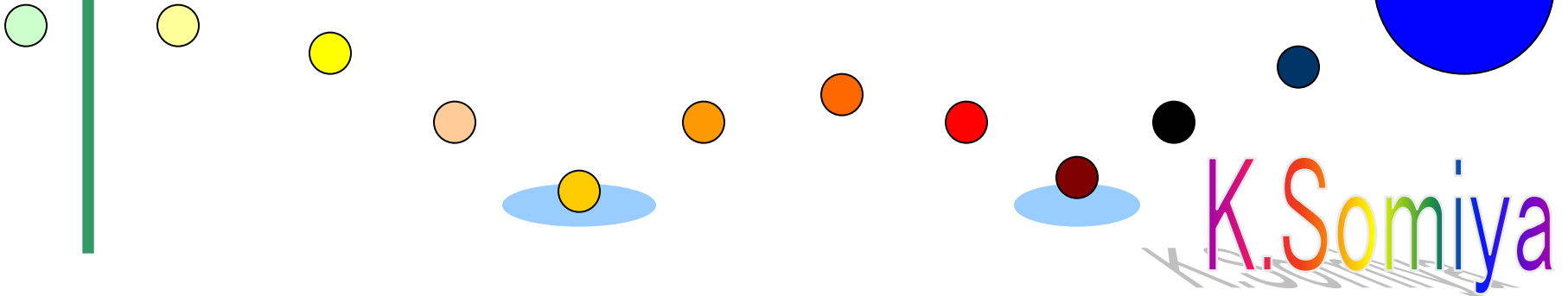


# Interface Control Document

LCGT F2F meeting @ ICRR  
Aug. 2011

*Tokyo Inst of Technology*  
**Kentaro Somiya**



# Contents of the talk

- Concept of interface control
- Prompt update system for ICD
- Allocation of tasks
- Trade-off study

# Without the interface control...

- (1) Two people may think that the other guy will take care of a shared item.
- (2) Some items could belong to none of the subsystems.



- (3) Two people may assume different parameters for a shared item.

⇒ **Importance of interface control**

**Interface Control Document  
of the LCGT Project**

2010/4/19 (ver 1.23)

LCGT Project

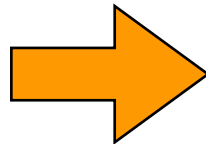
ICD: JGW-M0900018-v8

## Role of ICD

- Define subsystems (components, tasks)
- Set requirements
- List up interface parameters

