Getting Started

General XINA information and concepts.

Introduction and Ecosystem

XINA is an integrated data management platform, developed at NASA GSFC. XINA is provided as a managed service hosted on Amazon Web Services.

Overview

The XINA platform provides five primary functions:

- Structured Database Storage (MySQL on AWS RDS)
- File Storage (AWS S3)
- Task Management (XINA Run on AWS EC2, XINA Lambda on AWS Lambda)
- Web Client (XINA Web, Angular)
- Direct API Access (XINA Tunnel)

XINA supports Launchpad and NAMS integration for user management and authentication.

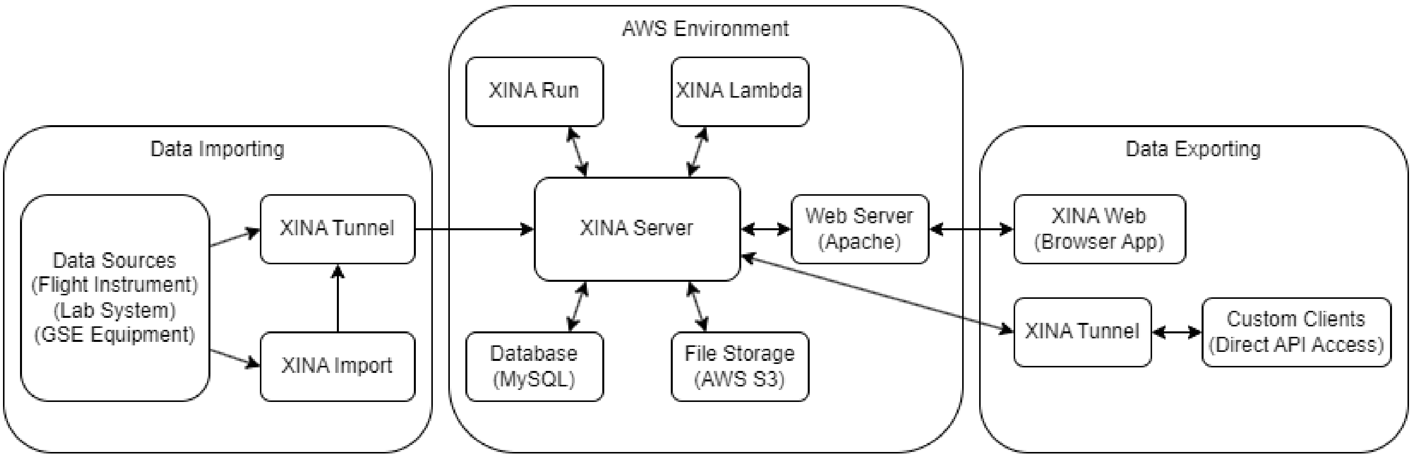
Limitations

XINA is not a single standalone application, and cannot currently be installed locally. We provide the software as a service through a NASA AWS account integration. Specific AWS requirements and costs will vary depending on project parameters.

XINA is not recommended as a gold copy for data storage. Although AWS cloud services are highly reliable and XINA is often used as a valuable backup tool, a full gold copy should always be kept onsite.

XINA System Components

The XINA platform is composed of several interconnected components and applications:



XINA Server

The XINA server is the core application of the XINA platform. It manages all incoming and outgoing XINA data and provides API access. The server is built on a MySQL database backend and uses the AWS S3 service for large file storage.

XINA Web

XINA Web (formerly XINA Online) is the primary XINA front-end application, written in TypeScript with Google's Angular web application platform. Authentication is integrated with NASA Launchpad and managed through NAMS.

XINA Tunnel

The XINA Tunnel utility is a Java application intended to facilitate communication with the XINA API. The tunnel connects directly to the XINA server and manages connection security and authentication. It then opens a local webserver to which client applications can connect and communicate with the core XINA server. Full reference is available here.

