

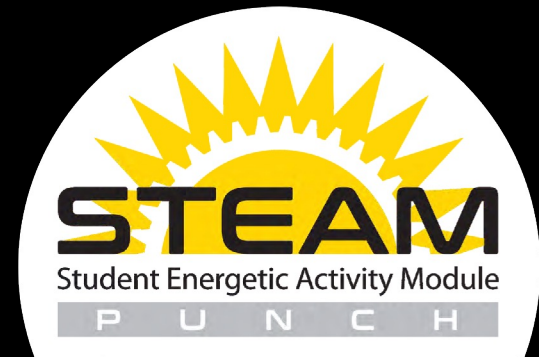
Polarimeter to Unify the Corona and Heliosphere

Student Thermal Energetic Activity Module STEAM

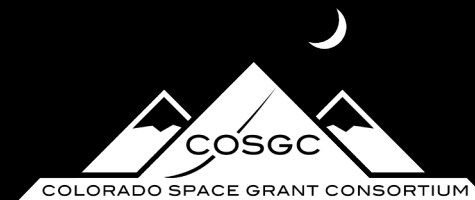


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STEAM Science
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Introduction

Science Objectives

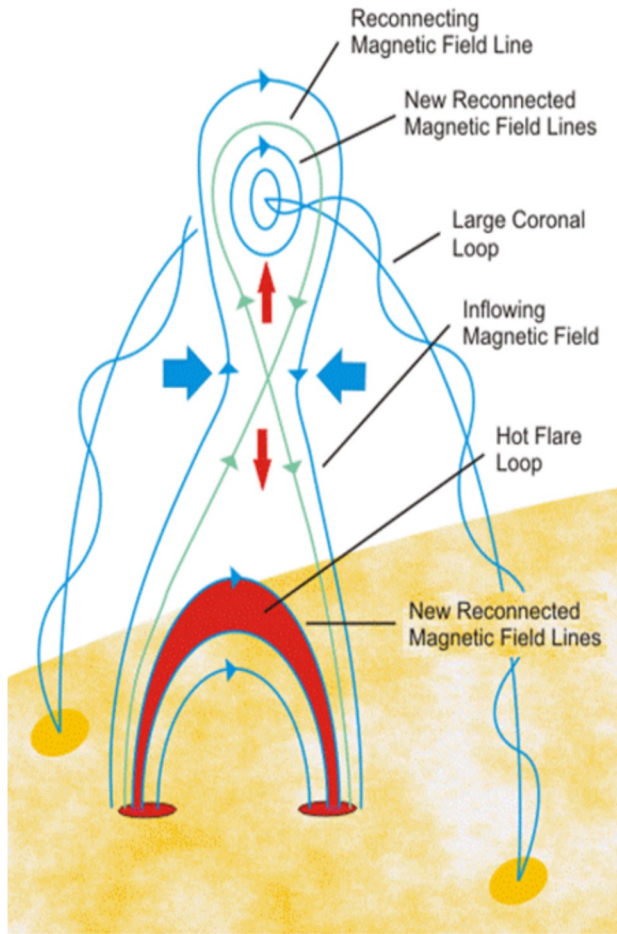
Explore the enhancement of low First Ionization Potential (FIP) elements in the solar corona.

Explore how solar coronal plasmas are heated in flares and quiescent active regions.

Support PUNCH science in understanding the source regions of solar wind and coronal mass ejections.



Magnetic Reconnection & Plasma Heating



Oppositely oriented field lines cancel



Field lines rearrange themselves into a lower energy state



Releases an explosion of energy



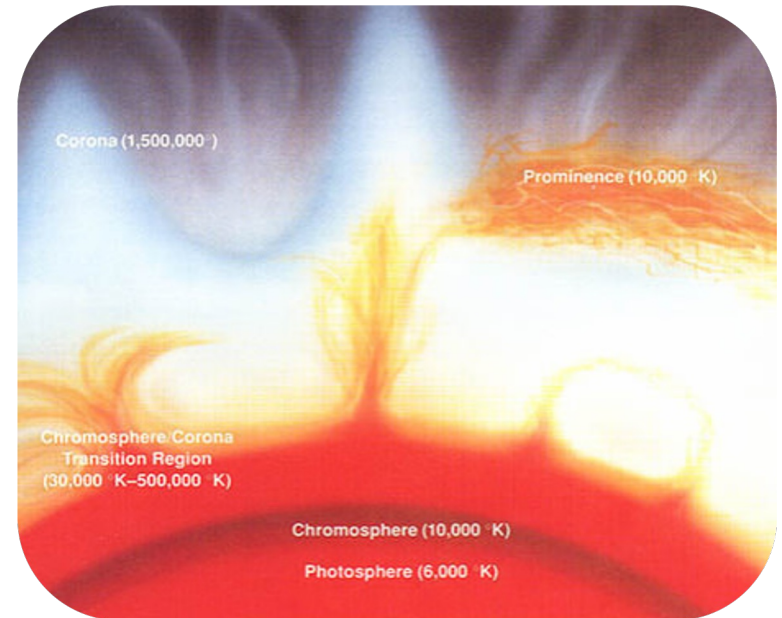
Releases heat and energy into the corona



