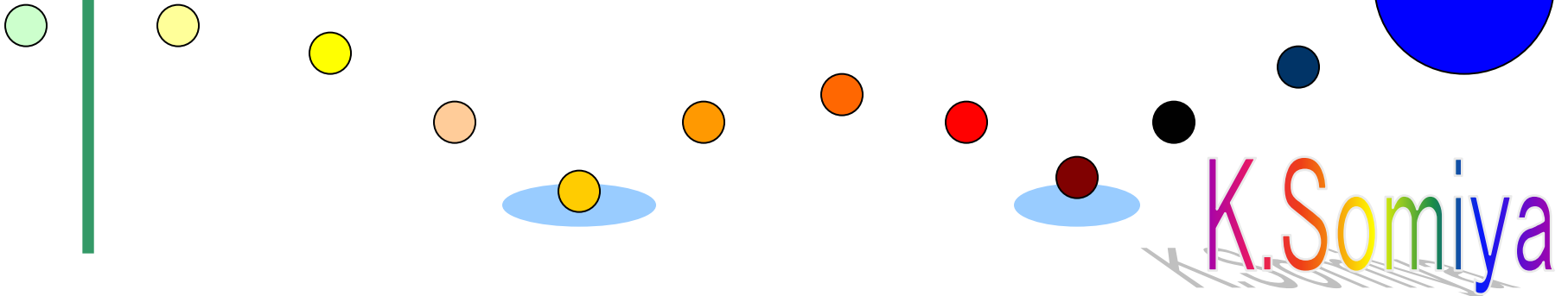


Interface Control Document

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

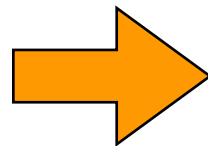
ICD: JGW-M0900018-v8

Role of ICD

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

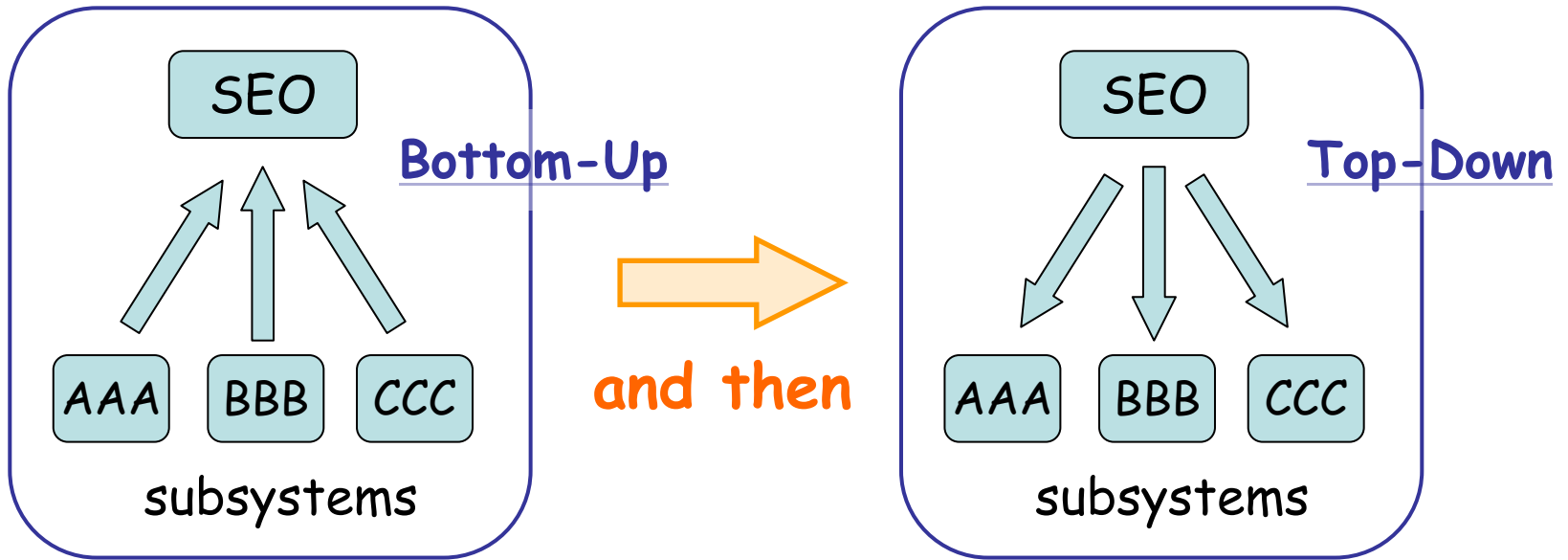
Problems of current ICD

- No consistency check
- Too many pages for prompt update



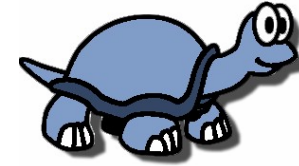
New ICD

New ICD (Interface Control Document)



- Bottom-up method alone leads to the inconsistency
- Top-down method alone may cause conflicts
- Both are necessary
- The first part has been quite done in the old ICD

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



```

31 Use line-break after each sentence to
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 \subsection[List of the subsystems and 3-letter codes]{
45 Analog Electronics (AEL)\V\
46 Auxiliary Optics (AOS)\V\
47 Cryogenics (CRY)\V\
48 Digital System (DGS)\V\
49 Facility (FCL)\V\
50 Input and Output Optics (IOO)\V\
51 Laser (LAS)\V\

```

```

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

```

VBA

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

Interface	ASC	SAS	IOO	FCL	DGS	CRY	AEL	AOS
parameters	ALL	CRY						
power_AEL	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_AOS	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_DGS	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_FCL	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_IOO	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_SAS	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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 air 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	ASC	SAS	IOO	FCL	DGS	CRY	AEL	AOS
parameters	ALL	CRY						
power_AEL	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_AOS	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_DGS	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_FCL	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_IOO	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
power_SAS	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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, siliconometers, 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.)