XINA Import

The XINA Import utility is a Java application to simplify importing data to the XINA server by importing XINA API actions from JSON files. Full reference is available here.

XINA Run

XINA Run is a Java application for managing and executing asynchronous tasks though the XINA platform. Full reference is available here.

XINA Lambda

XINA Lambda is an integrated service for executing asynchronous tasks from the AWS Lambda platform. Full reference is available here.

Terms and Concepts

Database

Databases are the core data storage structures in XINA. A database essentially defines a MySQL table, with additional features managed by the XINA server system.

Each database is defined by a set of **fields**, which specify the columns of the table. Fields are primarily defined by:

- Name, unique to the field in the database
- Static data type
- Whether a value must be provided by each record (an empty value being null)

A single unit of data in a database is a **record**, corresponding to a row of the table. Each record contains a value for each field of the database.

Structural database changes (adding / changing / removing fields) are very slow (hours to days for very large databases) so initial time investment to optimize database requirements is worthwhile.

Group

Databases in XINA are organized into a heirarchical structure of **groups**, which can each contain any number of groups and databases. For example:

- The `model` group contains a `journal` database and `data` group
- The `data` group contains a `housekeeping` database and `science` database

Image not found or type unknown

A dot notation is used to reference groups and databases. For example, `moma.data.science` refers to the science database in the above configuration.

Importing Data

There are several approaches for importing data into XINA, but for most projects we recommend the **XINA Import** utility.

XINA Import reads XINA API calls from JSON files and passes them to the XINA server. Each JSON file corresponds to a single API action, but may be paired with additional files of other types depending on the content.

For example, to upload some housekeeping data from a CSV requires two files. First, the JSON file:

```
{
 "action": "load",
 "database": "demo.model.data.hk.full",
 "columns": true,
 "delimit": ",",
 "line": "\n",
 "$object_id": "{local}/hk.csv"
}
```

The CSV file then looks like:

```
t,name,value
1602086313288000,SCAN_INDEX(Step),-1
1602086313288000,MO1_LD1_CURR(mA),0
1602086313288000,MO1_LD2_CURR(mA),0
1602086313288000,MO1_CASE_TEC(C),21.739
...
```

A couple notes on these:

- The `"line"` property in the JSON file must exactly match the new line character(s) in the CSV file. You can use `"\r\n"` if you prefer, but either way we recommend explicitly using one or the other when you write the files, as a general "print line" may use different output depending on the platform.
- The `"{local}"` in the `"$object_id"` property is a macro used by the XINA Import application to look for the CSV file in the same location as the JSON file. We recommend using this and keeping the files in the same location. If you need to separate them you can use a full path instead, but this is more fragile if folder organization needs to be changed.
- For best performance we recommend paging the CSV files so that each is 50MB or less.
- If you need to represent an empty value, you can either omit a data point or use `"NULL"` (without quotes). (`"NaN"` and `"Infinity"` are not supported at the database level.)

While this CSV approach is recommended for large data sets, data can alternatively be embedded directly in JSON files. For example, a file to insert a new instant might look like:

```
{
  "action": "insert",
  "database": "demo.model.data.ins",
  "records": [
    {
      "u_id": "58ea870a-52c3-33c7-b858-c20795ec3301",
      "p_id": 0,
      "s_id": 0,
      "type": 20,
      "level": 0,
      "t": 1606333792000000,
      "label": "SPECTRA_Startf-0_Stopf-1k",
      "content": "some additional text here...",
      "meta": {
        "Resolution Bandwidth": 2.07014,
        "Stop Frequency": 1000,
        "Average Factor": 30,
        "Start Frequency": 0
      }
    }
  ]
}
```


The full API reference can be found here.

Data Types

XINA has a fixed set of **data types** which apply to attributes and fields. They are intended to provide consistent behavior across MySQL, Java, and JavaScript data types.

