

# PANTR (PAN/TILT RADIOMETER)

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# PANTR

- Pan/Tilt Radiometer
- Autonomous sun-tracking measurement platform
- Developed at VLIZ for Hypermaq project

# PANTR requirements

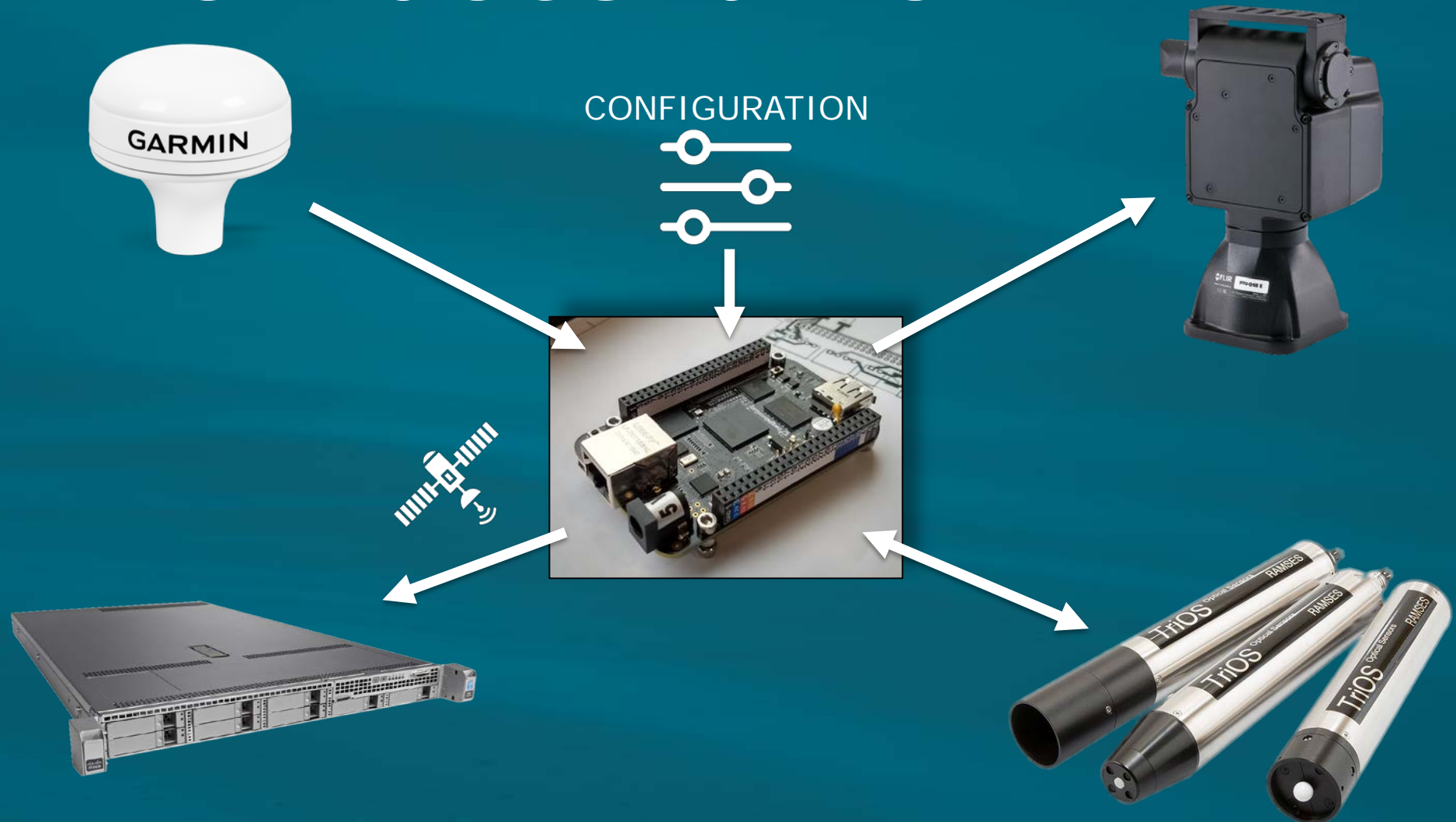
- Set and forget
- Reliable
- Configurable protocol, interval, min. sun elevation, ...
- Reasonable price

# System design

- Off-the-shelf-components
- Modular
- Linux based control system
- Mostly Python, with some use of bash and cron



