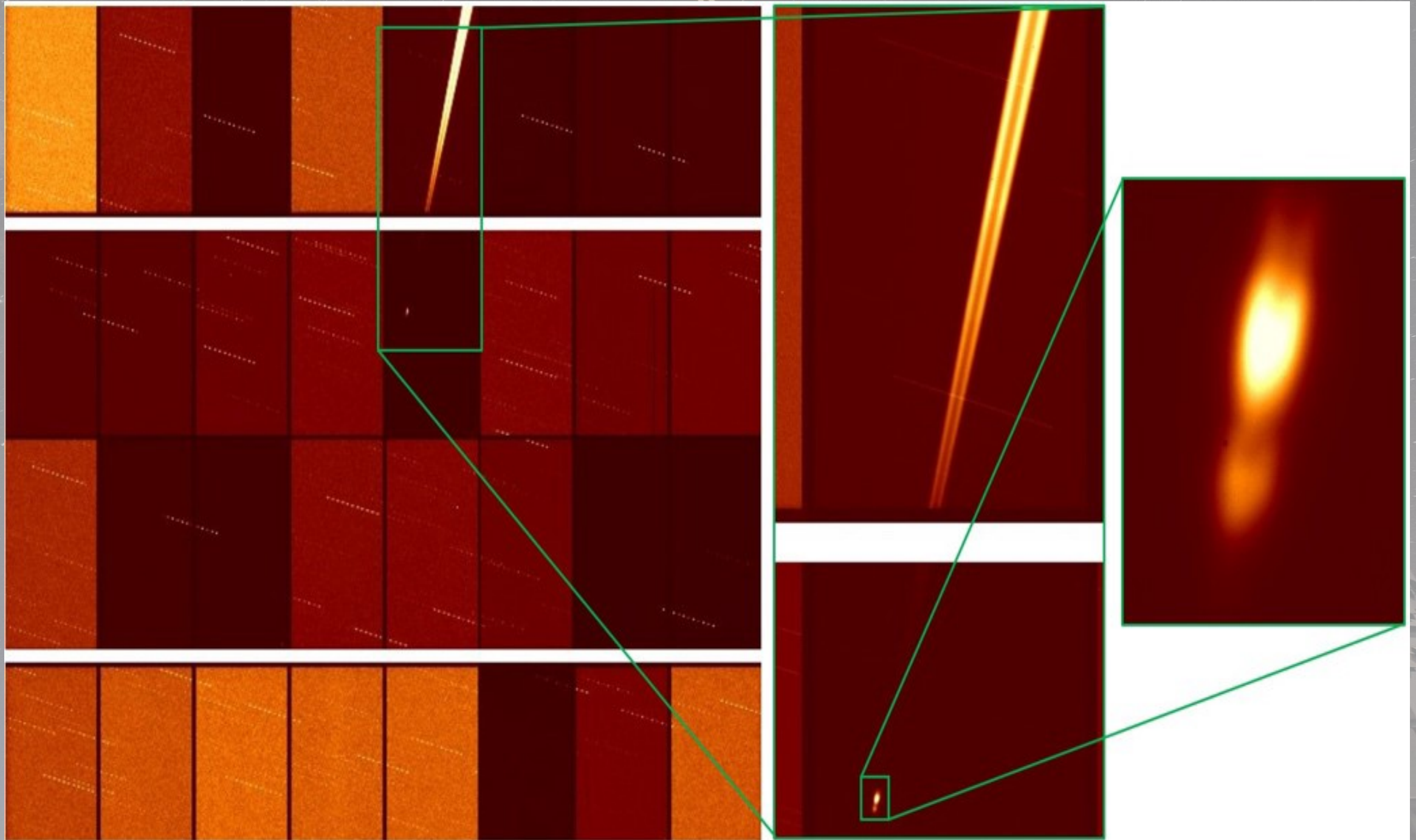


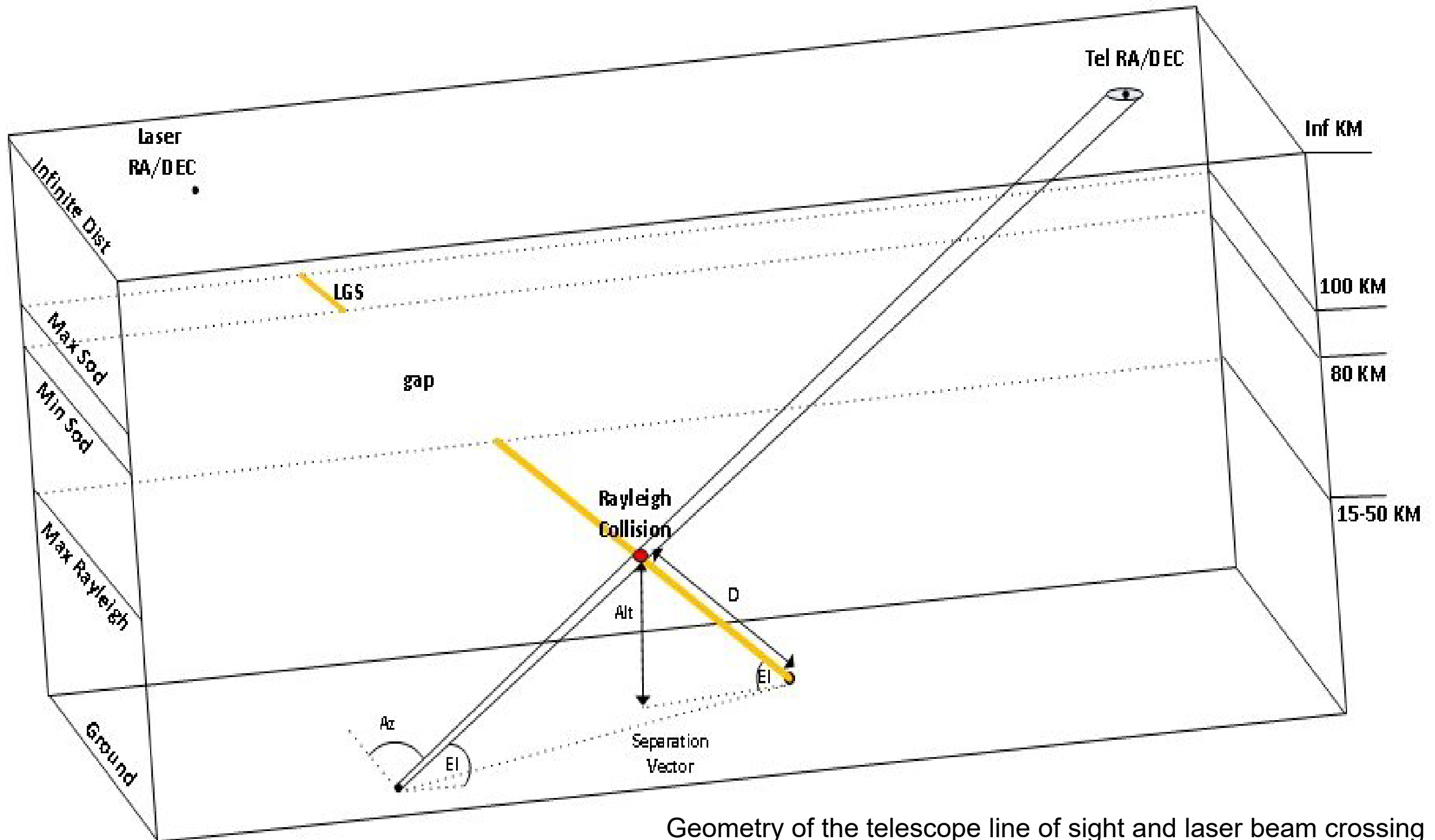


The effect of a laser collision

Example of 589nm laser contamination on OmegaCAM / VST



What is the cause of a collision?



Geometry of the telescope line of sight and laser beam crossing



Why do we need a tool ?