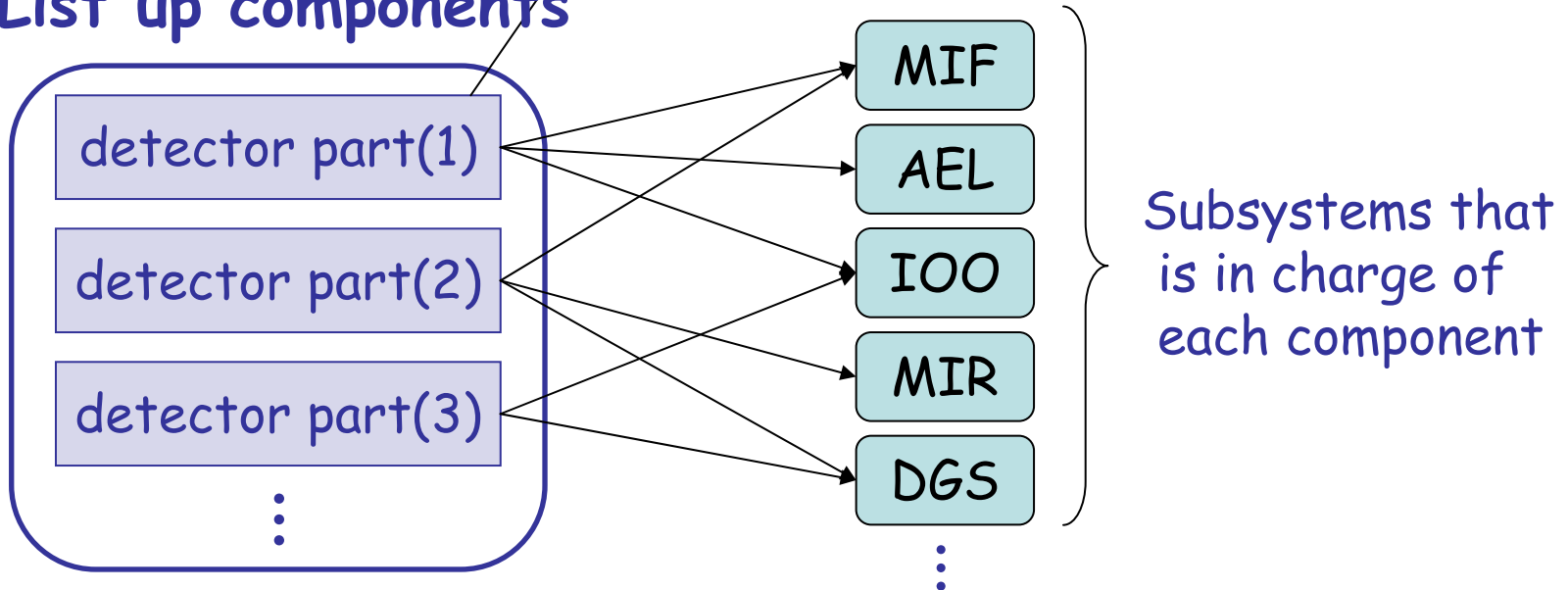
2.6 Main interferometer and core optics

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],

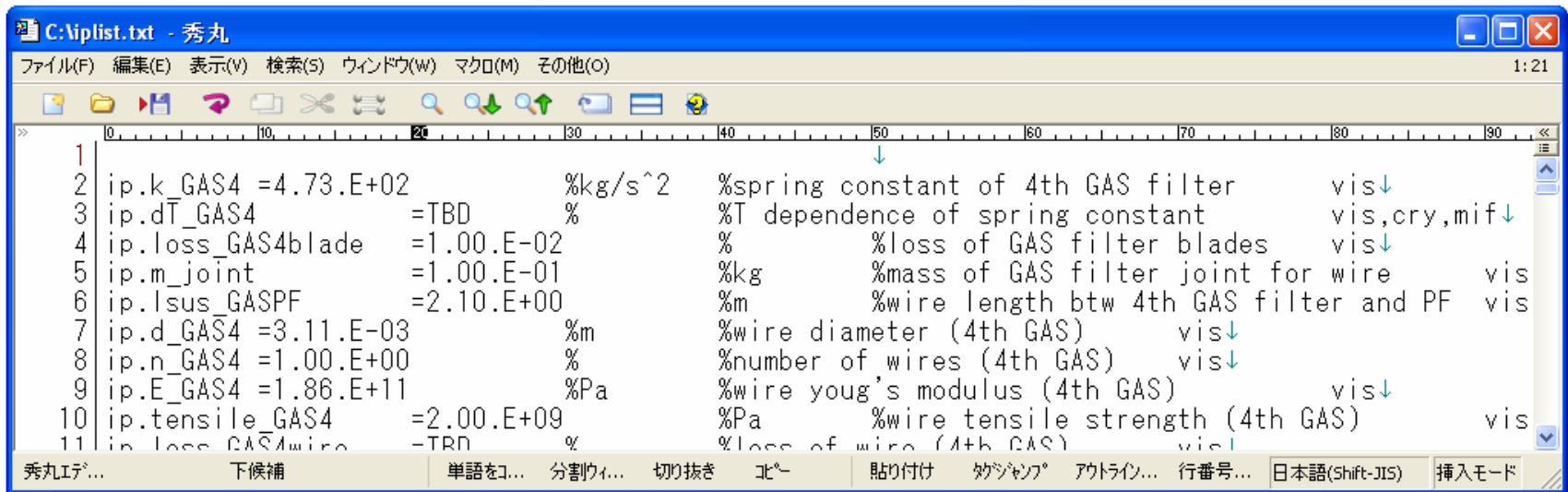
List up components



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



```
C:\Iplist.txt - 秀丸
ファイル(F) 編集(E) 表示(V) 検索(S) ウィンドウ(W) マクロ(M) その他(O) 1:21
>>
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↓
秀丸エディタ... 下候補 単語をコ... 分割ウイ... 切り抜き コピー 貼り付け 効シヤン? アウトライン... 行番号... 日本語(Shift-JIS) 挿入モード
```