Numeric Types

Type	Java	MySQL	JavaScript	Notes
`int(1)`	`byte`	`tinyint`	`number`	signed 1 byte integer, -2^{7} to $2^{7}-1$
`int(2)`	`short`	`smallint`	`number`	signed 2 byte integer, -2^{15} to $2^{15}-1$
`int(4)`	`int`	`int`	`number`	signed 4 byte integer, -2^{31} to $2^{31}-1$
`int(8)`	`long`	`bigint`	`number`	signed 8 byte integer, -2^{63} to $2^{63}-1$??
`float(4)`	`float`	`float`	`number`	IEEE 754 4 byte floating point
`float(8)`	`double`	`double`	`number`	IEEE 754 8 byte floating point
`boolean`	`boolean`	`tinyint`	`boolean`	MySQL treats `0` as `false`, non-zero as `true`

> ?? JavaScript number is 8 byte float, so only -2^{53} to $2^{53}-1$ is stored with exact precision

Character Types

Character data types offer two encoding options:

- **UTF-8** - default encoding, variable length, 1 to 4 bytes per character
- **ASCII** - subset of UTF-8, fixed length, 1 byte per character

Two SQL types:

- **char(n)** - data stored in the table, fastest search and index, uses fixed amount of space per row (n * max_bytes_per_character)
- **varchar(n)** - data stored in the table, fast search and index, uses variable amount of space per row (up to n * max_bytes_per_character)
- **text** - data stored outside the table, slower search and index, uses only as much space as needed

Two general types:

- **string** - text is **normalized** before insertion
  - leading and trailing whitespace is trimmed
  - all internal whitespace is reduced to a single space character
- **text** - text is inserted as provided

> Note, all string operations are **case-insensitive** by default. This can be overridden with the collate expression by specifying a binary collation.

Type	Java	MySQL	JavaScript	Notes
`utf8string(n)`	`string`	`char(n)`	`string`	n up to 128, uses `n*4` bytes, normalized
`utf8vstring(n)`	`string`	`varchar(n)`	`string`	n up to 128, uses up to `n*4` bytes, normalized
`utf8string`	`string`	`mediumtext`	`string`	up to 2^{24} bytes, normalized
`utf8text`	`string`	`mediumtext`	`string`	up to 2^{24} bytes, not normalized
`asciistring(n)`	`string`	`char(n)`	`string`	n up to 256, uses n bytes, normalized
`asciivstring(n)`	`string`	`varchar(n)`	`string`	n up to 256, uses up to n bytes, normalized
`asciistring`	`string`	`mediumtext`	`string`	up to 2^{24} bytes, normalized
`asciitext`	`string`	`mediumtext`	`string`	up to 2^{24} bytes, not normalized

Temporal Types

Temporal data types store time data. There are two categories of temporal types:

- **instants** - identify specific moment in time, independent of time zone
  - stored numerically in the database in milliseconds
  - `datetime` and `date` use Unix epoch
  - `datetime` and `date` comparable in database
  - `date` + `time` = `datetime`
  - typically displayed in local time zone in front-end applications
- **timestamps** - identify specific formatted time without time zone consideration (thus `local`)
  - stored as ISO 8601 formatted `string` in database
  - `localdate` and `localdatetime` comparable in database
  - `CONCAT(localdate, 'T', localtime)` = `localdatetime`

Type	Java	MySQL	JavaScript	Notes
`datetime`	`DateTime`	`bigint`	`date`	instant with millisecond precision, as Unix time

Type	Java	MySQL	JavaScript	Notes
`date`	`XDate`	`bigint`	`date`	instant at start of date UTC, as Unix time
`time`	`LocalTime`	`int`	`number`	length of time up to 23:59:59.999, as millisecond count
`localdatetime`	`LocalDateTime`	`char(24)`	`string`	full timestamp without timezone, stored as `string`
`localdate`	`LocalDate`	`char(10)`	`string`	date without timezone, stored as `string`
`localtime`	`LocalTime`	`char(12)`	`string`	length of time up to 23:59:59.999, as `string`

JSON Types

JSON data types store JSON data directly in the database.

