

# General Coordinates Network

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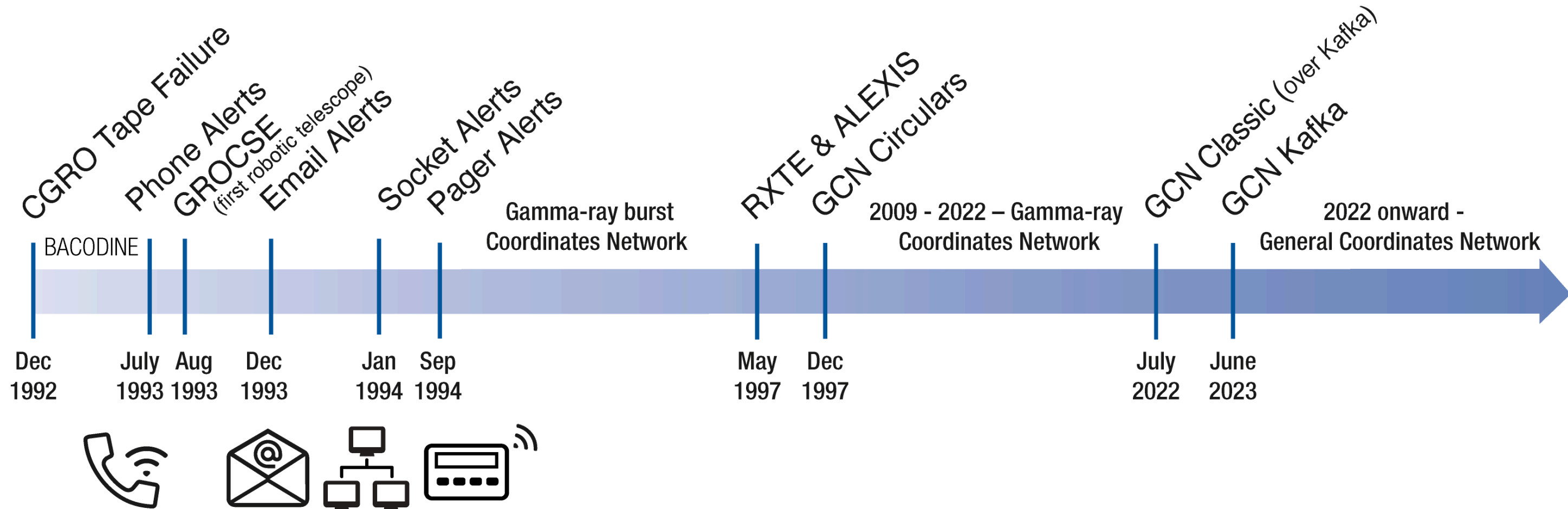
NASA's Next Generation Time-Domain and Multimessenger Alert System

A service of the [Astrophysics Science Division](#) at NASA's [Goddard Space Flight Center](#)

<https://gcn.nasa.gov>

**Judy Racusin (GCN PI, NASA GSFC)**

# Early History of GCN



- BACODINE provided new alert formats (phone, email, socket, and pager)
- New instruments and transient types led to the Gamma-ray Coordinates Network

# There are two kinds of GCN data products:

## GCN NOTICES

```
TITLE:          GCN/FERMI NOTICE
NOTICE_DATE:    Wed 26 Aug 20 22:10:07 UT
NOTICE_TYPE:    Fermi-GBM Flight Position
RECORD_NUM:     45
TRIGGER_NUM:    620172587
GRB_RA:         296.300d {+19h 45m 12s} (J2000),
                296.250d {+19h 45m 00s} (current),
                296.416d {+19h 45m 40s} (1950)
GRB_DEC:        +71.817d {+71d 49' 00"} (J2000),
                +71.868d {+71d 52' 03"} (current),
                +71.693d {+71d 41' 35"} (1950)
GRB_ERROR:      5.50 [deg radius, statistical plus systematic]
GRB_INTEN:      1078 [cnts/sec]
DATA_SIGNIF:    22.80 [sigma]
INTEG_TIME:     1.024 [sec]
GRB_DATE:       19087 TJD; 239 DOY; 20/08/26
GRB_TIME:       79782.72 SOD {22:09:42.72} UT
GRB_PHI:        20.00 [deg]
GRB_THETA:      150.00 [deg]
DATA_TIME_SCALE: 1.0240 [sec]
HARD_RATIO:     0.54
LOC_ALGORITHM:  3 (version number of)
MOST_LIKELY:    93% GRB
2nd_MOST_LIKELY: 4% Generic Transient
DETECTORS:      0,0,0, 0,1,1, 0,0,0, 0,0,0, 0,0,
SUN_POSTN:      156.00d {+10h 24m 01s} +10.00d {+09d 59' 51"}
SUN_DIST:       94.05 [deg] Sun_angle= -9.3 [hr] (East of Sun)
MOON_POSTN:     258.31d {+17h 13m 14s} -22.27d {-22d 15' 56"}
MOON_DIST:      97.64 [deg]
MOON_ILLUM:     63 [%]
GAL_COORDS:     103.87, 21.63 [deg] galactic lon,lat of the burst (or transient)
ECL_COORDS:     41.25, 79.40 [deg] ecliptic lon,lat of the burst (or transient)
LC_URL:         http://heasarc.gsfc.nasa.gov/FTP/fermi/data/gbm/triggers/2020/bn200826923/
COMMENTS:       Fermi-GBM Flight-calculated Coordinates.
COMMENTS:       This trigger occurred at longitude,latitude = 209.65,1.28 [deg].
COMMENTS:       The LC_URL file will not be created until ~15 min after the trigger.
```

- By and for machines
- Fixed, predefined format
- Schema specific to each notice type

## GCN CIRCULARS

```
TITLE:          GCN CIRCULAR
NUMBER:         28298
SUBJECT:        GRB 200826B: Fermi GBM detection
DATE:          20/08/27 21:10:30 GMT
FROM:          Christian Malacaria at NASA-MSFC/USRA <cmalacaria@usra.edu>
```

C. Malacaria (NASA-MSFC/USRA) and C.Meegan (UAH)  
report on behalf of the Fermi GBM Team:

"At 22:09:42.72 UT on 26 August 2020, the Fermi Gamma-Ray Burst Monitor (GBM) triggered and located GRB 200826B (trigger 620172587 / 200826923).

The on-ground calculated location, using the GBM trigger data, was reported in GCN 28292.