# How does it work

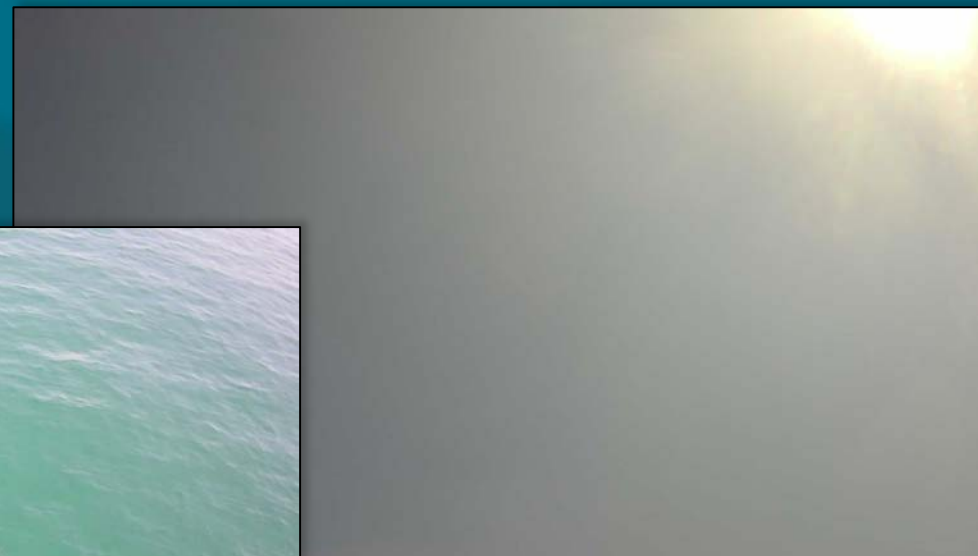


# First test: Acqua Alta (IT)

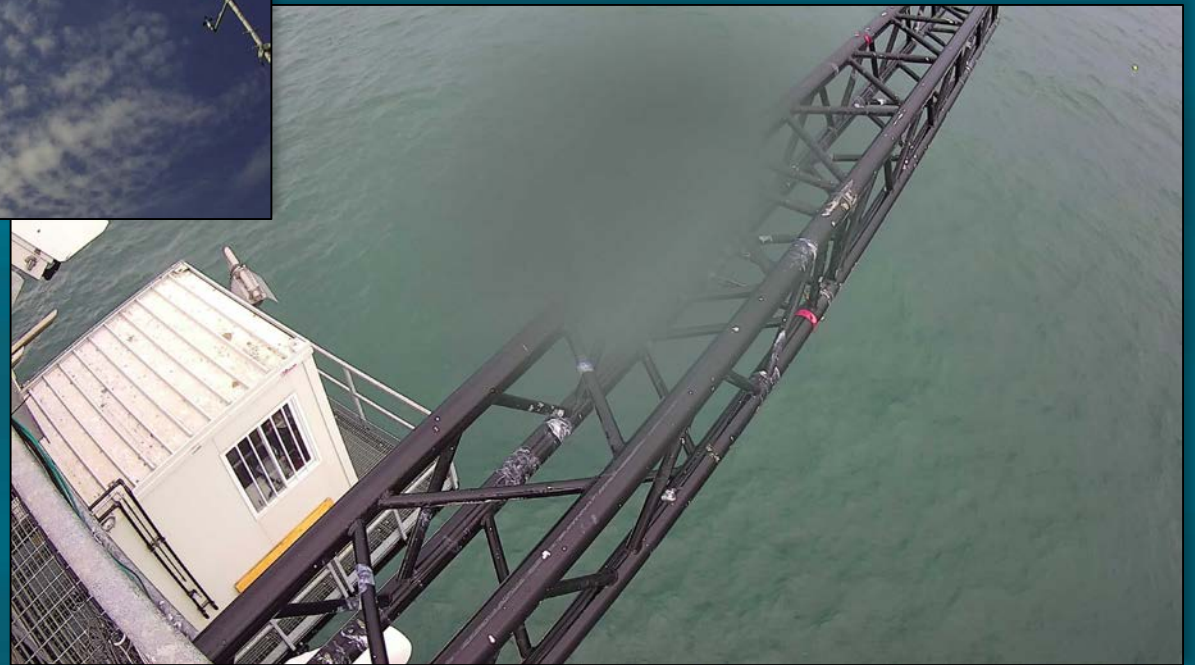


Result:  
Worked 6 continuous days  
13,350 measurements  
List of "issues"

