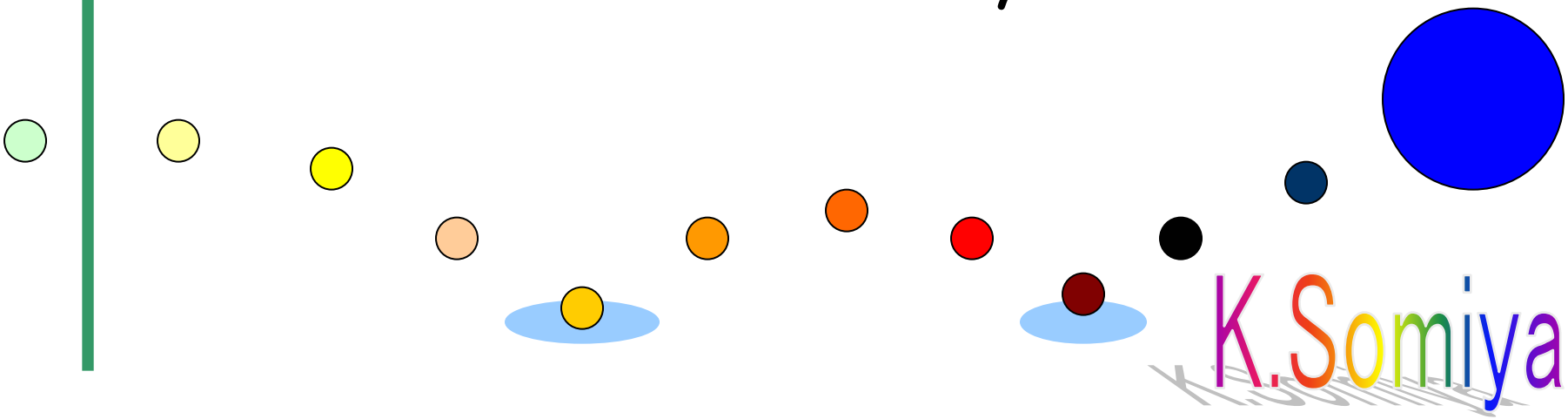
Interface Control Document

LCGT domestic meeting
Dec. 2011

Tokyo Inst of Technology
Kentaro Somiya

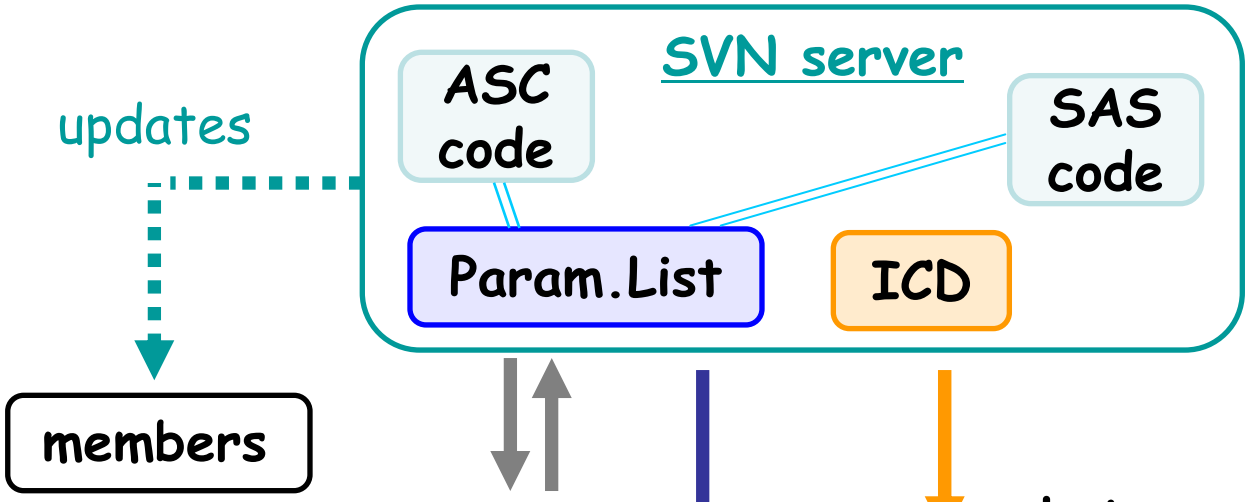


Contents

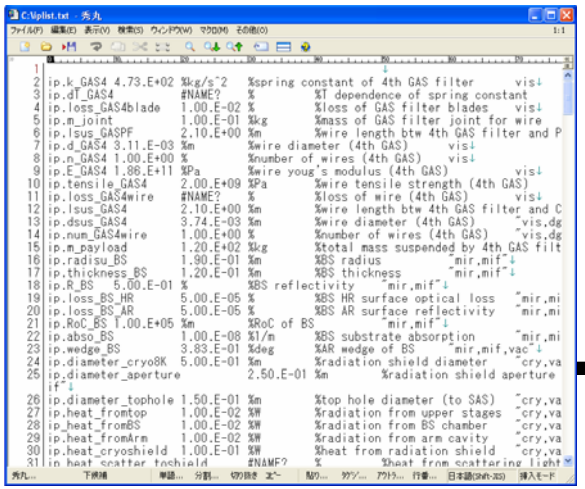
- ICD framework is ready
  (https://granite.phys.s.u-tokyo.ac.jp/svn/LCGT/trunk/ICD/)
- Please check
  (i) allocated tasks to your subsystem