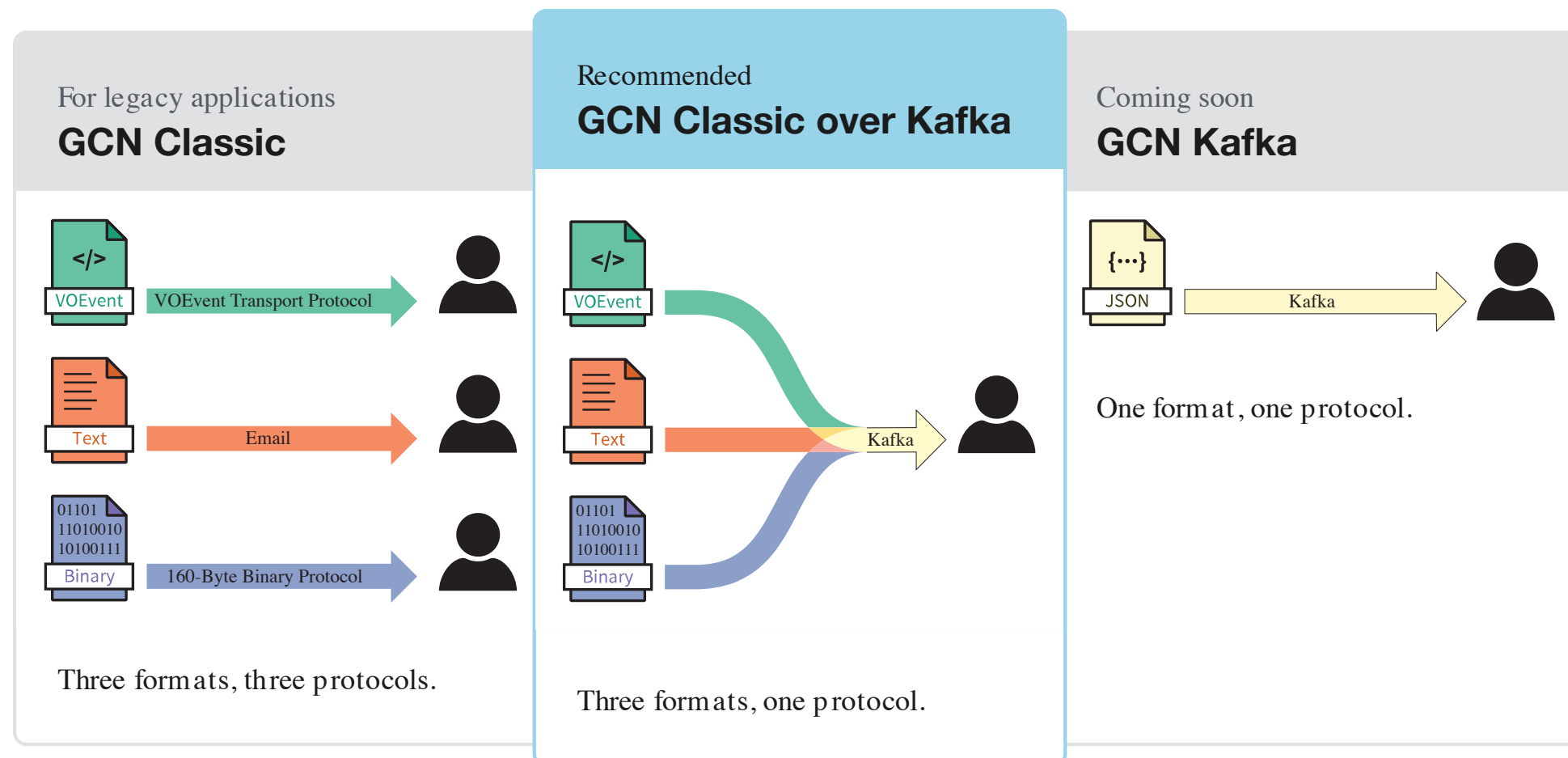
The GBM light curve shows an exceptionally bright long GRB with a duration (T90) of about 7.4 s (50-300 keV). The time-averaged spectrum from T0-0.003 s to T0+ 12.544 s is best fit by a Band function with Epeak = 410.3 +/- 5.6 keV, alpha = -0.64 +/- 0.01, and beta = -2.52 +/- 0.04. The event fluence (10-1000 keV) in this time interval is (1.414 +/- 0.006)E-04 erg/cm^2. The 1.024-sec peak photon flux measured starting from T0+5.1 s in the 10-1000 keV band is 110.1 +/- 0.7 ph/s/cm^2.

The spectral analysis results presented above are preliminary; final results will be published in the GBM GRB Catalog:  
<https://heasarc.gsfc.nasa.gov/W3Browse/fermi/fermigbrst.html>

For Fermi GBM data and info, please visit the official Fermi GBM Support Page:  
<https://fermi.gsfc.nasa.gov/ssc/data/access/gbm/>

- By and for humans (some automated)
- Freeform text (with established style)
- Citable (but not peer-reviewed)

# The New GCN is built on Kafka



- **GCN Classic** provides three formats over *three custom protocols*
- **GCN Classic over Kafka** provides all three formats over *one standard protocol: Apache Kafka*
- **GCN Kafka** will transition over the next few years to streaming all data in JSON format over Kafka (Notices and Circulars)

# Why switch to the new GCN?


## GCN Classic

## GCN Classic over Kafka

 **Self-service**

**NO.** Users need to contact administrator in order to make account and subscription changes

**YES.** Manage your own account and subscription settings through the web site

 **Open standards**

**NO.** Notices are sent using three custom protocols

**YES.** Notices are sent using one standard protocol, [Apache Kafka](#)

 **Open source**

**NO.** Custom software needed to receive notices

**YES.** Receive notices using open-source software

 **Highly available**

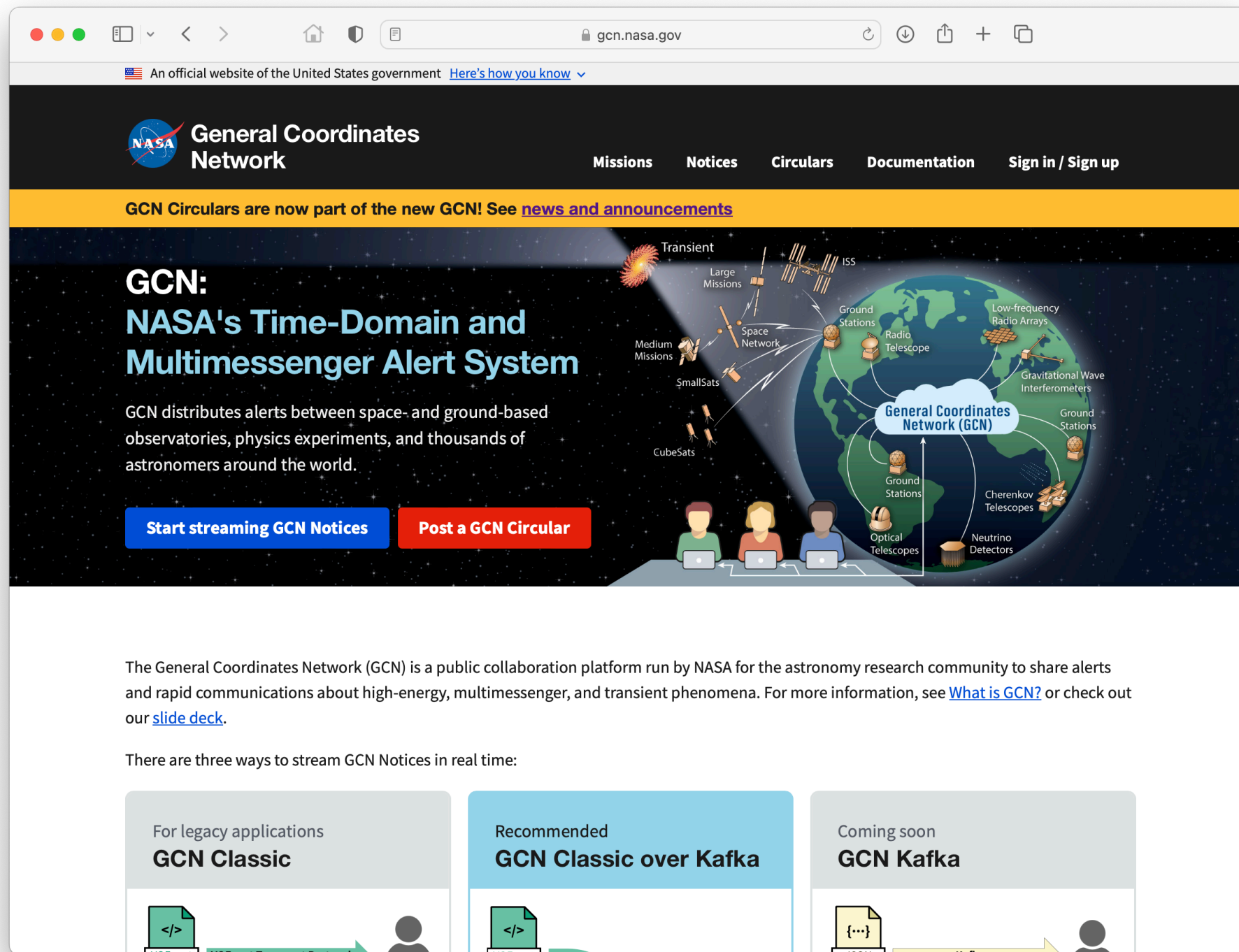
**NO.** Notices are broadcast by a single server

**YES.** Notices are broadcast by a cluster of highly-available Kafka brokers in the cloud

 **Secure**

**NO.** Notices are sent as plaintext

**YES.** Notices are protected with SSL/TLS



# New GCN web site

at <https://gcn.nasa.gov>

- Updated look and feel
- More accessible, based on [US Web Design System](#)
- Single sign on with:
  - email and password
  - Google
  - Facebook
  - LaunchPad (for NASA employees and affiliates)

# Self-service email alerts

Email is still the most popular way to receive GCN Notices.

