

# Activity Report for NAOJ Visiting Joint Research in FY( 2019 )

Date: 2020/2/18

Applicant (Host Researcher)	Name	勝川行雄
	Affiliation/ Title	太陽観測科学プロジェクト, 准教授
Research Title	SUNRISE-3気球観測に向けた太陽磁場診断コードの開発	
Work location	Mitaka	
Visiting Joint Researcher	Name	David Orozco Suárez
	Affiliation/ Title	Instituto de Astrofísica de Andalucía IAA-CSIC Ramón y Cajal Researcher
1. Summary of research		
<p>During the visit the following main scientific goals have been addressed:</p> <p>* Testing of the new Non-LTE inversion code DeSIRe using different datasets and simulations  We have used spectral observations of the Ca II near-IR triplet lines at 854 nm (target spectral lines by SCIP for the SUNRISE-3 balloon experiment) taken with the Vacuum Tower Telescope (with C. Quintero Noda etc.) for testing the inversion code DeSIRe. MHD simulations have also being used to synthesize the triplet Ca II near-IR lines at 854 nm and the Mg I b2 line (SUNRISE-3 IMAx+ target spectral line) for testing the code against realistic MHD models. During the visit, we have established a collaboration between Y. Kawabata (NAOJ) and IAA to continue the developing and testing of DeSIRe for its future application in the Sunrise III data, with special emphasis in SCIP instrument under development at NAOJ.</p> <p>* Generation of Stokes profiles (radiative transfer) using two different MHD simulations: MURAM and Wave simulations  During the visit, we have developed software tools (in FORTAN and IDL) to generate Stokes vectors from MHD simulations (MuRAM). This work is still in progress (fine-tuning of the synthesis codes and inclusion of magnetic field information). We have also perform first synthesis tests of Ca II 854 nm chromospheric line from the full 3-dimensional compressible magnetohydrodynamic (MHD) simulation done by T. Matsumoto (NAOJ). The simulations were made to investigate the thermal response of coronal loops in the presence of MHD waves. The idea was to generate associated Stokes profiles in order to investigate the observational counterparts of the waves and heating in the chromosphere. This study is ongoing to find proper boundary condition for the line synthesis.</p> <p>We have also performed the following tasks:</p> <p>* Birefringence measurements of Fabry-Pérot etalon:  A measurement of the Mueller matrix of a Y-cut Lithium Niobate etalon has been taken in the clean room of NAOJ with the help of Y. Suematsu and M. Hagino. The idea is to confirm recent results about the behaviour of crystalline etalons in polarized light. The measurement was done at the end of September.</p>		

\* CASPER mission: White paper for ESA Voyage2050 program

We have presented a white paper in response to Call for White Papers for the ESA's Voyage 2050 Science Program with Y. Katsukawa, R. Ishikawa and R. Kano in the team members. The CASPER mission is a low-risk and high-TRL mission to explore in detail the magnetism and dynamics of the solar chromosphere and TR using a spectropolarimeter covering the hydrogen Ly-alpha and Mg II h&k ultraviolet lines.

2. Research achievements \*Please fill out the attachment if you have made presentations at academic conferences or if your research has been published in academic journals

[Meeting, Workshop]

Organized "Non-LTE inversion Workshop", 16-18 Dec. 2019, Oslo

[Presentations]

"LTEインバージョンから探る光球大気構造変化のスペクトル線幅への影響", 石川遼太郎, 勝川行雄, D. Orozco Suarez, 他, 日本天文学会2019年秋季年会 (2019.9.11-13, 熊本大学)

"CASPER: A mission to study the time-dependent evolution of the magnetic solar chromosphere and transition regions (white paper)", D. Orozco Suárez, ESA Voyage 2050, Oct. 29-31, 2019, Madrid

3. Any comments on this program 【From the applicant】

4. Any comments on this program 【From the visiting joint researcher】

5. Joint research period	
Name/Affiliation	David Orozco Suárez
Period of stay	2019/07/01 ~ 2019/09/30 ( 92 ) days
Period of stay	YYYY/MM/DD ~ YYYY/MM/DD ( ) days
Total	( 92 ) days

(Notes)

•If additional space is required to complete any item within this form, please edit the size of the blank spaces as needed.