Low-FIP Elements in the Corona

Low FIP (< 10 eV) elemental abundances point to origin of plasma

- Prominent above thermal continuum
- Abundances enhanced by a factor of ~ 4 in corona over chromospheric values
- Abundances allow STEAM to infer origin of plasma for flares and active regions (AR)





Why X-rays

Soft X-ray Emissions

Provide most direct signatures for hot plasmas

Highly sensitive to hot temps & fluctuations

Not sensitive to cool temps

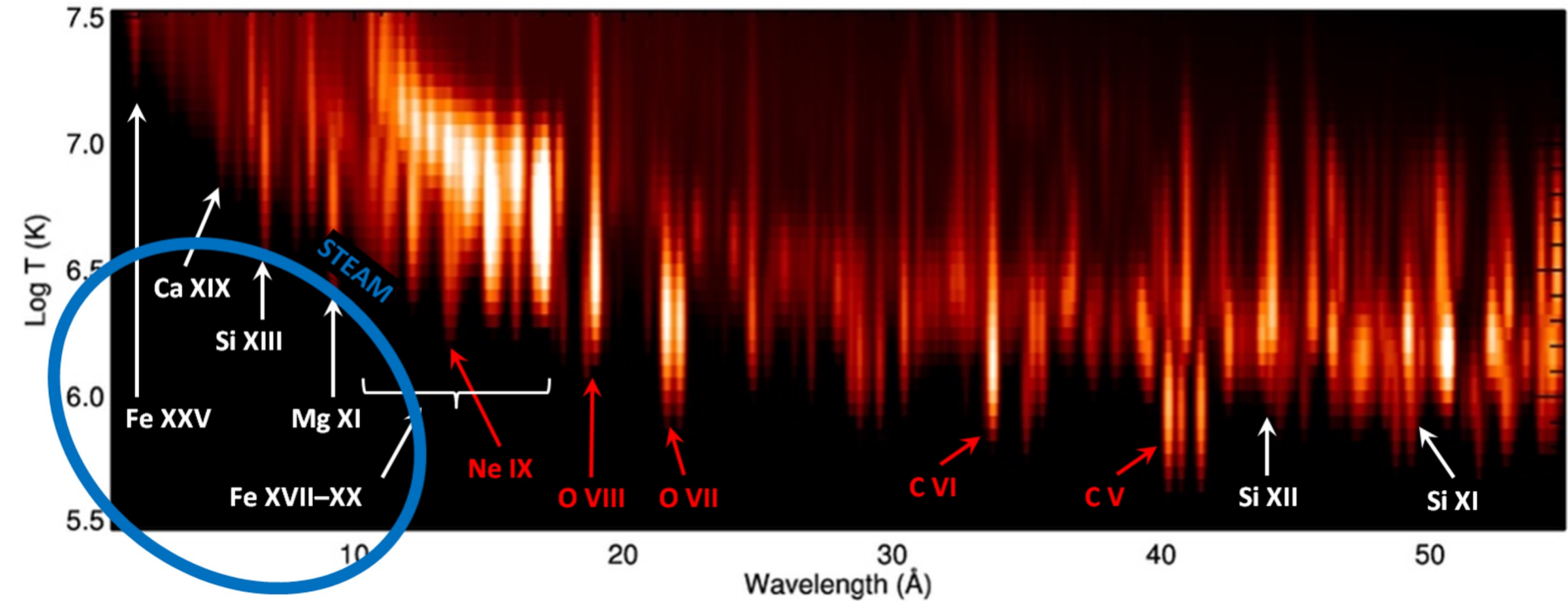
Hard X-ray Emissions

Provides a more complete look at plasma evolution

Covers higher energy events >10 keV

Extends thermal continuum

Comprehensive coverage of thermal plasma temperature and composition

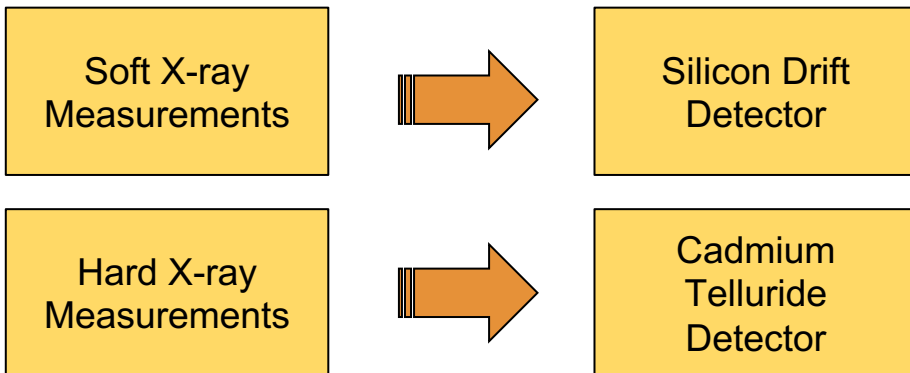


STEAM will be able to observe low FIP spectral lines with a greater resolution



What is STEAM?