File Std. Options Help

Telescopes, Instruments & Focus configurations

Telescope	Instrument	Value 1	Value 2	Value 3	Value 4
UT1	Cass : FORS	9.618	20	<input checked="" type="checkbox"/>	
	CouA : VLT	2.82	20	<input checked="" type="checkbox"/>	
	CouB : ESPRESSO	2.82	20	<input checked="" type="checkbox"/>	
	NasA : NACO	1.8	20	<input checked="" type="checkbox"/>	
	NasB : KMOS	7.2	20	<input type="checkbox"/>	
UT2	Cass : X-Shooter	1.5	20	<input checked="" type="checkbox"/>	
	CouA : VLT	2.82	20	<input checked="" type="checkbox"/>	
	CouB : ESPRESSO	2.82	20	<input checked="" type="checkbox"/>	
	NasA : FLAMES	25.2	20	<input checked="" type="checkbox"/>	
	NasB : UVES	1.14	20	<input checked="" type="checkbox"/>	
UT3	Cass : SINFONI	0.18	20	<input type="checkbox"/>	
	CouA : VLT	2.82	20	<input checked="" type="checkbox"/>	
	CouB : ESPRESSO	2.82	20	<input checked="" type="checkbox"/>	
	NasA : SPHERE	0.258	20	<input checked="" type="checkbox"/>	
	NasB : CRIFRES+	60	20	<input checked="" type="checkbox"/>	
UT4	Cass : VISIR	1.02	20	<input type="checkbox"/>	
	CouA : VLT	2.82	20	<input checked="" type="checkbox"/>	
	CouB : ESPRESSO	2.82	20	<input checked="" type="checkbox"/>	
	NasA : HAWK-I	13.8	20	<input type="checkbox"/>	
	NasB : MUSE	2.16	20	<input checked="" type="checkbox"/>	
AT1	Coude : VLT	2.82	20	<input type="checkbox"/>	A0
AT2	Coude : VLT	2.82	20	<input type="checkbox"/>	G1
AT3	Coude : VLT	2.82	20	<input type="checkbox"/>	J2
AT4	Coude : VLT	2.82	20	<input type="checkbox"/>	K0
VISTA	Cass : VIRCAM	100.2	20	<input type="checkbox"/>	
VST	Cass : OmegaCAM	85.2	20	<input checked="" type="checkbox"/>	
DIMM	Cass : ASM-DIMM	1	20	<input checked="" type="checkbox"/>	