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

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

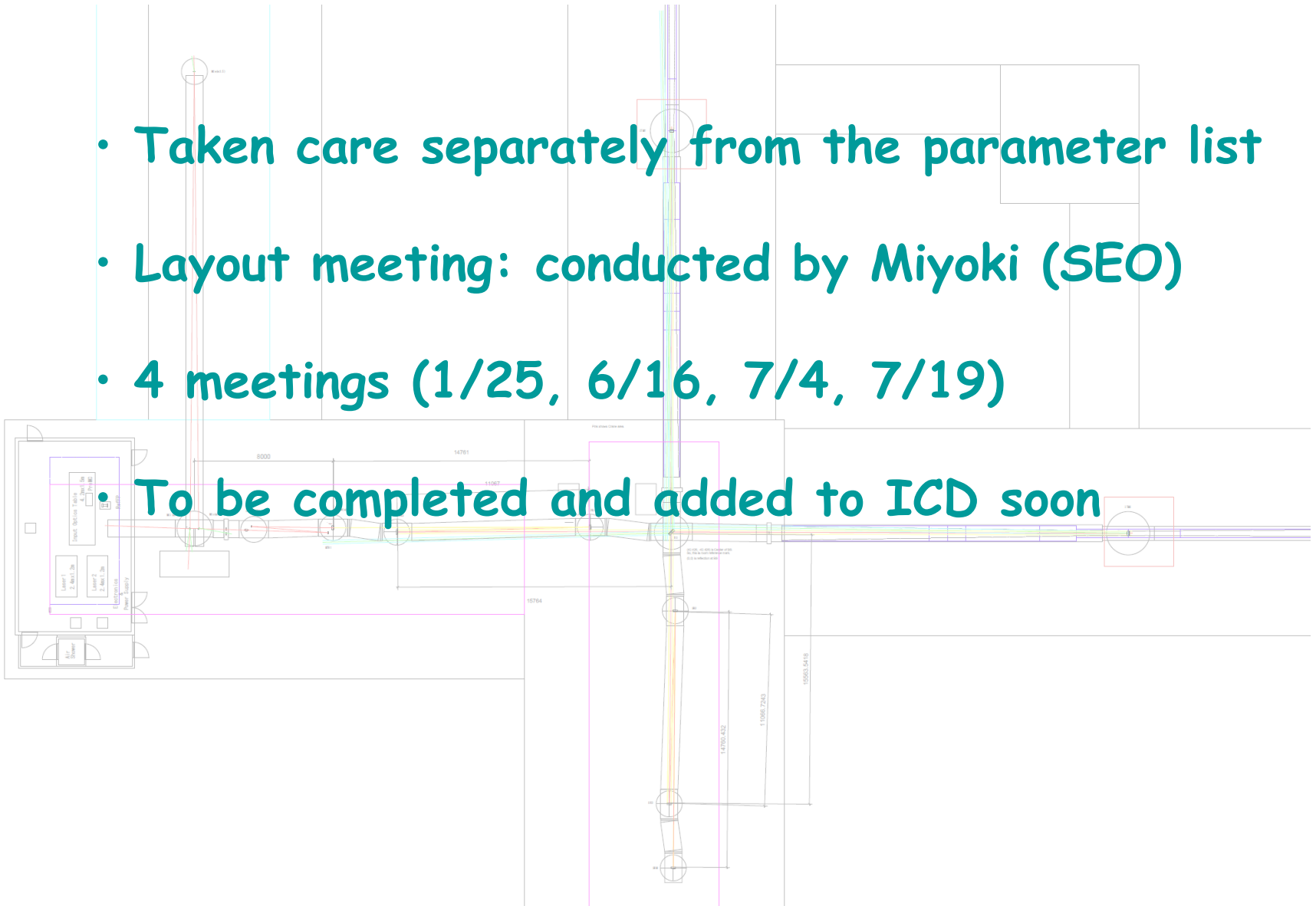
- Mirror spec (wedge, RoC error, absorption)
 - Coating mechanical loss
 - MIF control; UGF and feedforward gain
 - Intermediate mass temperature
 - Shield aperture and point scattering
 - OMC design
- ... etc.

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