Slide updated



Expected Performance

SXR

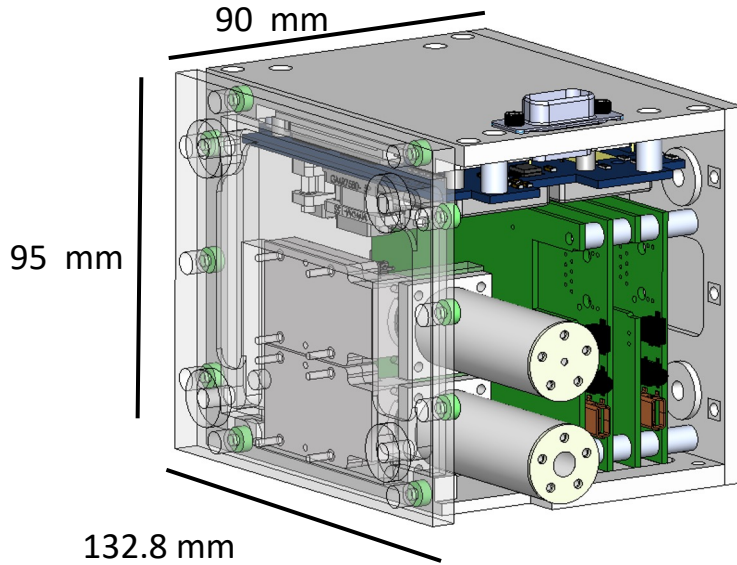
HXR

Expected Performance	SXR	HXR
Energy Range	1 to 7 keV	7 to 20 keV
Resolution	< 0.3 keV	< 1 keV
Field of View	5.25° to 10°	5.25° to 10°
Aperture Size	300 μm	2700 μm
Filter	PI, 5.5 μm	Al, 50 μm

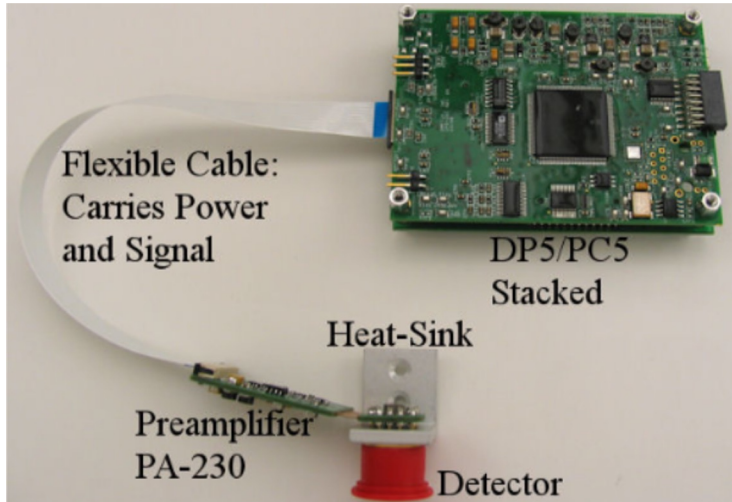




Current Model & Hardware



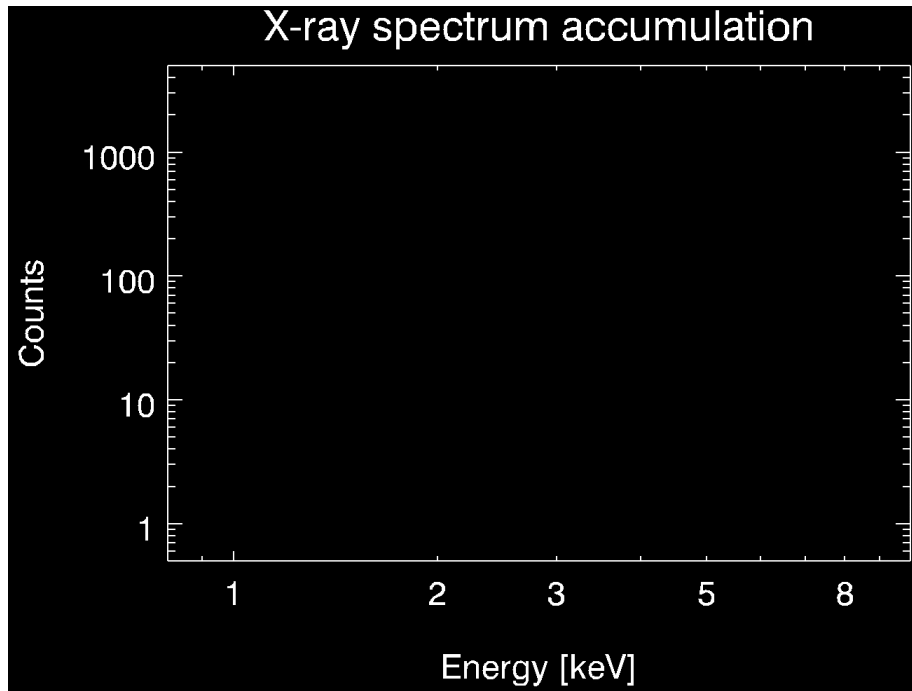
A rendering of the STEAM instrument and its dimensions



Detector head and electronics are about the size of a pack of cards.



