### Control

Stepping motor

and

Displacement sensor

and

Actuators

Dan Chen 2013/12/24 Cryo-payload meeting

# Test of actuator for initial alignment in cryogenic temperature

82	1.5.1	Stepping motor (ICRR)	134日	13/11/18 (月) 14/03/31 (月)	8%	8%	Chen Dan
83	1.5.1.1	Candidate list	27日	13/12/05 (木) 13/12/31 (火)	50%	50%	Sekiguchi Takanori,Takahashi R.,Chen Dan
84	1.5.1.2	Procurement of candidates	78日	13/11/29 (金) 14/02/14 (金)	0%	0%	Takahashi R.,Yamamoto Kazuhiro
85	1.5.1.3	Preparation for candidates test	26日	13/11/18 (月) 13/12/13 (金)	0%	0%	Chen Dan,Student from AEI Hannover
86	1.5.1.4	Test at cryo temp	1.43月	14/02/17 (月) 14/03/31 (月) 84,8	5 0%	0%	To be determined (ICRR),Small cryostat

### Candidate and Status

Name	Number we have in ICRR	comment
Stepping motor	0	The delivery time is 2.5 month. The company said this works at 4K. We have ordered.
Pico motor	1	We had a cooling test using a PT cooler. But it did not work below 200K.
Autex	0	Salesmen from Autex show us a motor (PZT). But they said they don't have experience at 10K. They will give us a sample for cooling test <b>tomorrow</b> . And they will search a

## Calculation of the requirement for the mass shifter Inrad ← P

1mrad ← Beginning adjustment limit by hand

Accuracy we need:

3urad  $\leftarrow 1$  step of the mass shifter = 1 cm shift of main beam on the other TM



For IM calcuration by Dan and Ono

Mass: 0.5kg

Drive range:  $\pm 4 \text{cm} \rightarrow \pm 1 \text{mrad}$ 

Mass: 1.0kg

Drive range:  $\pm 2 \text{cm} \rightarrow \pm 1 \text{mrad}$ 

Mass: 2.0kg

Drive range:  $\pm 1 \text{cm} \rightarrow \pm 1 \text{mrad}$ 

Drive accuracy:  $120\text{um} \rightarrow 3\text{urad}$ 

Drive accuracy:  $60\text{um} \rightarrow 3\text{urad}$ 

Drive accuracy:  $30\text{um} \rightarrow 3\text{urad}$ 

Virgo: start=1-1.5mrad, step=3urad, range=10mrad=±1.5cm, mass=0.27kg

1 step < 120um, 60um, 30um

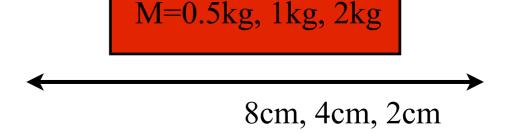
\*We assumed the cryo-payload is rigid. So the real dimanic range should be smaller.

11cm

TM 23kg

RM 23kg

- \*The drive accuracy of the mass shifter we will make can be smaller. So the accuracy angle can be finer.
- \*Do we need more dymamic range? We can not use water level?