- Previously, users had to contact the GCN Team to create or modify their subscriptions manually.
- Now, you can manage your email subscriptions yourself through our new web site.
- **Note:** to cancel legacy email subscriptions on the old web site, [contact us](#).

The screenshot shows a web browser window at the URL `gcn.nasa.gov/user/email/edit`. The page header includes the NASA logo and the text "General Coordinates Network". A navigation menu contains links for "Missions", "Notices", "Circulars", "Documentation", and a user profile dropdown for "leo.p.singer@nasa.gov". A yellow banner below the header reads: "Self-service email notifications for GCN Notices are here! See [news and announcements](#)".

The main content area is titled "Email Notifications" and contains the following fields and options:

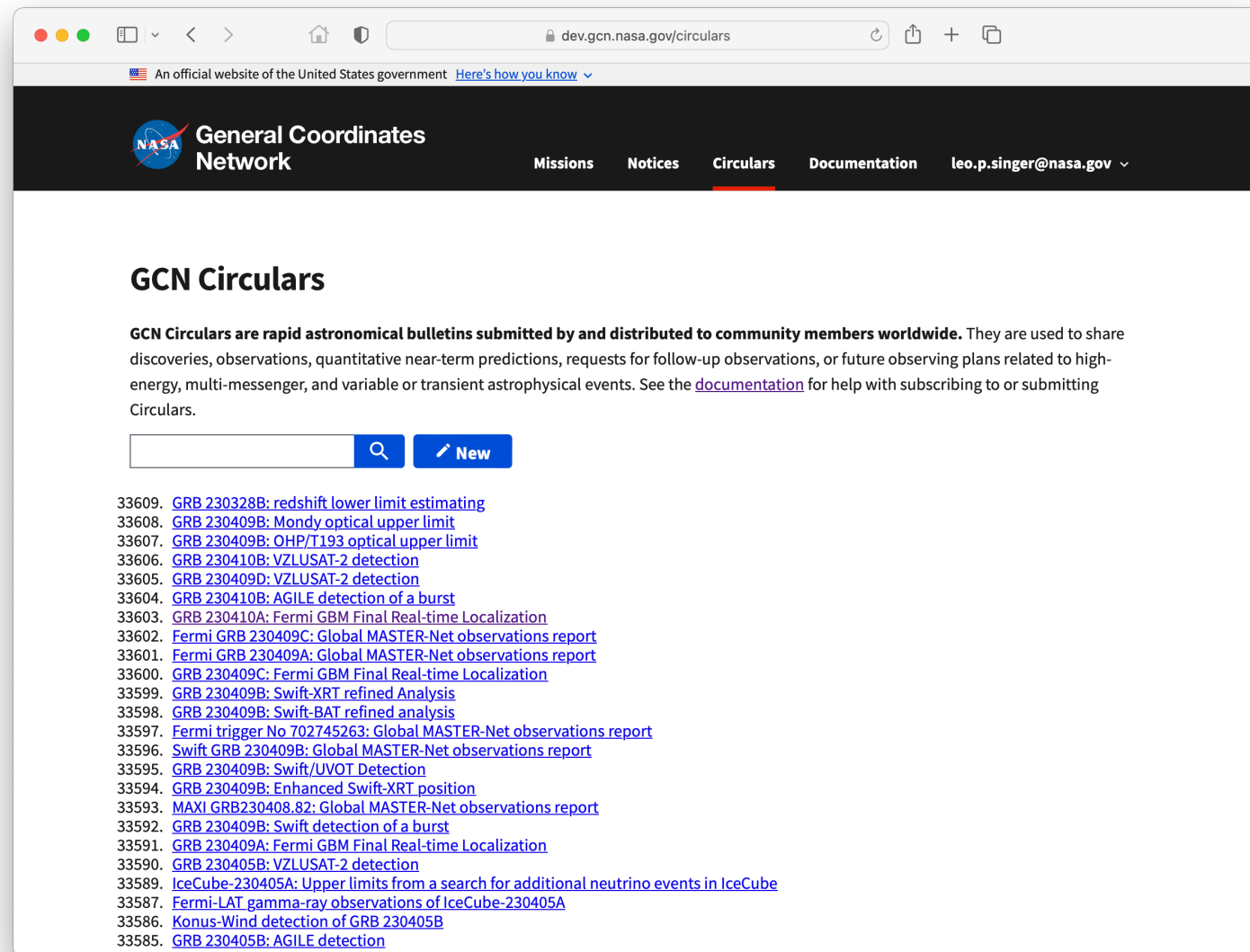
- Name\***: A text input field containing "Demo".
- Recipient\***: A text input field containing "leo.p.singer@nasa.gov".
- Format**: Three buttons labeled "Text", "VOEvent", and "Binary". The "Text" button is selected.
- Types**: A list of checkboxes with labels and links to details:
  - Agile ([Details](#))
  - AMON ([Details](#))
  - Calet ([Details](#))
  - Fermi ([Details](#))
  - IceCube ([Details](#))
  - INTEGRAL ([Details](#))

Below the "Types" list, there is a note: "Plain text key: value pairs separated by newlines."

New and improved:

# GCN Circulares

at <https://gcn.nasa.gov/circulars>



- Browse and search our new [archive](#).
- Manage your own email subscriptions.
- Enroll yourself and your colleagues to submit Circulares with arXiv-style peer endorsements.
- Submit Circulares with our [new Web form](#), or continue to submit by email.

(skip ahead for more on GCN Circulares)



# What's staying the same?

GCN Classic is not going away any time soon. The following are still fully supported:

- GCN Notices legacy delivery mechanisms (email, socket, VOEvent Transport Protocol) of all current notice types
- GCN Circulars submission and delivery via email
- The old GCN Classic web site, <https://gcn.gsfc.nasa.gov>
- The live archives of [GCN Notices](#) on the old web site

However, new features and notice types are only available on the new web site and GCN Kafka.

# Streaming GCN Notices in Python

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gcn.nasa.gov

An official website of the United States government [Here's how you know](#)

**NASA General Coordinates Network**

Missions Notices Circulars Documentation Sign in / Sign up

### The new GCN: Multimessenger astronomy alerts delivered over Kafka

GCN distributes alerts between space- and ground-based observatories, physics experiments, and thousands of astronomers around the world.