Type	Java	MySQL	JavaScript
`json`	`JsonValue`	`json`	`*`
`jsonarray`	`JsonArray`	`json`	`array`
`jsonobject`	`JsonObject`	`json`	`object`

Enum Types

Enum types map a series of discrete numeric integer values to text names. Though additional values may be added in the future, existing values will not change names or IDs.

`notification_level`

ID	Name	Notes
`0`	`none`	default level, no associated formatting
`1`	`success`	green
`2`	`info`	cyan
`3`	`notice`	yellow
`4`	`warning`	red
`5`	`primary`	blue, elevated over `none`
`6`	`secondary`	grey, below `none`

`notification_type`

ID	Name	Notes
`0`	`post`	
`1`	`task`	
`2`	`request`	request received
`3`	`response`	response to request received

`post_level`

ID	Name	Notes
`0`	`none`	default level, no associated formatting
`1`	`success`	green
`2`	`info`	cyan
`3`	`notice`	yellow
`4`	`warning`	red
`5`	`primary`	blue, elevated over `none`
`6`	`secondary`	grey, below `none`

Sandbox Quick Start Guide

In order to streamline onboarding for new XINA projects we have created a XINA "Sandbox" environment to test data pipelines and tools. Everything in the sandbox is fully configured as a typical XINA production environment.

Step 1: Request NAMS Access

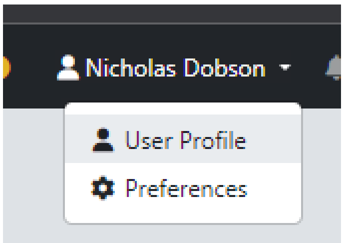
To get started, first request access through the NAMS service. The application name is "GSFC XINA Sandbox".

Step 2: First Login

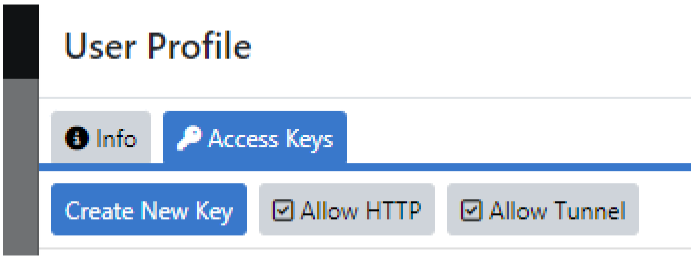
Once you receive confirmation that the account is approved, perform your first login to the XINA Sandbox by going to sandbox.xina.io. This initial login creates your user account. You will initially have access to a series of default Sandbox data. If you require access for a specific project contact our team and we will help finish setting up required permissions.

Step 3: Create an API Key

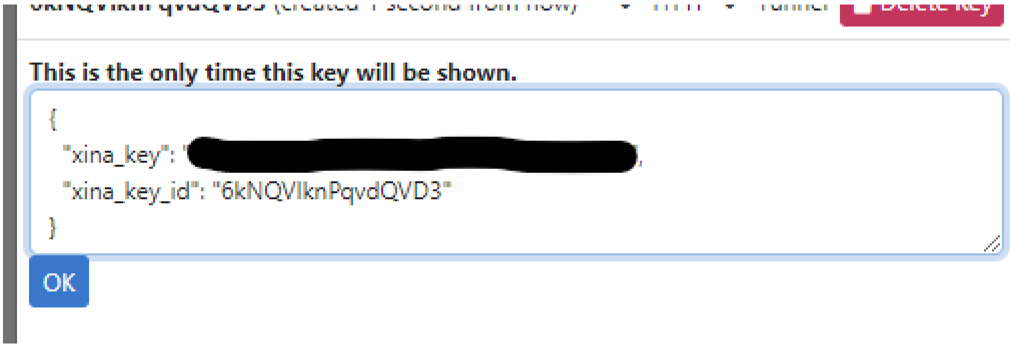
To access the XINA API for importing data you will require a XINA API key. In the XINA web application, click your user name in the top right, then "User Profile" in the drop down.