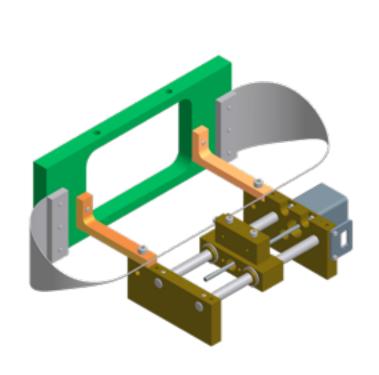
30cm

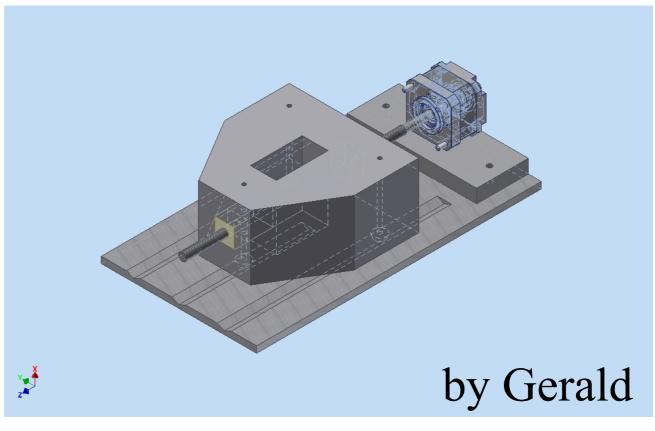
IM 60kg

Accuracy and dynamic range

# Test of actuator for initial alignment in cryogenic temperature A/I

- •We will make a test stage for Stepping motor.
  - ▶ We have to consider the connection point between the motor we ordered and this stage.
- •We have to consider the rotate component.
  - ▶ We have to calculate the requirement.





We drew a roughish figure.

## Test of Displacement sensor and actuators (OSEM) in cryogenic temperature

87	1.5.2	Displacement sensor and actuators (between Intermediate Mass and Intermediate Recoil Mass) (ICRR)	117日	13/11/04 (月) 14/02/28 (金)		0%	0%	Chen Dan
88	1.5.2.1	Candidate list of light sources and photo diodes	12日	13/11/04 (月) 13/11/15 (金)		0%	0%	Suzuki T,Takahashi R,Yamamoto Kazuhiro,Chen Dan
89	1.5.2.2	Procurement of candidates of light sources and photo diode	26日	13/11/16 (土) 13/12/11 (水)	88	0%	0%	Chen Dan
90	1.5.2.3	Preparation of test for the candidates of light sources and photo diode	12日	13/11/29 (金) 13/12/10 (火)		0%	0%	Chen Dan, Student from AEI Hannover
91	1.5.2.4		20日	13/12/12 (木) 13/12/31 (火)	90,89	0%	0%	Chen Dan,Small cryostat
92	1.5.2.5	Preparation for test of sensor	27日	13/11/17(日) 13/12/13(金)		0%	0%	Student from AEI Hannover
93	1.5.2.6	Test of sensor at cryogenic temperature	54日	14/01/06 (月) 14/02/28 (金)	92	0%	0%	To be determined (ICRR),Small cryostat

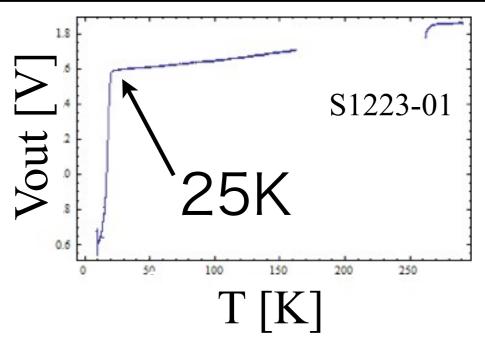
#### Status

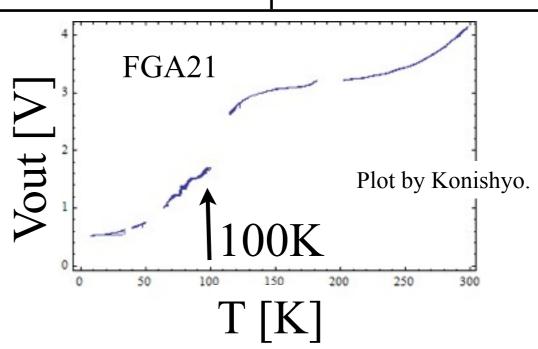
PD: We tasted 2 PDs at low temperature.

LED: Two of LD works at 77K.

### PD

Name	Type	Peak	We have	comment	Status
S1223-01	Si PIN PD	960 nm	5	We had a cooling test. Efficiency decreases at low T (37%)	Test: done Analysis: in progress
G8370-01	InGaAs PIN PD	1550 nm	0	Tomaru-san said this works at low T. I asked a quotation but is was out of stock.	-
FGA21	InGaAs Pin PD	1600 nm	2	The quantum efficiency decreases at low T(15%).	Test: done Analysis: not yet
FDG03	Ge PD	1550 nm	2	We ordered. ThourLab said it works at low T.	Delivery: done
S3590	Si PIN PD	980 nm	0	We can order. But LED doesn't work. So we don't need? -> I think we need.	Order: not yet







Name	Туре	Peak	Number we have in ICRR	comment
OP232	GaAIAs	890 nm	5	This is used in OSEM at room temperature.
L2656-03	GaAlAs	890 nm	20	Tomaru-san said this works at low T. I received.
ML925B45F	L925B45F InGaAsP 1550 nm 2		2	

### Liquid nitrogen test: 77K

OP232	Does not work
L2656-03	Works!
ML925B45F	Works!