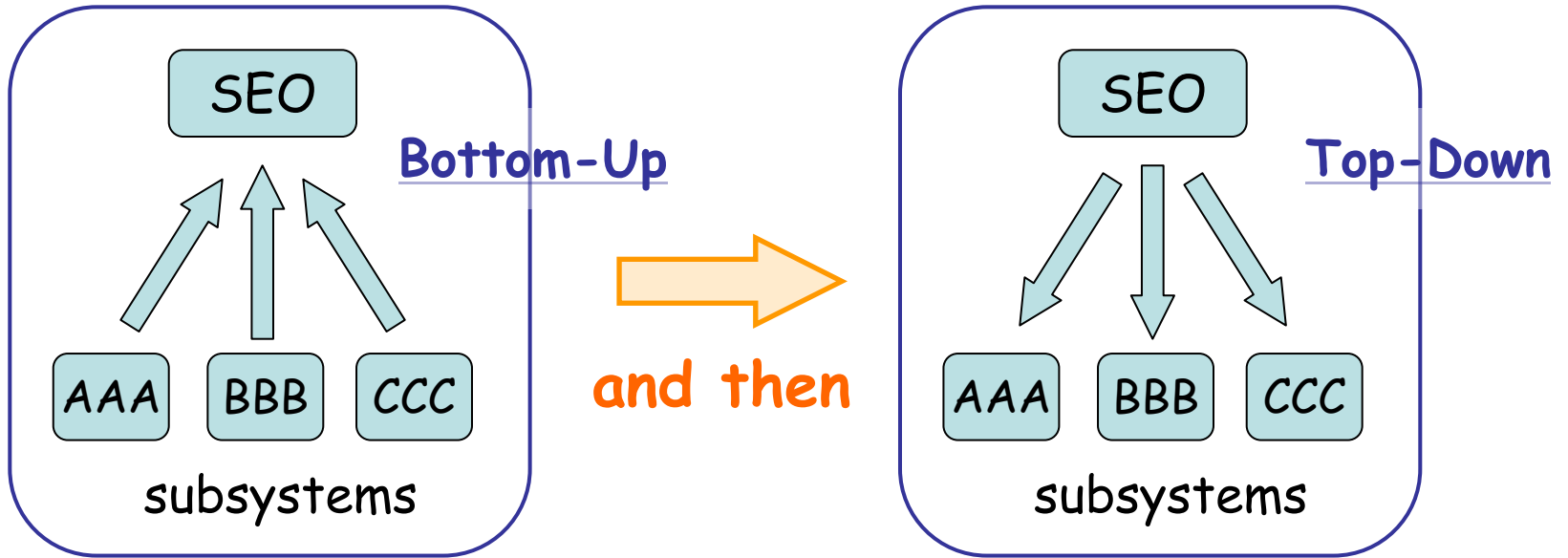
## Problems of current ICD

- Too many pages for prompt update
- No consistency check

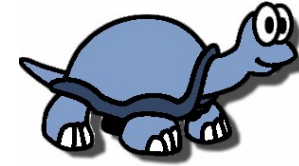


**New ICD**

# New ICD (Interface Control Document)



# New ICD (Interface Control Document)



TortoiseSVN  
Techfuels.com

SVN = Apache Subversion

SVN server

ASC code

SAS code

Param.List

ICD

updates



members



Ex: MIF



Latex



```

1 ip.k_GAS4 4.73.E+02 kg/s^2 kspring constant of 4th GAS filter visl
2 ip.gT_GAS4 #NAME? % kT dependence of spring constant
3 ip.loss_GAS4blade 1.00.E-02 % %loss of GAS filter blades visl
4 ip.m_joint 1.00.E-01 kg %mass of GAS filter joint for wire
5 ip.usus_GASPF 2.10.E+00 km %wire length btw 4th GAS filter and P
7 ip.d_GAS4 3.11.E-03 % wire diameter (4th GAS) visl
8 ip.n_GAS4 1.00.E+00 % number of wires (4th GAS) visl
9 ip.E_GAS4 1.88.E+11 kPa %wire young's modulus (4th GAS) visl
10 ip.tensile_GAS4 2.00.E+09 kPa %wire tensile strength (4th GAS)
11 ip.loss_GAS4wire #NAME? % %loss of wire (4th GAS) visl
12 ip.usus_GAS4 2.10.E+00 km %wire length btw 4th GAS filter and C
13 ip.dsus_GAS4 3.74.E-03 km %wire diameter (4th GAS) -vis,dg
14 ip.num_GAS4wire 1.00.E+00 % %number of wires (4th GAS)
15 ip.m_payload 1.20.E+02 kg %total mass suspended by 4th GAS filt
16 ip.radius_BS 1.90.E-01 km XBS radius -mir,mif
17 ip.thickness_BS 1.20.E-01 km XBS thickness -mir,mif
18 ip.R_BS 5.00.E-01 % XBS reflectivity -mir,mif
19 ip.loss_BS_HR 5.00.E-05 % XBS HR surface optical loss -mir,mi
20 ip.loss_BS_AR 5.00.E-05 % XBS AR surface reflectivity -mir,mi
21 ip.RoC_BS 1.00.E+05 km XRoC of BS -mir,mif
22 ip.abso_BS 1.00.E-08 1/m XBS substrate absorption -mir,mi
23 ip.wedge_BS 3.83.E-01 kgdeg XAR wedge of BS -mir,mif,vac
24 ip.diameter_cryo8K 5.00.E-01 km %radiation shield diameter cry,va
25 ip.diameter_aperture 2.50.E-01 km %radiation shield aperture
26 ip.diameter_tophole 1.50.E-01 km %top hole diameter (to SAS) -cry,va
27 ip.heat_frontop 1.00.E-02 % %radiation from upper stages -cry,va
28 ip.heat_frontBS 1.00.E-02 % %radiation from BS chamber -cry,va
29 ip.heat_frontArm 1.00.E-02 % %radiation from arm cavity -cry,va
30 ip.heat_cryoshield 1.00.E-01 % %heat from radiation shield cry,va
31 ip.heat_reartr trenchield #NAME? % %heat from reartr trenchield
  
