Light Pollution from artificial light sources

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02/08/2020

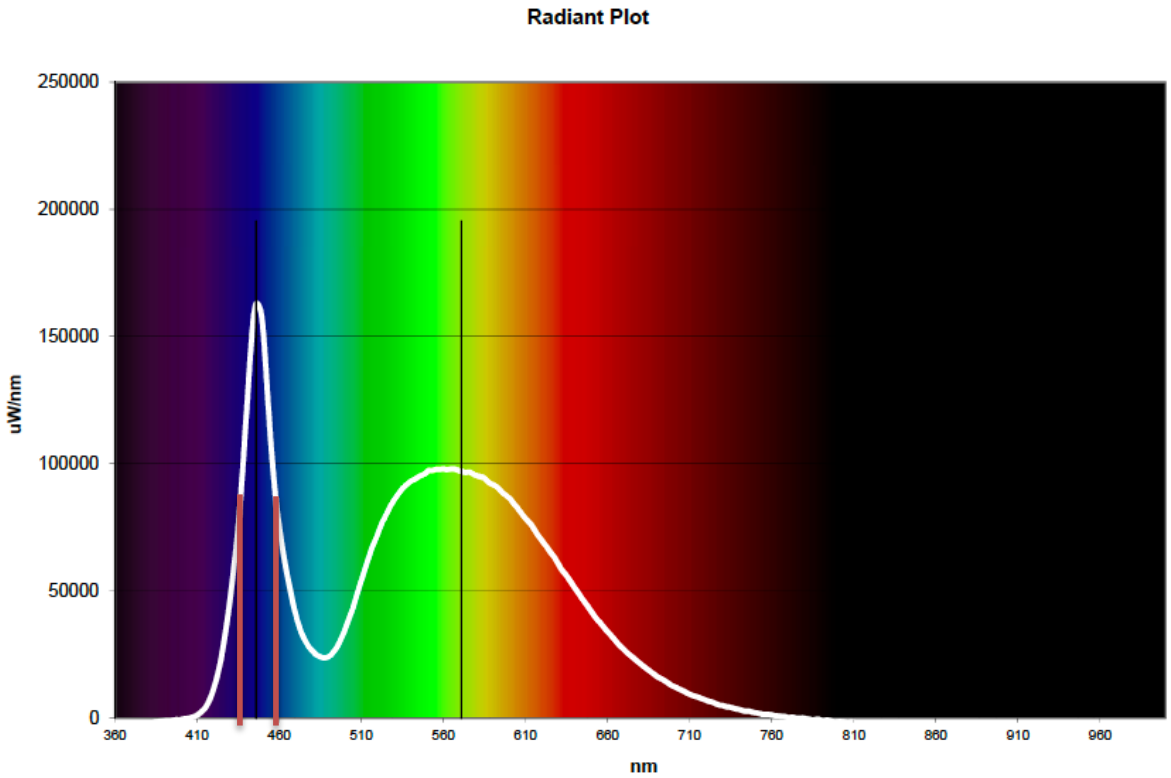
Data taking

- Sea campaign October 2019, HROV
- 18/10/2019, Run 6475 , 06:00 – 09:45 UTC
- Various trials with ROV projectors

627	Fri Oct 18 09:43:15 2019	Bertin	Europe	SeaOpHROV_2019-10-17	Allumage de tous les projecteurs par pilote HRov: distance oblique = 280 m
626	**Fri Oct 18 09:32:30 2019**	**Bertin**	**Europe**	**SeaOpHROV_2019-10-17**	Essai projecteurs: . distance oblique = 300 m . immersion = 2300 m
625	Fri Oct 18 09:26:01 2019	Lamare	Europe	SeaOpHROV_2019-10-17	Essai projecteurs : distance oblique = 400 m immersion = 2312 m
624	Fri Oct 18 09:21:35 2019	Lamare	Europe	SeaOpHROV_2019-10-17	Essai projecteurs : distance oblique = 500 m immersion = 2300 m
623	Fri Oct 18 09:17:12 2019	Lamare	Europe	SeaOpHROV_2019-10-17	Essai projecteurs : distance oblique = 600 m immersion = 2310 m
622	Fri Oct 18 09:08:13 2019	Lamare	Europe	SeaOpHROV_2019-10-17	Essai projecteurs : distance oblique = 800 m immersion = 2272 m
621	Fri Oct 18 09:01:03 2019	Bertin	Europe	SeaOpHROV_2019-10-17	Essai projecteurs : distance oblique = 1000 m immersion = 2215 m
620	Fri Oct 18 08:43:52 2019	Bertin	Europe	SeaOpHROV_2019-10-17	Allumage projecteurs : distance oblique = 1500 m immersion = 2180 m
619	Fri Oct 18 08:24:38 2019	Bertin	Europe	SeaOpHROV_2019-10-17	Allumage projecteurs : distance oblique = 2000 m immersion = 1865 m
618	Fri Oct 18 08:14:38 2019	Bertin	Europe	SeaOpHROV_2019-10-17	Essai projecteurs (2 projecteurs avant du ROV): distance horizontale au noeud = 2120 m

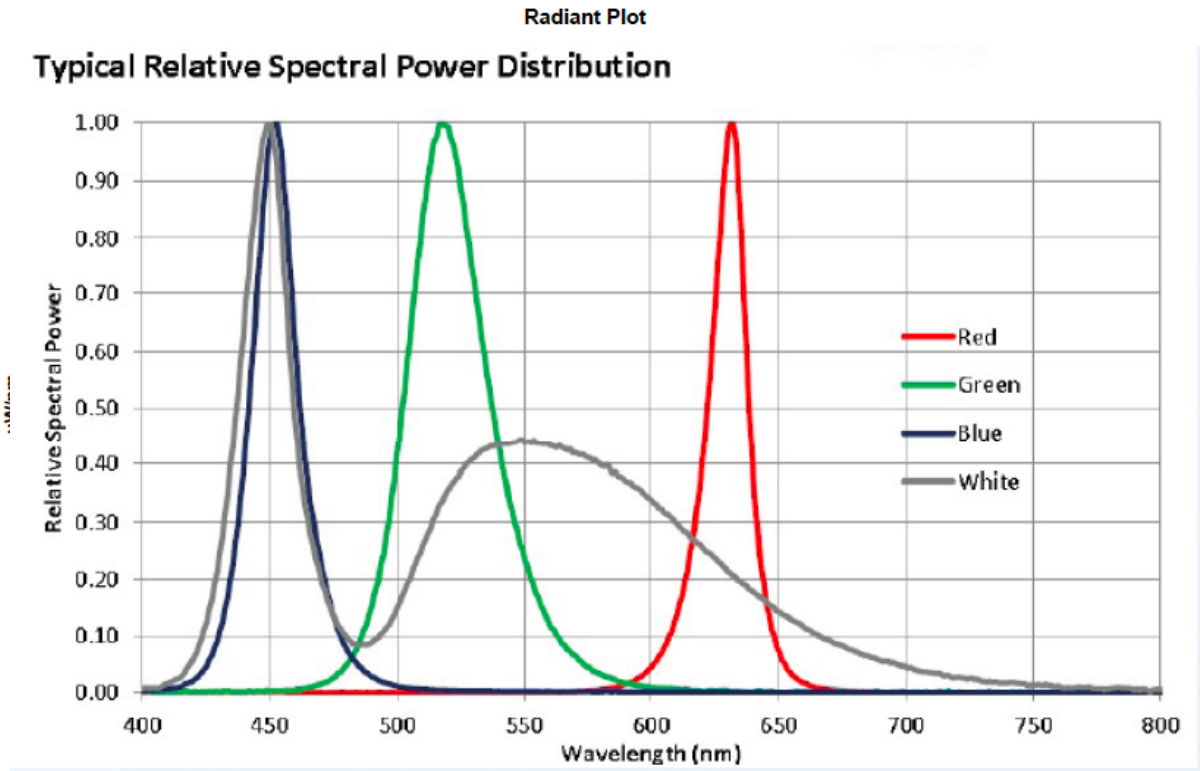
Projector Spectrum

- White Day light LED
- Two components, only blue interesting on large distances
- 446nm, FWHM = 25nm → 4W → N_γ = 446nm*4W/hc = 9 10^{18} /s