  (ii) interface parameters in charge
- "TBD" parameters should be filled or explained by the coming internal reviews
- Please start using SVN if you haven't
  (http://gwwiki.icrr.u-tokyo.ac.jp/JGWwiki/LCGT/SVN)

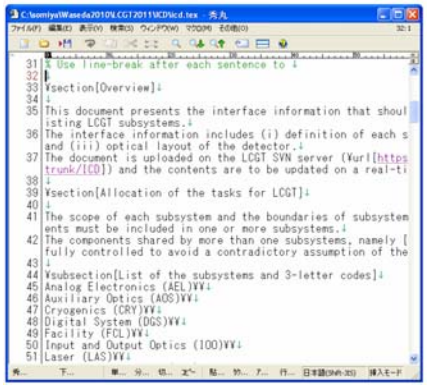
same slide as in Aug

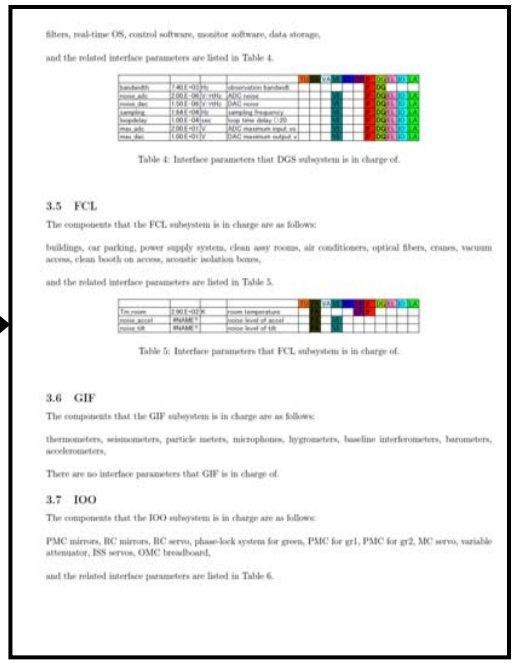
ICD structure (Interface Control Document)



