

MOSES Science

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Abstract

The *Multi-Order Solar EUV Spectrograph (MOSES)* is a rocket borne slitless imaging spectrograph with detectors at three spectral orders ($n = -1, 0, 1$). I will discuss the utility of this arrangement, the science goals of the *MOSES* rocket mission, and the parameters for application to Solar Orbiter.

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People and Institutions Involved

Montana State University

PI	Charles Kankelborg
Graduate students	J. Lewis Fox Melissa Cirtain Trae Winter
Engineering	Dustin Cram Michael Chase Emily Armitage Pancastya Agastra Wayne Janssen Hasan Rouf
Co-Is (Science)	Petrus Martens Dana Longcope Loren Acton

Goddard Space Flight Center (optics)

Co-I (Design)	Roger Thomas
Coatings	Ritva Keski-Kuha

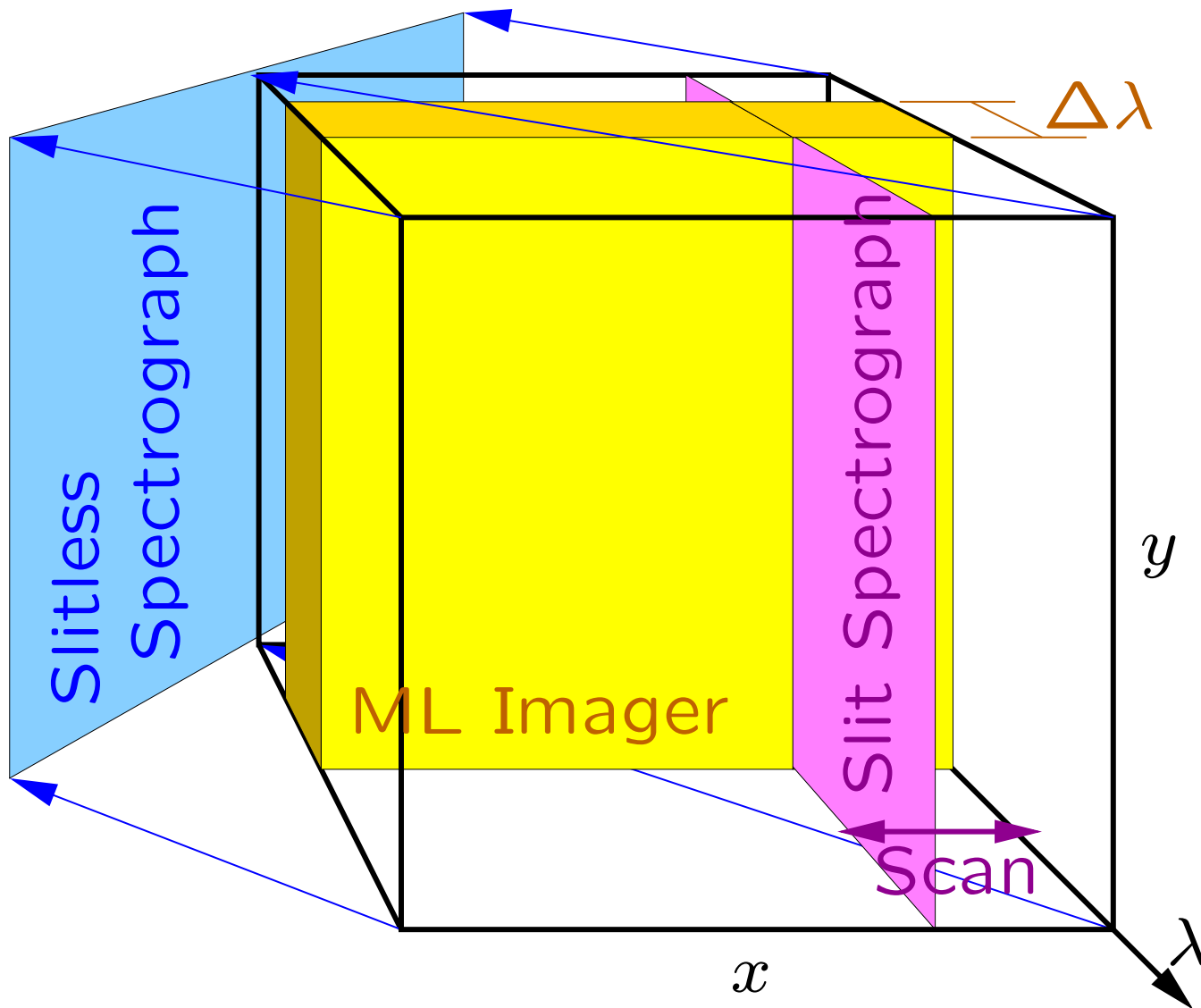
Mullard Space Sciences Laboratory (detectors)