Detect by sensor card

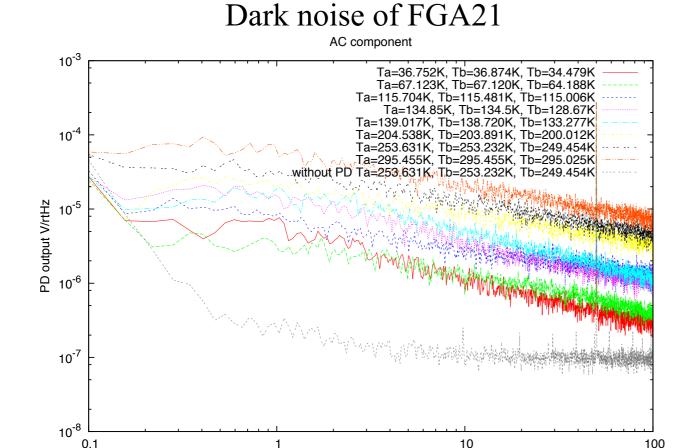
## Test of Displacement sensor and actuators (OSEM) in cryogenic temperature A/I

- •Search other PD and LED. (Manu is in process.)
- •Test LEDs we have in 77K and cryostat.
- •Calculate the noise from the data we have now.

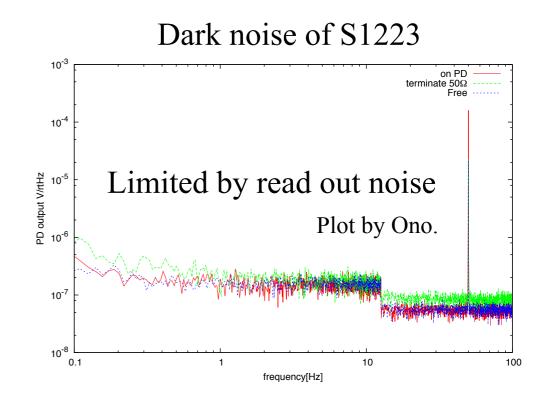
Plot by Ono.

•Actuator?

必要な周波数帯は0.5-100Hz?



frequency[Hz]



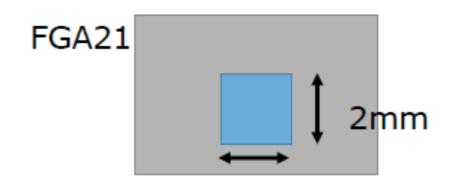
### Slide by Konishyo

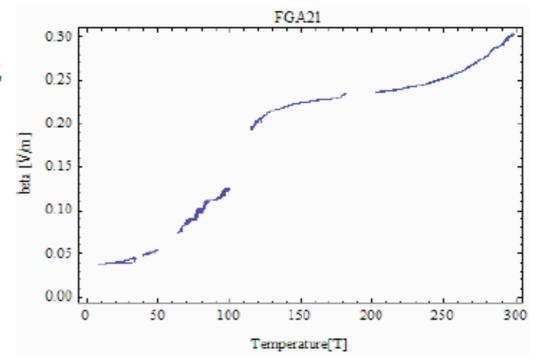
# To know the sensitivity of the PD (FGA21)

Use the results of experiments [Hz-V/rtHz] at different temperature and [T-A].

1. Calculate the efficiency of shadowsensor,  $\beta$  : V[V] = $\beta$ [V/m] \* x[m] from [T-V].

In the case of FGA21,R is  $1k\Omega$  and size is  $2mm \times 2mm$ .





### Slide by Konishyo

### 2. Divide [V/rtHz] by $\beta$ at the temperature.