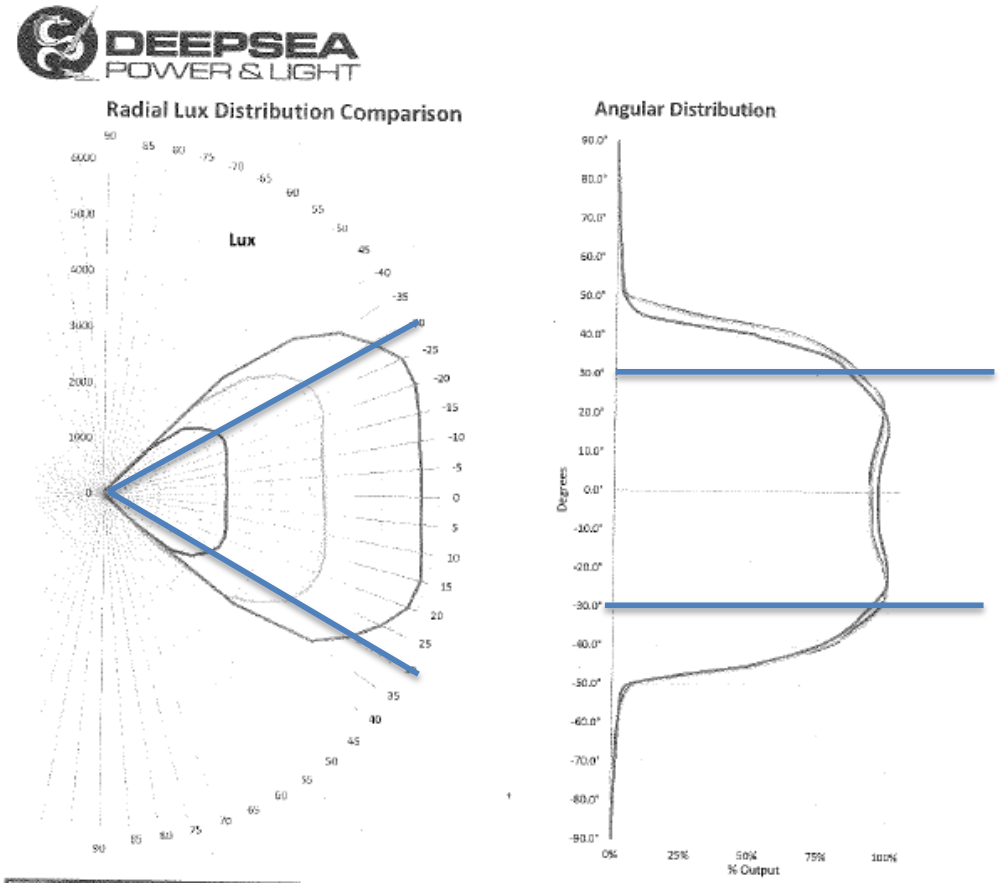
Comparison Wally

- White Day light LED → identical spectrum
- Two components, only blue interesting on large distances



Projector angular range

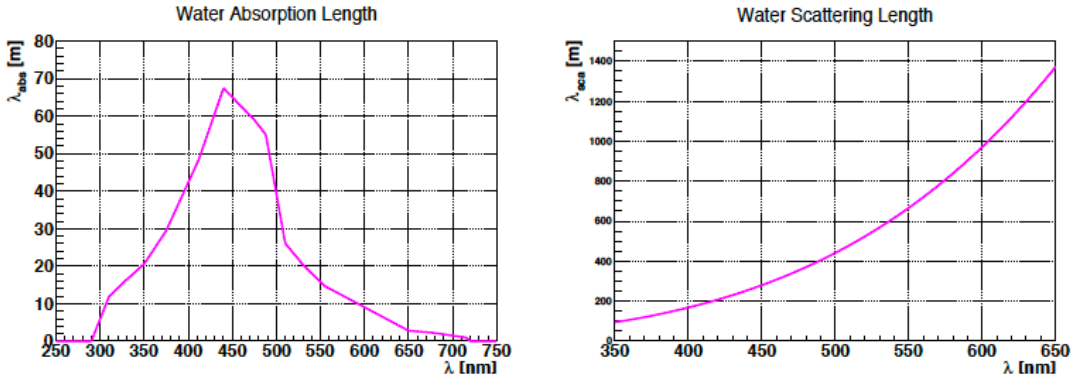
- Radial light distribution
- approximation used : constant +/- 30 deg

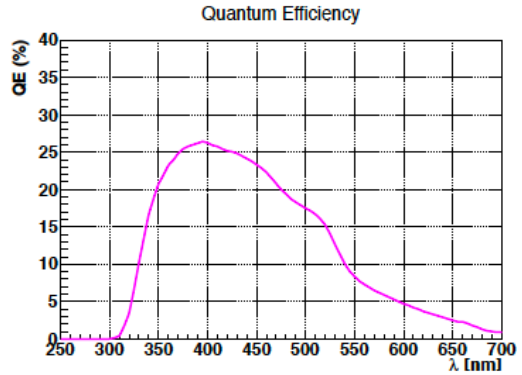


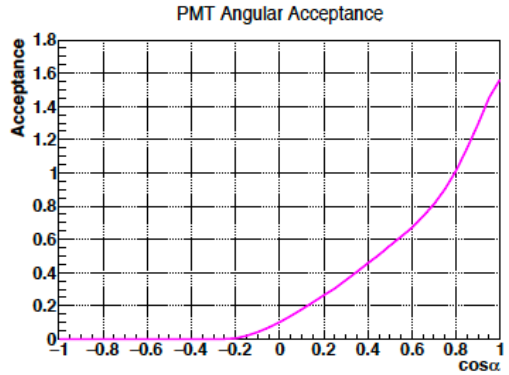
Rate Calculation

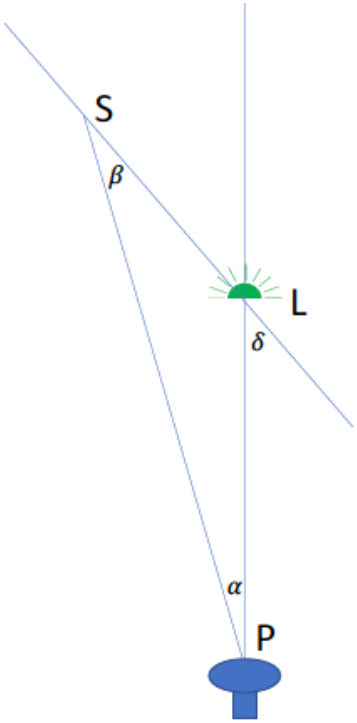
- Single scattering process
- Rayleigh scattering only

$$R(\lambda, d, \delta) = \Phi_0(\lambda) QE_{PMT}(\lambda) \int_0^{\inf} ds P_{abs}(\lambda, s + x) \frac{dP_{sca}}{ds}(\lambda, s) P_{PMT}(\alpha) \frac{dp_{sca}}{d\Omega}(\beta) \frac{A_{PMT}}{x^2}$$