# Measurement target photos



# Measurement target photos



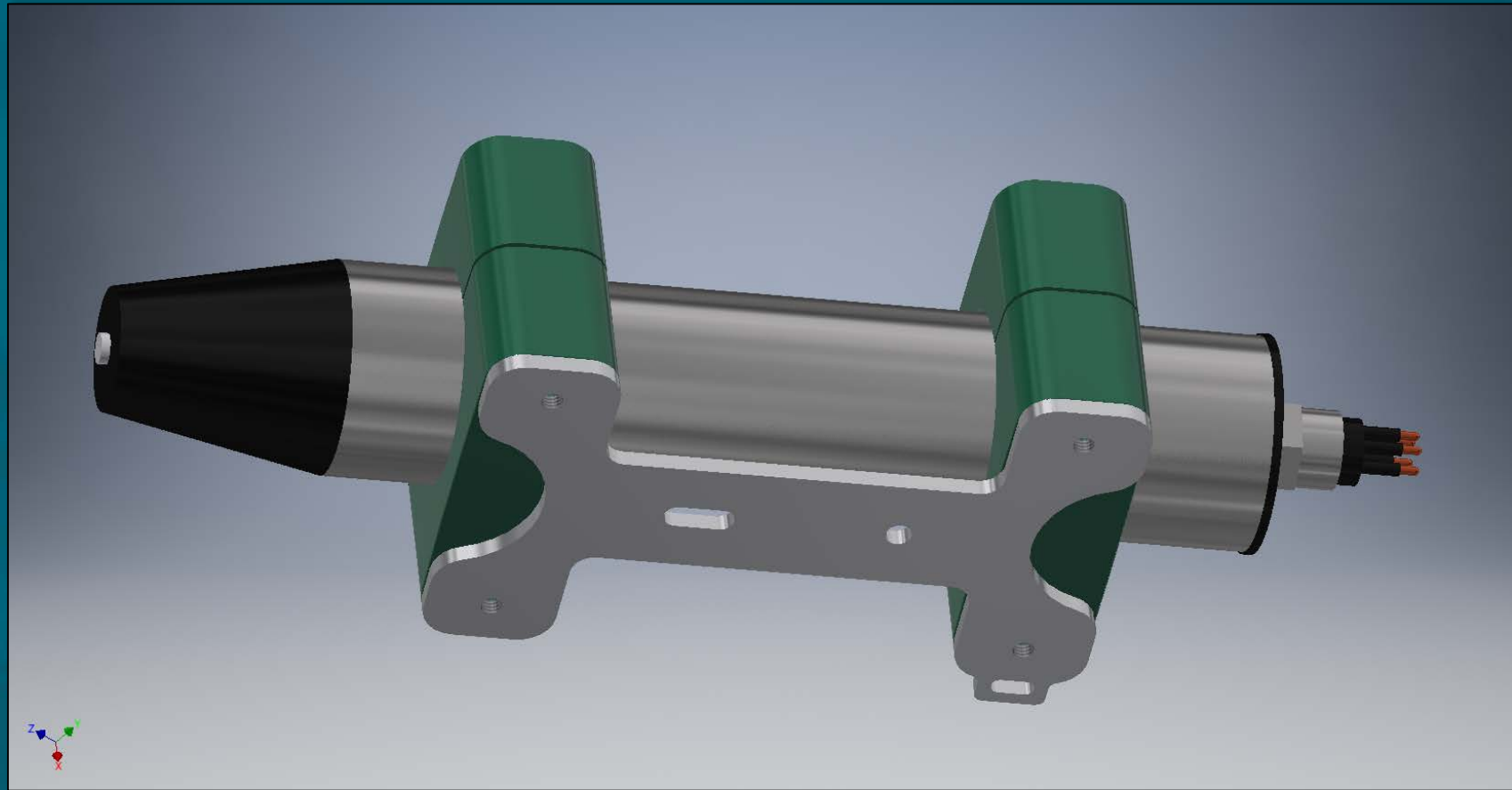


# PANTR benefits

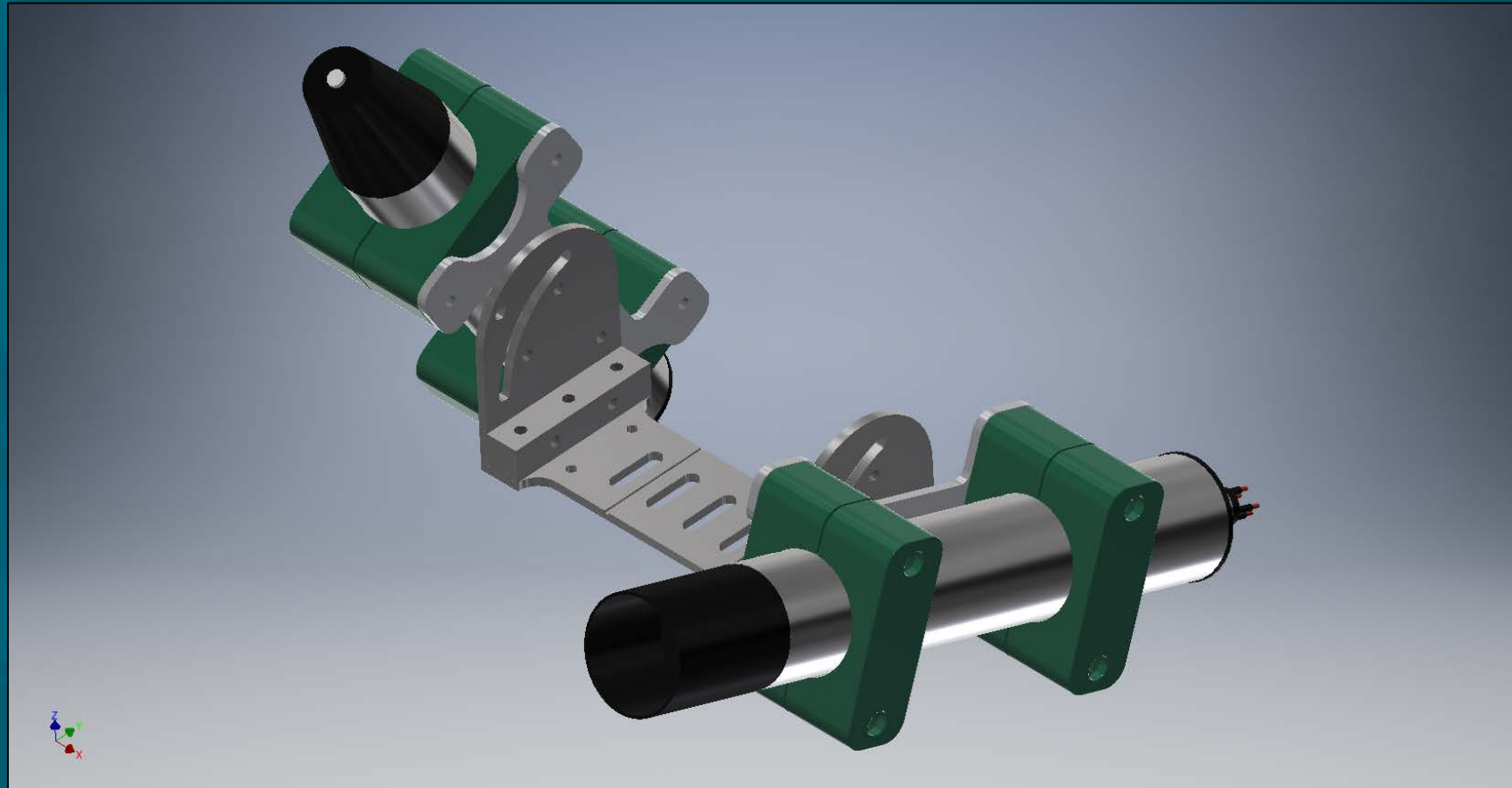
- More measurements
- Two sensors needed instead of three
- Measurement target photos
- Possible to test different measurement protocols
- Option to customize, add or change instruments