Integrating Photon Counts Over Time

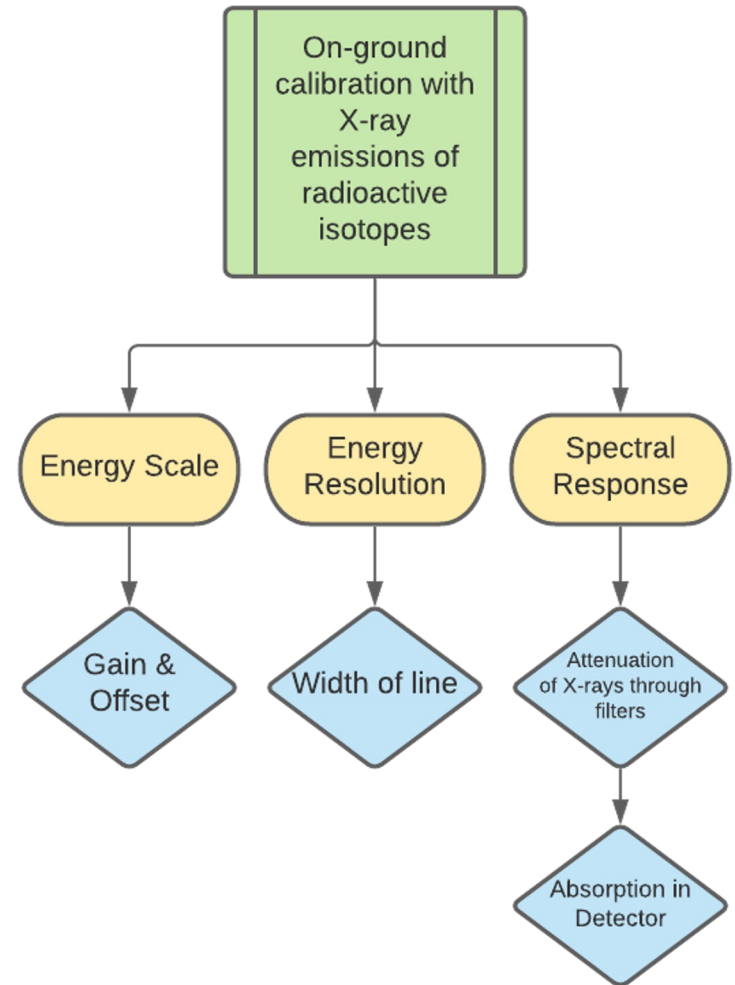
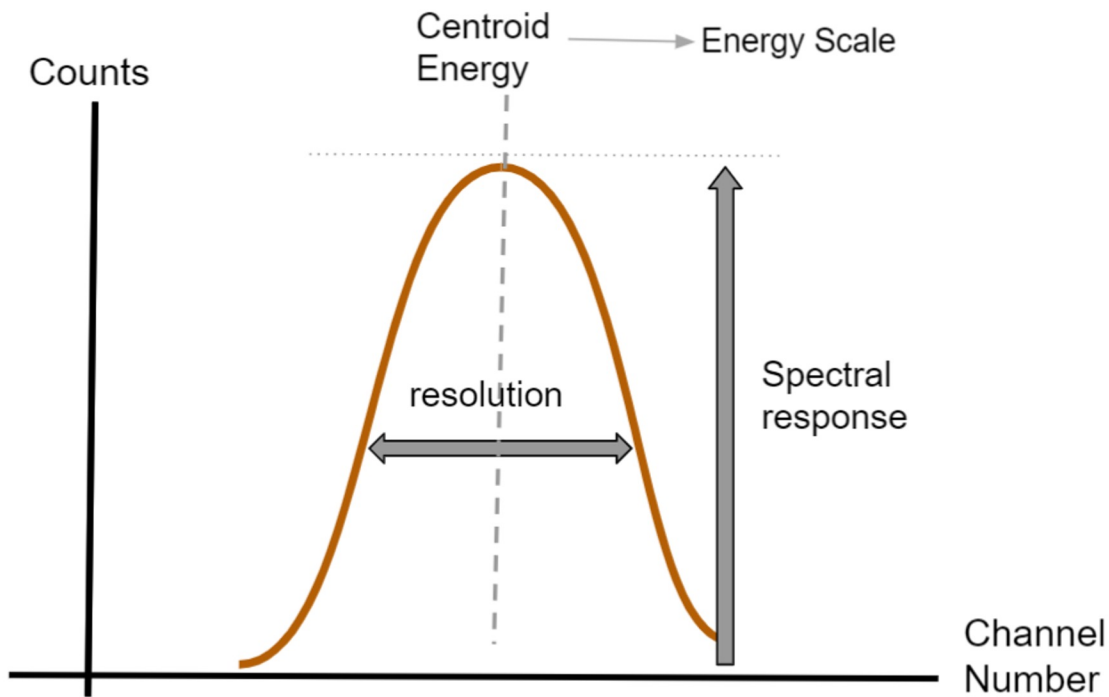


The individual histograms from 10-second integrations (red) can be summed to create a spectrum (white).