[Start streaming GCN Notices](#)

The General Coordinates Network (GCN) is a public collaboration platform run by NASA for the astronomy research community to share alerts and rapid communications about high-energy, multimessenger, and transient phenomena. For more information, see [What is GCN?](#)

There are three ways to stream GCN Notices in real time:

For legacy applications

**GCN Classic**

Recommended

**GCN Classic over Kafka**

Coming soon

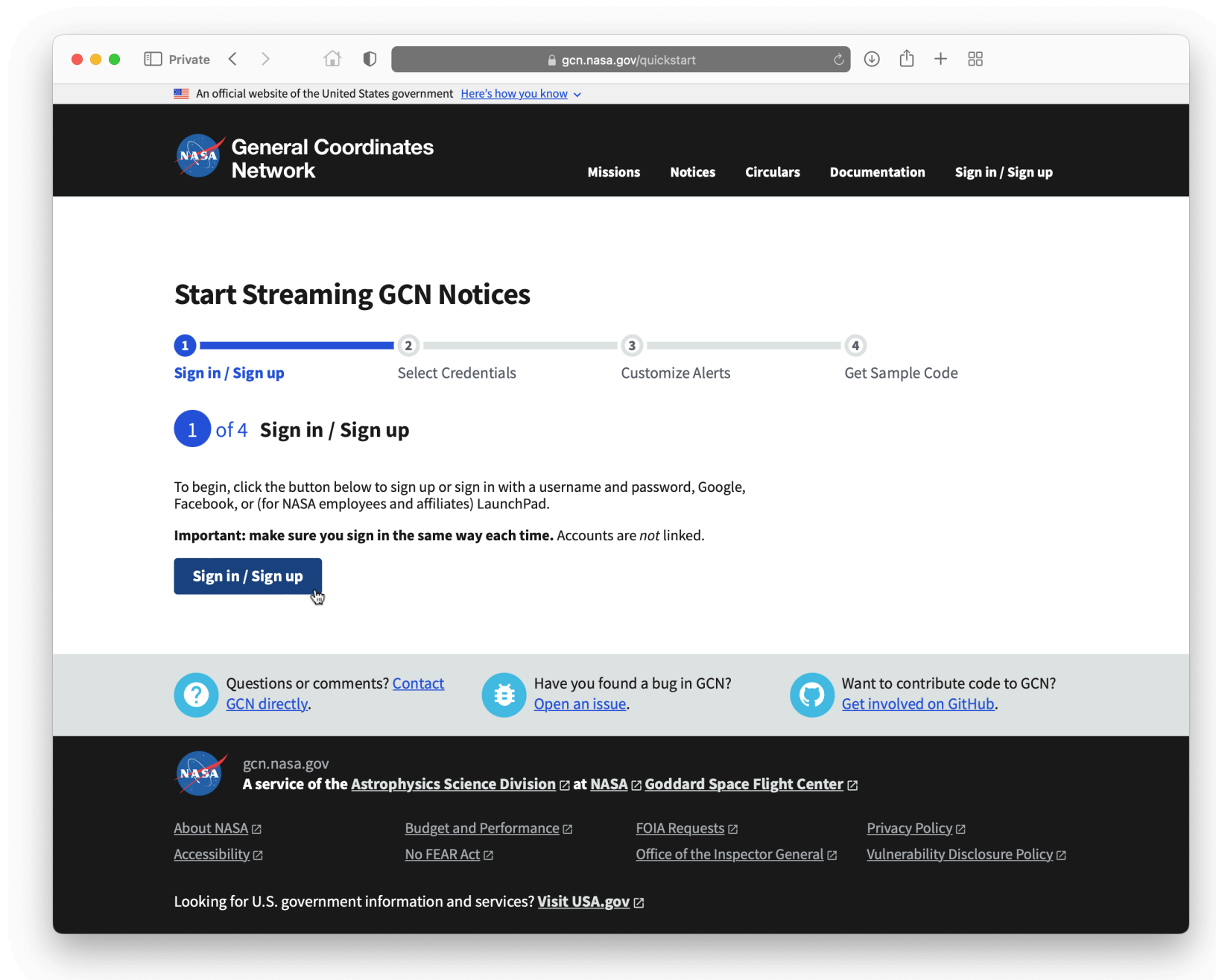
**GCN Kafka**

One format, one protocol

# Launch quick start

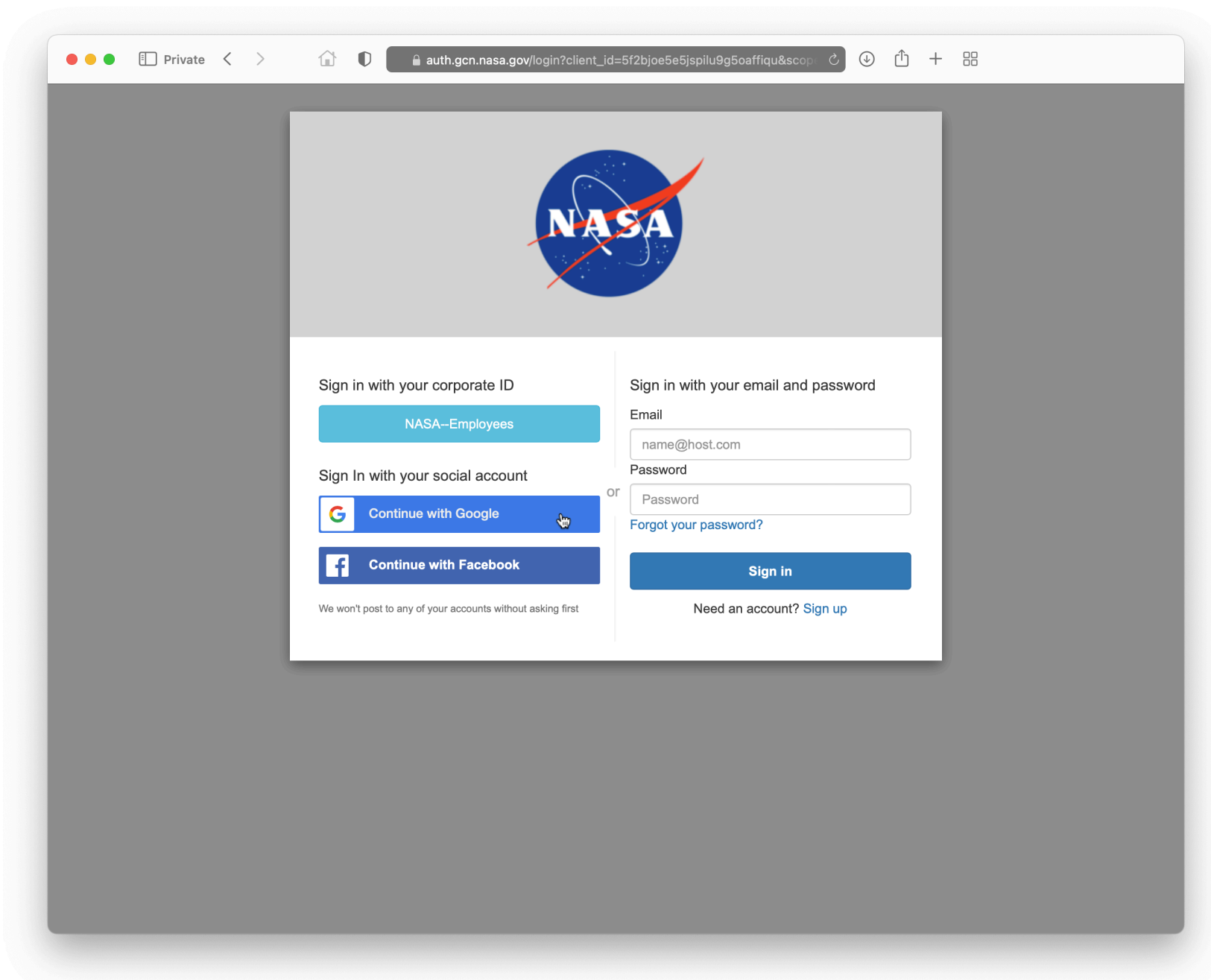
Go to <https://gcn.nasa.gov> and click Start streaming GCN Notices

(skip past demo)



# Step 1: Sign in / Sign up

Click "Sign in / Sign up" to create a GCN account.