SAVE RESTORE

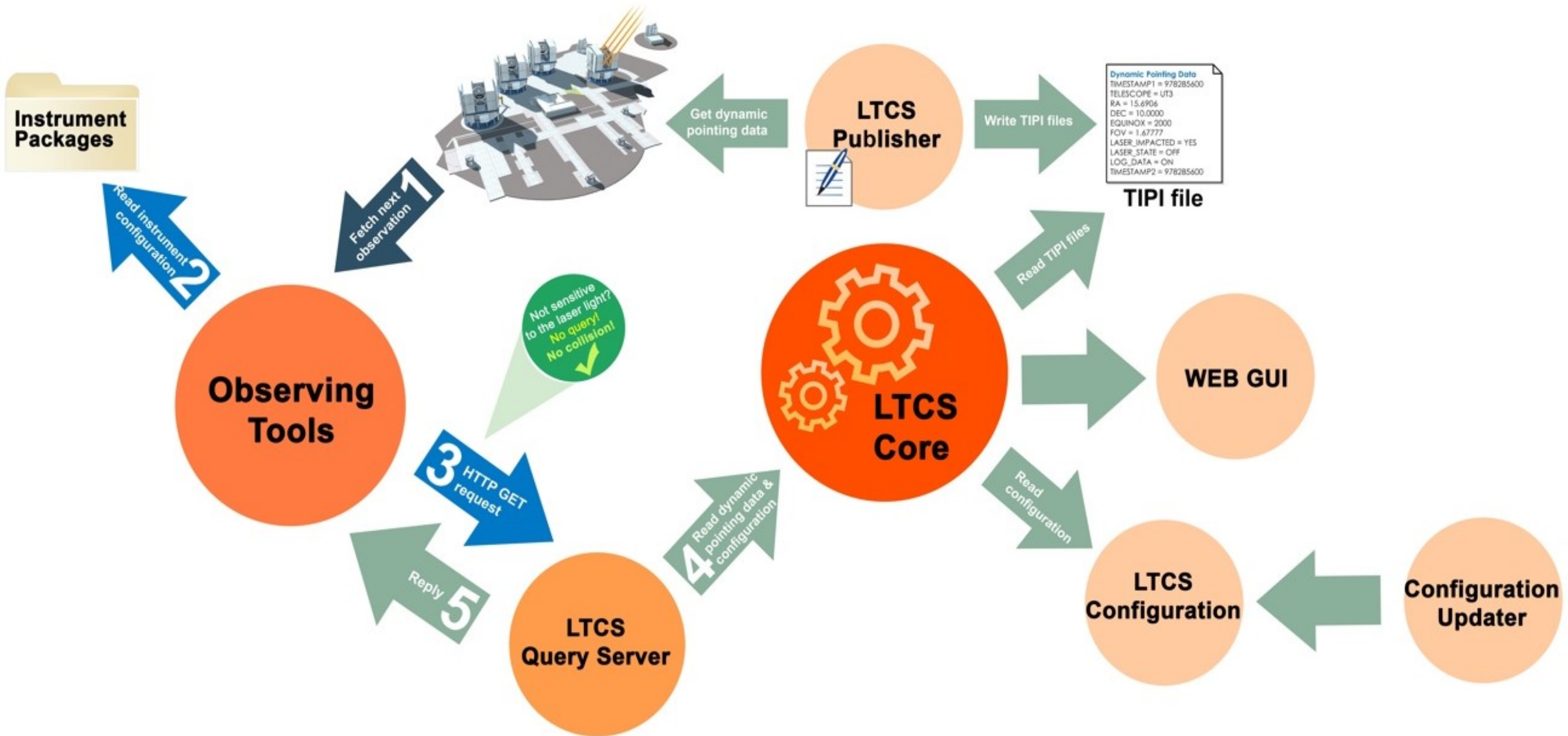
Instrument name

10 telescopes & 16 instruments and more to come...



What is our tool ?

LTCS : the Laser Traffic Collision System



Note:

LTCS @ ESO is a customized version of the LTCS @ MaunaKea

References:

- Summers, D. et al., 2003 in SPIE Proc., Vol. 4839
- Summers, D. et al., 2012 in SPIE Proc. Vol. 8447
- Amico, P. et al. 2015, The Messenger, 162, 19
- Santos, P. et al., 2016 in SPIE Proc. Vol. 9910



*Extension of the VLT Laser
Traffic Control System for
future collision predictions*

Philippe Duhoux, ESO Paranal

*a step
towards peaceful nights
at the VLT*



How shall we proceed ?

We will extend the timeline of the collision predictions

The existing features:

- 1 - From the live-view to
- 2 - The next observation

The extended features:

- 3 - The next hours and ultimately
- 4 - The next semester !



1 - the live-view

Real-time visual and audio notifications ahead of time

Last Updated: 19 Mar 2014 23:56:09

Observatories				Lasers				
	URL State	OVR State	Laser Sensitive		Laser State	Shutter Event (site,duration)	Predictions (number, site list)	
UT1	OK	NO	NO	UT4	On-Sky	None	1, VST	
UT2	OK	NO	YES					
UT3	OK	NO	YES	Collisions				
UT4	OK	NO	NO	Laser	Scope	Started	Ends	Priority
VISTA	OK	NO	NO	Laser "ON" Preview (Predictions & Collisions)				
VST	OK	NO	YES	Laser	Scope	Starts	Ends	Priority
_AT1	OK	NO	NO					
_AT2	OK	NO	NO					
_AT3	OK	NO	NO					
_AT4	STALE	NO	NO					
_DIMM	OK	NO	NO					

Heartbeat Status : Collector GA_Engine Status_Mgr

UT4 Collision Prediction(s)
Last Updated: 20 Mar 2014 23:58:07

Field	Value	Units
Involved Telescope	VST	
Laser Has Priority	NO	
Time to Collision	1297	
Duration	3489	Seconds
Start Time	00:19:44 Mar 21 2014 UTC	
End Time	01:17:53 Mar 21 2014 UTC	
Crossing Distance	28.424	Meters
Crossing Altitude	2676.07	Meters
Angle between Laser & Telescope	59.1733	Degrees
Angle between Laser & Separation Vector	101.871	Degrees