•For item 5, please include all period(s) of stay(s) of the joint researcher, adding extra lines as necessary. If you have invited more than one joint researcher, please copy and create a table for each invited person.

•If you have any concerns or difficulties with publicizing the items of this report, please identify the relevant items and the reasons for each.

(Request)

After a year following the completion of the joint research period, we will send you a request to submit a list of papers and other results that have been produced by this research collaboration. We appreciate your cooperation.

# **NAOJ visit results**

David Orozco Suárez and Yukio Katsukawa  
1-July-2019 to 30-sep-2019

# Summary of tasks

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- **Testing of the Non-LTE inversion code (desire)**
  - VTT data (Ca II IR)
  - IRIS data (Mg h&k IRIS - Okamoto)
  - Simulations (Ca II IR and Mg I 517 nm)
  - Yosuke Kawabata (involvement in desire development and testing)
- **Radiation transfer from MHD simulations**
  - Muram simulations (photosphere)
  - Matsumoto simulations (chromosphere)
- **Etalon lab tests (birefringence behavior)**
- **Talk at SST seminar**
- **Student meeting**
- **CASPER mission for ESA Voyage 2050 program**

# Summary of tasks

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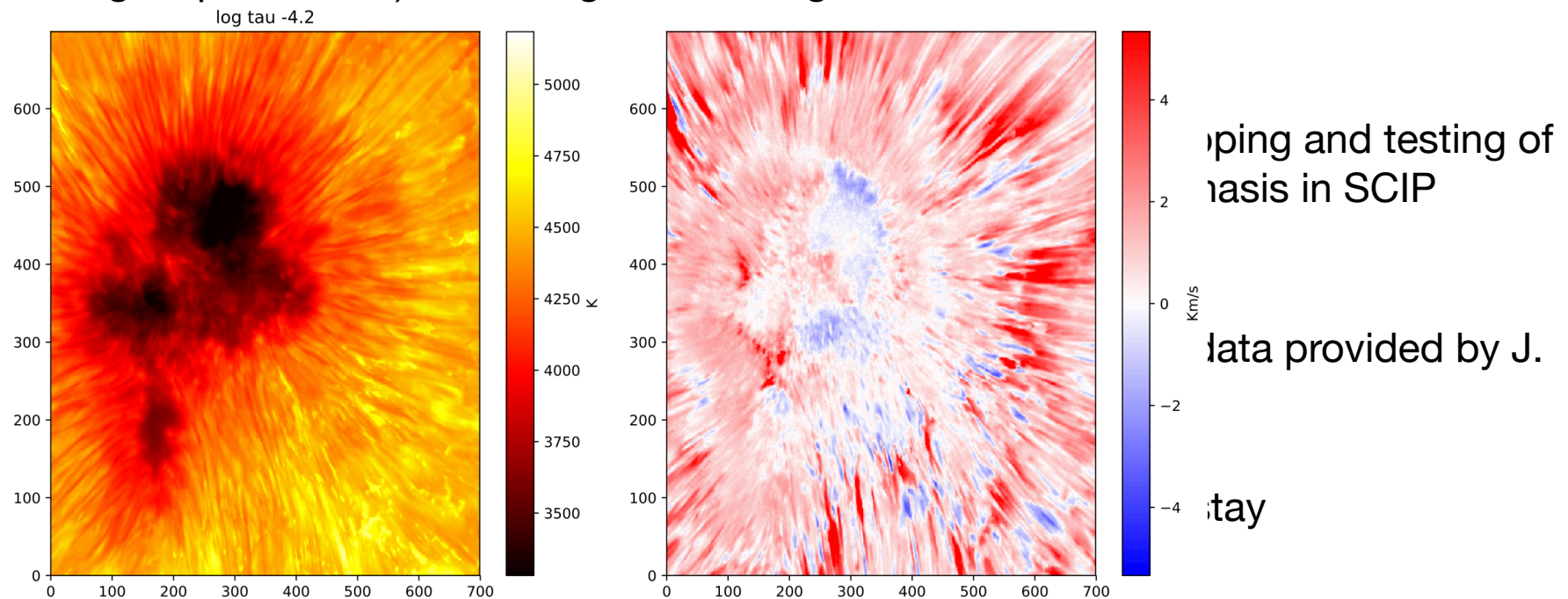
## Testing of the Non-LTE desire inversion code