Spectrometer Calibration

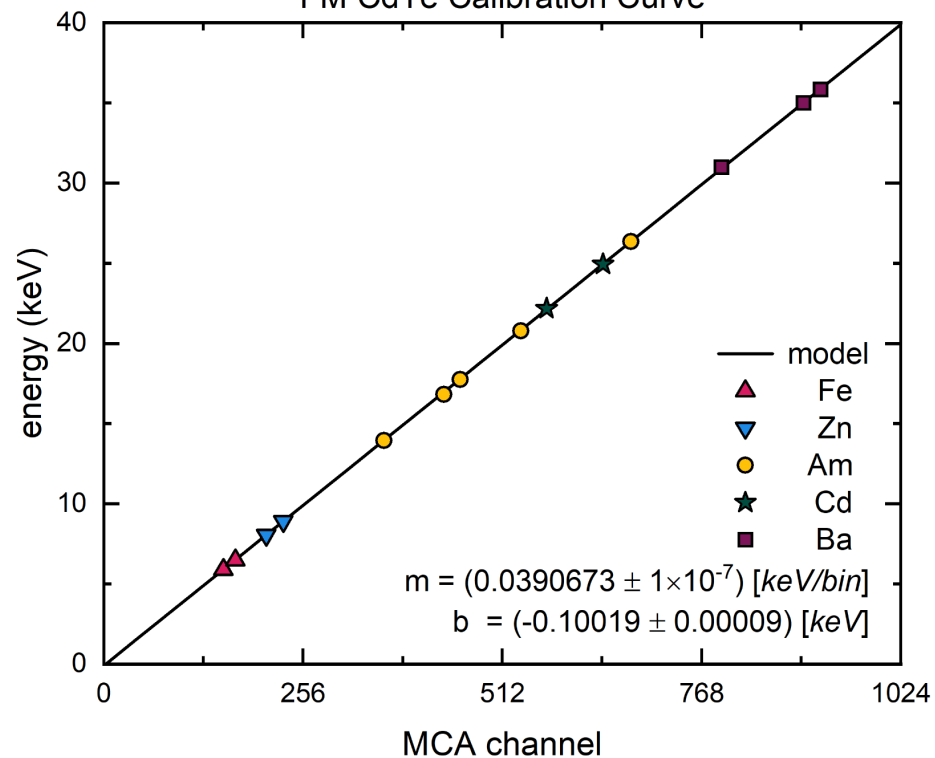
Below is a schematic of an emission line we would use to calibrate the energy scale of our detectors



