and Stacked modes
Stacked Bar	stacked_bar	Vertically stacked segments
Horizontal Bar	horizontal_bar	Category labels on Y-axis, values on X-axis
Pareto	pareto	Descending bars + cumulative % line (quality control)

5.4 Statistical Plots

5.5 Specialty & Scientific Plots

5.6 Series Configuration

Each series in a plot has configurable properties:

5.7 Color Palettes

TYPE	ID	DESCRIPTION
Histogram	histogram	Auto-binned; configurable bin count/width, normalization (count/density/probability)
Box Plot	box	Box-and-whisker; configurable IQR multiplier, notch, mean marker
Violin	violin	KDE-based violin plot; configurable bandwidth
Strip / Beeswarm	strip	Dot plot with jitter, swarm, or stack modes
Q-Q Plot	qq	Normal probability (quantile-quantile) plot
Error Bar	error_bar	Line + symmetric or asymmetric (low/high) error bars
Correlation	correlation	Pearson NxN correlation heatmap matrix

16 built-in palettes with 12 colors each. Select via the Series tab palette grid:

PALETTE	DESCRIPTION
Tokyo Night (default)	Dark-themed vibrant colors
Scientific	Publication-ready muted tones
Vibrant	High-saturation colors
Colorblind Safe	Accessible for all color vision
Nord	Nord palette theme
Solarized	Solarized color scheme
Material	Google Material Design colors
+ 9 more	Pastel, Spectral, Cool, Warm, Autumn, Ocean, Monochrome, Retro, Neon

TYPE	ID	DESCRIPTION
Heatmap	heatmap	2D color grid (colormaps: viridis, plasma, hot, cool)
Contour	contour	Isoline plot with optional filled contours
Hexbin	hexbin	Hexagonal 2D density binning for large scatter datasets
Bubble	bubble	X + Y + Size + Color encoded scatter (4D data)
Waterfall	waterfall	Cascading bars or lines (spectral comparisons)
Ridgeline	ridgeline	Overlapping density plots (joyplot)
Polar	polar	Angle + radius polar coordinate plot
Radar / Spider	radar	N equi-angular axes with fill, shared or independent scaling
Ternary	ternary	Three-component barycentric diagram (chemistry, geology)
Quiver	quiver	Vector field (angle + magnitude arrows), deg/rad angle unit
Wind Rose	windrose	Angular stacked histogram for wind direction + speed
Pie / Doughnut	pie	Proportional slices; configurable inner radius for doughnut
Sankey	sankey	Flow / alluvial diagram (source → target)
Control Chart	control_chart	Process QC: Run chart, X-bar, or CUSUM modes

A separate **Okabe-Ito colorblind-safe palette** is used specifically by the journal export presets (§17.2), distinct from the "Colorblind Safe" palette above.

5.8 Plot Interaction Tools

PROPERTY	DEFAULT	OPTIONS
Line Width	1.5 px	Any positive number
Point Size	0 (hidden)	0 = no markers, positive = marker diameter
Point Shape	circle	circle, square, triangle, triangle_down, diamond, pentagon, hexagon, octagon, cross, x, star, asterisk, circle_cross, square_cross, none
Fill Alpha	0 (line) / 0.15 (area)	0–1 opacity for area fills
Dash Pattern	[] (solid)	[4,2] = dashed, [2,2] = dotted, custom arrays
Color	from palette	Hex color, manually picked or palette-assigned
Y Axis	Y (left)	Y, Y2 (right), Y3+ (extra axes)
Visibility	true	Toggle on/off without removing data

Access tools from the Plot Toolbar or keyboard shortcuts:

Zoom history: Each zoom/pan action is recorded. Press `Ctrl+Z` to undo zoom, `Ctrl+Shift+Z` to zoom out one step.

5.9 Performance & Large Datasets

ALTAI PLOT uses a **4-tier Level of Detail (LOD) system** for smooth rendering of large datasets:

Decimation algorithms: LTTB (Largest Triangle Three Buckets) for datasets up to 2M points — preserves visual shape. MinMax for >2M points or coarse levels — ensures min/max peaks are not missed.

5.10 Axes & Presets

TOOL	SHORTCUT	DESCRIPTION
Pan	H	Click and drag to pan the view. Scroll wheel on axis bands adjusts zoom.
Zoom Box	Z	Draw a rectangle to zoom into that region
Lasso Mask	M	Select data points by rectangle, freehand lasso, or brush for masking/exclusion
Data Reader	D	Crosshair tooltip showing X and interpolated Y values for each series
Find Peaks	Tools menu	Automatic peak detection with prominence, min distance, and threshold settings
Baseline	Tools menu	Subtract baseline from data
Normalize	Tools menu	Normalize data to [0,1] range
Smooth	Tools menu	Apply smoothing filter
FFT Filter	Tools menu	Frequency-domain filtering
Integrate	Tools menu	Numerical integration under curve

LEVEL	DECIMATION FACTOR	APPROX. POINTS	WHEN USED
L0 (coarsest)	64x	~4,000	Full overview (zoomed out)
L1	16x	~16,000	25% zoom
L2	4x	~64,000	6% zoom
L3 (finest)	1x	~256,000	Near raw data quality

Configure axes via the Plot Config Panel (Appearance tab):

LOD queries run in a **Web Worker** (~2ms per query). When zooming past the LOD threshold, an async rebuild is triggered. Beyond the 4-tier system above, datasets of 100M+ points switch to a dedicated pipeline with its own 8-level decimation pyramid (1x/4x/16x/64x/256x/1024x/4096x/16384x) so the WebGL2 backend stays responsive at that scale.