Switch to the "Access Keys" tab and click "Create New Key".



Copy the entire displayed text and save it to a local file in your preferred location. You will need to reference this file when opening the XINA Tunnel to use the XINA API. A common naming convention is `<mission>_xina_key.json`. The key will only be displayed once upon creation, if lost you will need to make a new key.



Step 4: Download XINA Tunnel and XINA Import

The XINA Tunnel and XINA Import utilities are the recommended starting point for importing data. Details for each are available on their respective wiki pages.

Step 5: Import Sample Data

UNDER CONSTRUCTION

Spectra Quickstart

XINA Structs includes dedicated support for spectra data files (or basically any numeric XY data plotting). Spectra data is stored in files attached to event records.

Getting Started

Once the Sandbox Quick Start Guide is complete, you can create a new model in the Sandbox project, and then a new spectra database in that model.

Create Model

```
{
 "action": "struct_create",
 "create": "model",
 "parent": "sandbox",
 "name": "model_name",
 "label": "Model Name",
 "desc": "example model",
 "group_teams": ["sandbox", "sandbox_dev"],
 "database_teams": ["sandbox", "sandbox_dev"]
}
```

Note that for this example we use `"model_name"` as the name of the model, so if using a different name substitute anywhere `"model_name"` is used in the following examples.

Create Spectra Database

Finally, create a new event file database to hold the spectra. This is an example using many of the spectra-specific features:

```
{
 "action": "struct_create",
 "create": "event",
 "type": "file",
 "group": "sandbox.model_name",
 "name": "spectra",
 "label": "Spectra",
```