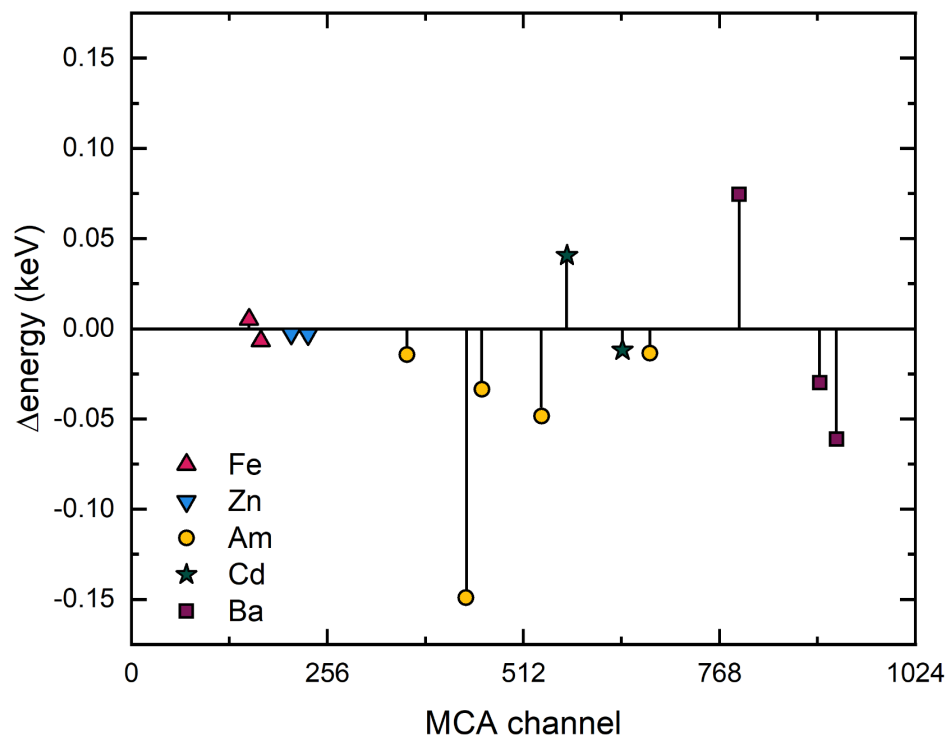


Calibration Data

FM CdTe Calibration Curve



FM CdTe Calibration Curve Residuals



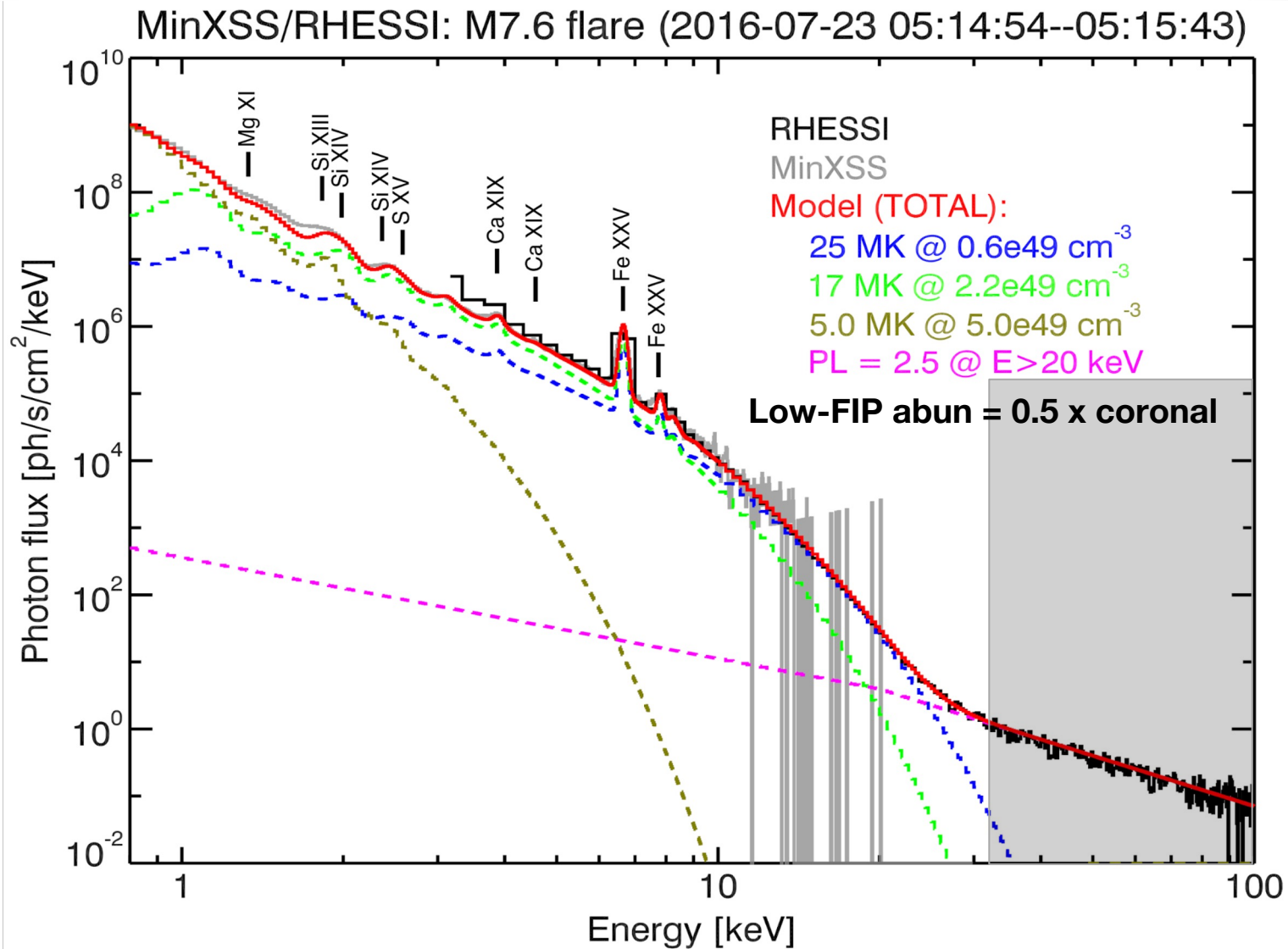


Achieving Science Goals

Observables	Applying the Physics	Modeling
<p data-bbox="343 629 653 701">X-ray photons from source</p> <p data-bbox="336 1001 660 1033">Respective energies</p>	<p data-bbox="832 401 1190 472">Define continuum and spectral line emissions</p> <p data-bbox="846 694 1176 765">Fit temperatures and abundances</p> <p data-bbox="857 915 1164 1072">SXR (bound-bound radiation) Majority of line emissions</p> <p data-bbox="846 1136 1176 1293">HXR (free-free and free-bound radiation) Helps to constrain continuum shape</p>	<p data-bbox="1367 401 1682 472">Continuum shape & line intensities</p> <p data-bbox="1367 651 1676 684">Forward Modeling</p> <p data-bbox="1360 836 1686 951">Use Bremsstrahlung and atomic emission databases</p> <p data-bbox="1290 1122 1756 1200">Chi-squared minimization to derive physical parameters</p>