- **Scale:** Linear, Log10, Log2 (fully implemented). Natural Log, Square Root, and Reciprocal are selectable but currently render as Linear — full support is planned
- **Presets:** Linear, Semi-log X, Semi-log Y, Log-Log (via toolbar dropdown)
- **Multi-axis:** Y2 (right side) + unlimited extra Y axes (Y3+)
- **Top X axis:** Optional second X axis with independent scale/offset
- **Axis breaks:** Remove empty ranges from axes

5.11 Annotations & Labels

Click the **Tags** icon in the Plot Toolbar to toggle annotations. Supported annotation types:

- **Text Boxes** — draggable text overlays with configurable font, color, background
- **Image Overlays** — embed images with position, opacity, rotation, and captions
- **Fit Result Boxes** — auto-generated equation, R^2 , RMSE, and parameters from curve fitting
- **Peak Markers** — labeled markers at detected peak positions
- **Reference Lines** — horizontal/vertical lines at specific values



Click to upload 2D_Plot_Gallery.png

(Show a gallery of 2D plot types: line, scatter, heatmap, box, violin, contour, ternary, polar with series configuration panel)

6. 3D Graphics & Visualization

ALTAI PLOT supports **15 distinct 3D chart types** powered by WebGL2. Open a 3D plot via Ctrl+P and selecting the 3D tab, or from the Command Palette.

6.1 3D Plot Types

Series-Mode Types (column-stacking model)

TYPE	DESCRIPTION
Waterfall Line	Lines stacked along Y axis (ideal for spectral data series)
Waterfall Filled	Filled ribbons stacked in depth
Waterfall Line + Markers	Line + marker symbols stacked in depth
Surface	Continuous surface from uniform X grid data
Ridgeline 3D	2D offset series in 3D (clearest for comparing distributions)
Wireframe	3D wireframe grid mesh

XYZ-Mode Types (require X, Y, Z columns)

6.2 3D Interaction

Interact with 3D graphics in real time:

Each 3D panel has an independent theme toggle (dark/light) and can display colorbar legends for surface/volume types.

6.3 Data Modes

TYPE	DESCRIPTION
Scatter 3D	3D scatter plot with point cloud rendering
Stem 3D	Vertical line + tip marker per point ("3D lollipop")
Mesh 3D	Delaunay triangulation mesh from unstructured XYZ points
Grid Surface	Pivoted regular-grid surface from XYZ triples
Bar 3D	3D cuboids/bars, one per (x,y,z) point
Trajectory	Ordered 3D path line with optional drop-lines to XY plane
Isosurface	3D isosurface extraction from scalar fields
Volume	Translucent voxel rendering for 3D scalar volumes
Cone	3D vector field (u/v/w components) as directional cones

- **Click-and-drag** to orbit/rotate the camera
- **Mouse wheel** to zoom in/out
- **Right-click drag** to pan the view
- **Double-click** to reset to default camera position
- **Camera modes:** Toggle between Perspective and Orthographic projection

3D plots support two data modes:

- **Series mode:** Stack multiple Y-columns along a depth axis (no X/Y grid needed). Ideal for spectral series.
- **XYZ mode:** Provide explicit X, Y, Z columns for unstructured point data. Required for scatter3d, stem3d, mesh, grid surface, bar3d, trajectory, isosurface, volume, and cone types.



Click to upload 3D_Surface_Render.png

(Show a 3D surface plot displaying custom color scales, contour projection slices, and colorbar legend)

7. Graph Properties & Customization

7.1 Axis Scaling & Limits

Six scaling modes are selectable per axis, though only the first three currently apply a real transform to the rendered scale — the rest are reserved for a future release and render as Linear today:

SCALE	DESCRIPTION	STATUS
Linear	Standard linear scale (default)	Implemented
Log ₁₀	Base-10 logarithmic	Implemented
Log ₂	Base-2 logarithmic (useful for octave-based analysis)	Implemented
ln (Natural)	Base-e logarithmic	Renders as Linear
Sqrt	Square root transform	Renders as Linear
Reciprocal	1/x transform (wavenumber ↔ wavelength)	Renders as Linear

Use the **Axes Preset** selector in the Plot Toolbar for quick switches: Linear, Semi-log X, Semi-log Y, Log-Log.

7.2 Dual-Axis & Multi-Axis Support

ALTAI PLOT supports flexible multi-axis configurations:

- **Secondary Y-axis (Y2):** Independent scale, range, grid, and color on the right side
- **Extra Y-axes:** Unlimited additional Y-axes beyond Y2, each with independent settings
- **Top X-axis:** Secondary horizontal axis with linear transform (e.g., nm ↔ eV, °C ↔ °F)
- **Axis breaks:** Discontinuities (skip ranges) on any axis for compressing empty regions

Assign series to axes via column roles (y, y2) or per-series yAxisId binding.

7.3 Legends, Markers, and Grid Lines

Modify legend position, grid opacity, tick markers, label fonts, and colors using the active Plot Properties sidebar panel. Toggle legend and grid visibility via the Plot Toolbar buttons.

7.4 Annotations

Add rich annotations to plots via the toolbar or right-click context menu:

TYPE	DESCRIPTION
Horizontal / Vertical Line	Reference lines at specified X or Y values
Rectangle	Shaded region overlay
Arrow	Directional arrow with customizable style
Text Label	Free-positioned text with data-coordinate anchoring
TextBox	Rich text box with font, color, background, border — stays anchored during zoom/pan
Peak Marker	Auto-generated markers from peak analysis
Fit Annotation	Coordinate-bound fit result boxes with equation, parameters, and confidence intervals
Image Overlay	Place external PNG/JPEG images with position, size, opacity, rotation

7.5 Color Palettes

Sixteen built-in color palettes with 12 colors each for publication-quality figures:

PALETTE	DESCRIPTION
Tokyo Night (default)	Dark-themed vibrant colors
Scientific	Publication-ready muted tones
Vibrant	High-saturation colors
Pastel	Soft, low-saturation tones
Spectral	Rainbow spectral sequence
Cool Blues	Cool-toned blue palette
Warm	Warm-toned reds/oranges
Colorblind Safe	Accessible for all color vision deficiencies
Nord	Nord color theme
Solarized	Solarized color scheme
Material	Google Material Design colors
Autumn	Fall-inspired warm tones
Ocean	Deep-sea blue palette
Monochrome	Grayscale for B&W publications
Retro	Vintage-inspired colors
Neon	Bright fluorescent colors

Apply palettes from the Plot Toolbar palette grid in the Series tab, or via the Export Modal palette selector. Journal export presets (§17.2) use a separate Okabe–Ito colorblind-safe palette rather than one of the 16 above.