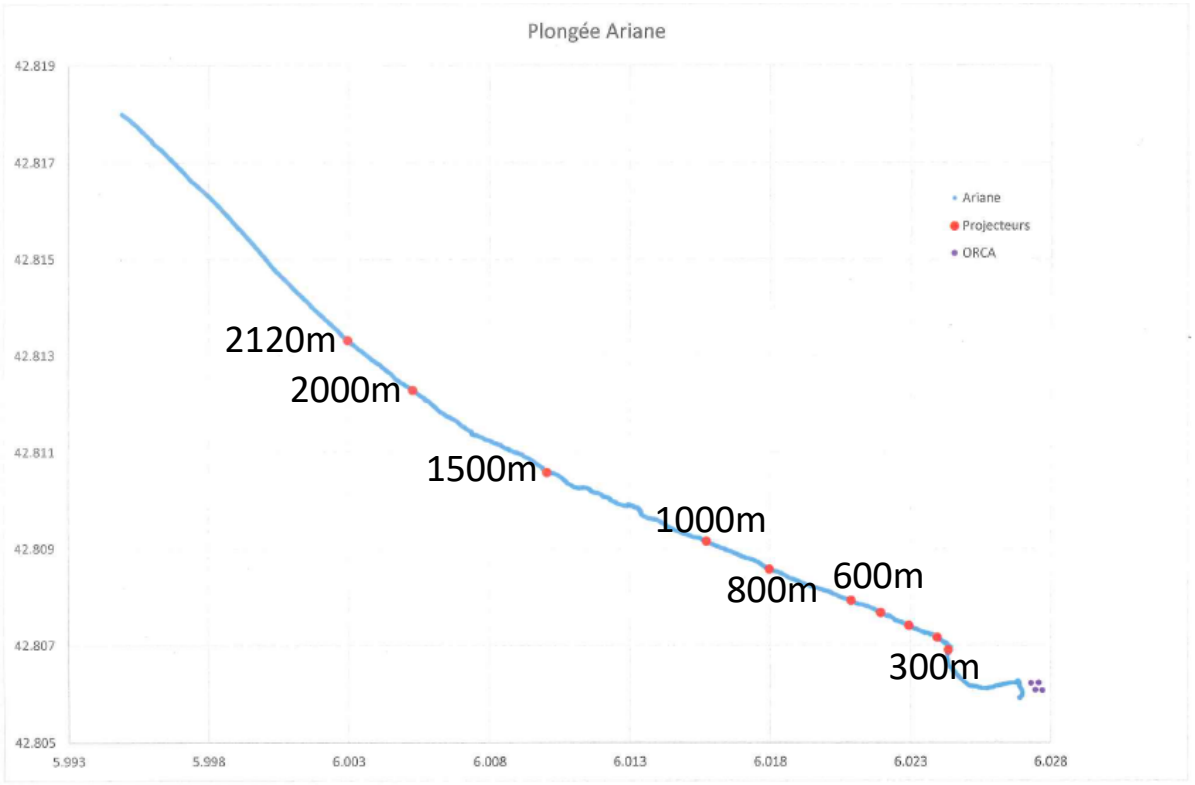






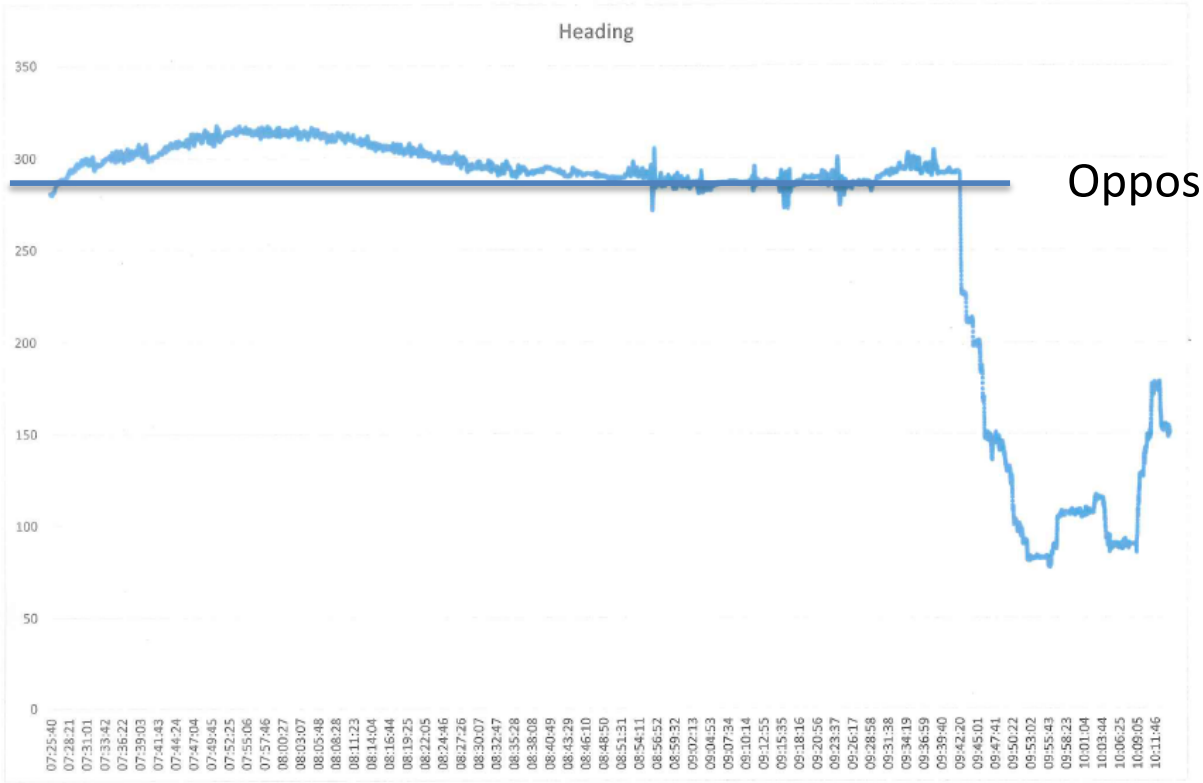
Movement of submarine

- Red dots : projectors tests, ORCA on lower right



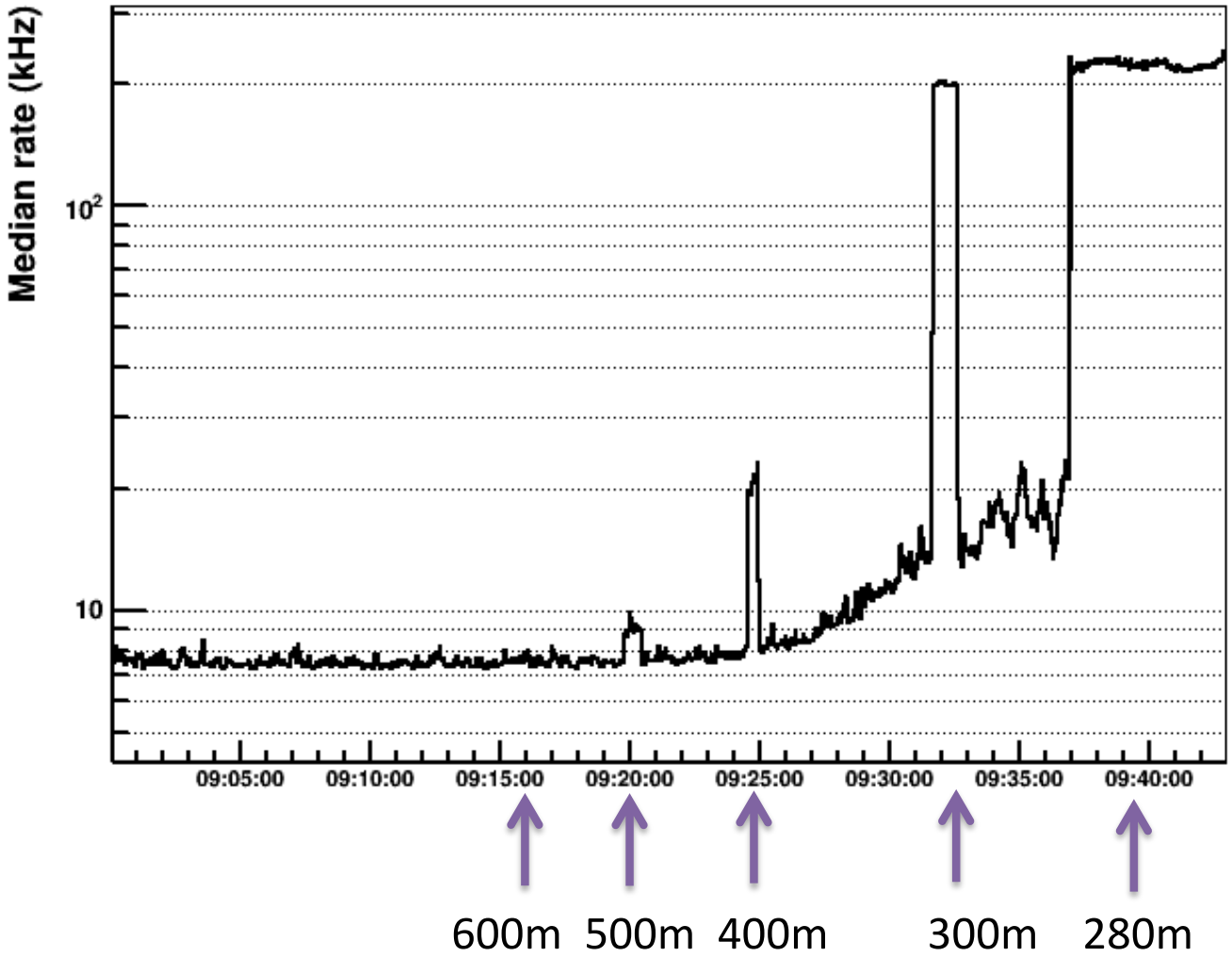
Orientation of submarine

- During approach ROV looks away from ORCA