SVN = Apache Subversion







same slide as in Aug

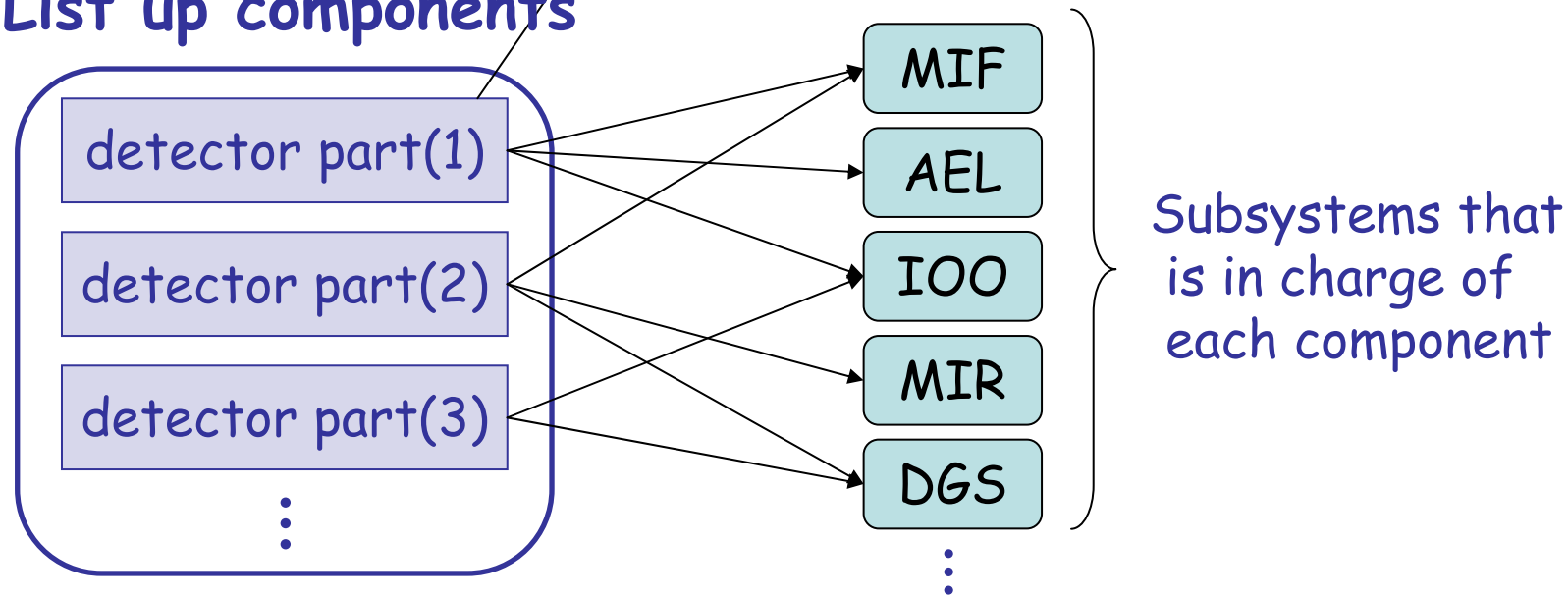
Allocation of tasks

Ex.)