```

```

31 Use line-break after each sentence to i
32
33 \section[Overview]{
34
35 This document presents the interface information that should
36 listing LCGT subsystems.
37 The interface information includes (i) definition of each s
38 and (iii) optical layout of the detector.
39 The document is uploaded on the LCGT SVN server (Url[https
40 trunk/ICD]) and the contents are to be updated on a real-ti
41
42 \section[Allocation of the tasks for LCGT]{
43
44 The scope of each subsystem and the boundaries of subsystem
45 ents must be included in one or more subsystems.
46 The components shared by more than one subsystems, namely [
47 fully controlled to avoid a contradictory assumption of the
48
49 \subsection[List of the subsystems and 3-letter codes]{
50 Analog Electronics (AEL)WV
51 Auxiliary Optics (AOS)WV
52 Cryogenics (CRY)WV
53 Digital System (DGS)WV
54 Facility (FCL)WV
55 Input and Output Optics (IOO)WV
56 Laser (LAS)WV
  
```

VBA

filters, real-time OS, control software, monitor software, data storage,  
and the related interface parameters are listed in Table 4.

Interface	AEL	AOS	CRY	DGS	FCL	IOO	LAS
beamline	Y	Y	Y	Y	Y	Y	Y
power_spl	Y	Y	Y	Y	Y	Y	Y
power_dia	Y	Y	Y	Y	Y	Y	Y
scattering	Y	Y	Y	Y	Y	Y	Y
transport	Y	Y	Y	Y	Y	Y	Y
vac_spl	Y	Y	Y	Y	Y	Y	Y
vac_dia	Y	Y	Y	Y	Y	Y	Y

Table 4: Interface parameters that DGS subsystem is in charge of.

### 3.5 FCL

The components that the FCL subsystem is in charge are as follows:  
buildings, car parking, power supply system, clean any rooms, air conditioners, optical fibers, cranes, vacuum access, clean booth on access, acoustic isolation boxes,  
and the related interface parameters are listed in Table 5.

Interface	AEL	AOS	CRY	DGS	FCL	IOO	LAS
beamline	Y	Y	Y	Y	Y	Y	Y
power_spl	Y	Y	Y	Y	Y	Y	Y
power_dia	Y	Y	Y	Y	Y	Y	Y

Table 5: Interface parameters that FCL subsystem is in charge of.

### 3.6 GIF

The components that the GIF subsystem is in charge are as follows:  
thermometers, winemeters, particle meters, microphones, hygrometers, baseline interferometers, barometers, accelerometers,  
There are no interface parameters that GIF is in charge of.