- Used intensity observations of the triplet Ca II near-IR lines at 854 nm (SCIP target spectral line) taken with the Vacuum Tower Telescope (C. Quintero Noda data) for testing desire
- Used MHD simulations (BIFROST) to synthesize the triplet Ca II near-IR lines at 854 nm (including information about the magnetic field) and the Mg I b2 line (IMaX+ target spectral line) for testing the code against realistic MHD models
- Establish a collaboration between NAOJ (Yusuke Kawabata <kawabata.yusuke@ac.jaxa.jp>) and IAA to continue the developing and testing of Desire for its future use in Sunrise III mission, with special emphasis in SCIP instrument.
- Start the analysis of IRIS Mg II h&k data (280nm) using desire (data provided by J. Okamoto)
- These activities have been carried out along the three months stay

# Summary of tasks

## Testing of the Non-LTE desire inversion code

- Used intensity observations of the triplet Ca II near-IR lines at 854 nm (SCIP target spectral line) taken with the Vacuum Tower Telescope (C. Quintero Noda data) for testing desire
- Used **MHD simulations** (BIFROST) to synthesize the **triplet Ca II near-IR lines** at 854 nm (including information about the magnetic field) and the Mg I b2 line (IMaX+ target spectral line) for testing the code against realistic MHD models

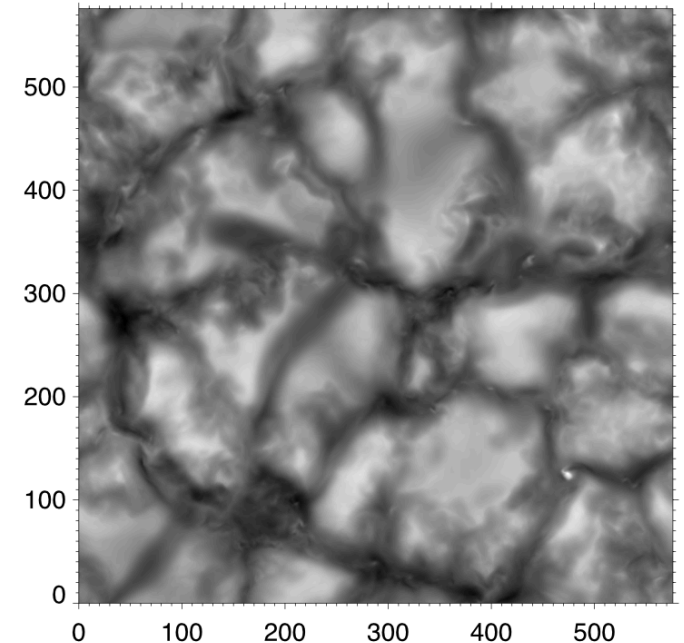


# Summary of tasks

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## Synthesis of Hinode/SP spectral lines from MHD simulations

- Develop software to generate Stokes vectors from MHD simulations (MURAM)
- Codes for doing the synthesis at NAOJ (Fortran and IDL)
- Still in progress (fine-tuning of the synthesis codes and inclusion of magnetic field information)
- From July to September