2.6 Main interferometer and core optics

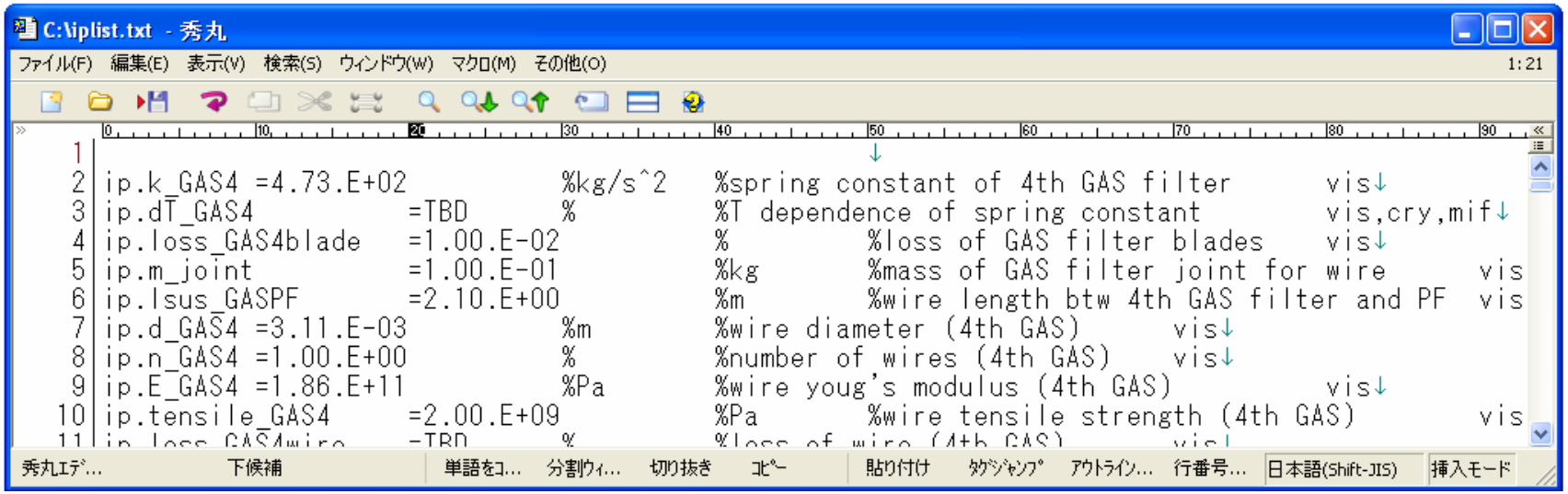
ITM (silica) [MIR],	ETM (silica) [MIR],	ITM (sapphire) [MIR],
ETM (sapphire) [MIR],	BS [MIR],	PRM [MIR],
PR2 [MIR],	PR3 [MIR],	SRM [MIR],
SR2 [MIR],	SR3 [MIR],	ASp pickoff mirror [MIR],
steering mirrors [AOS],	pico-motors for steering mirrors [AOS],	beam dampers [AOS],
PD for REFL (high/low) [AEL],	PD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