Opposite to detector

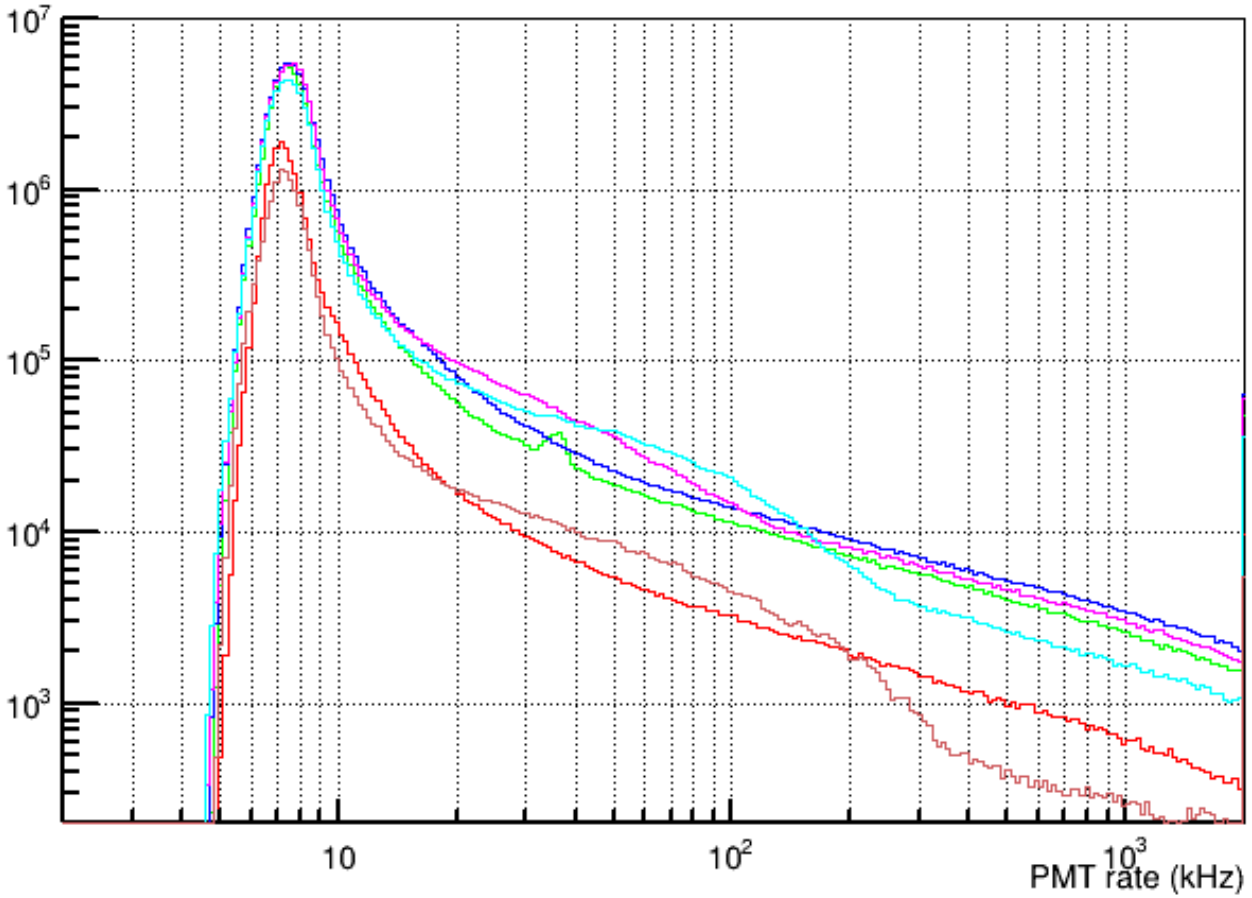
Signal summary

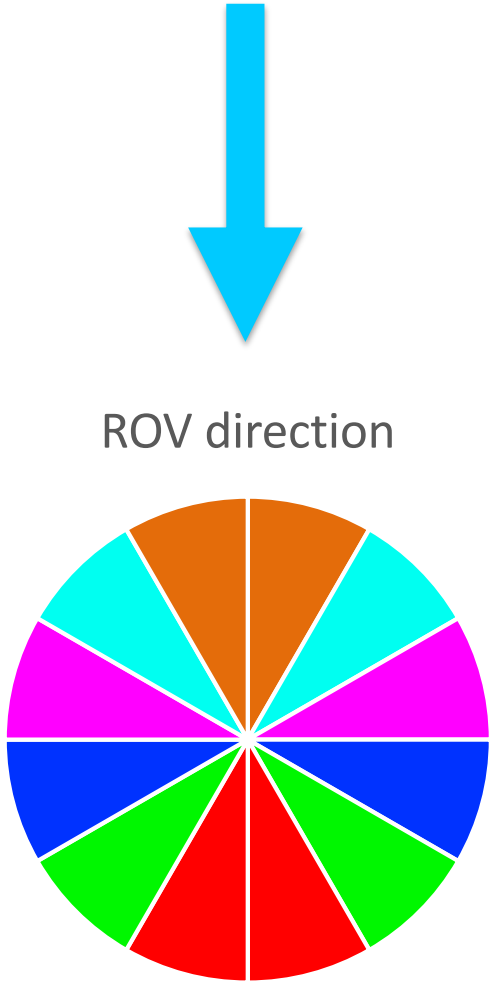


- 500m
  - 09:19:48
    09:20:28
- 400m
  - 09:24:33
    09:24:55
- 300m
  - 09:31:38
    09:32:35
- 280m
  - 09:36:59