# DEMO

# Instrument mounting



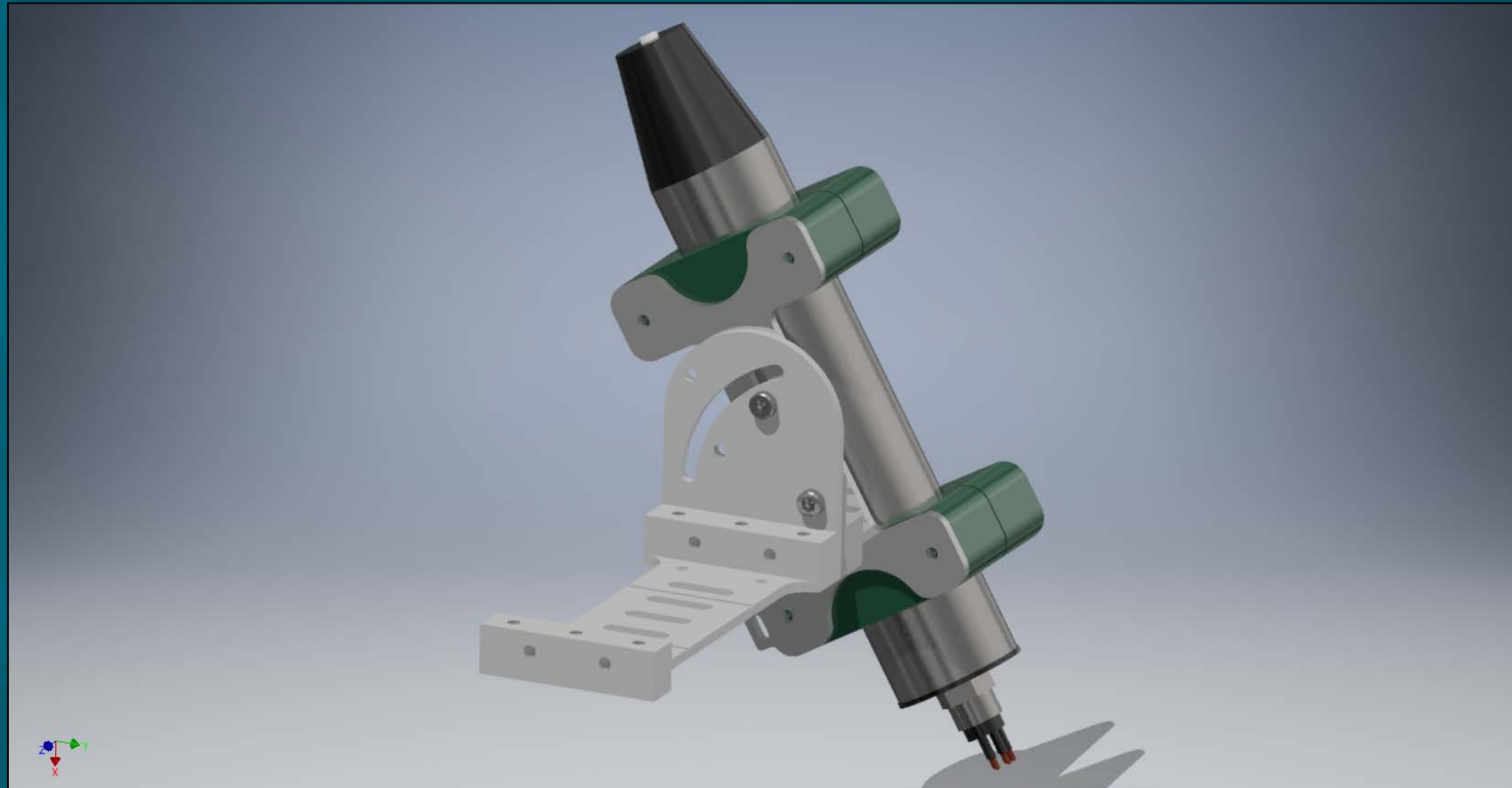
# Instrument mounting



# 20 degrees fixed



# 60 degrees fixed



# Database access

**phpLiteAdmin v1.9.7.1**  
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**Change Database**

[rw] .../hypermaq  
/data/test.db [↓]

.../hypermaq/data/test.db

[Table] logs  
[Table] measurements  
[View] not valid  
[Table] protocol  
[Table] queue  
[Table] settings  
[Table] test

**Create New Database [?]**

Create

Logout

/home/debian/hypermaq/data/test.db

Structure SQL Export Import Vacuum Rename Database Delete Database

**Database name:** /home/debian/hypermaq/data/test.db  
**Path to database:** /home/debian/hypermaq/data/test.db  
**Size of database:** 180 KB  
**Database last modified:** 2:47pm on June 11, 2018 (UTC)  
**SQLite version:** 3.16.2  
**SQLite extension [?]:** PDO  
**PHP version:** 7.0.27-0+deb9u1  
**phpLiteAdmin version:** 1.9.7.1