"desc": "spectra",
"singular": "spectrum",
"plural": "spectra",
"teams": ["sandbox", "sandbox_dev"],
"fields": [
  {
    "name": "test_stage",
    "label": "Test Stage",
    "type": "asciivstring(64)",
    "nul": true
  },
  {
    "name": "group_id",
    "label": "Group ID",
    "type": "asciivstring(128)",
    "nul": true
  },
  {
    "name": "active_mo",
    "label": "Active MO",
    "type": "asciivstring(8)",
    "nul": true
  },
  {
    "name": "active_pa",
    "label": "Active PA",
    "type": "asciivstring(8)",
    "nul": true
  },
  {
    "name": "optical_axis",
    "label": "Optical Axis",
    "type": "asciivstring(8)",
    "nul": true
  },
  {
    "name": "osa_confs",
    "label": "OSA Configurations",
    "type": "asciivstring(8)",
    "nul": true

```
},
{
  "name": "pa_current_sp",
  "label": "PA Current Setpoint",
  "type": "float(8)",
  "unit": "mA",
  "nul": true
},
{
  "name": "lom_temp",
  "label": "LOM Temperature",
  "type": "float(8)",
  "unit": "C",
  "nul": true
},
{
  "name": "peak_wavelength",
  "label": "Peak Wavelength",
  "type": "float(8)",
  "unit": "nm",
  "nul": true
},
{
  "name": "peak_amplitude",
  "label": "Peak Amplitude",
  "type": "float(8)",
  "unit": "dBm",
  "nul": true
},
{
  "name": "sidemode_lo_wavelength",
  "label": "Sidemode Lo Wavelength",
  "type": "float(8)",
  "unit": "nm",
  "nul": true
},
{
  "name": "sidemode_lo_amplitude",
  "label": "Sidemode Lo Amplitude",
  "type": "float(8)",
```

```
      "unit": "dBm",
      "nul": true
    },
    {
      "name": "sidemode_hi_wavelength",
      "label": "Sidemode Hi Wavelength",
      "type": "float(8)",
      "unit": "nm",
      "nul": true
    },
    {
      "name": "sidemode_hi_amplitude",
      "label": "Sidemode Hi Amplitude",
      "type": "float(8)",
      "unit": "dBm",
      "nul": true
    }
  ],
  "conf": {
    "spectrum": {
      "charts": {
        "summary": {
          "x": [
            "t_start",
            "t_end",
            "$groupRelativeTime",
            "$groupIndex",
            "lom_temp",
            "pa_current_sp",
            "$id"
          ],
          "y": [
            "peak_wavelength",
            "peak_amplitude",
            "sidemode_lo_wavelength",
            "sidemode_lo_amplitude",
            "sidemode_hi_wavelength",
            "sidemode_hi_amplitude"
          ]
        },
```

```
  "spectrum": {
    "x": [
      {
        "field": "Wavelength (nm)",
        "label": "Wavelength (nm)",
        "source": "file"
      },
      {
        "field": "Spectral Width About Peak (GHz)",
        "label": "Spectral Width About Peak (GHz)",
        "source": "file"
      }
    ],
    "y": [
      {
        "field": "Amplitude (dBm)",
        "label": "Amplitude (dBm)",
        "source": "file"
      },
      {
        "field": "Out of Band (%)",
        "label": "Out of Band (%)",
        "source": "file"
      }
    ]
  }
},
"filters": [
  {
    "name": "fast",
    "label": "Fast",
    "desc": "Fast",
    "color": "green",
    "checks": [
      {
        "field": "optical_axis",
        "value": "fast"
      }
    ]
  },
```

```
    {
      "name": "slow",
      "label": "Slow",
      "desc": "Slow",
      "color": "red",
      "checks": [
        {
          "field": "optical_axis",
          "value": "slow"
        }
      ]
    },
    {
      "name": "narrow",
      "label": "Narrow",
      "desc": "Narrow",
      "color": "purple",
      "checks": [
        {
          "field": "osa_confs",
          "value": "narrow"
        }
      ]
    },
    {
      "name": "wide",
      "label": "Wide",
      "desc": "Wide",
      "color": "orange",
      "checks": [
        {
          "field": "osa_confs",
          "value": "wide"
        }
      ]
    }
  ],
  "grouping": [
    "t_start",
    "group_id",
```

```
        "test_stage",
        "active_mo",
        "active_pa",
        "optical_axis",
        "osa_confs",
        "pa_current_sp"
      ]
    }
  }
}
```

There's a lot happening here, so we can unpack in sections.

Basic Database Parameters

```
{
  "action": "struct_create",
  "create": "event",
  "type": "file",
  "group": "sandbox.model_name",
  "name": "spectra",
  "label": "Spectra",
  "desc": "spectra",
  "singular": "spectrum",
  "plural": "spectra",
  "teams": [ "sandbox", "sandbox_dev" ]
}
```

This is the basic database configuration. The `"type": "file"` indicates each record will have an associated file (the spectrum data). The `"teams"` determines which users have read/write access to the database, and may need to be different depending on the XINA environment.