PMT angle versus ROV

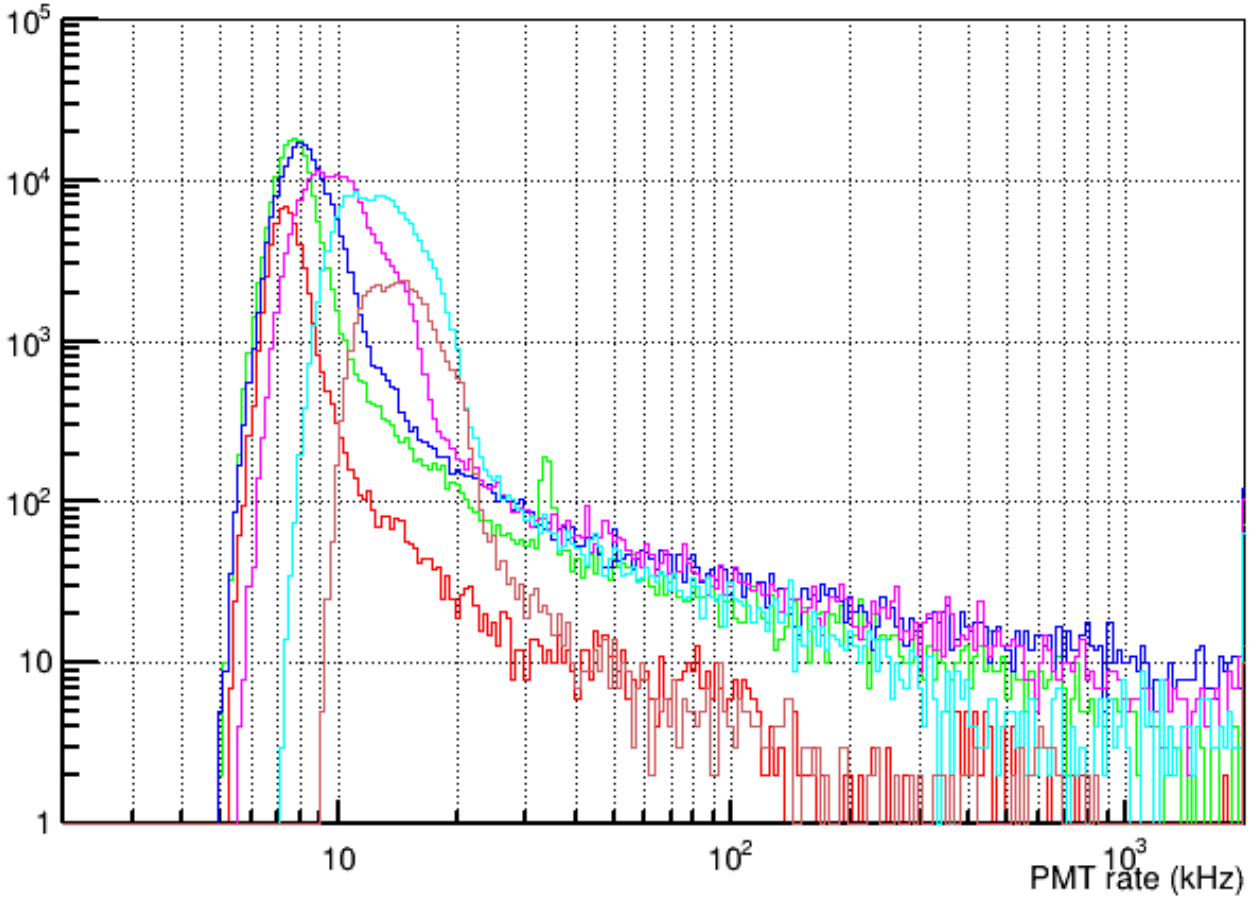
- No ROV light run 6475 (only small LED)



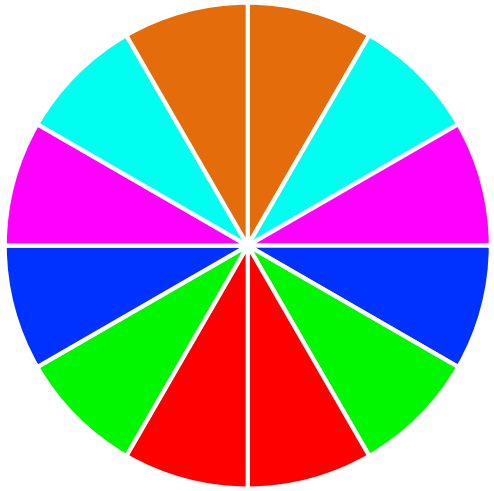


PMT angle versus ROV

- ROV at 486m

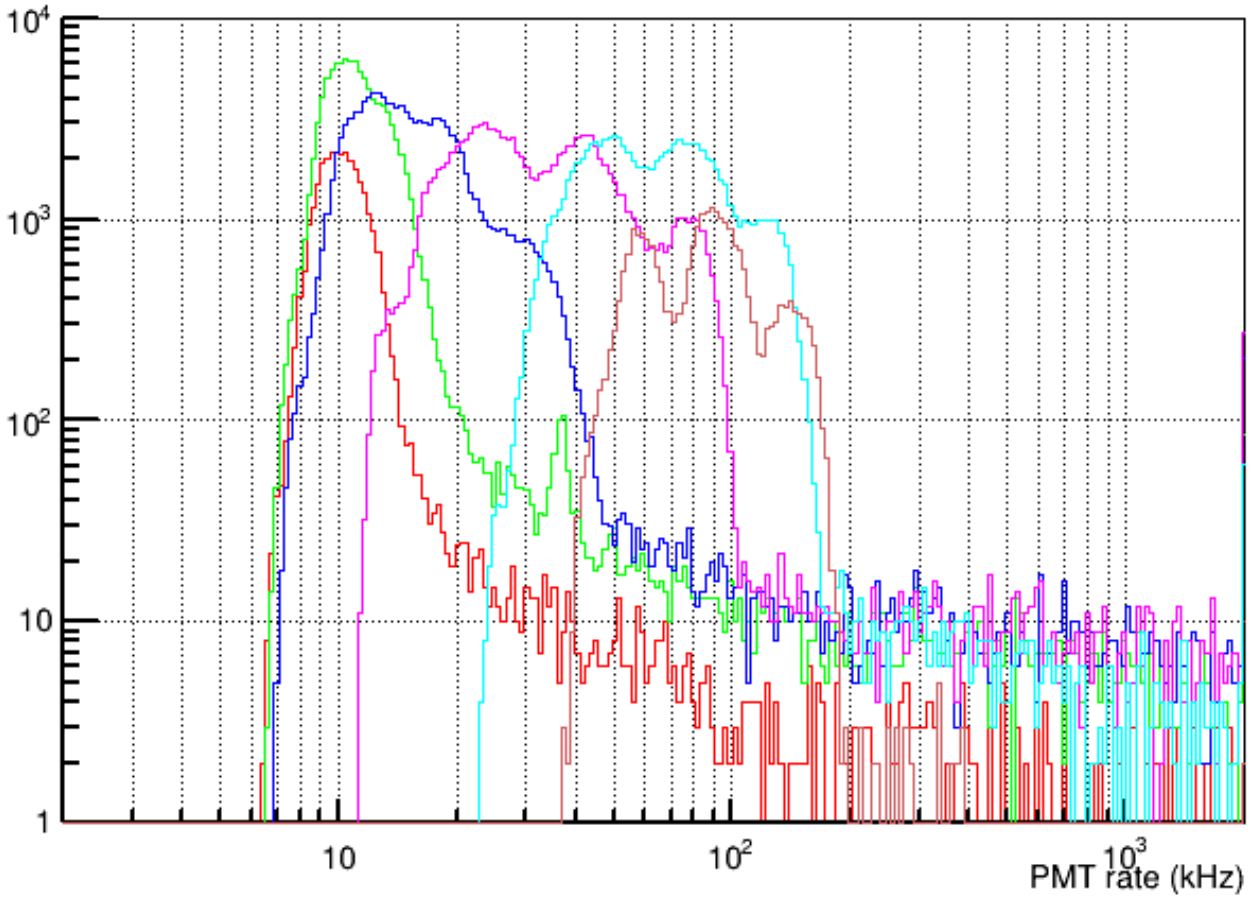


PMT-ROV	R_MC (kHz)	R_ROV (kHz)
0˚-30˚	52	17
30˚-60˚	29	13
60˚-90˚	11	10
90˚-120˚	0.008	8.5
120˚-150˚		7.8
150˚-180˚		7.5