Type [?]	Name	Action	Records
Table	logs	Browse Structure SQL Search Insert Export Import Rename Empty Drop	135
Table	measurements	Browse Structure SQL Search Insert Export Import Rename Empty Drop	163
View	not valid	Browse Structure SQL Search Export Drop	53
Table	protocol	Browse Structure SQL Search Insert Export Import Rename Empty Drop	3
Table	queue	Browse Structure SQL Search Insert Export Import Rename Empty Drop	61
Table	settings	Browse Structure SQL Search Insert Export Import Rename Empty Drop	14
Table	test	Browse Structure SQL Search Insert Export Import Rename Empty Drop	12
<b>7 Total</b>			<b>441</b>

**Create new table on database '/home/debian/hypermaq/data/test.db'**

Name:  Number of Fields:  Go

**Create new view on database '/home/debian/hypermaq/data/test.db'**

Name:  Select Statement [?]:  Go

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# Protocol

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Change Database  
[rw] .../hypermaq  
/data/test.db [↓]

.../hypermaq/data/test.db  
[Table] logs  
[Table] measurements  
[View] not valid  
[Table] protocol  
[Table] queue  
[Table] settings  
[Table] test

Create New Database [?]  
  
Create

Logout

/home/debian/hypermaq/data/test.db → protocol

Browse Structure SQL Search Insert Export Import Rename Empty Drop

Show : 100 row(s) starting from record # 0 as a Table

Showing rows 0 - 14, Total: 15 (Query took 0.0007 sec)  
SELECT \* FROM "protocol" LIMIT 0, 100

← T →			id	number	instrument	zenith	azimuth	repeat	wait
<input type="checkbox"/>	Edit	Delete	1	1	e	180	90	1	0
<input type="checkbox"/>	Edit	Delete	2	2	l	140	90	1	0
<input type="checkbox"/>	Edit	Delete	3	3	cam	40	225	1	0
<input type="checkbox"/>	Edit	Delete	4	4	l	180	225	1	0
<input type="checkbox"/>	Edit	Delete	8	8	e	180	135	1	0
<input type="checkbox"/>	Edit	Delete	9	9	l	140	135	1	0
<input type="checkbox"/>	Edit	Delete	10	10	cam	140	270	1	0
<input type="checkbox"/>	Edit	Delete	11	11	l	40	270	1	0
<input type="checkbox"/>	Edit	Delete	15	15	e	180	225	1	0
<input type="checkbox"/>	Edit	Delete	16	16	l	140	225	1	0
<input type="checkbox"/>	Edit	Delete	17	17	cam	140	90	1	0
<input type="checkbox"/>	Edit	Delete	18	18	l	40	90	1	0
<input type="checkbox"/>	Edit	Delete	23	23	l	140	270	1	0
<input type="checkbox"/>	Edit	Delete	24	24	cam	140	135	1	0
<input type="checkbox"/>	Edit	Delete	25	25	l	40	135	1	0