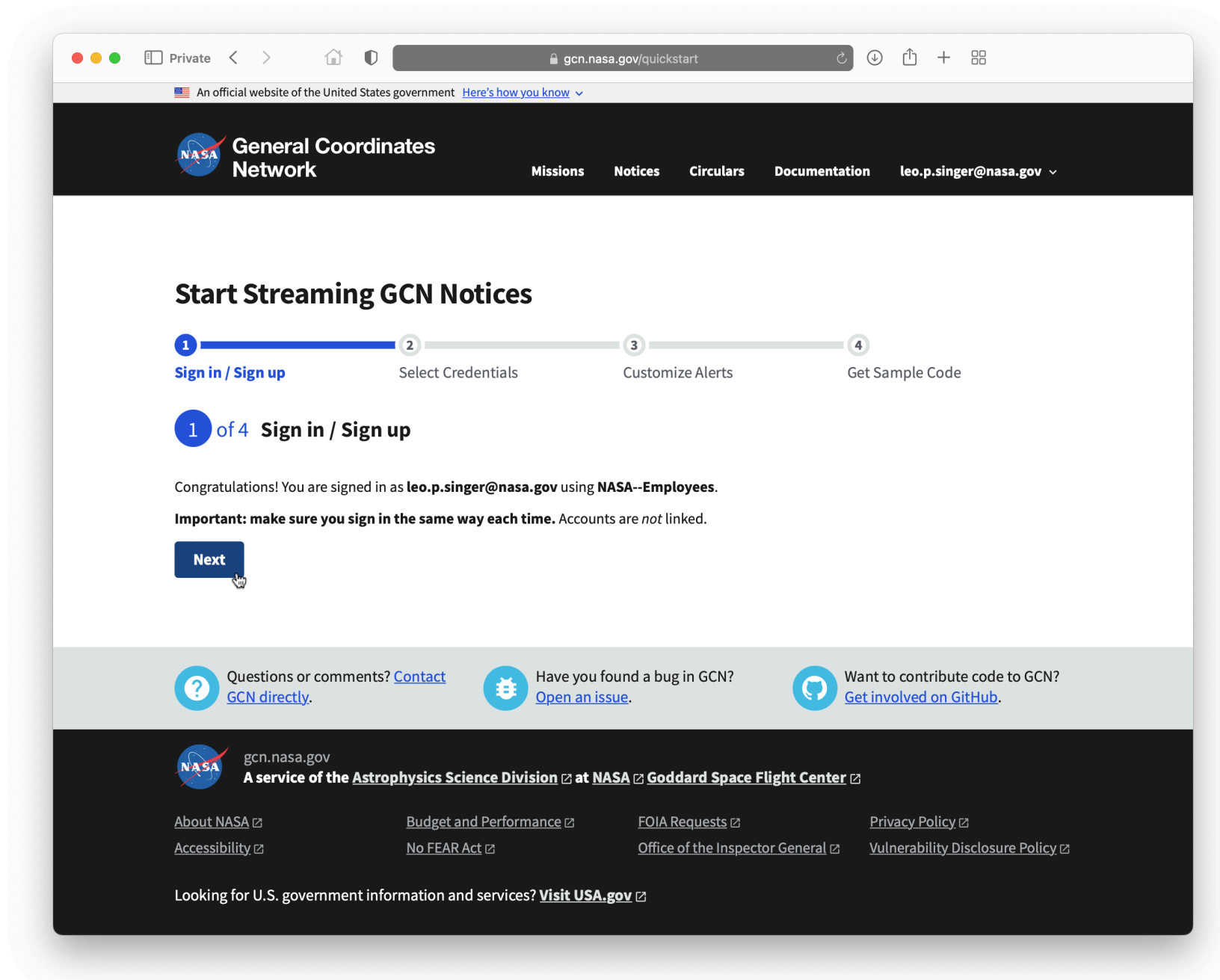


# Choose how to sign up

Choose any one of the following methods to sign up:

- Email and password
- Google
- Facebook
- (for NASA employees and affiliates) LaunchPad

**Important: make sure you sign in the same way each time.** Accounts are *not* linked.



# Step 1 is done

## Click "Next" to continue

gcn.nasa.gov/quickstart/credentials

An official website of the United States government [Here's how you know](#)

**General Coordinates Network** Missions Notices Circulars Documentation leo.p.singer@nasa.gov

### Start Streaming GCN Notices

- 1 Sign in / Sign up
- 2 **Select Credentials**
- 3 Customize Alerts
- 4 Get Sample Code

**2 of 4 Select Credentials**


Client credentials allow your scripts to interact with GCN on your behalf.

Choose a name for your new client credential.

The name should help you remember what you use the client credential for, or where you use it. Examples: "My Laptop", "Lab Desktop", "GRB Pipeline".

Name

Scope

I'm not a robot  reCAPTCHA  
Privacy · Terms

[Back](#) [Create New Credentials](#)

## Step 2: Select Credentials

Client credentials allow your scripts to interact with GCN on your behalf.

1. Choose a name for your credential.
2. Complete the CAPTCHA.
3. Click "Create New Credentials" to go to the next step.

gcn.nasa.gov/quickstart/alerts?clientId=1hfoomo26fpfn81nviaknjuph

An official website of the United States government [Here's how you know](#)

**General Coordinates Network** Missions Notices Circulars Documentation [judith.racusin@nasa.gov](mailto:judith.racusin@nasa.gov)

New Swift-BAT/GUANO and IceCube Notice Types Available! See [news and announcements](#)

### Start Streaming GCN Notices

- 1 Sign in / Sign up
- 2 Select Credentials
- 3 **Customize Alerts**
- 4 Get Sample Code

3 of 4 **Customize Alerts**

Choose how you would like your results returned. Select a Format and Notice type for each alert you would like to subscribe to. More details on the Notice Types can be found their respective pages under [Missions](#).

Notice Format

**Text** VOEvent Binary JSON

Plain text key: value pairs separated by newlines.

Notice Type

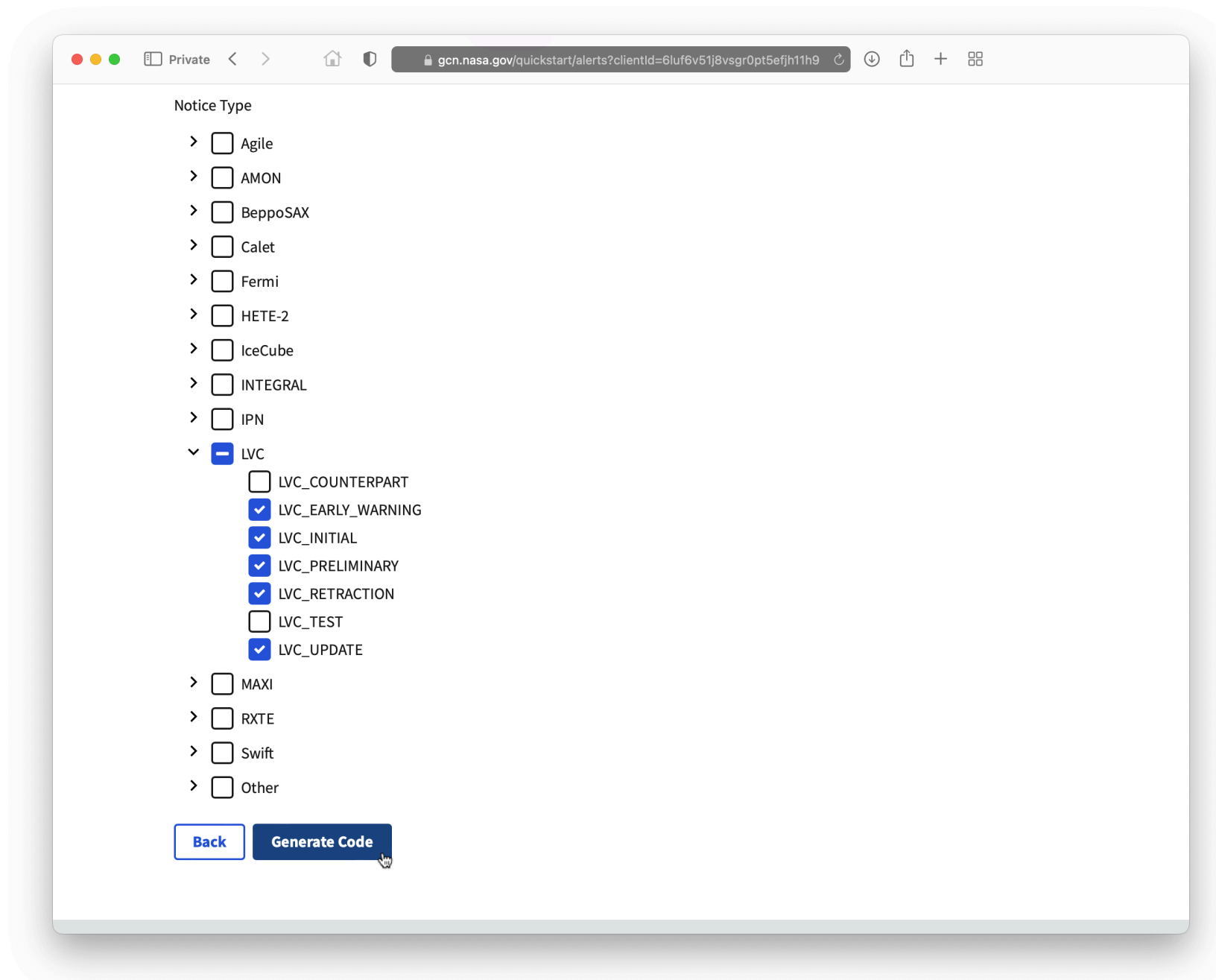
- >  AGILE [Details](#)
- >  AMON [Details](#)
- >  Calet [Details](#)
- >  Fermi [Details](#)
- >  GECAM [Details](#)
- >  IceCube [Details](#)
- >  INTEGRAL [Details](#)