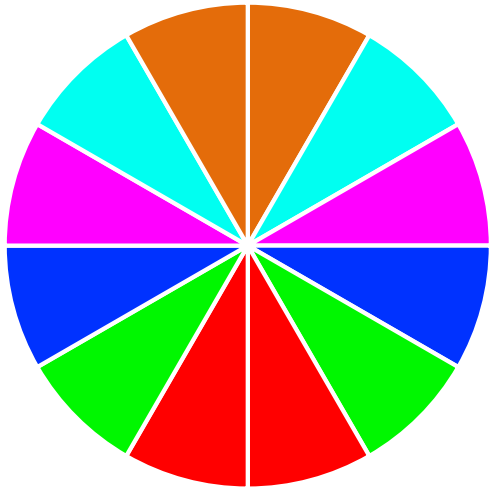


PMT angle versus ROV

- ROV at 400m

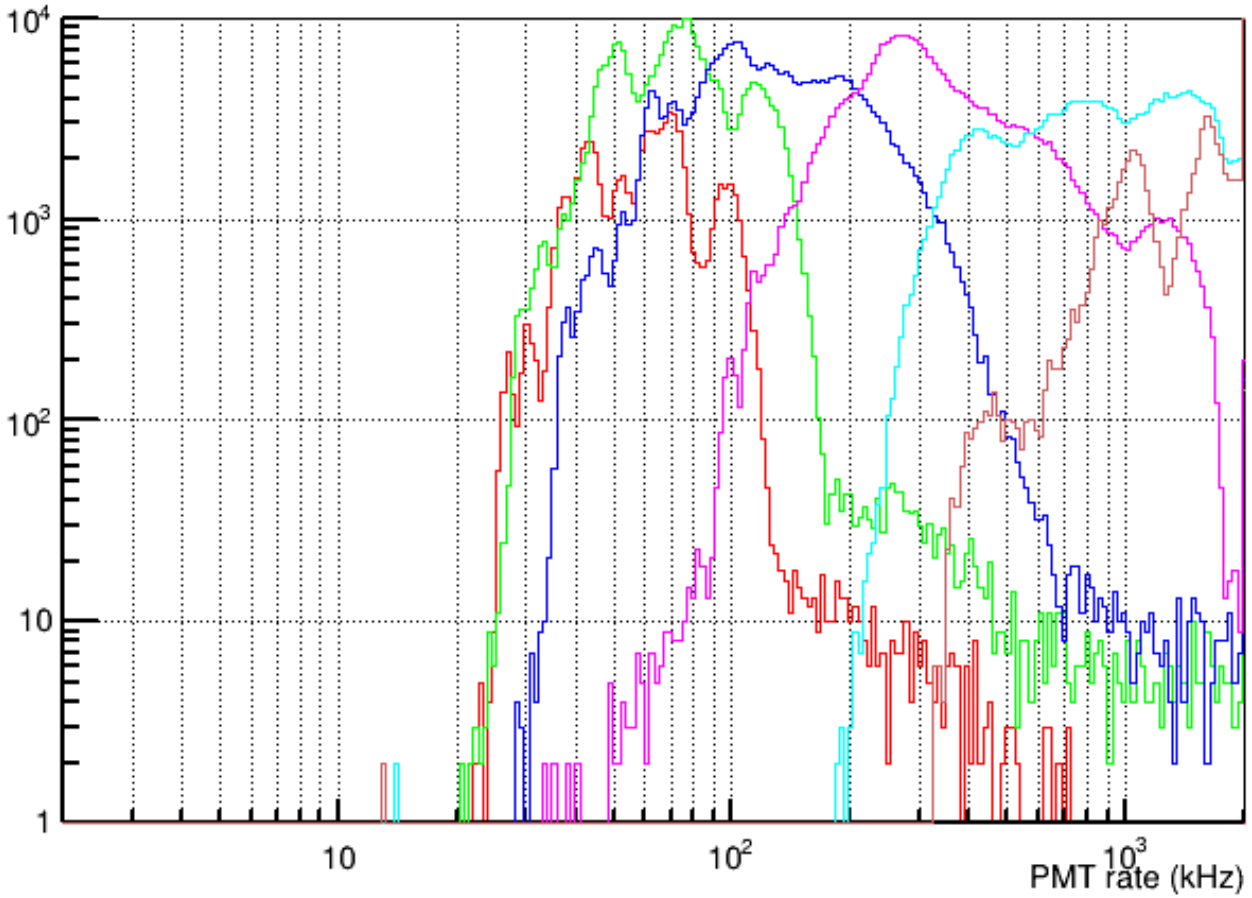


PMT-ROV	R_MC (kHz)	R_ROV (kHz)
0˚-30˚	280	60/90
30˚-60˚	150	50/80
60˚-90˚	58	25/40
90˚-120˚	0.06	15
120˚-150˚		12
150˚-180˚		10

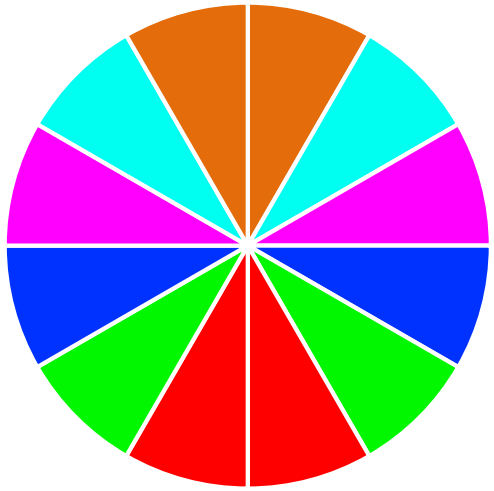


PMT angle versus ROV

- ROV at 312m → max 2 MHz

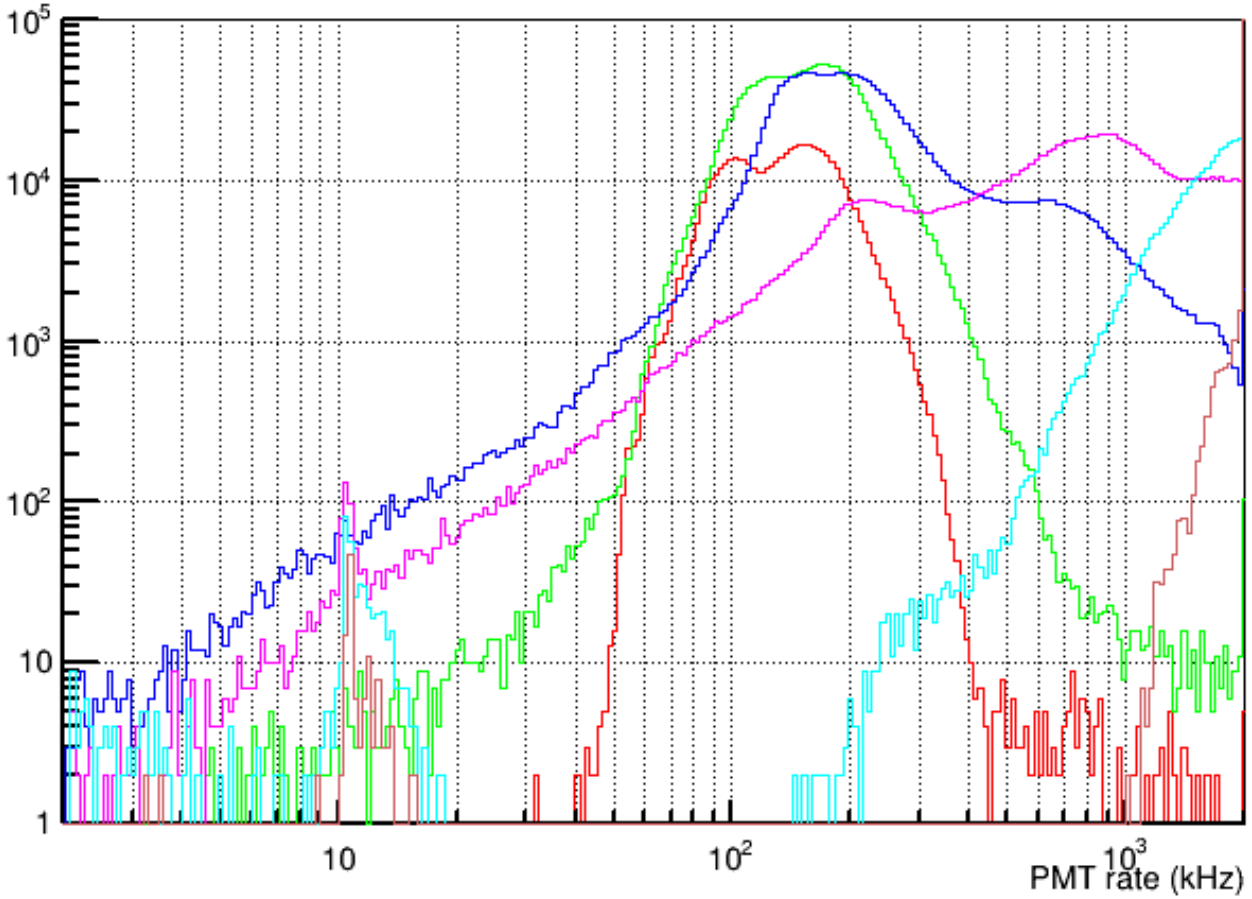


PMT-ROV	R_MC (kHz)	R_ROV (kHz)
0˚-30˚	1700	>1000
30˚-60˚	930	~1000
60˚-90˚	350	260
90˚-120˚	0.5	100-200
120˚-150˚		50-130
150˚-180˚		30-100