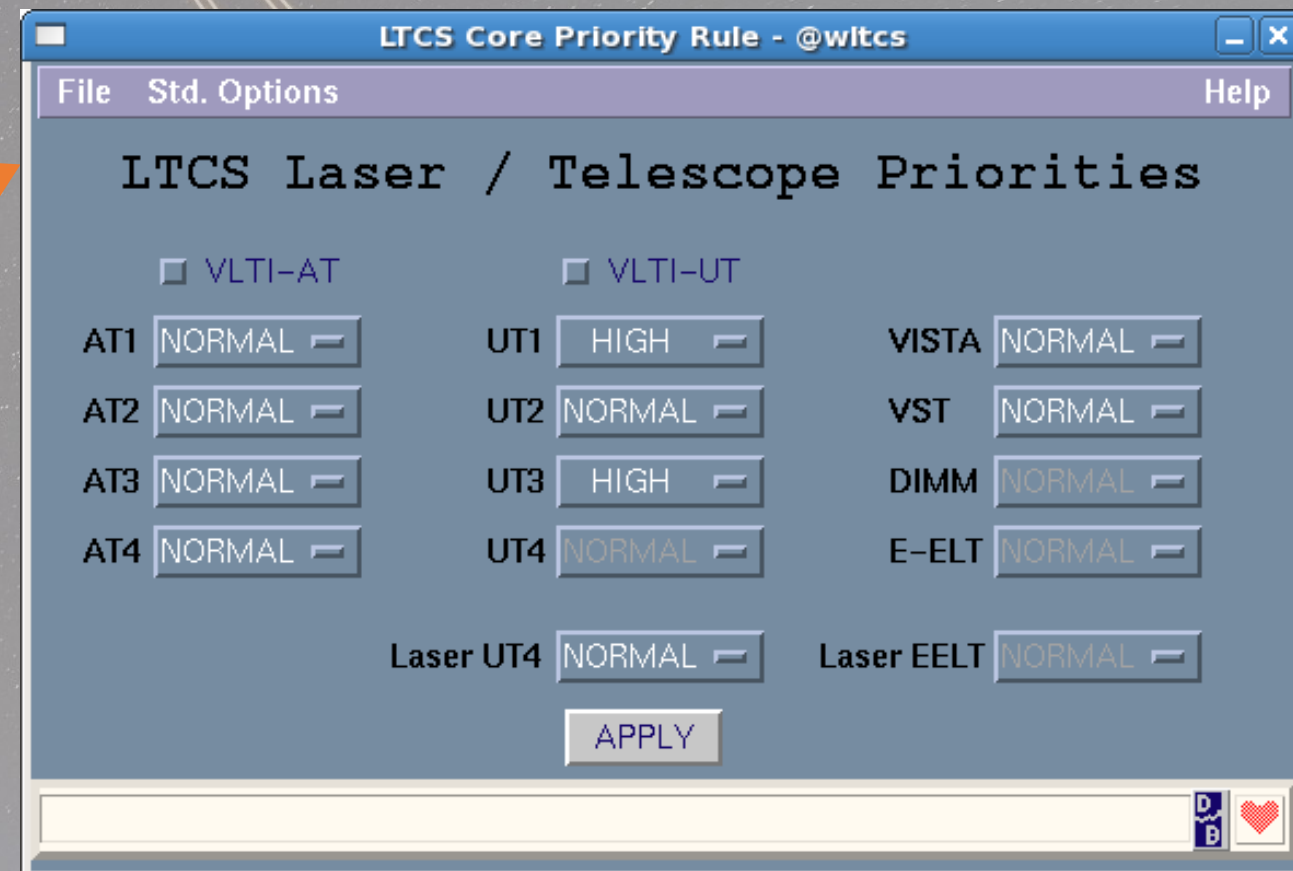
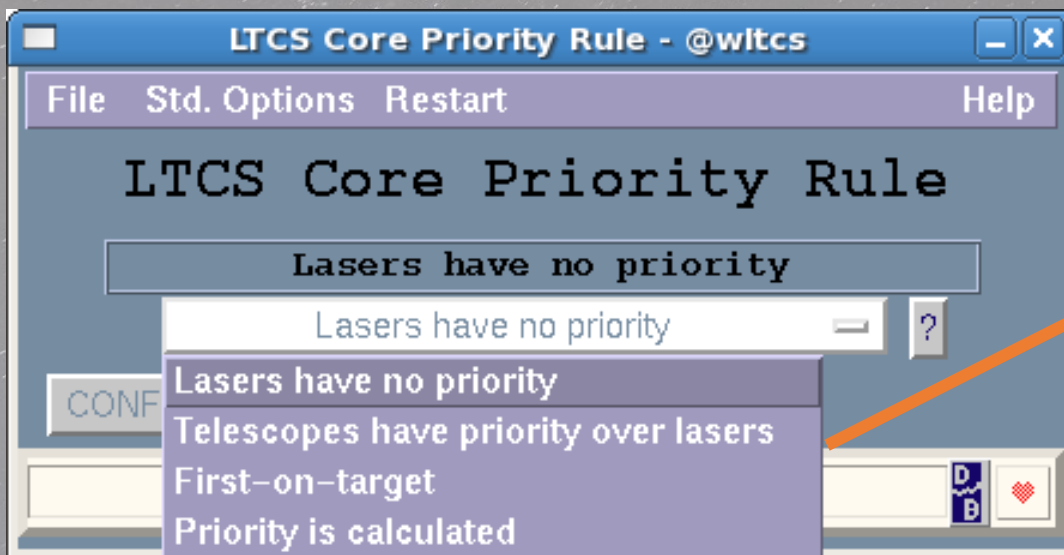


Collision status as of the actual positions of the telescopes against the laser emitting telescope(s)



1 - handling priorities

Not all telescopes have the same priority at all times



At equal priority,
First-on-Target scheme prevails

HIGH: Visitor mode
NORMAL: Service mode
LOW: Commissioning, Technical

2 - What if one would execute this observation now ?