# Measurement results

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	id	timestamp	valid	setup_ercycle_id	gncs_acquired	nss_que	gncs_lat	gncs_lon	ad_volta	head_temp	hptcycle	scarrrot	senso	prot_zenith	prot_azimuth	sun_heading	sun_elevation	scan_rep	rep_serial	val_001	val_002	val_003	val_004	val_005	val_006	val_007	val_008
9139	11587	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	1	SAM_8531	1544	1604	1640	1780	2075	2590	3281	41	
9140	11588	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	2	SAM_8531	1544	1612	1642	1777	2077	2592	3290	41	
9141	11589	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	3	SAM_8531	1544	1606	1640	1780	2071	2595	3285	41	
9142	11590	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	4	SAM_8531	1544	1612	1643	1787	2081	2604	3313	41	
9143	11591	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	5	SAM_8531	1544	1612	1643	1782	2073	2589	3275	40	
9144	11592	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	6	SAM_8531	1544	1612	1640	1789	2075	2595	3284	41	
9145	11593	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	7	SAM_8531	1544	1616	1644	1796	2086	2619	3322	41	
9146	11594	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	8	SAM_8531	1544	1612	1652	1788	2087	2596	3302	41	
9147	11595	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	9	SAM_8531	1544	1608	1659	1781	2088	2595	3296	41	
9148	11596	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	10	SAM_8531	1800	1610	1665	1790	2099	2612	3326	41	
9149	11597	2018/07/15_151358	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	25	l	40	270	264.41	36.33	11	SAM_8531	1544	1618	1657	1802	2083	2612	3302	41	
9150	11598	2018/07/15_151632	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.9/38.9	26	cam	40	270	264.9	35.89											
9151	11599	2018/07/15_151650	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.9/38.9	27	l	140	270	264.95	35.83	1	SAM_8531	1284	1296	1364	1614	2168	3123	4395	58	
9152	11600	2018/07/15_151650	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.9/38.9	27	l	140	270	264.95	35.83	2	SAM_8531	1284	1301	1367	1615	2162	3121	4390	58	
9153	11601	2018/07/15_151650	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.9/38.9	27	l	140	270	264.95	35.83	3	SAM_8531	1284	1291	1370	1609	2165	3114	4396	58	
9154	11602	2018/07/15_151734	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	28	e	180	270	265.09	35.71	1	SAM_8532	1284	1426	1641	2030	2635	3412	4376	53	
9155	11603	2018/07/15_151734	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	28	e	180	270	265.09	35.71	2	SAM_8532	1284	1440	1633	2033	2623	3418	4361	53	
9156	11604	2018/07/15_151734	y	2018/07/15_150005	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.9/38.9	28	e	180	270	265.09	35.71	3	SAM_8532	1284	1435	1631	2027	2632	3402	4366	53	
9157	11612	2018/07/15_152121	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.3/38.9	8	e	180	135	265.8	35.04	1	SAM_8532	1284	1410	1609	1977	2553	3302	4216	51	
9158	11613	2018/07/15_152121	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.3/38.9	8	e	180	135	265.8	35.04	2	SAM_8532	1284	1422	1599	1985	2545	3305	4209	51	
9159	11614	2018/07/15_152121	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.3/38.9	8	e	180	135	265.8	35.04	3	SAM_8532	1284	1409	1610	1972	2551	3289	4209	51	
9160	11615	2018/07/15_152215	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.3/38.9	9	l	140	135	265.97	34.88	1	SAM_8531	1284	1268	1326	1545	2029	2894	4030	53	
9161	11616	2018/07/15_152215	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.3/38.9	9	l	140	135	265.97	34.88	2	SAM_8531	1284	1262	1323	1542	2039	2887	4040	53	
9162	11617	2018/07/15_152215	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	42.2/38.3/38.9	9	l	140	135	265.97	34.88	3	SAM_8531	1284	1271	1324	1544	2032	2889	4028	53	
9163	11618	2018/07/15_152244	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	10	cam	140	135	266.06	34.8											
9164	11619	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	1	SAM_8531	1800	1637	1667	1803	2100	2626	3338	41	
9165	11620	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	2	SAM_8531	1800	1626	1668	1795	2096	2608	3315	41	
9166	11621	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	3	SAM_8531	1800	1632	1656	1804	2094	2624	3323	41	
9167	11622	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	4	SAM_8531	1800	1626	1674	1802	2106	2628	3345	41	
9168	11623	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	5	SAM_8531	1800	1635	1665	1802	2097	2622	3328	41	
9169	11624	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	6	SAM_8531	1800	1626	1673	1801	2107	2619	3340	41	
9170	11625	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	7	SAM_8531	1544	1631	1662	1803	2088	2603	3293	41	
9171	11626	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	8	SAM_8531	1800	1626	1668	1793	2097	2598	3301	41	
9172	11627	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	9	SAM_8531	1800	1625	1667	1794	2094	2599	3300	41	
9173	11628	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	10	SAM_8531	1800	1630	1662	1797	2077	2595	3273	40	
9174	11629	2018/07/15_152302	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	41.7/38.3/38.9	11	l	40	135	266.11	34.75	11	SAM_8531	1800	1630	1669	1810	2098	2628	3333	41	
9175	11630	2018/07/15_152536	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	40.6/38.9/38.9	12	cam	40	135	266.59	34.3											
9176	11631	2018/07/15_152554	y	2018/07/15_152006	2018-07-12 14:08:33	1	45.314031	12.508449	23.7	40.6/38.9/39.4	13	l	140	135	266.65	34.24	1	SAM_8531	1284	1260	1324	1530	2010	2849	3973	52	



**Thank you**



**Thank you**