### 3.7 IOO

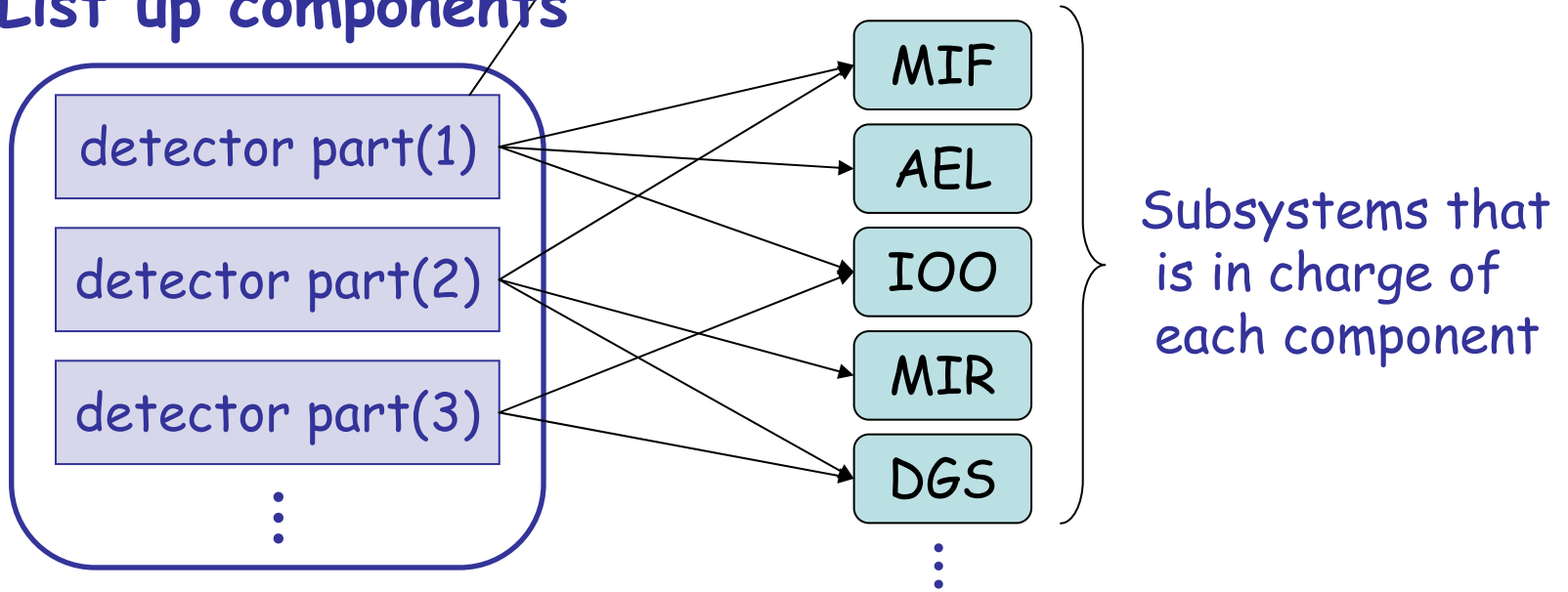
The components that the IOO subsystem is in charge are as follows:  
PMC mirrors, BC mirrors, BC servo, phase-lock system for green, PMC for gr2, MC servo, variable attenuator, BS servo, OMC (broadband),  
and the related interface parameters are listed in Table 6.

# Allocation of tasks

Ex.)

2.6 Main interferometer and core optics		
ITM (silica) [MIR], ETM (sapphire) [MIR], PR2 [MIR], SR2 [MIR], steering mirrors [AOS], PD for REFL (high/low) [AEL], PD for POX [AEL], PD for Y-trans [AEL], QPDs for AS (high/low) [AEL], lenses for AS WFS [MIF], CCDs for trans (X,Y) [MIF], CARM demodulator [AEL], MICH demodulator [AEL], digital system for MIF [DGS], network analyzer [MIF], TCS (if necessary) [AOS],	ETM (silica) [MIR], BS [MIR], PR3 [MIR], SR3 [MIR], pico-motors for steering mirrors [AOS], PD for POP (high/low) [AEL], PD for POY [AEL], QPDs for REFL (high/low) [AEL], lenses for REFL WFS [MIF], oplev for core optics [AOS], CCDs for REFL [MIF], DARM demodulator (RF) [AEL], SRCL demodulator [AEL], in-vacuum mirror cleaning tools [AOS], optical spectrum analyzer [MIF],	ITM (sapphire) [MIR], PRM [MIR], SRM [MIR], ASp pickoff mirror [MIR], beam dampers [AOS], PD for ASp (high/low) [AEL], PD for X-trans [AEL], QPDs for POP (high/low) [AEL], lenses for POP WFS [MIF], holes on baffles [AOS], attenuation mirror for REFL [MIF], PRCL demodulator [AEL], CARM servo [MIF], oscilloscopes [MIF], acoustic isolation boxes [FCL],