Query the collision status assuming the telescopes are not changing their observing line of sight

Handling priorities:

Night staff needs to exchange information

Special cases

Possible conflicts



Collision status always as of the actual positions of the telescopes against the laser emitting telescope(s)



2 - manual queries



Query Selection So

Select an observatory

Observatory :

LTCS - LTCS Query Tool for UT1 - Mozilla Firefox (on wltcs)

LTCS - LTCS Query Tool f... x +

wltcs.pl.eso.org/ltcs/screens/sim.php

LTCS Query Tool

RA : (1)

Dec : (1)

Equinox :

Instrument :

Field of View :

LTCS - Query Tool - Mozilla Firefox (on wltcs)

LTCS - Query Tool x +

wltcs.pl.eso.org/ltcs/screens/process_s

Query Tool

Last Updated: 4 Dec 2017 19:57:10

Query Completed for UT1

FORS : FoV = 0.1603 deg

NO COLLISIONS PREDICTED

[LTCS Main Page - VLT2016](#)
[Status & Alarms Summary](#)
[Configuration](#)
[Query Tool](#)
[Telescope Status](#)

Feature often used in technical time
and for time critical observations
(launched asynchronously)



2 - automatic queries in visitor and service modes

Observing Tool 3.5.0beta2

File Queues Reports Finding Charts Readme Ephemeris File

OT Queues

Execution Sequence All Queues Open Queues

Move To Top Move Up Move Down Display Finding Charts View Display Text Collision check

OB ID	Container ID	Prog.ID	Status	Laser Sensitive	Container	Requests Laser	RA	OB comment	Inst comment	OB name
1138845		094.B-0895(A)	+	✓			03:38:08.480	Yes	No	WFM NGC1396E 2
743377		60.A-9800(D)	+	✓			16:23:33.750	No	No	efficiency mon dic2 EG274
962645	962639	091.D-0633(A)	M	✓	T		03:49:11.220	Yes	Yes	pleioneC
1005235	1023057	092.C-0290(A)	M	✓	C		04:33:52.005	Yes	Yes	CITau
1023061	1023057	092.C-0290(A)	M	✓	C		06:08:55.820	Yes	Yes	CAL Hip029147-Tstd citau
743383		60.A-9800(D)	+	✓			20:10:56.845	No	No	efficiency mon dic2 LTT7987
1023068	1023064	092.C-0290(A)	+	✓	C		04:20:30.380	Yes	Yes	CAL Hip020258-Tstd dntau
1005238	1023064	092.C-0290(A)	+	✓	C		04:35:27.375	Yes	Yes	DNTau
743379		60.A-9800(D)	+	✓			23:19:58.390	No	No	efficiency mon dic2 Feige110
743381		60.A-9800(D)	+	✓			08:41:32.400	No	No	efficiency mon dic2 LTT3218
1019881		092.D-0295(A)	+	✓			05:15:38.479	No	Yes	CEP506 15
1005241	1023071	092.C-0290(A)	+	✓	CC		04:18:40.616	Yes	Yes	V892Tau
1023075	1023071	092.C-0290(A)	+	✓	CC		04:23:59.760	Yes	Yes	CAL Hip020533-Tstd V892Ta
1005247	1023087	092.C-0290(A)	+	✓	CC		04:19:41.272	Yes	Yes	LkCa7
1023088	1023087	092.C-0290(A)	+	✓	CC		04:23:59.760	Yes	Yes	CAL Hip020533-Tstd LkCa7
1023053	1023049	092.C-0290(A)	+	✓	CC		04:20:30.380	Yes	Yes	CAL Hip020258-Tstd dotau
1005232	1023049	092.C-0290(A)	+	✓	CC		04:38:28.580	Yes	Yes	DOTau
1049128	1049114	093.B-0615(A)	+	✓	G		12:54:54.560	Yes	Yes	outerhalo08 5
1049716		093.C-0929(D)	+	✓			22:57:27.850	Yes	Yes	51Peg 17
1053809	1053804	093.D-0415(A)	+	✓	T		08:24:57.207	Yes	Yes	hip41250 2