Custom Fields

```
{
  "fields": [
    {
      "name": "test_stage",
      "label": "Test Stage",
      "type": "asciivstring(64)"
    },
    {
```

```
  "name": "group_id",
  "label": "Group ID",
  "type": "asciivstring(128)",
  "nul": true
},
{
  "name": "active_mo",
  "label": "Active MO",
  "type": "asciivstring(8)",
  "nul": true
},
{
  "name": "active_pa",
  "label": "Active PA",
  "type": "asciivstring(8)",
  "nul": true
},
{
  "name": "optical_axis",
  "label": "Optical Axis",
  "type": "asciivstring(8)",
  "nul": true
},
{
  "name": "osa_confs",
  "label": "OSA Configurations",
  "type": "asciivstring(8)",
  "nul": true
},
{
  "name": "pa_current_sp",
  "label": "PA Current Setpoint",
  "type": "float(8)",
  "unit": "mA",
  "nul": true
},
{
  "name": "lom_temp",
  "label": "LOM Temperature",
  "type": "float(8)",
```

```
  "unit": "C",
  "nul": true
},
{
  "name": "peak_wavelength",
  "label": "Peak Wavelength",
  "type": "float(8)",
  "unit": "nm",
  "nul": true
},
{
  "name": "peak_amplitude",
  "label": "Peak Amplitude",
  "type": "float(8)",
  "unit": "dBm",
  "nul": true
},
{
  "name": "sidemode_lo_wavelength",
  "label": "Sidemode Lo Wavelength",
  "type": "float(8)",
  "unit": "nm",
  "nul": true
},
{
  "name": "sidemode_lo_amplitude",
  "label": "Sidemode Lo Amplitude",
  "type": "float(8)",
  "unit": "dBm",
  "nul": true
},
{
  "name": "sidemode_hi_wavelength",
  "label": "Sidemode Hi Wavelength",
  "type": "float(8)",
  "unit": "nm",
  "nul": true
},
{
  "name": "sidemode_hi_amplitude",
```

```
      "label": "Sidemode Hi Amplitude",
      "type": "float(8)",
      "unit": "dBm",
      "nul": true
    }
  }
}
```

These are the custom fields to include in the database, which will be used in addition to the default event database fields. A value for each field must be provided, unless `"nul"` is set to `true`.

Spectra Configuration

```
{
 "conf": {
  "spectrum": {
   "charts": {
    "summary": {
     "x": [
      "t_start",
      "t_end",
      "$groupRelativeTime",
      "$groupIndex",
      "lom_temp",
      "pa_current_sp",
      "$id"
     ],
     "y": [
      "peak_wavelength",
      "peak_amplitude",
      "sidemode_lo_wavelength",
      "sidemode_lo_amplitude",
      "sidemode_hi_wavelength",
      "sidemode_hi_amplitude"
     ]
    },
    "spectrum": {
     "x": [
      {
       "field": "Wavelength (nm)",
       "label": "Wavelength (nm)",
```

```
        "source": "file"
      },
      {
        "field": "Spectral Width About Peak (GHz)",
        "label": "Spectral Width About Peak (GHz)",
        "source": "file"
      }
    ],
    "y": [
      {
        "field": "Amplitude (dBm)",
        "label": "Amplitude (dBm)",
        "source": "file"
      },
      {
        "field": "Out of Band (%)",
        "label": "Out of Band (%)",
        "source": "file"
      }
    ]
  }
},
"filters": [
  {
    "name": "fast",
    "label": "Fast",
    "desc": "Fast",
    "color": "green",
    "checks": [
      {
        "field": "optical_axis",
        "value": "fast"
      }
    ]
  },
  {
    "name": "slow",
    "label": "Slow",
    "desc": "Slow",
    "color": "red",
```

```
      "checks": [
        {
          "field": "optical_axis",
          "value": "slow"
        }
      ]
    },
    {
      "name": "narrow",
      "label": "Narrow",
      "desc": "Narrow",
      "color": "purple",
      "checks": [
        {
          "field": "osa_confs",
          "value": "narrow"
        }
      ]
    },
    {
      "name": "wide",
      "label": "Wide",
      "desc": "Wide",
      "color": "orange",
      "checks": [
        {
          "field": "osa_confs",
          "value": "wide"
        }
      ]
    }
  ],
  "grouping": [
    "t_start",
    "group_id",
    "test_stage",
    "active_mo",
    "active_pa",
    "optical_axis",
    "osa_confs",
```

```
        "pa_current_sp"
      ]
    }
  }
}
```

Finally, the `"conf"` object contains the information required for XINA to interpret the event database as a spectra database. This contains three sections.