Click to upload Graph_Style_Inspector.png

(Show the Properties Inspector panel with axis configuration, dual-axis setup, color palette selector, and annotation options)

8. Region of Interest (ROI Gadget)

8.1 Interactive X-Range Slicing

The ROI Gadget is an **X-range selector** — a semi-transparent colored bounding box overlaid on the plot canvas. Drag its left/right borders or the center to select a specific X-axis range. The gadget stores { `id`, `plotId`, `xMin`, `xMax`, `useForFit` } and supports:

- **Drag borders** to adjust the X range
- **Drag center** to move the entire range
- **Multiple gadgets** per plot (but only one can be "active for fit" at a time)

8.2 Live Statistics Card

Each ROI displays a **live stats card** that updates as you drag:

METRIC	DESCRIPTION
N	Number of data points within the X range
Mean	Average of Y values in the range
Sigma	Standard deviation of Y values
Min / Max	Minimum and maximum Y values in the range
Integral	Trapezoidal numerical integration over the range
RMS	Root mean square of Y values

8.3 Fit Integration

Right-click the ROI area for contextual actions:

When a gadget has **"Use for Fit"** enabled, its [xMin, xMax] is synced live to the Curve Fitting panel. The fit, auto-guess, preview, and multi-peak fit all respect this range in real time as you drag the gadget boundaries.



Note: Only **one gadget** across all plots can have "Use for Fit" enabled at a time (exclusive flag). Enabling it on one automatically disables it on others.

8.4 Floating Actions

ACTION	DESCRIPTION
Mask	Zero out (set to NaN) all data points outside the ROI range. Does not modify source sheet — only affects plot display.
Unmask	Restore masked points to their original values
Extract	Copy the ROI range data to a new sheet for isolated analysis
Invert	Swap selection: mask inside ROI, unmask outside
Fit Masked	Run curve fitting on the masked (ROI-selected) data only
Cancel	Dismiss the floating action panel

8.5 Masking vs. Data Deletion

ROI masking is **non-destructive** — it does not modify the source spreadsheet values. Masked points are set to NaN in the plot's internal data buffer. You can:

- Unmask to restore original values at any time
- Extract the masked region to a new sheet (creates actual copies)
- Run analysis tools (FFT, fitting, statistics) on masked data only

8.6 Lasso Mask Tool (Advanced)

For more precise data selection, use the **Lasso Mask Tool** (press M or Tools > Mask Data). Unlike the ROI gadget (X-range only), the lasso supports:

MODE	DESCRIPTION
Rectangle	Draw a rectangle to select points within X and Y bounds
Lasso	Freehand polygon selection using point-in-polygon algorithm
Brush	Circular brush with configurable radius — paint over points to select them

Selected points can be masked (excluded from analysis) or unmasked (restored). Uses the MaskPointsCommand for undo/redo integration.



Click to upload
roi_activate_tool.png

Activate ROI selection inside the main graph tools.



Click to upload ROI_Spectral_Analysis.png

(Show a plot with an ROI gadget selecting a peak region, displaying live stats card with N, mean, sigma, integral, and the floating action buttons)

9. Digital Signal Processing

9.1 Fast Fourier Transform (FFT) & Welch PSD

Transform time-domain signals into frequency-domain representations. The Welch method provides averaged Power Spectral Density estimation with configurable segment overlap. Inverse FFT (IFFT) reconstructs time-domain signals from frequency data.

9.2 Filtering

Nine filter types available via the Plot Toolbar > Tools > Clean/Transform menu, plus a Wiener adaptive filter:

Note: the four frequency-domain filters are FFT brick-wall filters, not IIR Butterworth filters. A true Butterworth design (`scipy.signal.butter`) is available as a Python Script Console snippet (§14.3) when you need one.

9.3 Additional Transform Tools

- **Hilbert Transform:** Compute analytic signal and instantaneous amplitude/phase
- **Derivative:** Finite-difference or Savitzky-Golay-based differentiation
- **Deconvolution:** Reverse the effect of a known impulse response
- **Interpolation:** Resample data using linear, cubic, or nearest-neighbor methods
- **Convolution:** General-purpose signal convolution via worker

9.4 Baseline Subtraction

Six baseline correction algorithms:

9.5 Wavelet Transform

FILTER	TYPE	DESCRIPTION
Savitzky-Golay	Time-domain	Polynomial smoothing (degree 1–5); preserves peak shape and derivatives
Moving Average	Time-domain	Simple sliding-window average
Gaussian Kernel	Time-domain	Convolution with Gaussian kernel
Median Filter	Time-domain	Non-linear; removes spike noise while preserving edges
Lowpass	Frequency-domain (FFT brick-wall)	Zeroes frequency bins above cutoff
Highpass	Frequency-domain (FFT brick-wall)	Zeroes frequency bins below cutoff
Bandpass	Frequency-domain (FFT brick-wall)	Keeps only a frequency range, zeroes the rest
Bandstop	Frequency-domain (FFT brick-wall)	Zeroes a frequency range, keeps the rest
Wiener	Adaptive	Noise-adaptive filter based on signal-to-noise estimation

Analyze localized frequencies over time using Continuous Wavelet Transform (CWT) or Discrete Wavelet Transform (DWT) decompositions, with a choice of Morlet, Mexican Hat, Haar, or Daubechies wavelet families. Ideal for non-stationary signals where FFT alone is insufficient.