List up components



same slide as in Aug

Parameter list



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

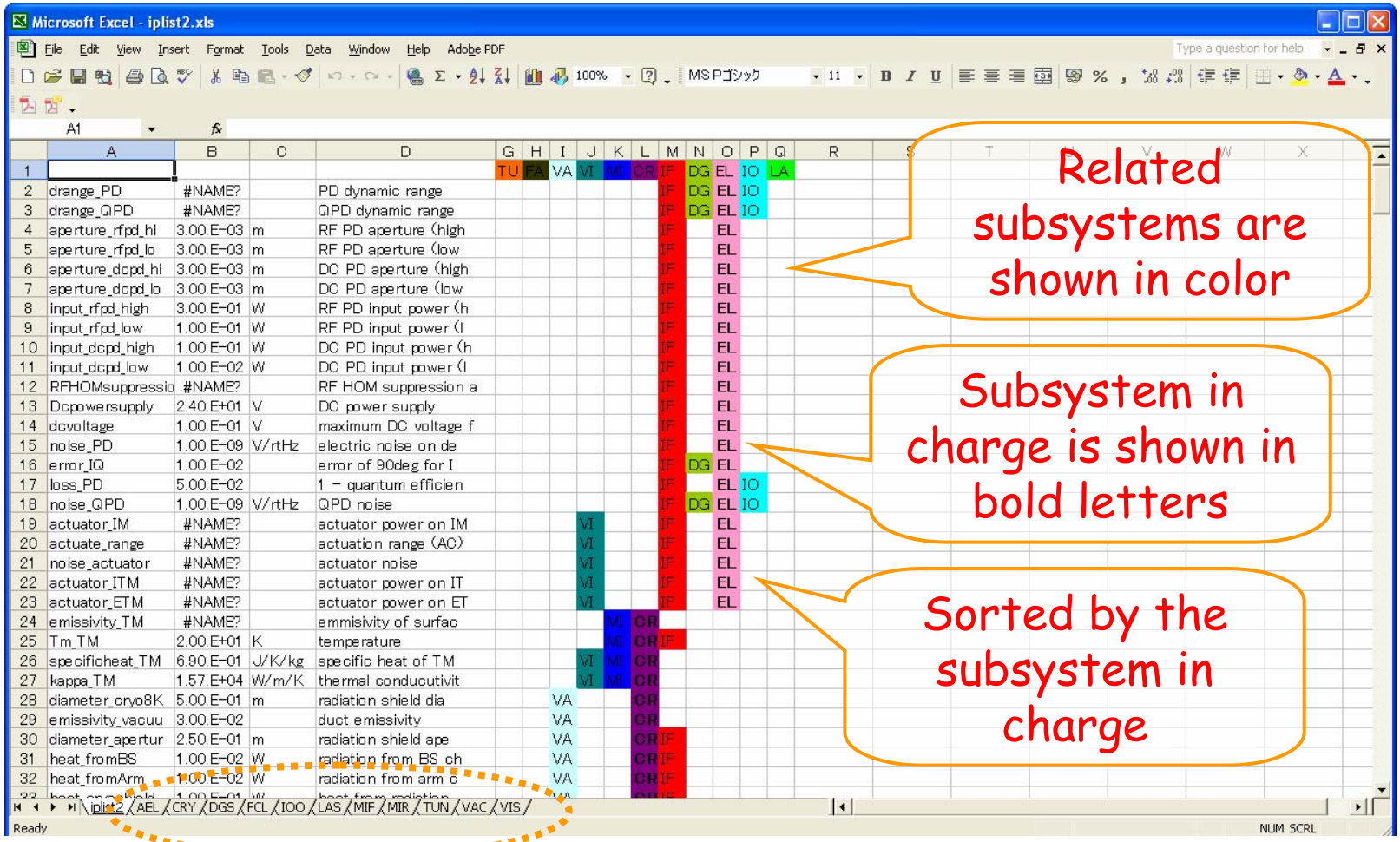
- **The interface parameters have been discussed with all the subsystem chiefs (parameter meetings)**
- **Once a parameter is changed, the list will be updated and the chief will be informed via SVN**