Collision check done <----> Date: Thu Mar 05 16:44:17 GMT 2015

Collision Details Ob Tree View

OB ID: 743377

Collision checked on: 2015-03-05T16:44:03 UTC

OB collision status: COLLISION NOW

COLLISIONS				
Start	End	Laser telescope	Telescope	Priority
2015-03-05T16:44:02 UTC	2015-03-05T17:14:02 UTC	UT4	UT1	UT4
2015-03-05T18:44:02 UTC	2015-03-05T19:44:02 UTC	UT4	UT1	UT4

Automatic laser collision check: on fetch only

Best ranked observations are checked for possible collisions
Every 90s, on change and on demand



2 - Humans have the last word!

OB name	Container ID	Prog.ID	Status	Laser Sensitive	Requests Laser	OB comment	Inst
MACSJ0150_1005_C_02_pr...	1193090	095.B-0721(A)	+	✓		Yes	No
HD140538_UVES580_SimC...		60.A-9022(B)	M	✓		No	No
FLAMES_IFUstd_Feige66		60.A-9022(B)	S			Yes	No
j1452		094.C-0202(A)	+	✓		Yes	Yes
POS2OB_5	1135867	094.A-0765(A)	+	✓		Yes	Yes
TARGET2_2	1195886	095.D-0843(A)	+	✓		No	Yes
SkyFlat UBVRI 1226-0638		60.A-9022(C)	+	✓		No	No
MACSJ0150_1005_C_02	1193090	095.B-0721(A)	+	✓		Yes	Yes
MACSJ0150_1005_C_02_p...	1193090	095.B-0721(A)	+	✓		Yes	No

ATTENTION

Warning: the OB [1193091] you want to execute collides with UT4 in 07h17m03s.
 Do you still want to send this OB to BOB?

Night staff confirmation always required
 when observation would be causing a
 collision

cked on: 2015-04-02T04:24:14 UTC
 status: PREDICTED COLLISION(s)
 collision status [1193090]: PREDICTED COLLISION(s)

COLLISIONS				
Start	End	Laser telescope	Telescope	Priority
2015-04-02T11:41:18 UTC	2015-04-02T12:15:53 UTC	UT4	UT2	UT4

3 - What about the next hours ?

But that does not guaranty a peaceful night !

WHY ?

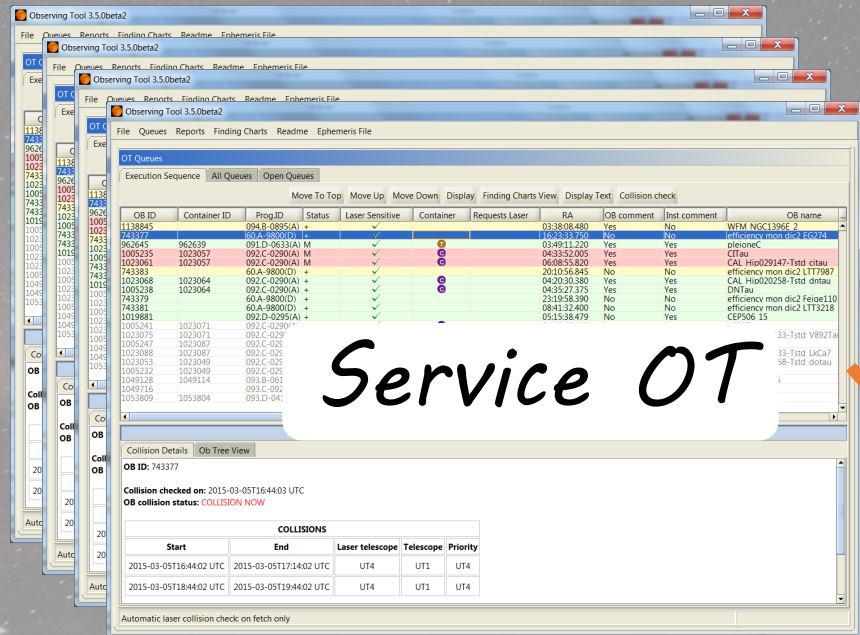
*Because the problem repeats
for each OB of each telescope*

AND WHAT CAN WE DO ?