9.6 Data Cleanup Tools



Click to upload Signal_Processing_Filters.png

(Show comparison curves before and after applying Savitzky-Golay smoothing, baseline correction, and FFT filtering)

METHOD	DESCRIPTION
Rolling Ball	Morphological opening (erosion + dilation); configurable ball radius
SNIP	Statistics-sensitive Non-linear Iterative Peak-clipping
AsLS	Asymmetric Least Squares (Eilers & Boelens 2005)
AirPLS	Adaptive Iteratively Reweighted Penalized Least Squares
Linear	Straight line connecting first and last data points
Polynomial	Fitted polynomial baseline (order up to 8)

- **Clamp:** Clip values to a specified min/max range
- **Fix NaN:** Repair missing values (interpolation or fill)
- **Detrend:** Remove linear or polynomial trend from signal
- **Normalize:** Scale column data to [0, 1] range

10. Curve Fitting Engine

10.1 Model Catalog

Choose from **100+ mathematical models** organized into six categories:

CATEGORY	EXAMPLE MODELS
Basic	Linear, Polynomial (2nd–5th degree), Power, Logarithmic, Rational, Allometric, Segmented Linear, Hyperbola
Peak	Gaussian, Multi-Gaussian (N peaks), Lorentzian, Multi-Lorentzian (N peaks), Pseudo-Voigt, Multi-Pseudo-Voigt, Voigt, Pearson VII, Skew Normal
Biology	Logistic (4PL/5PL), Hill, Michaelis-Menten, Gompertz, Boltzmann, Richards, Chapman, Dose-response, binding/inhibition models
Kinetics	Exponential decay/growth, bi- and tri-exponential, Box-Lucas, biphasic, Bi-Bi sequential kinetics
Engineering	Sine, damped sine, Langmuir, Weibull, Arrhenius, Carreau, log-normal, Poisson, Beta/Laplace distributions
Custom	User-defined formula via built-in expression parser

Parameterized families (polynomial degree, multi-peak count) accept a count parameter, making the effective model count essentially unlimited.

10.2 Fitting Algorithms

Levenberg-Marquardt (LM)

The core optimizer uses a custom LM implementation with bound constraints, numeric Jacobian with caching, and Cholesky solve for normal equations.

Robust Fitting (IRLS)

For datasets with outliers, enable robust fitting with IRLS (Iteratively Reweighted Least Squares):

LOSS FUNCTION	DESCRIPTION
Standard (L2)	Ordinary least squares (default)
Huber	L2 for small residuals, L1 for large — reduces outlier influence
Cauchy	Aggressive outlier rejection via $\log(1 + r^2/c^2)$ weighting

Speed Modes

MODE	DATA CAP	USE CASE
Quick	5,000 points (uniform subsampling)	Interactive exploration, real-time parameter adjustment
Fit (default)	100,000 points	Standard fitting workflow
Advanced	No cap (streaming LM)	Large datasets (100M+ points) processed in memory-safe blocks

10.3 Goodness-of-Fit Metrics

Automatic fit reports include:

Export fit reports in CSV, HTML, or LaTeX format via the Fit Panel export button.

10.4 Multi-Peak Fitting & Deconvolution

- **R^2 and Adjusted R^2** — coefficient of determination
- **RMSE** — Root Mean Square Error
- **Reduced χ^2** — chi-squared per degree of freedom
- **AIC / BIC** — Akaike and Bayesian Information Criteria
- **Standard Error** and **95% Confidence Intervals** per parameter
- **Confidence Bands** and **Prediction Bands** (95%)
- **Convergence status** and iteration count

Resolve overlapping peaks with a guided workflow:

1. **Detect:** Automatic peak detection using prominence analysis (with optional SG smoothing + AsLS pre-processing)
2. **Confirm:** Review detected peaks; add, remove, or adjust before fitting
3. **Fit:** Multi-parameter LM optimization across all components simultaneously
4. **Result:** Decomposed components with per-peak amplitude, center, FWHM, area, and shape fitting

Supported peak shapes: Gaussian, Lorentzian, Pseudo-Voigt.

10.5 Interactive Parameter Adjustment

For 6 model families (Gaussian, Lorentzian, Exponential, Polynomial, Linear, Power), use **draggable handles** directly on the plot to interactively adjust fit parameters (center, amplitude, sigma, offset) in real-time.

10.6 AI-Assisted Model Selection

The AI Fit Tool evaluates your data against a library of candidate models, fitting all in parallel. Results are ranked by AIC/BIC to recommend the best mathematical fit. Default candidates include linear, polynomial (2–4), exponential, logarithmic, power-law, Gaussian, Lorentzian, sinusoidal, and damped-sine models.



Note: The AI Fit Tool is a deterministic information-criteria model selection — not an LLM-based tool. It provides reproducible, auditable results.



Click to upload Multi_Peak_Fit_Report.png

(Show a plot displaying decomposed peak components, baseline, residuals, and fitting statistics table)

11. Statistical Analysis

11.1 Descriptive Statistics

Compute summary statistics for any column selection via the column context menu → Statistics, or the Script Console:

- Count, Mean, Median, Mode, Variance, Standard Deviation
- Minimum, Maximum, Range, Sum
- Percentiles (25th, 50th, 75th) and Interquartile Range (IQR)
- Skewness and Kurtosis
- Standard Error of the Mean (SEM)

11.2 Hypothesis Tests

Note: Shapiro-Wilk is currently the only normality test implemented — Kolmogorov-Smirnov, Anderson-Darling, and D'Agostino-Pearson are not yet available.

11.3 Correlation Analysis

Compute pairwise correlation matrices between columns:

METHOD	USE CASE
Pearson	Linear correlation (default)
Spearman	Monotonic correlation (rank-based, robust to outliers)
Kendall	Ordinal association (small sample sizes)

Results display as a heatmap matrix (Correlation chart type) or as a tabular report.