## Step 3: Customize Alerts

Select one of these alert formats.

- Text: plain text key-value pairs separated by newlines.
- VOEvent: [VOEvent XML](#).
- Binary: 160-byte binary format. Field packing is [specific to each notice type](#).
- JSON: key-value pairs and arrays, allows embedding attachments.





## Step 3 Continued: Choose Notice Types

Select the missions that you want to subscribe to. Expand a mission to fine-tune notice types.

The screenshot shows a web browser window at `gcn.nasa.gov/quickstart/code?noticeFormat=text&LVC_INITIAL=or`. The page is titled "Start Streaming GCN Notices" and features a progress bar with four steps: 1. Sign in / Sign up, 2. Select Credentials, 3. Customize Alerts, and 4. Get Sample Code. The fourth step is currently active. Below the progress bar, there are tabs for different programming languages: Python, Node.js (ESM), Node.js (CommonJS), C/C++, and C#. The Python tab is selected, showing instructions to install the `gcn-kafka` package using `pip` or `conda`. A Python code snippet is provided for a consumer that connects to the GCN Kafka service and subscribes to topics.

```
from gcn_kafka import Consumer

# Connect as a consumer.
# Warning: don't share the client secret with others.
consumer = Consumer(client_id='4bukph141cmsi7ef11saa1iro',
                    client_secret='1iq5lc4gc2ritfncujb30hk7dh3gb2bhnu2rr42e8i17vjeqkibj')

# Subscribe to topics and receive alerts
```

## Step 4: Get Sample Code

Copy and paste Python client code or download it to your computer to run.

Client sample code is also available in Node.js (ESM or CommonJS), C/C++, C#.

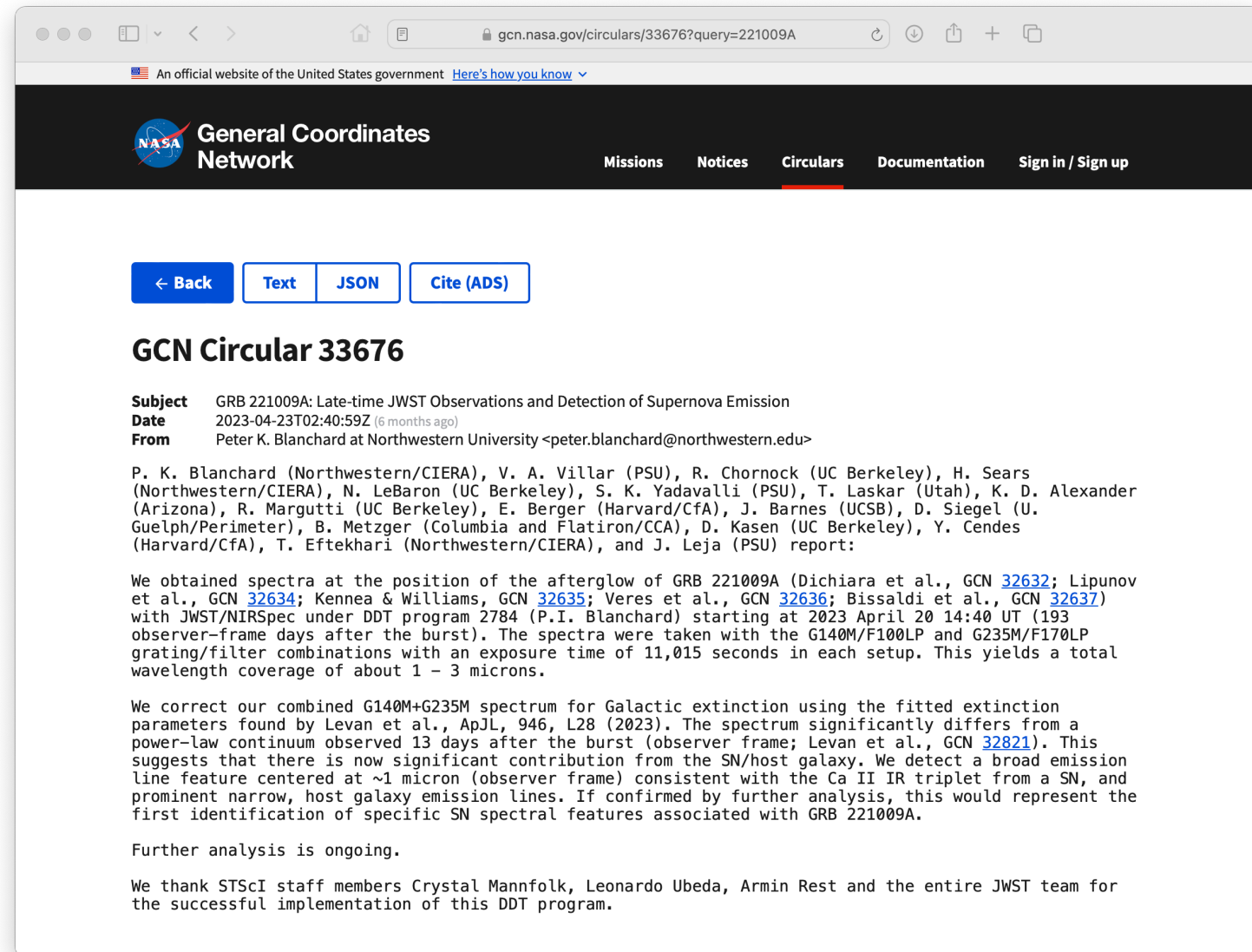
# The New GCN Circulars

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# Improvements to Circulars

The new GCN Circulars are:

- **Self service:** Manage your own subscriptions and settings.
- **More inclusive:** It's easy to join the community and submit a GCN Circular.
- **Fast:** Email notifications are distributed in parallel to all users within seconds.
- **Robust:** Circulars run on highly available, distributed cloud services.
- **Sustainable:** GCN Circulars are robustly funded by NASA and are part of the open source GCN project.



