



*Earth and Space Science*

Supporting Information for

**Sounding of the Atmosphere using Broadband Emission Radiometry (SABER):  
Instrument and Science Measurement Description**

The SABER Team

**Contents of this file**

This file contains an image in portable document format (pdf) of a poster presented at the 2014 AGU Meeting. The citation to the poster and a link to the abstract is given here:

Mlynczak, M. G., et al., (2014). Middle atmosphere sounder and thermal emission radiometer – MASTER, Abstract SA43A-4081 presented at 2014 Fall Meeting, AGU, San Francisco, Calif., 15-19 Dec.

<https://abstractsearch.agu.org/meetings/2014/FM/SA43A-4081.html>



# Middle Atmosphere Sounder and Thermal Emission Radiometer - MASTER

M. G. Mlynczak<sup>1</sup>, D. Scott<sup>2</sup>, R. Esplin<sup>2</sup>, S. Bailey<sup>3</sup>, and C. Randall<sup>4</sup>

<sup>1</sup>NASA Langley Research Center; <sup>2</sup>USU-Space Dynamics Lab; <sup>3</sup>Virginia Tech; <sup>4</sup>Univ. Colorado.

## Introduction

Infrared and near-IR emission limb sounding have played a central role in measurement of Earth's middle atmosphere since the 1970's

- Nimbus VII – LIMS
- SME – NIRS
- UARS – CLAES, ISAMS, HRDI, WINDII
- EOS Aura – HIRDLS
- EnviSAT- MIPAS
- Odin – OSIRIS
- TIMED – SABER, TIDI

These instruments comprise a "golden age" of discovery of the middle atmosphere

Presently no identified missions to continue exploration of the middle atmosphere

MASTER is a prime candidate for future

MASTER science addresses **both** NASA Earth Science and Heliophysics disciplines

## Science Motivation

Middle atmosphere science faces a looming data gap in key areas:

- Stratospheric temperature profile
- Stratospheric water vapor profile
- Stratospheric ozone day AND night
- Stratospheric tracers
- Mesosphere T, O<sub>3</sub>, CO<sub>2</sub>, H<sub>2</sub>O, O<sub>3</sub>, O, H

These measurements are now being made by the Microwave Limb Sounder on EOS-Aura launched 2004 and by SABER on TIMED

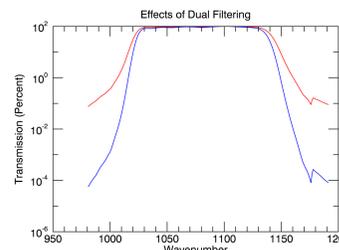
In five years' time, as the Aura (15 years on) and TIMED (18 years on) satellites approach end of life, ***a gap in these key climate variables is highly likely***

MASTER can fill this gap with a small, build-ready instrument with all components now at TRL-9

## MASTER Technical Advantages and Instrument Details

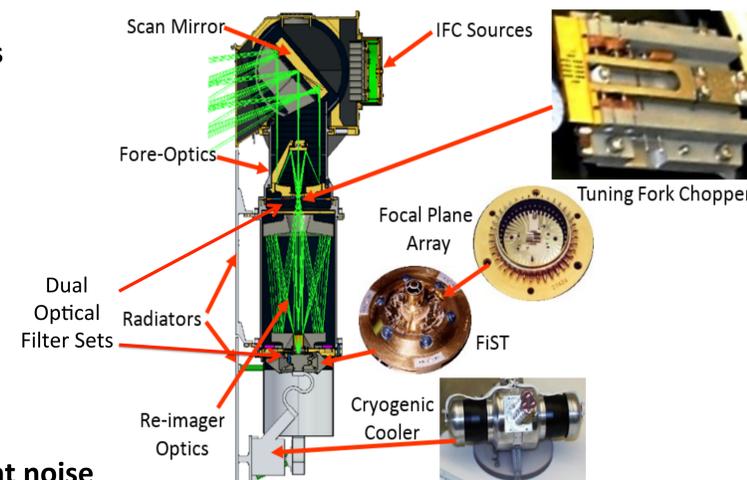
MASTER draws on lessons learned from HIRDLS, SABER, LIMS, SME

