

# Activity Report for NAOJ Visiting Joint Research in FY(2018)

Date: 2019-03-06

Applicant (Host Researcher)	Name	Matteo LEONARDI
	Affiliation/ Title	GWPO / Assistant professor
Research Title	Coherent Control of squeezed state of light & correlating structural defects to absorption measurement in sapphire samples	
Work location	NAOJ Mitaka Campus	
Visiting Joint Researcher	Name	Marco BAZZAN
	Affiliation/ Title	University of Padova (IT) / Researcher
1. Summary of research		
<p>The activity performed during the stay concerned three main aspects, detailed in the following: (1) Collaboration to the frequency dependent squeezing experiment: MB participated in several experimental shifts at the TAMA laboratory collaborating in the setup of the squeezing bench. In particular the activity was devoted to setting up the coherent control system for the generation of squeezed vacuum with controlled squeezing angle. (2) Characterization of sapphire substrates from different producers using PCI absorption measurements. (3) Scientific discussion and bibliographic research on the relationship between observed absorption structures and structural defects related to the crystal growth mechanism. All the above mentioned activities are documented by daily reports on the official KAGRA e-logbook.</p>		

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

The activity at the frequency dependent squeezing experiment resulted in the successful locking of the coherent control beam and of the cavity locking beam with the main laser, plus the alignment of the squeezed vacuum field and of the local oscillator beam on the homodyne detector. Those achievements allowed the experimental observation of squeezing, which was previously reported with the setup in TAMA but needed to be reset after a long stop. Some results were also obtained on the implementation of the locking loop for coherent control: the back-reflection from the OPO cavity of the coherent control beam was successfully detected and used to obtain an error signal to be fed in the stabilization loop of the CC. The activity in the absorption characterization resulted in the characterization of seven sapphire samples from two companies and in the subsequent participation in meetings with the producers. This opened up few interesting research lines, such as the influence of the different production methods (Top Seeded Melt Growth versus Edge-Defined Growth) and the possibility to compare the results of the absorption characterization with the growth history of the samples, made available by the producers. Scientific discussion activity resulted in a model explaining the origin of the absorption structures observed in sapphire substrates based on the anisotropic growth of the material and on slight changes of the segregation coefficient, leading to an inhomogeneous incorporation of impurities. A paper on this topic is under preparation.

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

This program allows the growth of our group giving us the possibility to invite at NAOJ Campus highly qualified researchers from around the world. With this specific visit the project did a huge step ahead and the students had the possibility to greatly improve their training.

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

The possibility to visit and work in first person on the experiments at NAOJ gave me a much better feeling of the scientific problems to be addressed. Additionally, the opportunity of a deep direct interaction with the local team resulted in fruitful discussion and comments that significantly improved my contribution to the team work.

5. Joint research period			
Name/Affiliation	Marco BAZZAN / University of Padova (IT)		
Period of stay	2019/02/01	~	2019/03/03 ( 31 ) days
Period of stay	YYYY/MM/DD	~	YYYY/MM/DD ( ) days
Total	( 31 ) 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.