The screenshot shows a web browser window displaying the NASA General Coordinates Network (GCN) website. The URL is gcn.nasa.gov/circulars/33676?query=221009A. The page features a navigation bar with links for Missions, Notices, Circulars (highlighted), Documentation, and Sign in / Sign up. Below the navigation bar, there are buttons for Back, Text, JSON, and Cite (ADS). The main content area displays the title "GCN Circular 33676" and the following details:

**Subject** GRB 221009A: Late-time JWST Observations and Detection of Supernova Emission  
**Date** 2023-04-23T02:40:59Z (6 months ago)  
**From** Peter K. Blanchard at Northwestern University <peter.blanchard@northwestern.edu>

P. K. Blanchard (Northwestern/CIERA), V. A. Villar (PSU), R. Chornock (UC Berkeley), H. Sears (Northwestern/CIERA), N. LeBaron (UC Berkeley), S. K. Yadavalli (PSU), T. Laskar (Utah), K. D. Alexander (Arizona), R. Margutti (UC Berkeley), E. Berger (Harvard/CfA), J. Barnes (UCSB), D. Siegel (U. Guelph/Perimeter), B. Metzger (Columbia and Flatiron/CCA), D. Kasen (UC Berkeley), Y. Cendes (Harvard/CfA), T. Eftekhari (Northwestern/CIERA), and J. Leja (PSU) report:

We obtained spectra at the position of the afterglow of GRB 221009A (Dichiara et al., GCN [32632](#); Lipunov et al., GCN [32634](#); Kennea & Williams, GCN [32635](#); Veres et al., GCN [32636](#); Bissaldi et al., GCN [32637](#)) with JWST/NIRSpec under DDT program 2784 (P.I. Blanchard) starting at 2023 April 20 14:40 UT (193 observer-frame days after the burst). The spectra were taken with the G140M/F100LP and G235M/F170LP grating/filter combinations with an exposure time of 11,015 seconds in each setup. This yields a total wavelength coverage of about 1 – 3 microns.

We correct our combined G140M+G235M spectrum for Galactic extinction using the fitted extinction parameters found by Levan et al., ApJL, 946, L28 (2023). The spectrum significantly differs from a power-law continuum observed 13 days after the burst (observer frame; Levan et al., GCN [32821](#)). This suggests that there is now significant contribution from the SN/host galaxy. We detect a broad emission line feature centered at ~1 micron (observer frame) consistent with the Ca II IR triplet from a SN, and prominent narrow, host galaxy emission lines. If confirmed by further analysis, this would represent the first identification of specific SN spectral features associated with GRB 221009A.


Further analysis is ongoing.

We thank STScI staff members Crystal Mannfolk, Leonardo Ubeda, Armin Rest and the entire JWST team for the successful implementation of this DDT program.

# Migrating GCN Circulars from GCN Classic

On April 17, 2023, GCN Circulars moved from the old site to the new one. If you had an account on the old system, then you already have an account on the new one!

## GCN CIRCULARS MIGRATION CHEAT SHEET

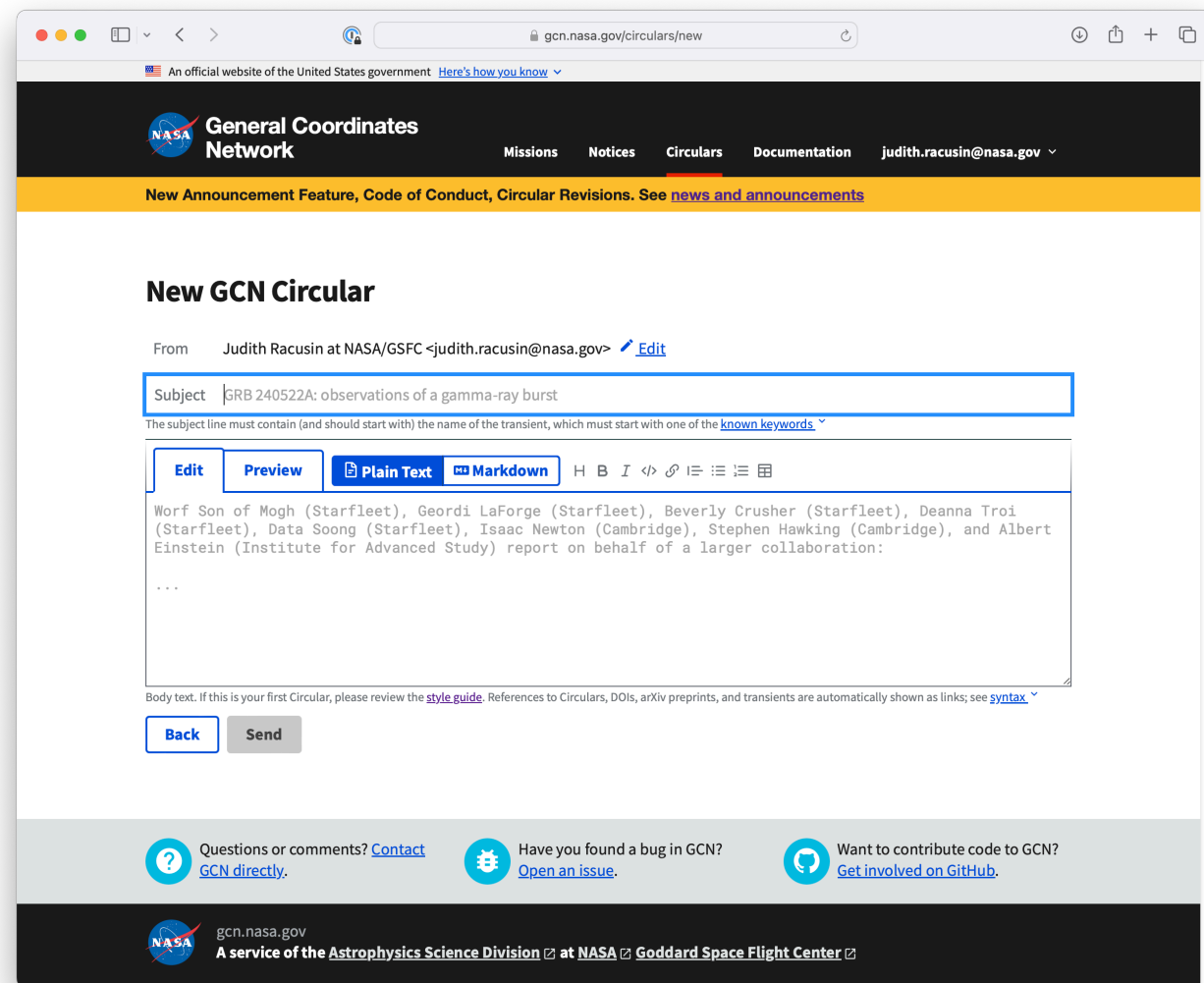
|  | Old   | New  |
|--|---|--|
|  <b>Web archive</b>                    | <a href="https://gcn.gsfc.nasa.gov/gcn3_archive.html">https://gcn.gsfc.nasa.gov/gcn3_archive.html</a> | <a href="https://gcn.nasa.gov/circulars">https://gcn.nasa.gov/circulars</a>  |
|  <b>Emails come from</b>             | gcncirc@capella2.gsfc.nasa.gov  | no-reply@gcn.nasa.gov  |
|  <b>Submit Circulars by email to</b> | <a href="mailto:gcncirc@capella2.gsfc.nasa.gov">gcncirc@capella2.gsfc.nasa.gov</a>                    | <a href="mailto:gcncirc@capella2.gsfc.nasa.gov">gcncirc@capella2.gsfc.nasa.gov</a><br><a href="mailto:circulars@gcn.nasa.gov">circulars@gcn.nasa.gov</a> (recommended) |
|  <b>Submit Circulars by web form</b> | (not supported)   | <a href="https://gcn.nasa.gov/circulars/new">https://gcn.nasa.gov/circulars/new</a>  |

# New Features of Circulars

- Embed tables, coordinates, images, and styled text in Circulars with “Astro Flavored Markdown”
- Minor revisions to Circulars in archive
- Interoperability with other transient Kafka brokers (e.g. [SCiMMA](#))
- Real-time integration with [SAO/NASA Astrophysics Data Service \(ADS\)](#)

## Coming Soon to Circulars

- Receive Circulars over Kafka
- Link multiple emails with your account
- Browse Circulars by event and source class
- Data extraction via Natural Language Models



## More enhancements are coming to GCN:

- New alert types and alerts from new missions and facilities
  - New Kafka-only notices for Swift-BAT/GUANO and IceCube
  - Many others in development including Einstein Probe, Glowbug, BurstCube, Super-K, Fermi-GBM, AMON
- Integrated, searchable database of Notices and Circulars (GCN Viewer)

The screenshot shows a web browser window with the URL `gcn.nasa.gov/docs/noti`. The page is titled "New Notice Producers" and is part of the "General Coordinates Network" website. The navigation menu includes "Missions", "Notices", "Circulars", "Documentation", and "judith.racusin@nasa.gov". A yellow banner at the top reads "New GCN Circulars features for September 2023! See [news and announcements](#)".

