

EVERT NASEDKIN

SIMULATED INSTRUMENTAL CONSTRAINTS  
ON SUB-STELLAR ATMOSPHERIC  
RETRIEVALS FOR THE JAMES WEBB SPACE  
TELESCOPE'S MID-INFRARED  
INSTRUMENT.

Evert Nasedkin

*Simulated Instrumental Constraints on Sub-Stellar Atmospheric Retrievals for the  
James Webb Space Telescope's Mid-Infrared Instrument.*

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TITLEBACK

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CONTACTS

✉ [evertn@student.ethz.ch](mailto:evertn@student.ethz.ch)



Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich

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## ACKNOWLEDGEMENTS

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## ABSTRACT





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# 1

## INTRODUCTION

### 1.1 BROWN DWARFS

#### 1.1.1 Physics

#### 1.1.2 Observational Properties

*T-Type*

*L-Type*

*Y-Type*

### 1.2 EXOPLANETS

#### 1.2.1 Direct imaging

#### 1.2.2 Characteristic Examples

$\beta$  *Pictoris b*

*HR 8799 System*

*PDS 70 b,c*

### 1.3 CURRENT STATUS OF ATMOSPHERIC CHARACTERIZATION

#### 1.3.1 Transmission Spectroscopy

#### 1.3.2 Emission Spectroscopy

#### 1.3.3 JWST Studies

#### 1.3.4 Biosignatures and Future Missions



# 2 | MIRI: THE MID-INFRARED INSTRUMENT

## 2.1 JWST

## 2.2 MRS

### 2.2.1 Integrated Field Spectroscopy

### 2.2.2 Optical Systems

Channels, bands, etc **ref:Chen2019**

### 2.2.3 Detectors

## 2.3 COORDINATES

## 2.4 OBSERVATIONS

### 2.4.1 Dithering

### 2.4.2 Readout Modes

### 2.4.3 Exposure time calculations



# 3 | MODELLING THE MIRI MRS

## 3.1 MIRISIM

### 3.1.1 Architecture

### 3.1.2 Data Products

### 3.1.3 Instrumental effects

### 3.1.4 Fringing

Random fringing text example **ref:Argyriou2018**.

*FM Data*

*CV Data*

*Modelling*

### 3.1.5 Implementation

## 3.2 FRINGING MODEL COMPARISON





# 4

## SPECTRUM EXTRACTION

### 4.0.1 JWST Pipeline

*Stage 1 Processing*

*Stage 2 Processing*

*Fringing correction*

*Aperture Photometry*

### 4.1 FRINGING RESULTS

#### 4.1.1 Cross-Correlation

#### 4.1.2 Effects of fringing on spectral extraction



# 5 | ATMOSPHERIC RETRIVALS

## 5.1 INTRODUCTION

## 5.2 ATMOSPHERIC MODELING

### 5.2.1 petitRadTrans

*Radiative Transfer*

*Line-by-line*

*Correlated K*

*Clouds*

## 5.3 BAYESIAN METHODS

### 5.3.1 MCMC

### 5.3.2 Nested Sampling

### 5.3.3 multinest

*Hyperparameters*

## 5.4 TARGETS

### 5.4.1 Atmospheric Parameters

### 5.4.2 petitRadTrans

## 5.5 RESULTS

### 5.5.1 Posterior Distributions



# 6 | CONCLUSIONS

[1]



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