same slide as in Aug

Parameter list

VBA transforms the list to the table below.

(Visual Basic Application)



	A	B	C	D	G	H	I	J	K	L	M	N	O	P	Q
1					TU	FA	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	RFHOMsuppressio	#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/rtHz	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/rtHz	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?		emmisivity of surfac					MI	CR					
25	Tm_TM	2.00.E+01	K	temperature					MI	CR	IF				
26	specificheat_TM	6.90.E-01	J/K/kg	specific heat of TM				VI	MI	CR					
27	kappa_TM	1.57.E+04	W/m/K	thermal conducutivit				VI	MI	CR					
28	diameter_cryo8K	5.00.E-01	m	radiation shield dia			VA			CR					
29	emissivity_vacuu	3.00.E-02		duct emissivity			VA			CR					
30	diameter_apertur	2.50.E-01	m	radiation shield ape			VA			CR	IF				
31	heat_fromBS	1.00.E-02	W	radiation from BS ch			VA			CR	IF				
32	heat_fromArm	1.00.E-02	W	radiation from arm c			VA			CR	IF				

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

What's new (1)

				TU	FA	VA	VI	MI	CR	IF	DG	EL	IO*	LA	AO	GI	DA
rho_ETM	4.00.E+03	kg/m^3	mirror bulk density					MI									
rho_ITM	4.00.E+03	kg/m^3	mirror bulk density					MI									
E_ETM	4.00.E+11	Pa	Young's modulus of E					MI									
E_ITM	4.00.E+11	Pa	Young's modulus of I					MI									
sigma_ETM	2.90.E-01		mirror bulk Poisson					MI									
sigma_ITM	2.90.E-01		mirror bulk Poisson					MI									
alpha_ETM	5E-09	1/K	mirror thermal expan					MI	CR								
alpha_ITM	5E-09	1/K	mirror thermal expan					MI	CR								
Cs_ETM	6.90.E-01	J/K/kg	mirror specific heat					MI	CR								
Cs_ITM	6.90.E-01	J/K/kg	mirror specific heat					MI	CR								
kappa_ETM	1.57.E+04	W/m/K	mirror thermal condu					MI	CR								
kappa_ITM	1.57.E+04	W/m/K	mirror thermal condu					MI	CR								
E.coat_silica	7.20.E+10	Pa	silica coating Young					MI	CR								
E_coat_tantala	1.40.E+11	Pa	tantala coating Youn					MI	CR								
sigma_coat_silic	1.70.E-01		silica coating Poiss					MI	CR								
sigma_coat_tanta	2.30.E-01		tantala coating Pois					MI	CR								
Cv_coat_silica	1.64.E+06	J/K/m^3	silica coating speci					MI	CR								
Cv_coat_tantala	2.10.E+06	J/K/m^3	tantala coating spec					MI	CR								
alpha_coat_silic	5.10.E-07	1/K	silica coating therm					MI	CR								
alpha_coat_tanta	3.60.E-06	1/K	tantala coating ther					MI	CR								
alpha_coat_silic	1.38.E+00	W/m/K	silica coating therm					MI	CR								
alpha_coat_tanta	3.30.E+01	W/m/K	tantala coating ther					MI	CR								
diamter_TM	2.20.E-01	m	TM diameter					MI	CR	IF					AO		
thickness_TM	1.50.E-01	m	TM thickness					MI	CR	IF					AO		
abso_coat	5.00.E-07		coating absorption					MI	CR	IF					AO		
abso_AR	1.00.E-06		AR surface absorptio					MI	CR	IF					AO		
R_BS	5.00.E-01		BS reflectivity					MI		IF							
loss_BS_HR	5.00.E-05		BS HR surface optica					MI		IF							
RoC_BS	5.00.E+05	m	RoC of BS					MI		IF							
abso_BS	1.50.E-04	1/m	BS substrate absorpt					MI		IF							
radisu_BS	1.90.E-01	m	BS radius					MI		IF					AO		
thickness_BS	1.20.E-01	m	BS thickness					MI		IF					AO		
loss_BS_AR	5.00.E-05		BS AR surface reflec					MI		IF					AO		
diameter_PRM	2.50.E-01	m	PRM diamter					MI		IF					AO		
thickness_PRM	1.00.E-01	m	PRM thickness					MI		IF					AO		

added AOS,GIF,DAS

22cm mirrors

- Some other parameters have been also updated
- All the parameters are written in the MKS system

What's new (2)