The main content area is titled "New Notice Producers" and contains the following text: "The following steps guide new instrument, mission, or observatory producers into setting up new notices streams that are distributed to the user community via [Kafka](#). This process requires interaction with the [GCN Team](#) to enable accounts and Kafka topics creation on the GCN Kafka broker. The GCN Team is also happy to work with the mission teams to help construct your alerts."

The page is organized into sections:

- Start Producing Alerts**
  - 1 Sign in / Sign up**

Decide which of your team members will have programmatic access to produce your alerts. Make sure that they have all signed in at least once to the [GCN website](#) and the [GCN test website](#).
  - 2 Name Your Kafka Topics**

Names of Kafka topics follow the format `gcn.notices.mission.notice_type`. Pick a prefix for your Kafka topic names, `mission.*`.
  - 3 Contact the GCN Team**

Send the [GCN Team](#) your list of team members from Step 1 and your chosen Kafka topic prefix from Step 2. The GCN Team will reply after they have configured producer permissions for your team.
  - 4 Draft Your Schema**

As a GCN Notice producer, you can create your own instrument-specific schema. Please contribute your schema to our [GitHub repository](#), placing it in a folder under `gcn/notices/mission` and submit a pull request for the GCN Team to review. For details, please refer to the [schema documentation](#).
  - 5 Build Producer Code**
    - Log out and log back in.
    - Go through the [Start Streaming GCN Notices](#) process.
    - On Step 2, choose the scope `gcn.nasa.gov/kafka-mission-producer`.
    - Your producer code will look very similar to the [client example code](#) and Step 4 of [Start Streaming GCN Notices](#). `client_id` and `client_secret` can be found in Step 4 client example code.
    - Start from this and adjust the `client_id`, `client_secret`, `topic` and `data` content:

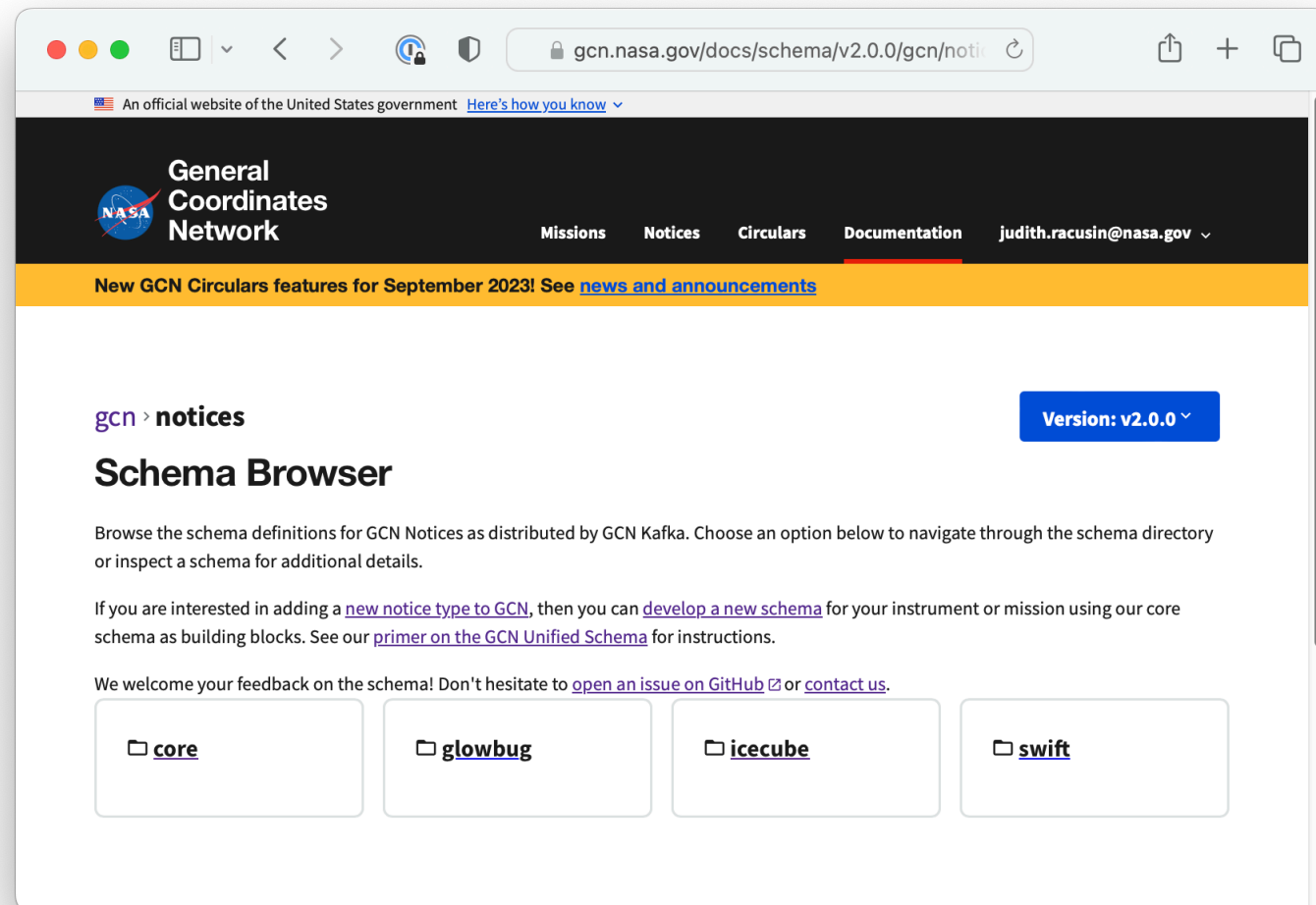
# Create new Notice types

- All new notice topics will only be distributed by GCN Kafka
- See [step-by-step instructions](#)
- Preferred notice format is JSON
- [Unified JSON schema](#) provides common core



# Unified schema and alert format for GCN Kafka

- JSON schema with common core fields
- Instrument/mission/observatory specific fields where needed
- Schema development documentation
- Schema Browser
- GitHub project: [nasa-gcn/gcn-schema](https://github.com/nasa-gcn/gcn-schema)



# GCN Notices Sample Schema

```
{
  "$id": "https://gcn.nasa.gov/schema/main/gcn/notices/mission/sample.schema.json",
  "$schema": "https://json-schema.org/draft/2020-12/schema",
  "type": "object",
  "unevaluatedProperties": false,
  "title": "Your Schema Name",
  "description": "A description for your schema",
  "allOf": [
    {"$ref": "../core/Alert.schema.json"},
    {"$ref": "../core/Localization.schema.json"}
  ],
  "properties": {
    "example_field_1": {
      "type": "string",
```

# GCN Notices Sample Example


```
  "$schema": "https://gcn.nasa.gov/schema/main/gcn/notices/mission/sample.schema.json",
  "alert_datetime": "2023-09-28T01:40:30Z",
  "ra": 197.44871198,
  "dec": -23.38397612,
  "example_field_1": "The ultimate answer to life, the universe, and everything",
  "example_field_2": 42
}
```

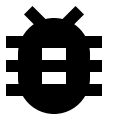
<https://gcn.nasa.gov/docs/notices/schema>


# Thanks for listening!

Web site: <https://gcn.nasa.gov>

This presentation: <https://nasa-gcn.github.io/gcn-presentation/>

 **Questions or comments?** [Contact GCN directly](#)

 **Have you found a bug in GCN?** [Open an issue](#)

 **Want to contribute code to GCN?** [Get involved on GitHub](#)