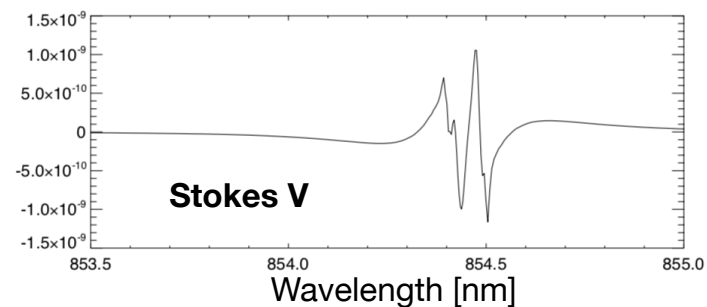
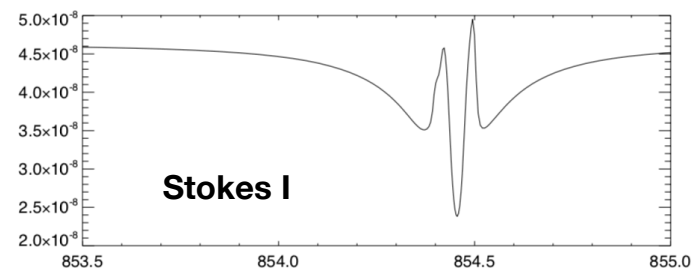
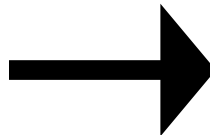
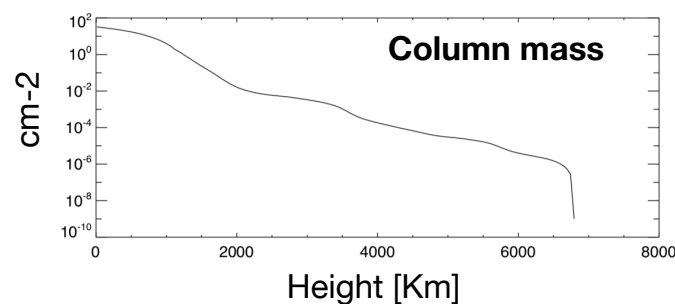
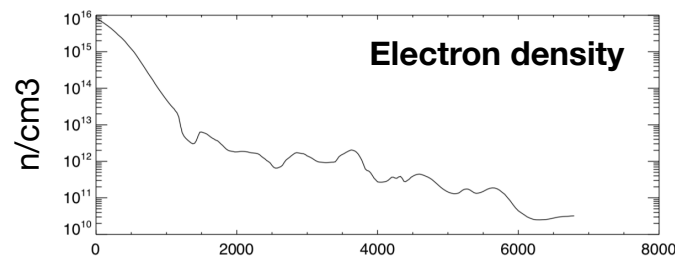




# Summary of tasks

## Synthesis of Ca II H&K lines from coronal loop simulations

- Synthesis of Ca II 854 nm chromospheric line from the full 3-dimensional compressible magnetohydrodynamic (MHD) simulation of T. Matsumoto.
- The simulations were made to investigate the thermal response of coronal loops to the presence of MHD waves.
- The idea was to generate associated Stokes profiles in order to investigate the observational counterparts of the waves and heating. This study is ongoing.

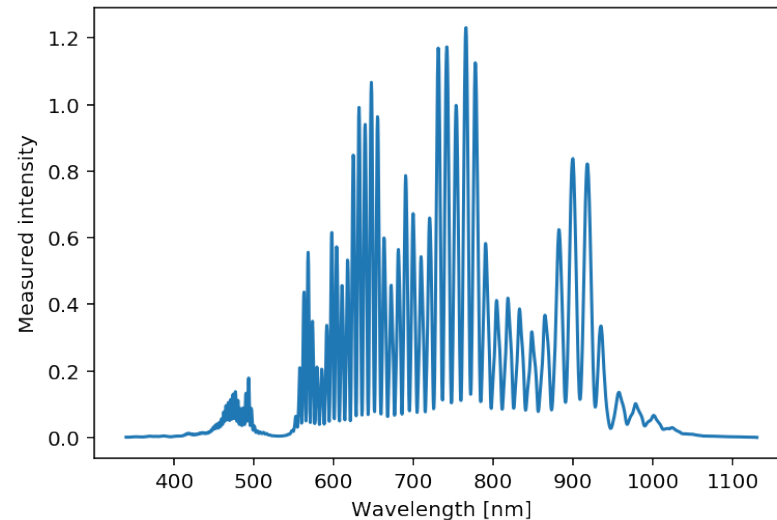


# Summary of tasks

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## Birefringence measurements of Fabry-Pérot etalon