List up components



# Allocation of tasks

- List-up process will be done by SEO (top-down; in order to avoid missing objects)
- Allocation of each component will be done by SEO + subsystems (mostly bottom-up)
- A subsystem that determines the requirement of each component (not the one that purchases the component)
- For example...
  - AOS is in charge of the oplev, while AEL buys the QPDs and IOO buys the steering mirrors.



# Parameter list

```
1
2 ip.k_GAS4 =4.73.E+02          %kg/s^2    %spring constant of 4th GAS filter      vis↓
3 ip.dT_GAS4          =TBD      %          %T dependence of spring constant      vis,cry,mif↓
4 ip.loss_GAS4blade  =1.00.E-02  %          %loss of GAS filter blades           vis↓
5 ip.m_joint         =1.00.E-01  %kg        %mass of GAS filter joint for wire     vis
6 ip.lsus_GASPF      =2.10.E+00  %m         %wire length btw 4th GAS filter and PF vis
7 ip.d_GAS4          =3.11.E-03  %m         %wire diameter (4th GAS)              vis↓
8 ip.n_GAS4          =1.00.E+00  %          %number of wires (4th GAS)            vis↓
9 ip.E_GAS4          =1.86.E+11  %Pa        %wire young's modulus (4th GAS)       vis↓
10 ip.tensile_GAS4   =2.00.E+09  %Pa        %wire tensile strength (4th GAS)      vis
11 ip.loss_GAS4wire  =TRD       %          %loss of wire (4th GAS)              vis↓
```

Name (tab) =value (tab) %unit (tab) %description (tab) AAA,BBB,CCC

This part can be directly used with a Matlab code.

AAA: subsystem in charge  
BBB+: related subsystems

- The interface parameters have been discussed with all the subsystem chiefs (parameter meetings)
- Once a parameter is changed, the list will be updated and the chief will be informed via SVN

# Parameter list

VBA transforms the list to the table below.  
(Visual Basic Application)