TEST	TYPE	USE CASE
Student's t-test (one-sample)	Parametric	Test if mean differs from a hypothesized value
Student's t-test (two-sample)	Parametric	Compare means of two independent groups
Paired t-test	Parametric	Compare means of paired/related observations
Welch's t-test	Parametric	Two-sample t-test without equal variance assumption
One-way ANOVA	Parametric	Compare means across 3+ independent groups
Two-way ANOVA	Parametric	Compare means with two factor variables
Shapiro-Wilk	Normality	Test if data follows a normal distribution
Mann-Whitney U	Non-parametric	Compare distributions of two independent groups without a normality assumption
Wilcoxon Signed-Rank	Non-parametric	Compare paired/related observations without a normality assumption
Chi-Square	Non-parametric	Test independence in contingency tables (goodness-of-fit and independence variants)

11.4 Distribution Analysis

Fit probability distributions to data and compare visually:

- Fit Normal, Lognormal, Weibull, or Exponential distributions to a column's data
- Histogram overlay with fitted PDF curve
- KDE (Kernel Density Estimation) overlay, available from the Histogram tool
- Q-Q plot for visual normality assessment (currently supports the Normal distribution only)



Click to upload Statistical_Analysis_Report.png

(Show descriptive statistics table, histogram with fitted distribution, and correlation heatmap)

12. Plugin System



Preview architecture — not yet functional end-to-end. The Plugin Manager UI, permission model, and SDK described below represent the intended design. As of this release: installing a plugin from the UI is disabled ("coming soon"), declared permissions are not yet enforced at runtime, and the plugin SDK package is a template only — the bundled example plugin cannot currently be loaded and run. Treat this chapter as a roadmap, not a working feature.

12.1 Plugin Manager

Open the Plugin Manager from the **Tools** menu or the Command Palette. The manager UI lists plugins and their declared metadata and permissions, but plugin loading is currently a renderer-side mock — no plugin code is actually executed yet.

12.2 Installing Plugins (Planned)

- Browse and install plugins from a built-in plugin marketplace — planned; the current "Install" action shows a "coming soon" message
- Import local plugin packages (.zip or .aplug file — the file picker does not accept a .aplotplugin extension)
- Each plugin declares a manifest with metadata, permissions, and entry point

12.3 Plugin Permissions (Declared, Not Yet Enforced)

Plugins declare permissions as chips in the manager UI. Common permissions include the ones below — but the permission check currently always passes regardless of what a plugin declares, so this is not yet a real security boundary:

12.4 Example: Spectroscopy Plugin (Reference Source Only)

PERMISSION	DESCRIPTION
data:read	Read sheet data and column values
data:write	Create sheets, write column data
export:*	Export data and figures
ui:panel	Create custom UI panels

A bundled **Spectroscopy Plugin** source file demonstrates the intended plugin API shape — custom analysis tools, specialized plot types for wavelength/intensity data, and batch workflows for spectral series — but it imports SDK functions (`definePlugin`) that are not yet implemented, so it cannot currently be loaded or run. Read it as a design reference, not a working example.

12.5 Developing Plugins (Not Yet Available)

A Plugin SDK package (`packages/plugin-sdk`) is scaffolded for building custom TypeScript extensions against the v7 engine API (sheet data, plot creation, fitting, analysis tools), but it currently contains only a template — there is no working SDK to build against yet.

13. Node-Based Analysis Pipelines

13.1 Visual DAG Editor

Connect boxes visually to build Directed Acyclic Graphs (DAG) on the Pipeline Canvas. The editor supports undo/redo, zoom, pan, and a minimap for navigating large workflows. Nodes snap to a grid and connections are validated for data-type compatibility.

13.2 Node Types (34)

Source Nodes

NODE	DESCRIPTION
Sheet Source	Reference an existing workbook sheet
Multi-Sheet Source	Reference multiple sheets as parallel inputs
Folder Pattern	Batch-import all matching files by glob pattern (there is no single-file import node — use a Sheet Source after importing via §4.2)

Transform Nodes

Analysis Nodes

Output & Annotation Nodes

13.3 Batch Processing

13.4 Pipeline Management

NODE	DESCRIPTION
Smooth	Savitzky-Golay or Moving Average smoothing
Baseline	6 methods: Linear, Polynomial, Rolling Ball, SNIP, AsLS, AirPLS
Derivative	Finite-difference or Savitzky-Golay derivative
Integrate	Trapezoidal or Simpson's rule integration
FFT	Forward Fast Fourier Transform (no inverse-FFT node yet)
FFT Filter	Frequency-domain lowpass/highpass/bandpass/bandstop (brick-wall, not IIR)
Wavelet	Continuous or Discrete Wavelet Transform (Morlet, Mexican Hat, Haar, Daubechies)
Hilbert Transform	Analytic signal, instantaneous amplitude/phase
Deconvolution	Wiener deconvolution against a known impulse response
Downsample	LTTB-based point reduction for large series
Resample	Linear, cubic, or nearest-neighbor interpolation
Clamp	Clip values to min/max range
Fix NaN	Repair missing values
Normalize	Scale to [0, 1]
Detrend	Remove linear or polynomial trend

Run automated loops over folders of files using WorkfLowRunner. Configure error bypass policies (stop-on-error, skip-and-continue). Processing runs in parallel using Web Workers for maximum throughput.