				TU	FA	VA	VI	MI	CR	IF	DG	EL	IO	LA	AO	GI	DA
hb	1.05457.E-34	J*s	reduced Planck constant							IF			IO		AO		
c	2.99792458.E+08	m/s	speed of light							IF			IO	LA	AO		
kb	1.38.E-23	J/K	Boltzmann's constant			VA	VI	MI	CR								
g	9.8.E+00	m/s^2	acceleration of gravity			VA	VI	MI	CR	IF					AO		
lambda	1.064.E-06	m	wavelength			VA		MI	CR	IF			IO	LA	AO		
rho_sap	4.0.E+03	kg/m^3	density of Sapphire				VI	MI	CR								
Y_sap	4.0.E+11	Pa	Young's modulus of Sapphire				VI	MI	CR								
sigma_sap	2.9.E-01		Poisson ratio of Sapphire				VI	MI	CR								
alpha_sap	5.6.E-09	1/K	thermal expansion of Sapphir					MI	CR								
Cs_sap	6.9.E-01	J/kg/K	specific heat of Sapphire					MI	CR								
kappa_sap	1.57.E+04	W/m/K	thermal conductivity of Sapp					MI	CR								
n_sap	1.754.E+00		refractive index of Sapphire			VA		MI		IF					AO		
tensile_sap	TBD	Pa	tensile strength of Sapphire				VI		CR								
rho_sil	2.2.E+03	kg/m^3	density of Silica				VI	MI									
Y_sil	7.2.E+10	Pa	Young's modulus of Silica				VI	MI		IF							
sigma_sil	1.7.E-01		Poisson ratio of Silica					MI									
alpha_sil	5.1.E-07	1/K	thermal expansion of Silica					MI									
Cs_sil	1.64.E+06	J/m^3/K	specific heat of Silica					MI									
kappa_sil	1.38.E+00	W/m/K	thermal conductivity of Sili					MI									
n_sil	1.45.E+00		refractive index of Silica			VA		MI		IF					AO		
Y_tan	1.4.E+11	Pa	Young's modulus of Tantala				VI	MI		IF							
sigma_tan	2.3.E-01		Poisson ratio of Tantala					MI									
alpha_tan	3.6.E-06	1/K	thermal expansion of Tantala					MI									
Cs_tan	2.1.E+06	J/m^3/K	specific heat of Tantala					MI									
kappa_tan	3.3.E+01	W/m/K	thermal conductivity of Tant					MI									
n_tan	2.07.E+00		refractive index of Tantala			VA		MI		IF					AO		
rho_Cu	8.93.E+03	kg/m^3	density of Copper				VI		CR								
Y_Cu	1.298.E+11	Pa	Young's modulus of Copper				VI		CR								
sigma_Cu	3.43.E-01		Poisson ratio of Copper				VI		CR								
alpha_Cu	TBD	1/K	thermal expansion of Copper						CR								
Cs_Cu	TBD	J/kg/K	specific heat of Copper at 2						CR								
kappa_Cu	TBD	W/m/K	thermal conductivity of Copp						CR								
RRR_Cu	2.0.E+01		RRR of Copper						CR								
tensile_Cu	TBD	Pa	tensile strength of Cu fiber				VI		CR								
rho_Al	2.69.E+03	kg/m^3	density of Aluminum				VI		CR								
Y_Al	7.03.E+11	Pa	Young's modulus of Aluminum				VI		CR								
sigma_Al	3.45.E-01		Poisson ratio of Aluminum				VI		CR								
alpha_Al	TBD	1/K	thermal expansion of Aluminu						CR								
Cs_Al	TBD	J/kg/K	specific heat of Aluminum at						CR								
kappa_Al	TBD	W/m/K	thermal conductivity of Alum						CR								
RRR_Al	4.0.E+03		RRR of Aluminum						CR								
tensile_Al	TBD	Pa	tensile strength of Al fiber				VI		CR								
rho_bol	7.60.E+03	kg/m^3	density of Bolfur				VI		CR								
Y_bol	1.568.E+11	Pa	Young's modulus of Bolfur				VI		CR								
sigma_bol	TBD		Poisson ratio of Bolfur				VI		CR								
alpha_bol	TBD	1/K	thermal expansion of Bolfur						CR								
Cs_bol	TBD	J/kg/K	specific heat of Bolfur						CR								
kappa_bol	TBD	W/m/K	thermal conductivity of Bolf						CR								
RRR_bol	TBD		RRR of Bolfur						CR								
tensile_bol	3.528.E+09	Pa	tensile strength of 100um Bo				VI		CR								
bigG	6.673.E-11	m^3/kg/	Gravitational constant														DA
ms	1.989.E+30	kg	solar mass														DA
neutron	1.4.E+00	solar ma	neutron star mass														DA
fmax	1.570.E+00	Hz	end freq of BNS inspiral														DA
snr	8.0.E+00		SNR for IR calculation														DA

- Physical constants have been added.
  ex. Planck constant, Young's moduli, refractive indices, etc.

4 Optical layout

The Optical layout of bLCGT is shown in JGW-D1100685-v1 (dxf file).

5 Schedule

The Schedule of LCGT is shown here: http://gwlcgt.icrr.u-tokyo.ac.jp:13013/PWA (mpp file; password protected).