Microsoft Excel - iplist2.xls

	A	B	C	D	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	V	W	X
1					TU	PA	VA	VI	MI	CR	IF	DG	EL	IO	LA						
2	drange_PD	#NAME?		PD dynamic range								<b>IF</b>	<b>DG</b>	<b>EL</b>	<b>IO</b>						
3	drange_QPD	#NAME?		QPD dynamic range								<b>IF</b>	<b>DG</b>	<b>EL</b>	<b>IO</b>						
4	aperture_rfpd_hi	3.00.E-03	m	RF PD aperture (high								<b>IF</b>		<b>EL</b>							
5	aperture_rfpd_lo	3.00.E-03	m	RF PD aperture (low								<b>IF</b>		<b>EL</b>							
6	aperture_dcpd_hi	3.00.E-03	m	DC PD aperture (high								<b>IF</b>		<b>EL</b>							
7	aperture_dcpd_lo	3.00.E-03	m	DC PD aperture (low								<b>IF</b>		<b>EL</b>							
8	input_rfpd_high	3.00.E-01	W	RF PD input power (h								<b>IF</b>		<b>EL</b>							
9	input_rfpd_low	1.00.E-01	W	RF PD input power (l								<b>IF</b>		<b>EL</b>							
10	input_dcpd_high	1.00.E-01	W	DC PD input power (h								<b>IF</b>		<b>EL</b>							
11	input_dcpd_low	1.00.E-02	W	DC PD input power (l								<b>IF</b>		<b>EL</b>							
12	RFHOMsuppression	#NAME?		RF HOM suppression a								<b>IF</b>		<b>EL</b>							
13	Dcpowersupply	2.40.E+01	V	DC power supply								<b>IF</b>		<b>EL</b>							
14	dcvoltage	1.00.E-01	V	maximum DC voltage f								<b>IF</b>		<b>EL</b>							
15	noise_PD	1.00.E-09	V/rHz	electric noise on de								<b>IF</b>		<b>EL</b>							
16	error_IQ	1.00.E-02		error of 90deg for I								<b>IF</b>	<b>DG</b>	<b>EL</b>							
17	loss_PD	5.00.E-02		1 - quantum efficien								<b>IF</b>		<b>EL</b>	<b>IO</b>						
18	noise_QPD	1.00.E-09	V/rHz	QPD noise								<b>IF</b>	<b>DG</b>	<b>EL</b>	<b>IO</b>						
19	actuator_IM	#NAME?		actuator power on IM				<b>VI</b>				<b>IF</b>		<b>EL</b>							
20	actuate_range	#NAME?		actuation range (AC)				<b>VI</b>				<b>IF</b>		<b>EL</b>							
21	noise_actuator	#NAME?		actuator noise				<b>VI</b>				<b>IF</b>		<b>EL</b>							
22	actuator_ITM	#NAME?		actuator power on IT				<b>VI</b>				<b>IF</b>		<b>EL</b>							
23	actuator_ETM	#NAME?		actuator power on ET				<b>VI</b>				<b>IF</b>		<b>EL</b>							
24	emissivity_TM	#NAME?		emmissivity of surfac								<b>IF</b>		<b>EL</b>							
25	Tm_TM	2.00.E+01	K	temperature				<b>VI</b>	<b>MI</b>	<b>CR</b>	<b>IF</b>			<b>EL</b>							
26	specificheat_TM	6.90.E-01	J/K/kg	specific heat of TM				<b>VI</b>	<b>MI</b>	<b>CR</b>	<b>IF</b>			<b>EL</b>							
27	kappa_TM	1.57.E+04	W/m/K	thermal conductivit				<b>VI</b>	<b>MI</b>	<b>CR</b>	<b>IF</b>			<b>EL</b>							
28	diameter_cryo8K	5.00.E-01	m	radiation shield dia				<b>VA</b>				<b>CR</b>		<b>IF</b>							
29	emissivity_vacuu	3.00.E-02		duct emissivity				<b>VA</b>				<b>CR</b>		<b>IF</b>							
30	diameter_apertur	2.50.E-01	m	radiation shield ape				<b>VA</b>				<b>CR</b>	<b>IF</b>	<b>IF</b>							
31	heat_fromBS	1.00.E-02	W	radiation from BS ch				<b>VA</b>				<b>CR</b>	<b>IF</b>	<b>IF</b>							
32	heat_fromArm	1.00.E-02	W	radiation from arm c				<b>VA</b>				<b>CR</b>	<b>IF</b>	<b>IF</b>							
33	heat_fromField	1.00.E-04	W	heat from radiation				<b>VA</b>				<b>CR</b>	<b>IF</b>	<b>IF</b>							

Related subsystems are shown in color

Subsystem in charge is shown in bold letters

Sorted by the subsystem in charge

Create tables with each subsystem in charge (used in ICD)