*So one needs to prepare a
scheduling overview valid over the next hours*



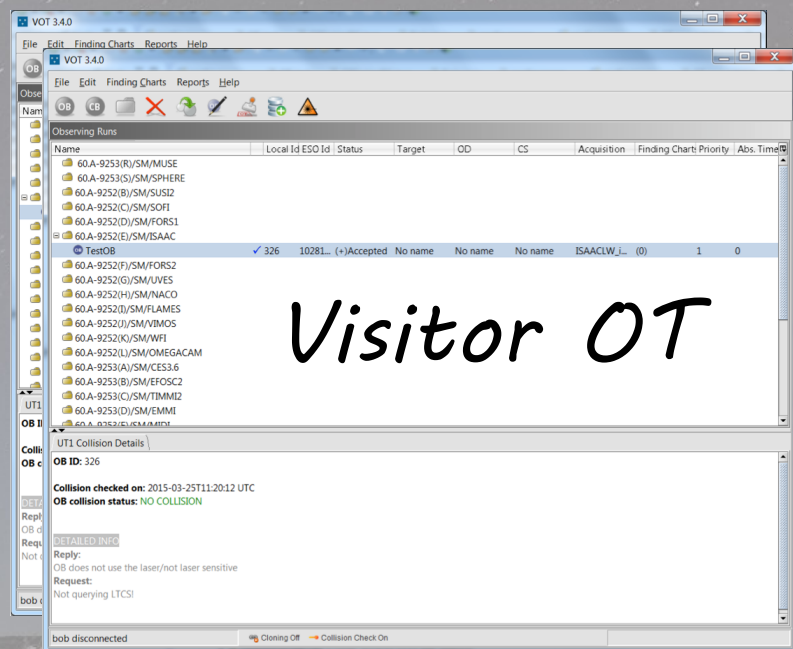
3 - Dynamic overview of the night



Service OT

Mock-up display of the timeline and highlight predicted collisions

Analyze the execution sequences of all telescopes (from OT & vOT) Every 90s / on change



Visitor OT

Add new target wish

RA:

Dec:

Length:

Start time:

Instrument:

Time critical?

Edit selected target wish

RA:

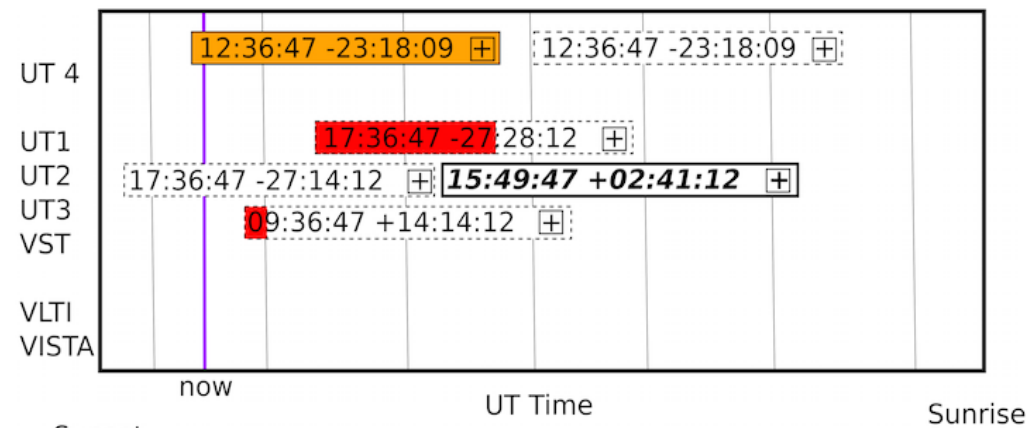
Dec:

Length:

Start time:

Instrument:

Time-critical?



Iterate on the order of the OBs in the execution sequences

Conclusions

- 1 - *Live-view: Operator is informed in real-time of collisions (ahead of time)*
- 2 - *Queries: Always considering the actual positions of the telescopes
Communication between Night Operators & Astronomers,
Gentleman agreement when visitors conflict*
- 3 - *Scheduling: a step towards more peaceful nights
Fully dynamic overview for the next hours
Minimizing the collision cases at observatory level*
- 4 - *Planning: Collision / conflictual situations reduced to minimum*



and the timeline

Requirements review on-going

Deliveries:

Step 3 for Apr 2020

Step 4 for Oct 2019