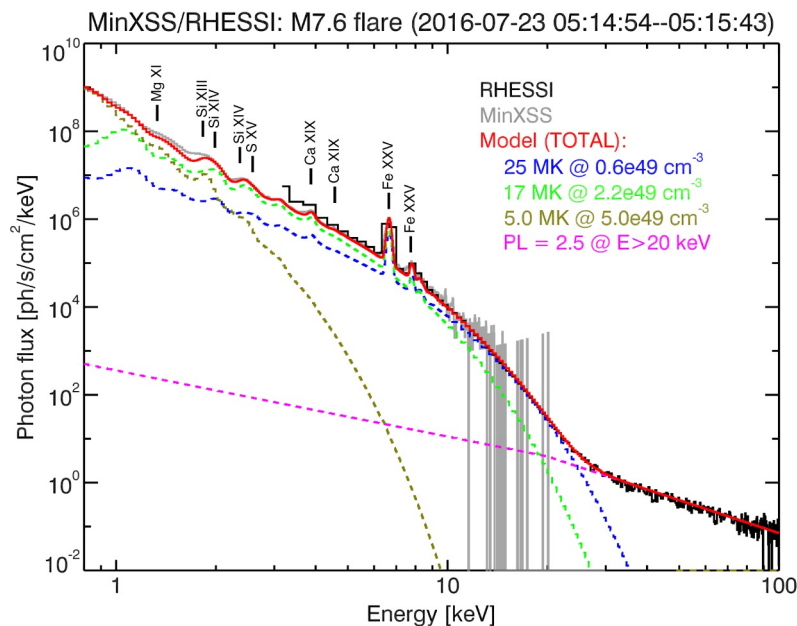
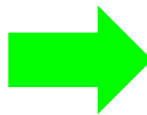
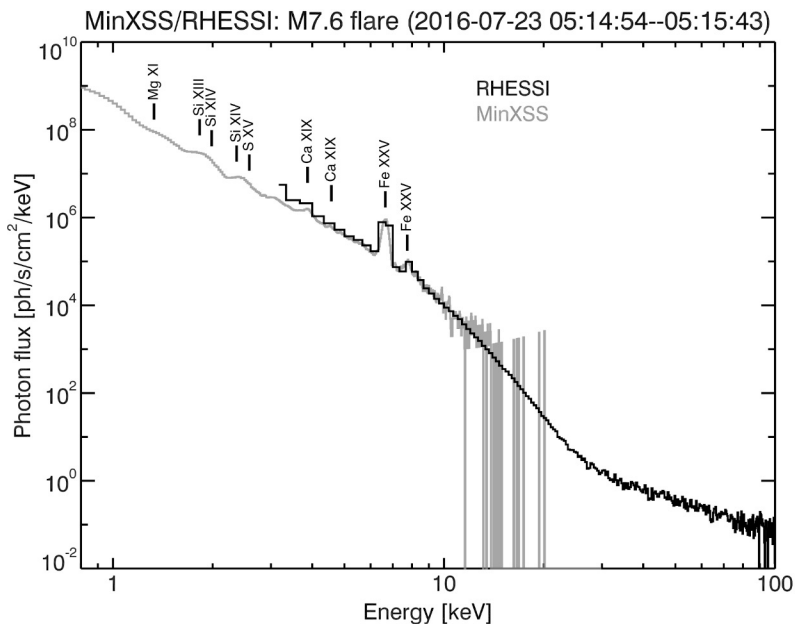
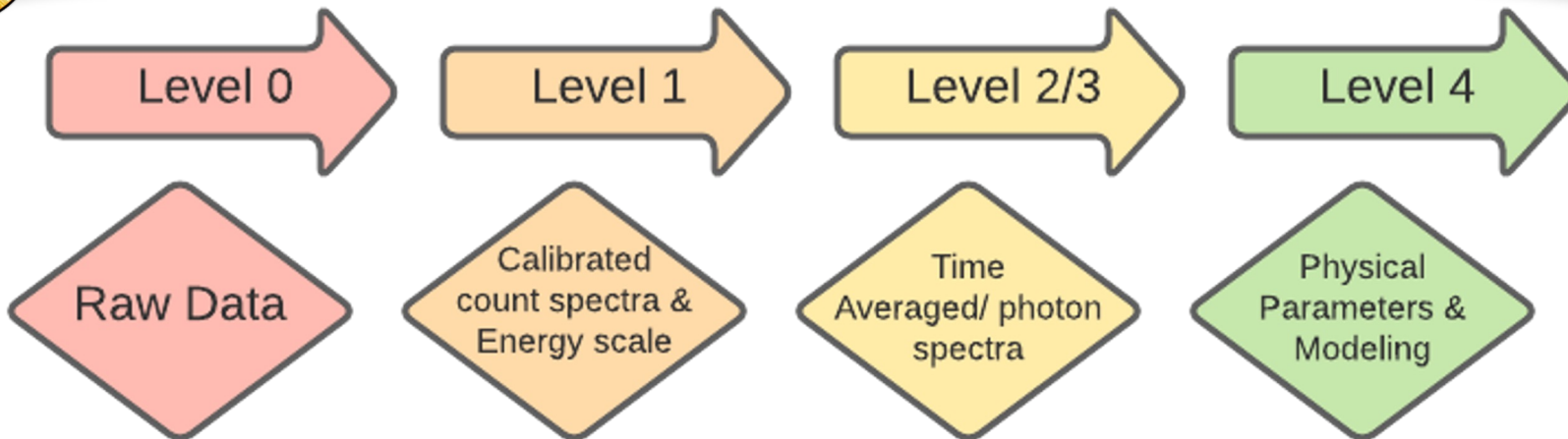