# Discussions in the parameter meetings

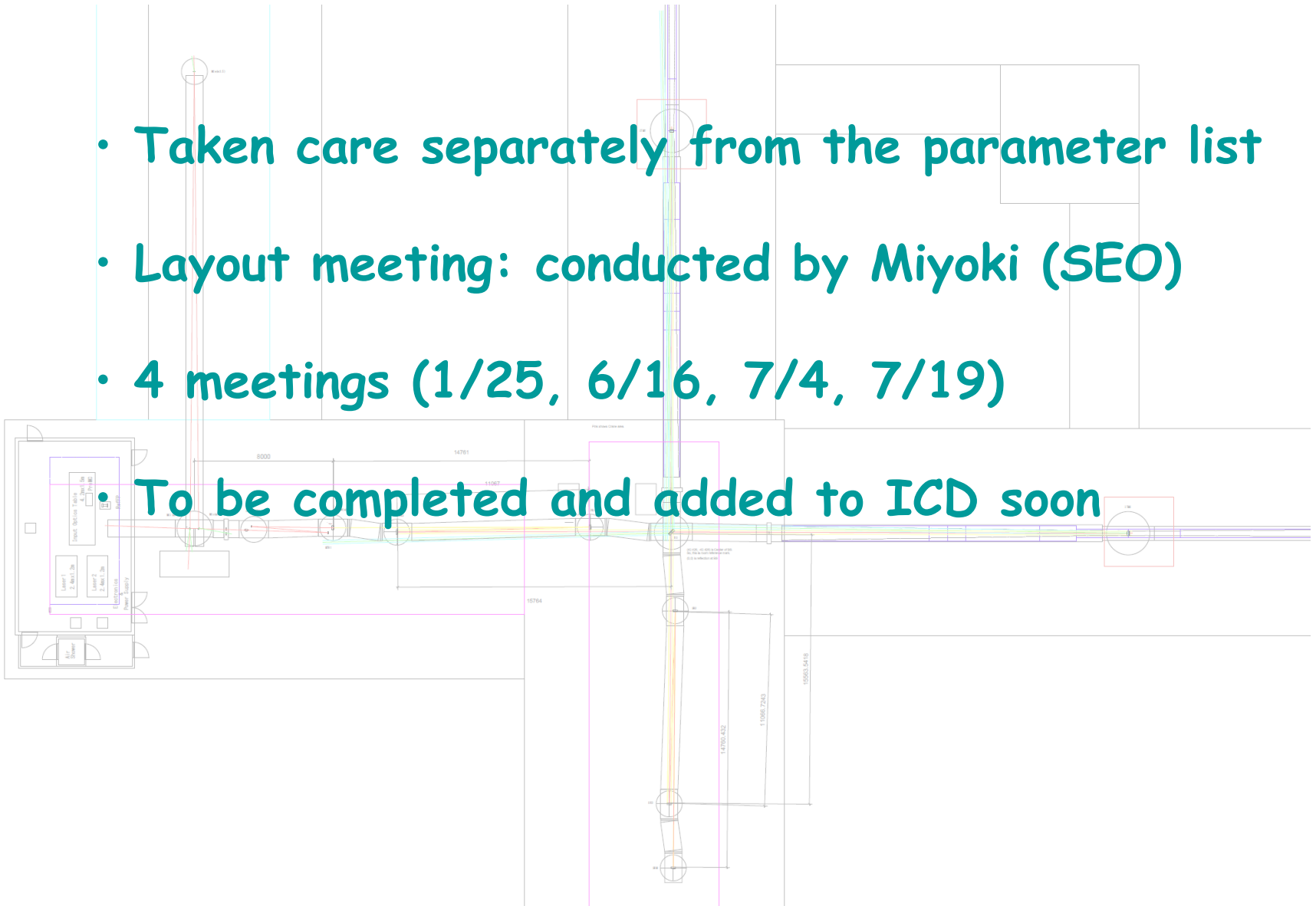
- Mirror spec (wedge, RoC error, absorption)
  - Coating mechanical loss
  - MIF control; UGF and feedforward gain
  - Intermediate mass temperature
  - Shield aperture and point scattering
  - OMC design
- ... etc.

Some of them are not specified yet.

# Optical layout

- Taken care separately from the parameter list
- Layout meeting: conducted by Miyoki (SEO)
- 4 meetings (1/25, 6/16, 7/4, 7/19)

• To be completed and added to ICD soon



# How to proceed hereafter

- Cross-check the component list (SEO)
- Subsystem study meetings (led by Ando)
- Discuss the allocation with subsystems
- Complete the parameter list
- Add the optical layout
- Complete the ICD
- Add the link to Matlab codes