Charts

The charts section contains two subsections, `"summary"`, and `"spectra"`. The summary chart is displayed on the top of the Spectra Tool and plots one data point per spectrum. The configuration specifies the fields which should be listed as selectable options for the X and Y axes. This can include any of the event database default fields and/or custom fields. It also may include macros, indicated by starting with the `$` character. These add additional logic and are implemented in the spectra tool itself.

The spectra chart is displayed at the bottom of the tool, and plots the full set of data for each selected spectrum. The options for each axis must be defined here to be correctly located in the associated file.

Other Features

The `"filters"` section defines filter options that will appear on the spectra tool, and the `"grouping"` option defines which fields should be available as options to create spectra groupings in the summary chart. More info on other settings is available here.

Spectrum Data Files

The spectrum files may either use a JSON format or DSV format. More formats may be added in the future.

JSON Format

A spectrum JSON file must contain a single JSON object, where each member should have an array of the same length of numeric values. An example compatible with the above spectra database could look like:

```
{
 "Wavelength (nm)": [ 1, 2, 3 ],
 "Spectral Width About Peak (GHz)": [ 0, 1, 0 ],
 "Amplitude (dBm)": [ 100, 200, 300 ],
 "Out of Band (%)": [ 5, 6, 7 ],
 "Comment": "ignored"
}
```

Note that the keys for each array must exactly match the names in the spectra `"conf"` object, or they will not be recognized correctly. Keys may be included which are not listed there, but they will be ignored for data purposes.

DSV Format

The spectrum DSV file format is based on the standard XINA Structs DSV file format, but doesn't require a time field. For example, a file with the same data as the above JSON example could look like:

```
# ignored comment
Wavelength (nm), Spectral Width About Peak (GHz), Amplitude (dBm), Out of Band (%)
1, 0, 100, 5
2, 1, 200, 6
3, 0, 300, 7
```

Modifications

A number of actions are available for changing the structure of a spectra database.

Drop

The drop action can delete an entire database (or group/model). This is permanent and deletes all data within the database as well, but is useful during initial experimentation as it gives a clean slate.

Drop Group

```
{
 "action": "drop",
 "drop": "group",
 "group": "sandbox.model_name",
 "drop_children": true
}
```

Note that when dropping a group, the `"drop_children"` flag must be `true` if the group contains any child groups or databases. In doing so all child groups and databases (and all data within) are deleted permanently.

Drop Database

```
{
 "action": "drop",
 "drop": "database",
 "database": "sandbox.model_name.spectra"
}
```

Reset Action

The reset action deletes all data in a database permanently. This is the fastest way to clear a database.

```
{
  "action": "reset",
  "database": "sandbox.model_name.spectra"
}
```

Altering Fields

Fields can be added or removed using the alter actions.

Add Fields

```
{
  "action": "alter",
  "alter": "database",
  "op": "add_fields",
  "database": "sandbox.model_name.spectra",
  "fields": [
    {
      "name": "new_field",
      "label": "New Field",
      "type": "float(8)",
      "nul": true
    }
  ]
}
```

Note that when adding fields to a database containing data, `"nul"` should typically be set to `true` (since existing records won't have a value for the field).

Drop Fields

```
{
  "action": "alter",
  "alter": "database",
  "op": "drop_fields",
  "database": "sandbox.model_name.spectra",
  "fields": [
    "unused_field"
  ]
}
```

Note that any data in dropped fields is deleted permanently.

Alter Configuration

The `struct_alter_database_conf` action can be used to update the spectrum configuration object. Care should be used when making changes here to ensure updates align with existing/added fields, and do not reference dropped fields, or errors may occur when loading the tool. Additionally, this replaces the entire `"spectrum"` object, so any existing configuration must be included to be preserved.

```
{
  "action": "struct_alter",
  "alter": "database",
  "op": "conf",
  "database": "sandbox.model_name.spectra",
  "conf": {
    "spectrum": { ... }
  }
}
```