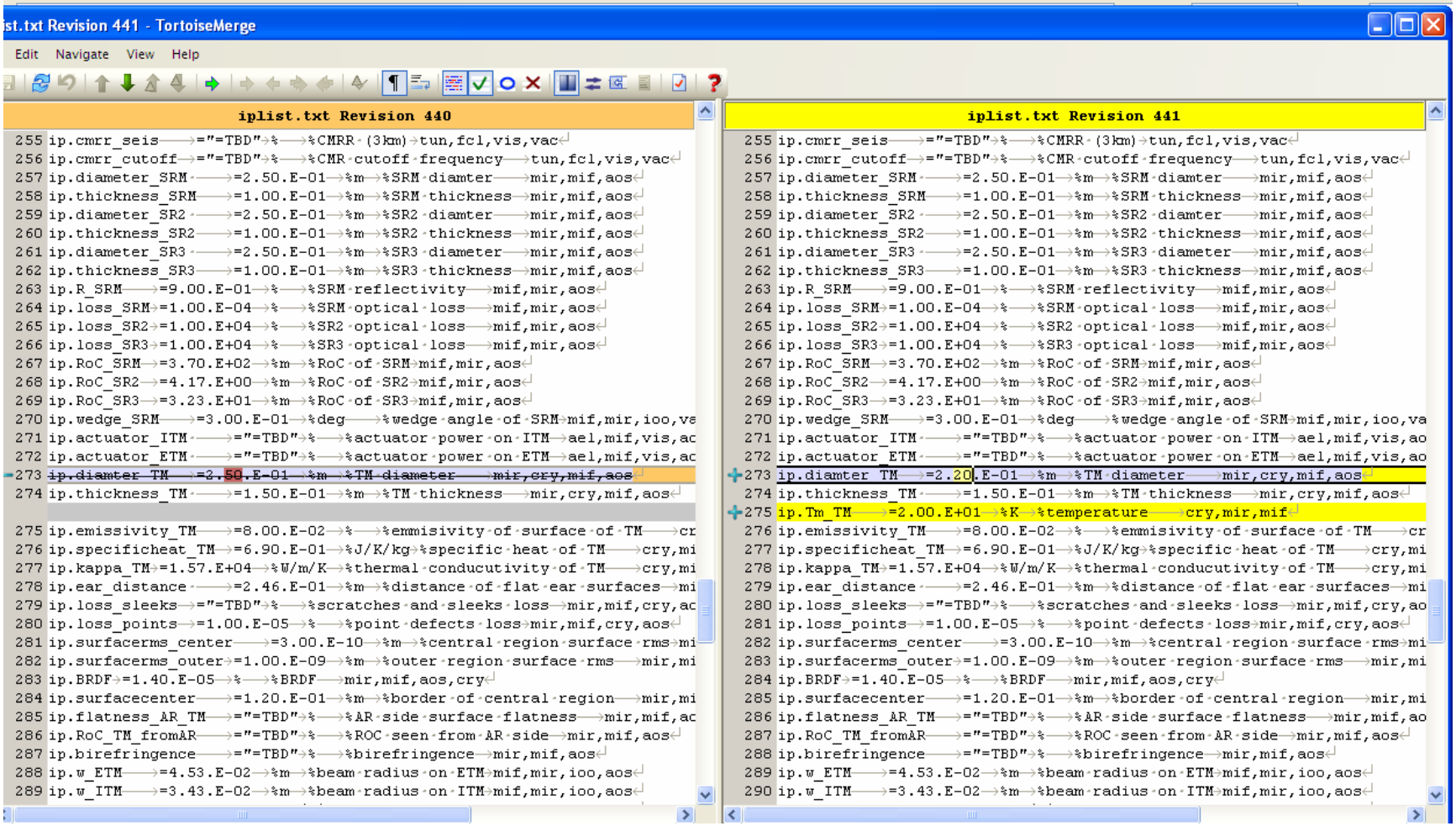
6 Glossary

AA : *anti-aliasing*
ADC : *analog-digital converter*
AI : *anti-imaging*
AOM : *acoustic-optic modulator*
AR : *anti-reflective coating*
AS : *anti-symmetric port*
BS : *beamsplitter*
CARM : *common-mode arm length change*
CMR(R) : *common-mode rejection (rate)*
DAC : *digital-analog converter*

⋮

- Links to optical layout and schedule and glossary have been added.

Checking updates in SVN



- SVN "Show Log" command shows the updates in yellow
- Changes of the mirror diameter and temperature are shown above
- Email alert could be sent to a mailing list (to be discussed)