Expected Data & Analysis/Modeling



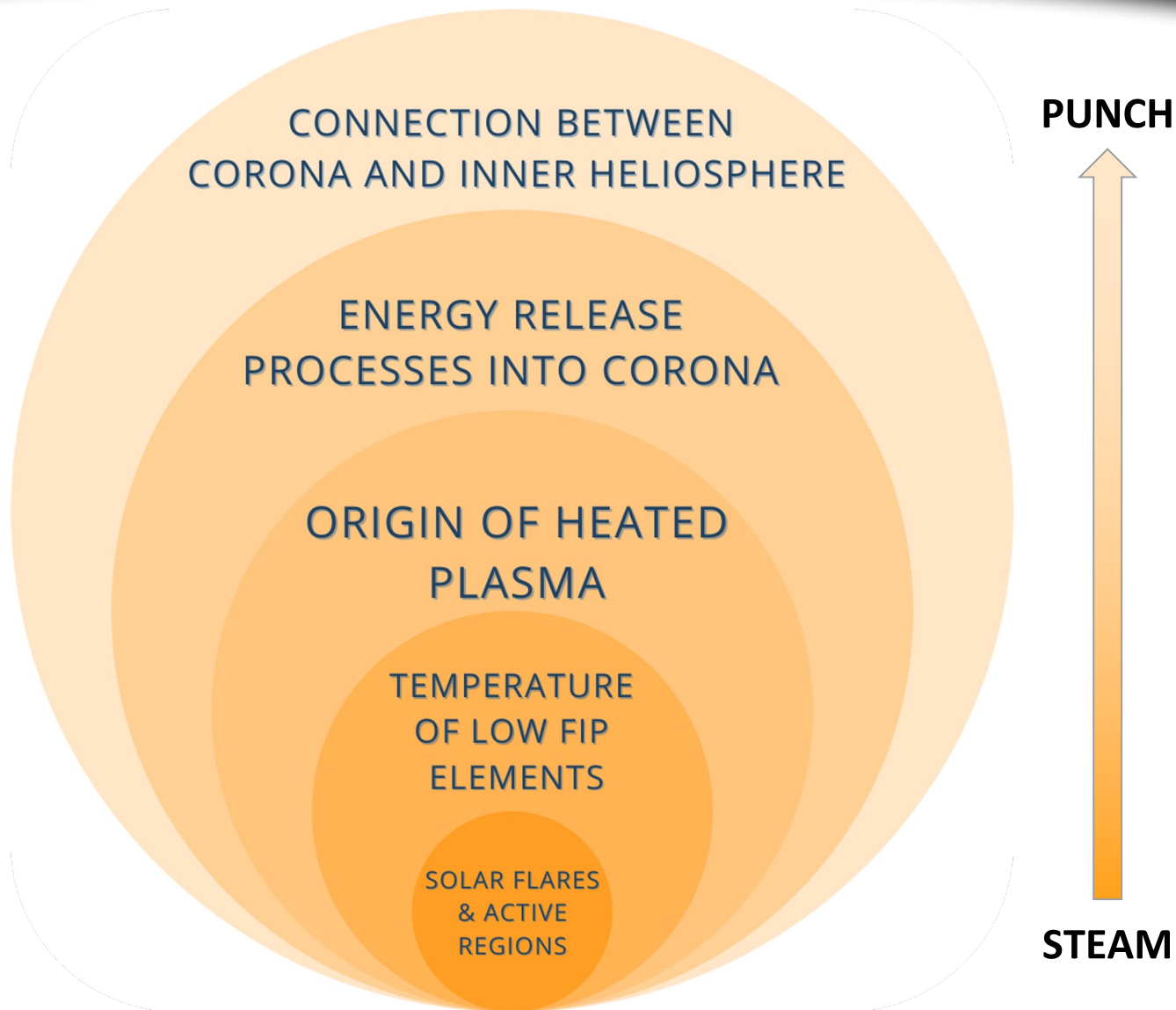


Tentative Data Pipeline





Connections to PUNCH





Current Work and Future Outlook

Current Work:

Finish assembly of Flight Model (FM)

FM Environmental tests

Analysis of FM spectrometer data for calibration between tests

Future Outlook:

Finish FM environmental tests

Complete final comprehensive testing

Delivery in August!