1. Dual Filtering of the focal plane:
  - Eliminates out of band light leaks
  - Successfully used on HIRDLS



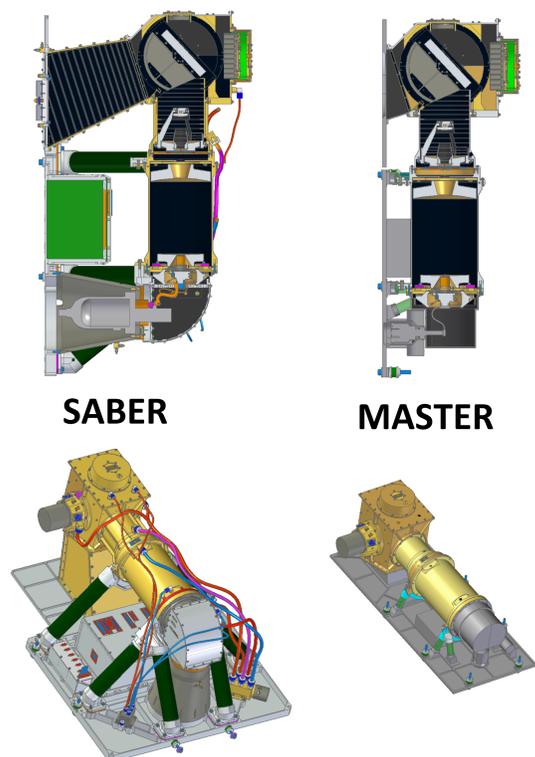
2. Shortened telescope baffle:
  - Off-axis radiation below instrument noise

3. Substantial size and mass reduction with contemporary cryo-cooler, electronics, and materials



**MASTER Instrument Layout**

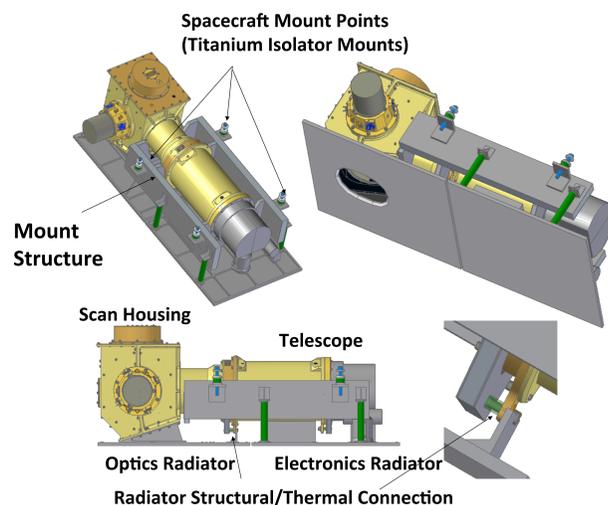
## SABER and MASTER Comparison



**MASTER**

**1/2 mass, 1/2 power, 1/3 volume  
Identical radiometric performance!**

## MASTER Spacecraft Mounting



**Simplified, direct mount to spacecraft radiator reduces mass substantially while maintaining critical thermal performance**

## MASTER Channel Lineup

CO <sub>2</sub> - A	15 um	Temperature 15-110 km
CO <sub>2</sub> - B	15 um	Temperature 15-110 km
Ozone - A	9.6 um	Mesosphere O <sub>3</sub>
Ozone - B	9.6 um	Upper Trope/Lower Strat
H <sub>2</sub> O - A	7.1 um	Strat/Lower Meso
H <sub>2</sub> O - B	6.75 um	Upper Trope/Lower Strat
OH	2.0 um	Mesopause O; input to T retrieval
CO	4.7 um	Carbon budget closure
NO	5.3 um	Thermosphere energy budget;
O( <sup>1</sup> D)	577 nm	Ionosphere energy inputs
O( <sup>1</sup> S)	630 nm	Lower thermosphere O chemistry
CO <sub>2</sub>	4.3 um	Carbon dioxide mesosphere
CO <sub>2</sub>	2.7 um	Carbon dioxide stratosphere
CH <sub>4</sub>	7.2 um	Stratospheric tracer
NO <sub>2</sub>	6.2 um	Thermosphere-stratosphere coupling
NO <sup>+</sup>	4.35 um	Auroral activity

### LEGEND

- Red – Heliophysics Focus
- Blue – Earth Science Focus
- Black – Earth and Heliophysics

## MASTER Summary

MASTER is an advanced IR limb sounder  
Heritage traceable to SABER, HIRDLS, SME, LIMS  
Science applicable to both Earth Science and Heliophysics disciplines in NASA  
All technologies at TRL-9  
All algorithms exist to process data to Level 2  
Will readily fit on small launch vehicles