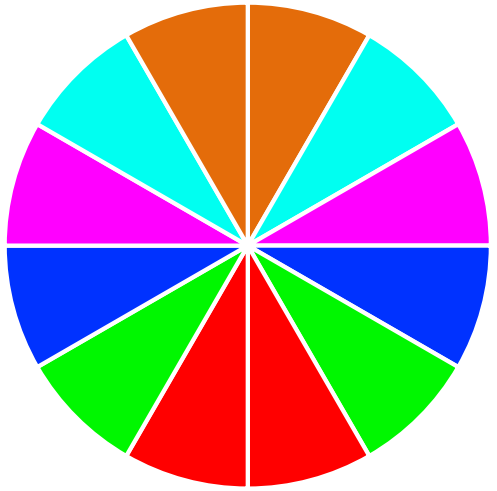


PMT angle versus ROV

- ROV at 272m

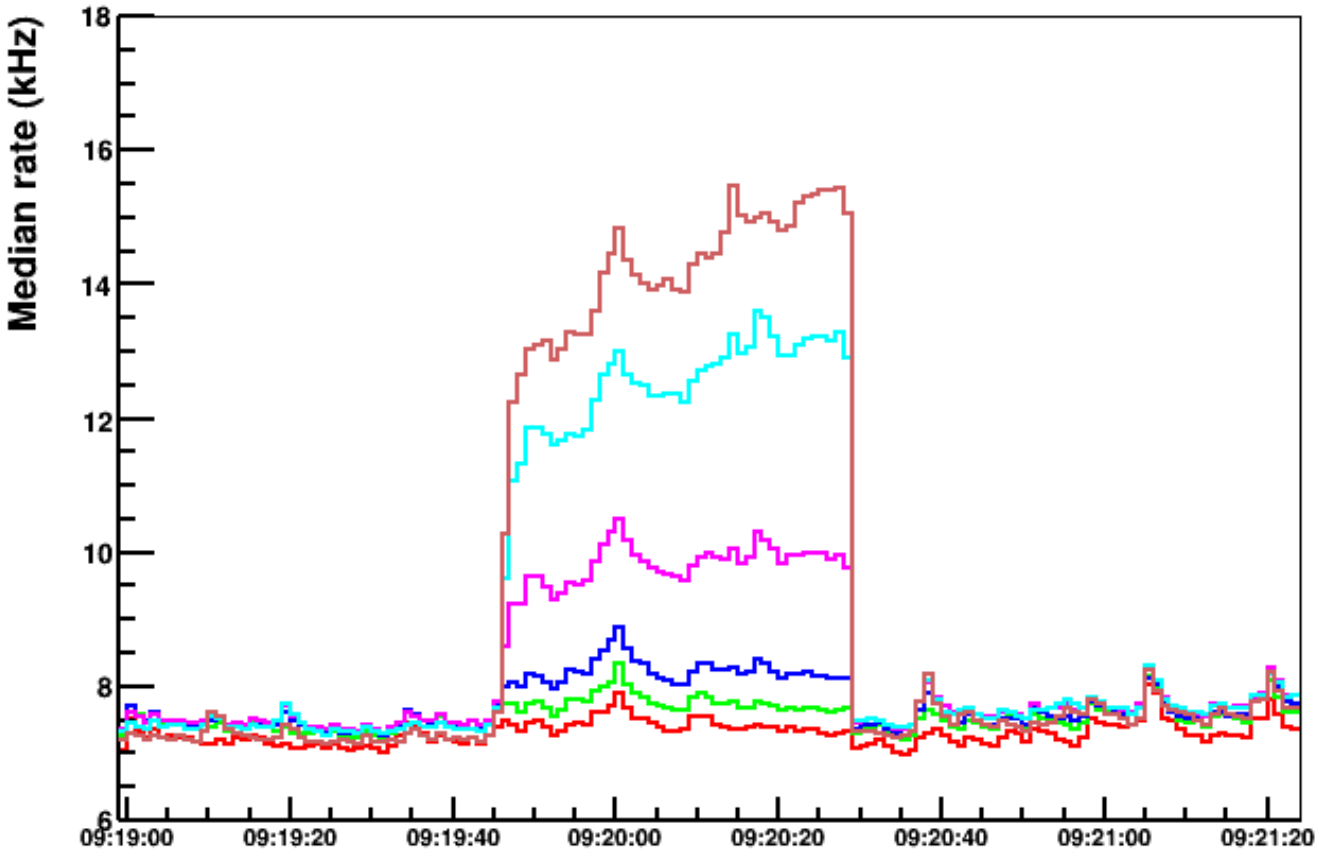


PMT-ROV	R_MC (kHz)	R_ROV (kHz)
0˚-30˚	4000	2000
30˚-60˚	2200	2000
60˚-90˚	830	~1000
90˚-120˚	1.5	150-300
120˚-150˚		100-300
150˚-180˚		100-200