Co-I	Len Culhane
Cameras	Chris McFee

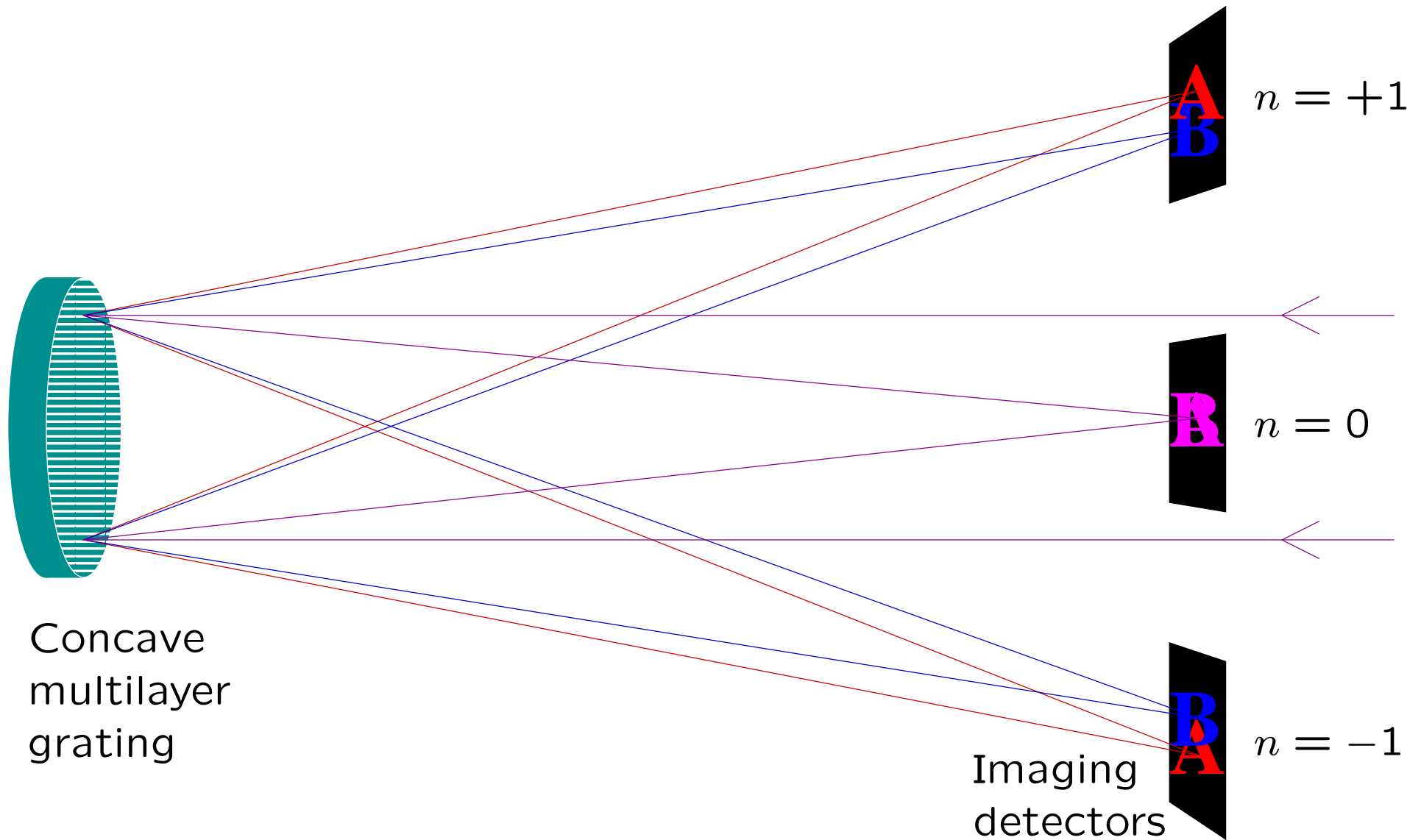
Lockheed-Martin Solar and Astrophysics Laboratory (LOTS)

Co-I	Jean-Pierre Wuelser
Science	Tom Metcalf

EUV Imaging Spectroscopy



A Multi-Order Slitless Spectrometer



Concave
multilayer
grating

Imaging
detectors

Our detectors are 2-dimensional, but EUV radiation from the Sun lives in a 3-dimensional space: $I(x, y, \lambda)$. This has led to a series of compromises:

Instrument Type	Measures	Comments
ML Imager	$I(x, y)$	Fixed spectral response
Slit Spectrograph	$I(\lambda, y)$	Scan to build image
Slitless Spectrograph	$I(x + n\lambda, y)$	Spatial-Spectral Overlap
MOSES	$I(x - \lambda, y), I(x, y), I(x + \lambda, y)$	Deconvolution required

MOSES has high information bandwidth compared to other approaches because it has multiple detectors and no slit.

What can we measure with the multi-order technique?

1. **High dispersion:** Line profile parameters for 1-2 isolated lines
2. **Low dispersion:** Several line intensities

The information content of the data depends on the number of orders imaged.

MOSES and He II

The *MOSES* rocket mission will address the over-brightness of He II $\lambda 304 \text{ \AA}$.

- He II doppler and linewidth maps will characterize TR turbulence on arcsecond scales at 10 s cadence. If much of the excess linewidth in He II is due to macroscopic turbulence, then the velocity redistribution mechanism can be falsified.
- Simultaneous images of Si XI $\lambda 303.3 \text{ \AA}$ and He II $\lambda 303.8 \text{ \AA}$ will allow us to assess the role of PIR (now almost discounted).

Application to Solar Orbiter

The *MOSES* approach offers several advantages for Solar Orbiter:

- Fast, high resolution imaging
- Truly simultaneous spectral information over the whole image
- Light and simple
 - No moving parts (except shutter)
 - Only 1-2 optics, high throughput

Disadvantages:

- Narrow wavelength range

Questions

If the *MOSES* technique is right for Orbiter,

- What is the physics of interest? *E.g.* Solar wind source regions.
- Are we more interested in line profiles or line ratios?
- What wavelength range?
- Detectors at how many orders?