[This page is for internal use only]

FASR Science Use Case Template

Version 0.2

Template Change Record

Version	Date	Author	Affected Section(s)	Comments
0.1	09/10/2025	S. Yu	All	First draft.

FASR Science Use Case # XX

Where and how are energetic electrons accelerated in solar flares?

Sijie Yu[1], Author 2[2], Author 3[3]…
[1]New Jersey Institute of Technology
[2]Affiliation 2
[3]Affiliation 3
…

I. Science Goal(s) *[Briefly summarize the key science goal(s) for this science case. A few sentences will be sufficient.]*

II. Scientific Rationale

(A) Scientific Importance *[Provide a brief discussion on the scientific importance of this science use case.]*

The primary goal of this use case is to map and understand the nature, structure, and evolution of magnetic fields in the solar corona, and to determine how these fields govern solar activity and space weather. Coronal magnetic fields are the fundamental "skeleton" of the Sun's atmosphere—they store energy and channel plasma—making them central to many outstanding problems in solar physics. By quantitatively measuring these fields, we aim to reveal how magnetic energy is built up and explosively released in solar flares and coronal mass ejections (CMEs), and how the magnetic topology (open vs. closed fields, loops, null points, etc.) relates to such eruptions. A key objective is to characterize coronal field configurations before and during flares/CMEs to understand the triggers of energy release and the mechanisms by which magnetic reconnection occurs. In addition, mapping the coronal field will illuminate how and where the solar corona is heated and how the solar wind is accelerated, since these processes are also intimately linked to magnetic structure □(). These insights have direct space weather implications: the Sun's magnetic fields drive phenomena that impact Earth's space environment □. By improving our knowledge of coronal magnetism, we ultimately aim to enhance space weather prediction – for example, identifying magnetic configurations prone to erupting and producing hazardous solar storms □. In summary, the science goals are to achieve the first comprehensive measurements of coronal magnetic fields and to use them to understand solar activity (flares, CMEs) and their consequent effects on the heliosphere and Earth.

(B) Uniqueness to FASR Capabilities (e.g., frequency coverage, dynamic range, resolution, etc.) *[Is this science case uniquely addressed by FASR? Why can't other facilities address this science and achieve the same goal?]*

One of the primary challenges in the past was that previous and currently operating hard X-ray and radio instruments did not have the necessary dynamic range to perform spectral imaging for both strong sources and extremely weak sources in the flaring region.

(C) Synergies

Describe potential synergies/complementarities between this FASR science case and those from current/future/planned facilities at all wavelengths (e.g., DKIST, MUSE, FIERCE, COSMO, ngGONG, etc.).

(D) Measurements Required by FASR

Provide a description of the necessary measurements to be carried out by the FASR to

adequately address this science case. Please coordinate these measurements with the Science Requirements table in Section III.

III. Science Requirements Tables

(A) OBSERVATIONAL TARGET		
Type of observation (what defines a 'target')	Provide a brief description of the target [e.g., gyrosynchrotron radiation from coronal mass ejections in the low corona (<1.5 solar radii)]	
Number of targets		
Size of a single target (arcsec x arcsec)		
Distribution of all targets (arcmin x arcmin)		
Peak brightness (sfu/beam or Kelvin)		
RMS brightness (sfu/beam or Kelvin)		
Expected circularly polarized flux density	Stokes V (sfu/beam)	
	V/I	
Expected linearly polarized flux density	Stokes Q or U (sfu/beam)	
	Q/I or U/I	

(A) Observational Target Description

Provide a brief discussion describing how these values are obtained/estimated, any trade-offs, interrelationships between the values, or anything else that is not captured in the above table.

(B) SPECTRAL-TEMPORAL REQUIREMENTS	
Central Frequency (GHz)	
Instantaneous Bandwidth (GHz/pol; max 20 GHz)	
Spectral resolution [MHz]	
Temporal resolution (in seconds)	

(B) Spectro-Temporal Requirements Discussion

Provide a brief discussion describing how these values are obtained/estimated, any trade-offs, interrelationships between the values, or anything else that is not captured in the above table.

(C) POLARIZATION DATA PRODUCTS REQUIRED	
(y/n)	Stokes I
(y/n)	Stokes Q
(y/n)	Stokes U
(y/n)	Stokes V

(C) Polarization Product Discussion

Provide a brief discussion describing how these values are obtained/estimated, any trade-offs, interrelationships between the values, or anything else that is not captured in the above table.

(D) IMAGING REQUIREMENTS		
Required angular resolution (arcsec) (single value or range)		
Largest angular scale required (arcsec)		
Mapped image size (arcmin x arcmin)		
Required pixel resolution (arcsec)		
Number of output/image channels		
Output bandwidth (minimum and maximum frequency - GHz)		
Channel width (MHz)		
Required rms (sfu/beam or Kelvin) [per channel] (if polarization products required define for each)		
Dynamic range within image (if polarization products required define for each)		
Polarization accuracy (%)		
Zero spacing/total power required?	(y/n)	
Required maximum latency (in seconds, or N/A)		
Required flux density scale calibration accuracy		1-3%
		5%
		10%
		20-50%

(D) Imaging Requirements Discussion

Provide a brief discussion describing how these values are obtained/estimated, any trade-offs, interrelationships between the values, or anything else that is not captured in the above table.

(E) Other Performance or Functional Requirements

If there are any additional performance or functional requirements not captured above,

describe them here. For example, beamforming array mode, phased array, etc.

IV. Appendix: Additional material, relevant calculations/estimates, etc.

Please provide any other relevant material necessary to understand and substantiate this Science Use Case.