MUSE and PUNCH: A Harmonious Collaboration

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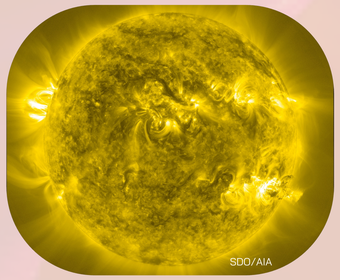
Unexpectedly Hot & Twisted



- The temperature of the Sun's atmosphere (**corona**) is **unexpectedly hot**
- The energetic corona contributes to a steady stream of particles called the **solar wind**
- The corona is dominated by the tangled **solar magnetic field** which shapes the coronal plasma, powers solar flares, and **launches the solar wind**

But why, and how?

This is where NASA's **Multi-slit Solar Explorer (MUSE)** comes in. Expected to **launch in 2027**, MUSE will measure the properties of the hot plasma in the Sun's atmosphere to **identify the sources of heating and the solar wind**. The stored magnetic energy that fuels these energetic events plays a part in heating the corona, but understanding the details of these processes requires **higher-resolution observations**. MUSE is designed to provide high-resolution observations and **diagnose the energy budget** of magnetic processes in the corona. Not only are these diagnostics **crucial to solving the coronal heating problem**, understanding these processes helps us **better predict space weather events** that impact satellites, our power grids, astronauts in space, and humans on Earth.

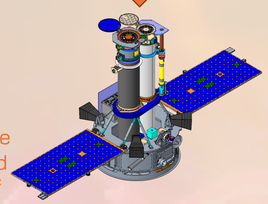
Spectroscopy: Legacy and Future

NASA's **Interface Region Imaging Spectrograph (IRIS)** mission **launched in 2013** and is still observing the Sun's lower atmosphere from low-Earth, Sun-synchronous orbit today. IRIS instruments include a **four-passband slit-jaw imaging spectrograph**, which is used to scan dynamic magnetic events in the **solar chromosphere.**


NASA/LMSAL: IRIS/Explorer 94 Spacecraft

Challenge: These events often **evolve faster than the single-slit spectrograph can scan them**, so a multi-slit spectrograph is **necessary to "freeze" plasma evolution** in space and time.

Developed from IRIS legacy technology, the multi-slit spectrograph onboard **MUSE will improve observations of solar flares** in the multimillion-degree corona, capturing EUV spectra **35x faster** than current spectrometers. The MUSE spacecraft includes a **two-passband context imager** and a **three-passband 35-slit spectrograph** which will be used to scan solar flares, nanojets, coronal rain, and many other dynamic events on the Sun. Because of the improved instrumentation, **MUSE will be able to see these events better spatially, temporally, and spectrally**.

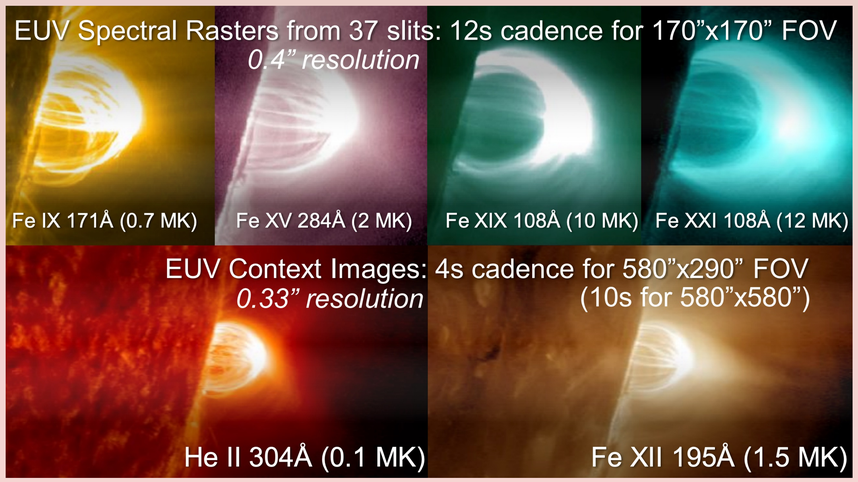

NASA/LMSAL: model of MUSE spacecraft

The MUSE Generation

MUSE is a critical, **significant improvement** on existing instruments, as well as a **crucial complement** to proposed instruments. MUSE's **innovative instrumentation** will:

- capture EUV spectra **35x faster**
- offer spatial resolution that is **10x better**
- use a **larger field of view** to capture dynamic events
- take spectral measurements **every 12 seconds**
- use **diagnostic tools** unavailable on any current mission

Synthetic observations (right) illustrate the fantastic capabilities of MUSE, not only imaging the solar atmosphere but also capturing **detailed spectral rasters** of dynamic solar events like **coronal rain** and **magnetic reconnection**. This is **crucial information for diagnosing the mechanisms behind coronal heating and space weather**.



Mission Synergies: MUSE and PUNCH

MUSE & PUNCH Mission Science:

While MUSE focuses on understanding the Sun's multimillion-degree corona, PUNCH aims to **unify the corona and the heliosphere**, extending into the realm of **space weather**. Working in tandem, these missions will **improve our understanding of the energetic solar wind** and provide better boundary conditions for **space weather models**.

Outreach Advisory Board:

The **MUSE Outreach Program** is led by Dr. Rebecca Robinson (me) and headquartered at the **SETI Institute** in California. The program has three main partners:

- California Academy of Sciences
- Chabot Space & Science Center
- Boys & Girls Club of the Peninsula, East Palo Alto Clubhouse

Each partner is supported by the outreach program to **curate outreach products, scientific visualizations, internships, and events**.

The **PUNCH Outreach Program** is directed by Dr. Cherilynn Morrow and headquartered at the **Southwest Research Institute**. Cherilynn sits on Becca's **Board of Advisors** and has **generously offered expertise, insight, ideas, and products**.

Outreach Products and Activities:

Since PUNCH is 2+ years ahead of MUSE, the MUSE team has taken **great inspiration** from PUNCH outreach products and ideas.

First up: 3-Hole PUNCH Pinhole Projectors:

Screenshot of MUSE pinhole mockups based on PUNCH pinhole products

MUSE has taken the lead from PUNCH to create our own version of the 3-Hole PUNCH Pinhole Projectors. **These products are made possible by your generosity and ingenuity.**

Stay tuned: MUSE Virtual Team Cards inspired by YOU!

Disclaimer & Acknowledgement: Understanding the dynamic Sun is a global initiative, and we've partnered with folks all around the world to help make MUSE happen. This poster was prepared by the MUSE Outreach Lead and is based on work done by the MUSE and IRIS Science Teams at Lockheed Martin Advanced Technology Center, the MUSE Outreach Team at SETI Institute, and the NASA Communications team at NASA HQ and NASA Goddard Space Flight Center.

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