NODE	DESCRIPTION
Statistics	Descriptive stats (mean, median, std, percentiles, min/max)
Peak Detection	Prominence-based peak finding with FWHM, area, shape fitting
Curve Fit	LM fitting with any of 100+ models (§10.1)
Auto Fit	AIC/BIC-ranked model selection across candidate models (§10.6)
Multi-Gaussian Fit	Multi-peak Gaussian deconvolution (§10.4)
Custom Fit	Fit against a user-defined expression
Correlation	Pearson, Spearman, Kendall correlation matrix
Hypothesis Test	One/two-sample t-test, Mann-Whitney, ANOVA, Shapiro-Wilk, Wilcoxon, or chi-square goodness-of-fit (§11.2)
Laser / ASE Analysis	Domain-specific spectral analysis for laser/ASE measurements
Pulse Analysis	Pulse-shape metrics (rise time, width, area) for time-domain traces

NODE	DESCRIPTION
Sheet Output	Write results to a new or existing sheet
Figure Output	Generate a plot with configurable type and style
Export	Export the figure as PNG, JPEG, TIFF, SVG, PDF, or EPS (data export to CSV/XLSX is done from the sheet, §3.10, not this node)
Sticky Note	Freeform annotation node for documenting a pipeline's intent

- **Save/Load:** Save pipeline configurations as reusable templates
- **DAG Validation:** Automatic cycle detection and data-type compatibility checks
- **Provenance:** Plots created by a pipeline are linked back to their source workflow via a provenance badge in the Plot Toolbar



Click to upload Pipeline_DAG_Canvas.png

(Show the visual node editor canvas displaying a signal processing chain: Source → Smooth → Baseline → FFT → Peak Detection → Figure Output)

14. Dual-Mode Script Console

14.1 JavaScript vs. Python Execution

Switch dynamically between two scripting kernels in the same console:

ENGINE	RUNTIME	LIMITS	LIBRARIES
JavaScript	QuickJS-WASM sandbox	10s timeout, 64 MB heap	Math, Date, JSON (no external libs)
Python	CPython 3.12 sidecar (subprocess)	60s timeout, 512 MB memory	NumPy, SciPy, Pandas (pre-installed)

Select the kernel with the Python/JS toggle button in the console toolbar.

14.2 Sheet Data Access

Python (via Pandas DataFrame)

The active sheet is automatically mapped to a Pandas DataFrame named `df`:

```
# Smooth intensity using scipy
from scipy.signal import savgol_filter
df['Smooth_Y'] = savgol_filter(df['Intensity'], window_length=11, polyorder=2)
ALTAIPL0T.Plot.update()
```

JavaScript (via host API)

14.3 Snippet Library

```
// Read column data
const x = ALTAIPLLOT.Sheet.getColumnData('Sheet1', 0);
const y = ALTAIPLLOT.Sheet.getColumnData('Sheet1', 1);

// Write computed column
const result = x.map((v, i) => Math.sin(v) * y[i]);
ALTAIPLLOT.Sheet.setColumnData('Sheet1', 2, result);
```

The console includes **70+ bilingual snippets** (JS + Python) organized into 7 categories:

CATEGORY	EXAMPLES
Data	Read/write column, create sheet, list sheets, column stats
Signal	FFT, PSD, smoothing, peak detection
Fit	Gaussian fit, polynomial fit, multi-peak
Plot	Create scatter/line, add annotation, change theme
Analysis	Descriptive stats, correlation, baseline removal
File	Export CSV, export plot PNG, import data
Targeting	Write to specific column, append to sheet

Open the snippet panel via the **{ }** button in the console toolbar. Click any snippet to insert it into the editor.

14.4 User Presets ("Komutlarım")

Save frequently used commands as named presets (up to 100). Access saved presets from the presets dropdown in the console toolbar for one-click execution.

14.5 Monaco Editor Integration

The editor provides: syntax highlighting (JavaScript/Python), code completion with IntelliSense (full `.d.ts` type declarations), error markers with inline diagnostics, and bracket matching.

14.6 Normal vs. Expert Mode

Toggle between **Normal** and **Expert** modes in the console settings. Expert mode displays: full Python tracebacks, execution timing, memory usage, and detailed RPC protocol logs.

14.7 Reactive Cells

Toggle a code cell to **reactive** mode to auto-re-execute when bound spreadsheet columns change. The system detects which columns your script reads (`df["col"]`, `df.iloc[:, i]`) and only triggers when those specific columns are modified. A cycle guard prevents infinite loops.

14.8 Console Output

Console supports: plain text, rich tables (markdown format), and inline images (base64 PNG). Output is capped at 500 lines. Use the copy button to copy output to clipboard.



Click to upload Script_Console_Interface.png

(Show the Monaco editor console with Python kernel active, snippet panel open, and inline plot output)

15. Interactive Analysis Notebooks

15.1 Cell-Based Coding Environment

ALTAI PLOT supports interactive notebooks where Python, JavaScript, and Markdown cells live side-by-side. Open the Notebook panel from the bottom dock (next to the Script Console tab).

- **Python cells:** Execute via CPython sidecar with NumPy/SciPy/Pandas
- **JavaScript cells:** Execute via QuickJS sandbox
- **Markdown cells:** Rich text with headings, lists, bold/italic, and inline code

15.2 Reactive Cell Triggers & Auto-Updates

Link cell outputs to worksheet columns. When you toggle a cell to **reactive** mode, it automatically re-executes whenever bound spreadsheet columns change. The system detects column references via static analysis of your code (`df["col"]`, `df.iloc[:, i]`, `ALTAIPLOT.Sheet.getColumnData()`).

15.3 Execution Model

- Cells execute **sequentially** (cell N completes before cell N+1 starts)
- Errors stop execution of remaining cells (with clear error messages)
- Each cell stores its last execution result (text, tables, images, errors)

15.4 Limits & Management

- Up to **20 notebooks**, each with up to **200 cells**
- Notebooks are saved within the `.aplot7` project file
- Reorder cells via drag-and-drop in the cell list

15.5 Export Formats

FORMAT	DESCRIPTION
.ipynb	Standard Jupyter Notebook format (nbformat v4)
.py	Jupytertext percent format (# %% cell markers)



Click to upload Interactive_Notebook_Cells.png

(Show an analysis notebook with Python cell output, inline plot, markdown heading, and reactive indicator)

16. Layout Composer

The Layout Composer assembles multiple plot panels into publication-ready multi-panel figures. Open it from the top toolbar **Composer** button or the Command Palette.