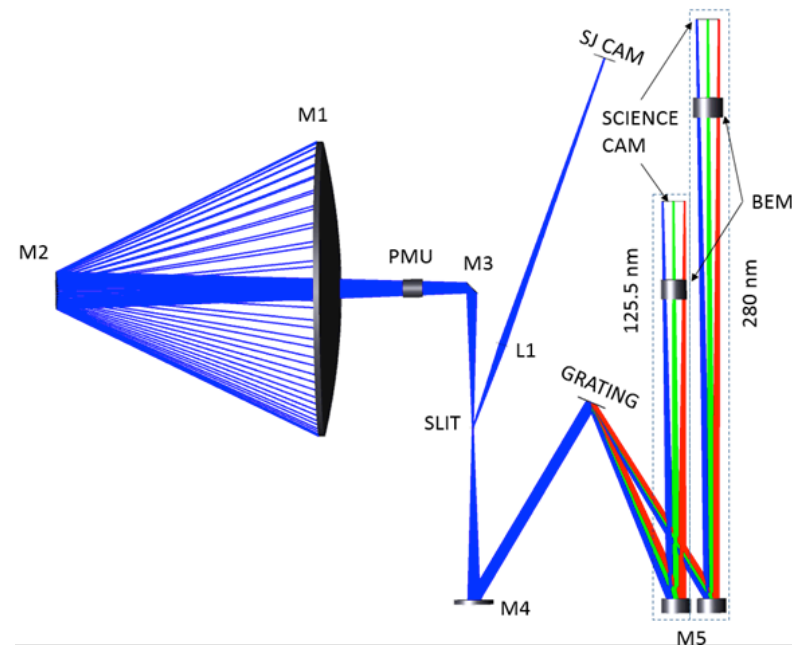
- Measurement of the mueller matrix of a Y-cut Lithium Niobate etalon with the help of Y. Suematsu and H. Masaoki.
- The idea is to confirm recent results about the behavior of crystalline etalons in polarized light.
- Measurements were done at the end of September. Analysis of data is being carried out now.



# Summary of tasks

## CASPER white paper mission for ESA Voyage2050 program

- Presentation of a white paper in response to: Call for White Papers for the ESA's Voyage 2050 Science Program with Y. Katsukawa, R. Ishikawa and R. Kano in the team members
- CASPER mission: a low-risk and high-TRL mission to explore in detail the magnetism and dynamics of the solar chromosphere and TR using a spectropolarimeter covering the hydrogen Ly-alpha and Mg II h&k ultraviolet lines.



**[Attachment] Activity Report for NAOJ Visiting Joint Research**

Name	Affiliation	Research Title	ID
D. Orozco Suarez	Instituto de Astrofísica de Andalucía IAA-CSIC	SUNRISE-3気球観測に向けた太陽磁場診断コードの開発	

Date:

**1 Refereed Papers in European languages**

No need to fill out	Authors' names (No need to fill out if DOI has been assigned)	Year of publication	Title	Journal	Volume (※1)	Page or ID (No need to fill out if DOI has been assigned)	DOI (if assigned)	Year of survey	Notes
								/	
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**2 Refereed Papers in Japanese.**

Alphabet of first author	Authors' names (No need to fill out if DOI has been assigned)	Year of publication	Title	Journal	Volume (※1)	Page or ID (No need to fill out if DOI has been assigned)	DOI (if assigned)	Year of survey	Notes
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**3 Presentations at international/domestic conferences, and/or meetings.**

No need to fill out	Speakers' names	Year	Title	Name	Location + period	Invited lecture (※2)	Year of survey	Notes
	石川遼太郎, 他	2019	LTEインバージョンから探る光球大気構造変化のスペクトル	日本天文学会2019年秋季年	熊本大学, Sep. 11-13, 2019		/	
	D. Orozco Suarez	2019	CASPER: A mission to study the time-dependent evolution of the solar corona	ESA Voyage 2050	Madrid, Oct. 29-31, 2019		/	

**4 Master/Doctor thesis**

No need to fill out	Authors' name	Year	Title	University	Language	Type of degree	DOI (if assigned)	Year of survey	Notes
								/	
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**5 Others**

Organized "Non-LTE Inversion Workshop", 16-18 Dec. 2019, Oslo
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(※1) You may leave this column blank if there is no volume number. If you need to describe the issue number, write it in parentheses.  
 (※2) In the case of an invited lecture, put a "\*" in the column.