16.1 Layout Modes

The Composer currently supports one layout mode — free-positioning ("Free") and stacking ("Stack") modes described in earlier drafts of this manual are not yet implemented:

MODE	DESCRIPTION
Grid	Arrange panels in a configurable rows × columns grid with adjustable row/column weights

16.2 Panel Configuration

- **Drag-and-drop** plots from the Entity Explorer into grid cells
- **Snap-to-grid** alignment with configurable gap and margin
- **Panel lettering:** Automatic (a), (b), (c) labels with style options: lowercase, uppercase, numeric, lowercase/uppercase roman numerals, or none
- **Custom dimensions:** Set figure width/height in mm, inches, or pixels

16.3 Shared Axes

Link X or Y axes across panels for synchronized zoom/pan. When one panel is zoomed, linked panels follow automatically — essential for multi-panel comparisons.

16.4 Figure-Level Annotations

Three built-in presets are available via `Ctrl+Alt+1/2/3`:

The underlying figure engine supports overlays spanning the full canvas — arrows, text labels, brackets, reference lines, and LaTeX equation blocks — but the Composer UI does not yet expose a way to add them. This is an engine capability ahead of its UI, not a user-facing feature today.

16.5 Additional Features

- **Shared colorbars** for heatmap/surface panels
- **Figure-level legend** collection (global or per-panel)
- **Panel titles** and axis visibility per-panel
- **Background color** and optional title
- **Composite Figure Builder** for combining pre-rendered canvases with panel labels

16.6 Layout Presets

- **Analysis** — spreadsheet left, plot right
- **Fit Mode** — plot top, fit results bottom
- **Compare** — two plots side-by-side

Save custom layout presets via View > Save Layout Preset.



Click to upload Layout_Composer_Grid.png

(Show a 2×2 grid composer with four spectral plot panels, (a)–(d) lettering, shared Y-axis, and LaTeX equation)

17. Exporting Publication-Ready Figures

Open the Export Modal via `Ctrl+Shift+E` or the Export button in the Plot Toolbar. The modal has four tabs: **Plot**, **Data**, **Report**, and **Batch**.

17.1 Plot Export Formats

FORMAT	TYPE	BEST FOR
PDF	Vector	Publications, infinite scalability
SVG	Vector	Web, further editing in Illustrator/Inkscape
EPS	Vector	Legacy publishing systems
PNG	Raster	Presentations, web (lossless)
TIFF	Raster	Journal submissions (lossless, multi-page)
JPEG	Raster	Small file size (configurable quality)

17.2 Journal Publication Presets

27 built-in presets matching major journal submission guidelines:

Science's commonly-cited column widths are noted as approximate in the source configuration — always verify exact dimensions against the target journal's current author guidelines before submission.

PRESET	WIDTH	HEIGHT	DPI
Nature (1-col)	89 mm	69 mm	300
Nature (1.5-col)	136 mm	100 mm	300
Nature (2-col)	183 mm	119 mm	300
IEEE (1-col)	88.9 mm	66 mm	600
IEEE (2-col)	182 mm	120 mm	600
ACS (1-col)	84.7 mm	60 mm	600
ACS (2-col)	177.8 mm	110 mm	600
Elsevier (1-col)	90 mm	70 mm	1000
Elsevier (1.5-col)	140 mm	100 mm	1000
Elsevier (2-col)	190 mm	130 mm	1000
PRL (1-col)	86 mm	64 mm	600
Science (1-col)	55 mm	45 mm	600
Science (2-col)	121 mm	90 mm	600
Science (full)	183 mm	120 mm	600

PRESET	WIDTH	HEIGHT	DPI
PNAS (1-col)	87 mm	65 mm	600
PNAS (1.5-col)	114 mm	85 mm	600
PNAS (2-col)	178 mm	118 mm	600
Cell Press (1-col)	85 mm	64 mm	600
Cell Press (2-col)	174 mm	116 mm	600
RSC (1-col)	83 mm	62 mm	600
RSC (2-col)	171 mm	114 mm	600
Springer (1-col)	84 mm	63 mm	600
Springer (2-col)	174 mm	116 mm	600
Wiley (1-col)	86 mm	64 mm	600
Wiley (2-col)	178 mm	118 mm	600
A4 Full (generic)	210 mm	148 mm	300
Presentation (generic)	254 mm	143 mm	150

17.3 DPI Resolution

Six presets: **72** (screen), **96** (default), **150** (presentation), **300** (standard print), **600** (high-quality print), **1200** (line art). DPI is embedded as metadata in PNG (pHYs chunk) and JPEG (JFIF) files.

17.4 Color Palettes

Eight publication-ready palettes: APlot Default, Nature (NPG), IEEE (tab10), Science (AAAS), Okabe-Ito (CVD-safe), Tol Bright, Viridis, and Grayscale. Also configure font family (Sans/Serif), font scale, and line width scale.

17.5 Additional Options

- **Transparent background** toggle
- **Legend, Grid, Annotations** visibility toggles
- **Per-plot theme:** Light / Dark / Publication
- **Watermark** (license-gated)
- **Clipboard copy:** Right-click any plot → "Copy Image" (2x screen resolution PNG), or "Paste Image" to drop a clipboard image onto the plot as a draggable layer

17.6 Data Export

Export spreadsheet data in CSV, JSON, XLSX, HDF5, or MAT format with configurable encoding, separator, and header options.

17.7 Report Export

Generate comprehensive reports including plots, data tables, statistics, and fit results in: HTML, Markdown, LaTeX, PDF, or DOCX format. Configure page size (A4/Letter/A3/A5), orientation, margins, and font size.

17.8 Batch Export

The Batch tab shows a live job queue with progress bars per export. Jobs run through stages: Validate → Preprocess → Render → Encode → Write. Each job shows duration, file size, and can be cancelled mid-export.

17.9 Export Profiles, Plot Templates & Composer Presets

Three separate, easy-to-confuse persistence systems save your styling choices — each scoped differently:

SYSTEM	SCOPE	SAVES
Export Profile	One export (Plot or Report tab)	Named, reusable format/DPI/palette/margin combination for repeat exports
Plot Template	One plot's full style	Axes, colors, fonts, legend position — reapply to any other plot
Composer Preset / Quick Slot	A multi-plot page layout	Up to 8 quick-access slots in Layout Composer (Ch.16) for a full page arrangement, not a single plot's style



Click to upload Export_Modal_Presets.png

(Show the Export Modal with Plot tab active: format selector, Nature preset selected, 300 DPI, palette dropdown)

18. AI Assistant & Smart Analysis

ALTAI PLOT includes an on-device analysis assistant that recognizes what kind of data you're working with and suggests next steps — no cloud calls, no external model, all inference runs locally against the plotted data.

18.1 Semantic Advisor & Smart Hints

As you plot data, the Semantic Advisor inspects the X/Y columns and infers a data "fingerprint" — currently Spectroscopy, XRD, LiDAR, Laser Spectrum, Laser Pulse, or Generic — from shape, spacing, and value ranges. When it recognizes a pattern, a floating **Smart Hint** banner appears over the plot suggesting the relevant next tool (e.g., peak fitting for a spectroscopy trace, background subtraction for XRD). Completing a suggested step chains to the next logical one (a "workflow chain"), and the same panel flags basic data-quality issues (clipping, noise floor, missing regions) and validates tool parameters live while a graph tool is open. The advisor's suggestions are advisory only — nothing runs automatically without a click — and its interface is fully localized in Turkish and English.

18.2 Smart Parameter Estimation

When you open a fitting or processing tool, ALTAI PLOT pre-fills starting parameters (peak center, width, baseline, smoothing window, etc.) estimated directly from the visible data rather than generic defaults. This reduces manual guess-and-check for the initial fit attempt; all estimated values remain fully editable before running.

18.3 AI-Assisted Model Selection (Auto Fit)

The **Auto Fit** tool (Curve Fitting panel) fits several candidate models in parallel — linear, polynomial, Gaussian, Lorentzian, exponential, logarithmic, sinusoidal, damped sine, and power-law — and ranks them by AIC/BIC (see §10, Model Selection) so you can compare goodness-of-fit across model families at a glance instead of trying each one manually.

18.4 Laser & Pulse Analysis Engines

For data recognized as a laser spectrum or pulse trace, dedicated analysis engines compute spectrum-specific metrics (linewidth, ASE background, sideband ratios) or pulse-specific metrics (rise/fall time, FWHM, repetition rate) and present them in a compact report overlay docked to the plot, in addition to the general DSP (§9) and Statistical Analysis (§11) tools.



This chapter documents the assistant's **current** capabilities as of this build. It is an actively developed subsystem — behavior around first-load hints and recognized data types may expand in future releases.

19. Troubleshooting & FAQ

19.1 License Verification Errors

If online checking fails, check that your computer has internet access. For offline setups, double-check that your hardware ID matches the `.lic` file key values exactly. The Welcome Screen displays the current license status badge.

19.2 Python Kernel Crashes

Python scripts exceeding 60 seconds or 512 MB memory usage trigger an automatic kernel restart to prevent app hangs. Refactor loop structures, use generators for large iterations, or decimate massive datasets before processing.

19.3 JavaScript Sandbox Timeout

The QuickJS sandbox enforces a 10-second timeout and 64 MB heap limit. For long-running computations, switch to the Python kernel or use the Pipeline system's Web Workers for parallel processing.

19.4 Python Sidecar Connection Failure

If the Python kernel shows "Disconnected":

1. Check that the bundled CPython 3.12 sidecar is not blocked by antivirus software
2. Verify the `resources/python/` directory exists in the installation folder
3. Restart the kernel via the console toolbar restart button
4. If persistent, reinstall ALTAI PLOT to restore the sidecar binaries

19.5 WebGL2 Driver Issues

If 3D plots, heatmaps, or large 2D datasets fail to render:

- Ensure WebGL2 is enabled in your graphics driver control panel
- Update GPU drivers to the latest version
- On laptops with dual GPUs, force ALTAI PLOT to use the dedicated GPU
- Integrated Intel UHD 620+ or equivalent is the minimum requirement

19.6 Large Dataset Performance

For datasets with millions of rows:

- Use the **Quick** fit mode (auto-subsamples to 5K points)
- Enable the spreadsheet's virtual scrolling (automatic for sheets > 10K rows)
- Use the **Advanced** streaming LM for fitting without data caps
- Consider the Pipeline system's parallel Web Workers for batch operations

19.7 Undo/Redo Not Working

The undo/redo system uses a tree-based command history. If an action doesn't undo properly, check the History Panel (dropdown next to undo button in the top bar) — you can jump to any point in the history tree.

19.8 Keyboard Shortcuts Not Responding

Ensure the correct panel has focus. Spreadsheet shortcuts (Tab, Enter, F2, Delete) only work when the spreadsheet is focused. Plot shortcuts (H, Z, M, F, P) only work when a plot panel is focused. Press ? to see all available shortcuts.

19.9 Telemetry & Crash Reporting

Crash reporting (Sentry) is gated by the same one-time telemetry consent shown on first launch (§1.4) — there is no separate crash-report opt-in. Each session generates a fresh anonymous session ID that is never tied to your license or persisted across launches. Telemetry is fail-open: if the reporting service is unreachable, the app is never blocked or slowed.



Support: For further issues, contact us at support@altaipLOT.com or browse the community forums at www.altaipLOT.com.