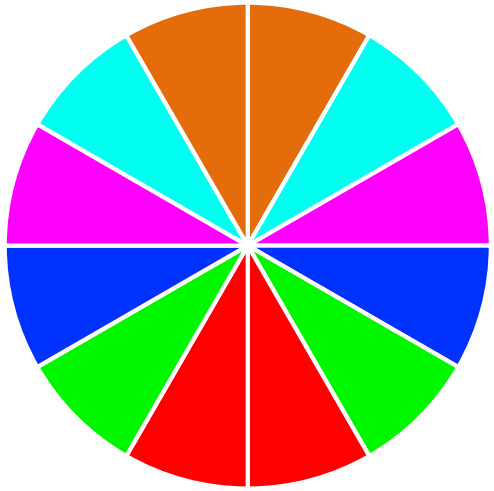


PMT angle versus ROV

- ROV at 486m

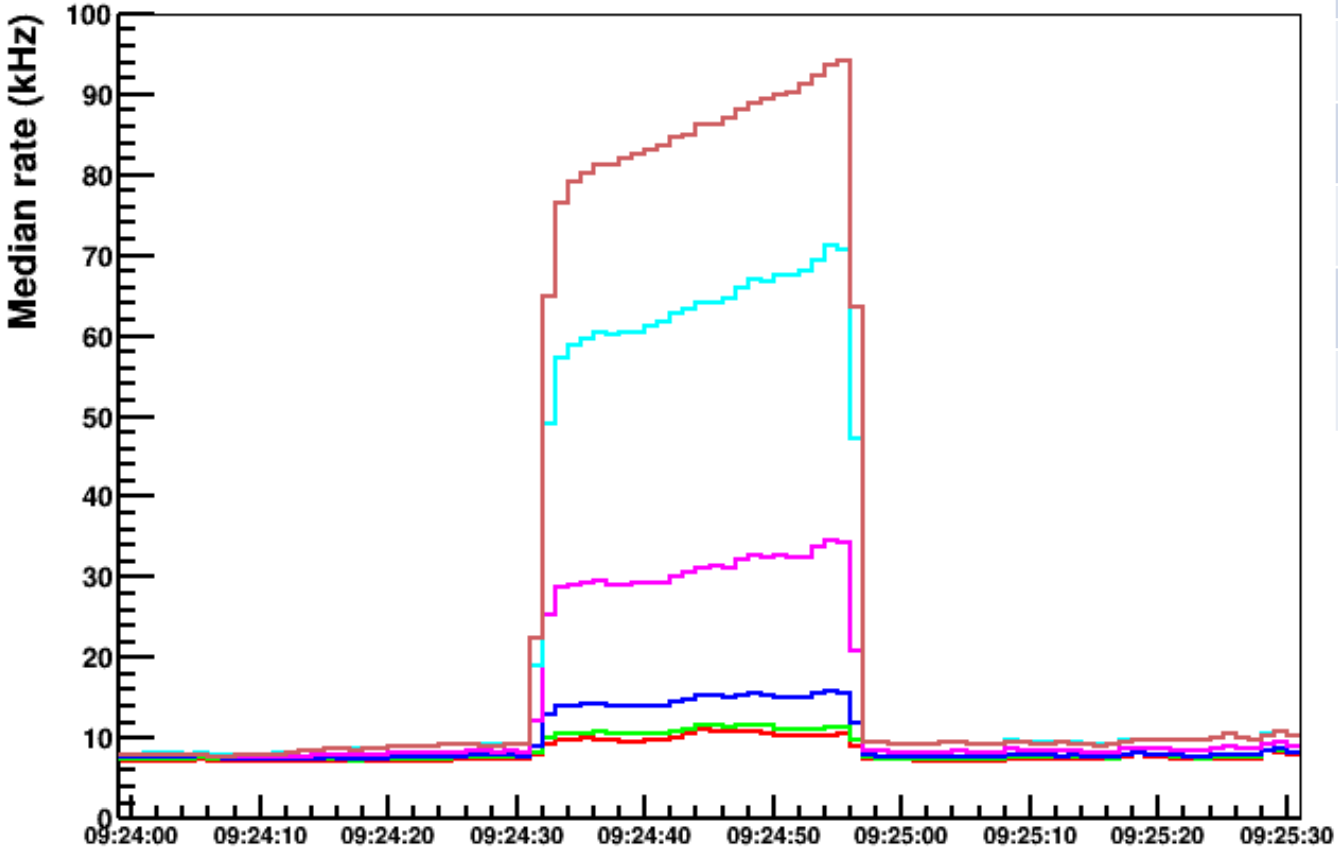


PMT-ROV	R_MC (kHz)	R_ROV (kHz)
0˚-30˚	52	6.5
30˚-60˚	29	5.0
60˚-90˚	11	2.3
90˚-120˚	0.008	0.7
120˚-150˚		0.3
150˚-180˚		0

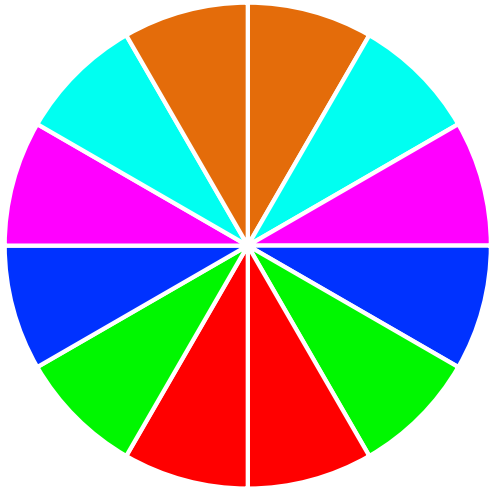


PMT angle versus ROV

- ROV at 400m

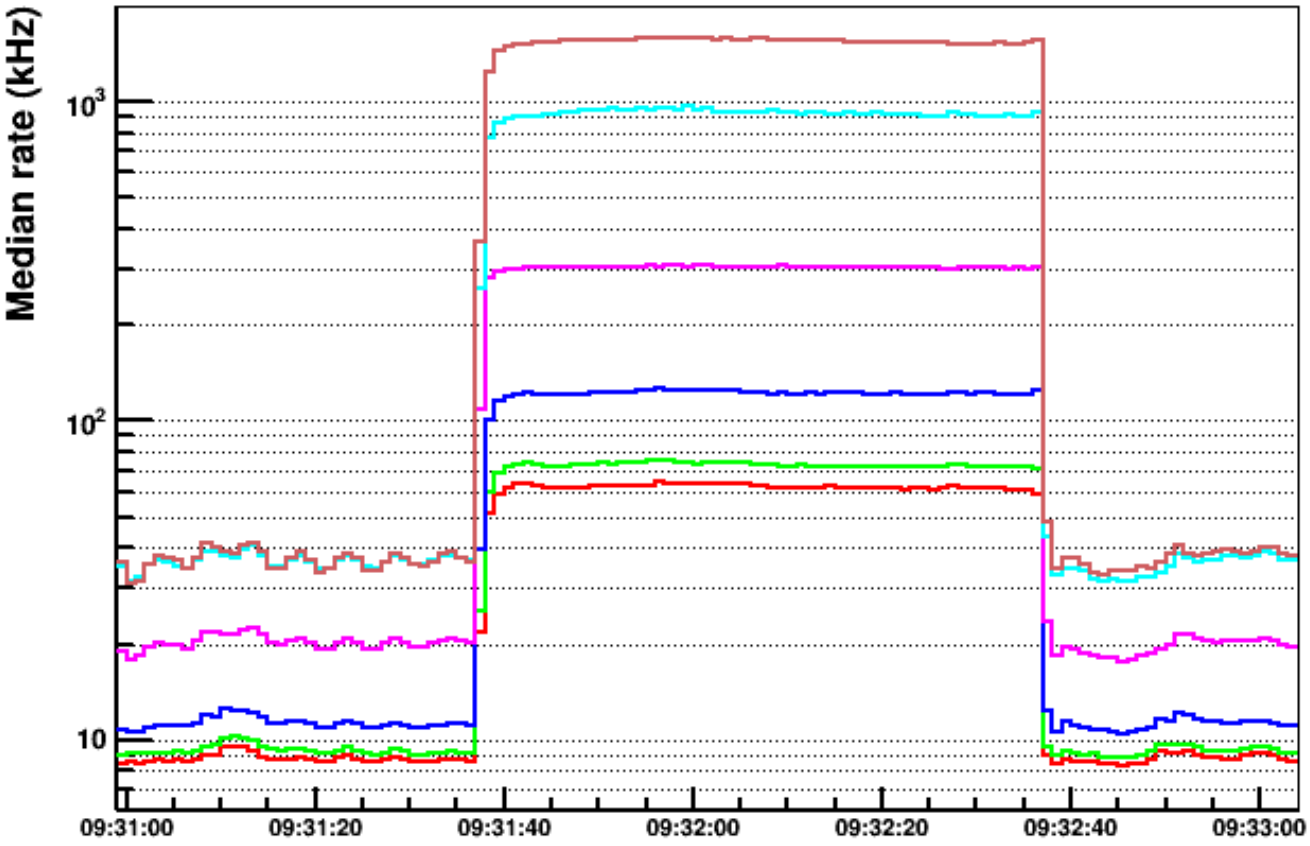


PMT-ROV	R_MC (kHz)	R_ROV (kHz)
0˚-30˚	280	78
30˚-60˚	150	56
60˚-90˚	58	23.5
90˚-120˚	0.06	7.2
120˚-150˚		3.5
150˚-180˚		2.7

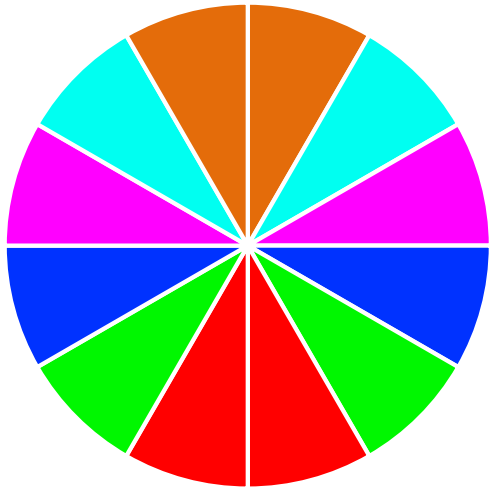


PMT angle versus ROV

- ROV at 312m

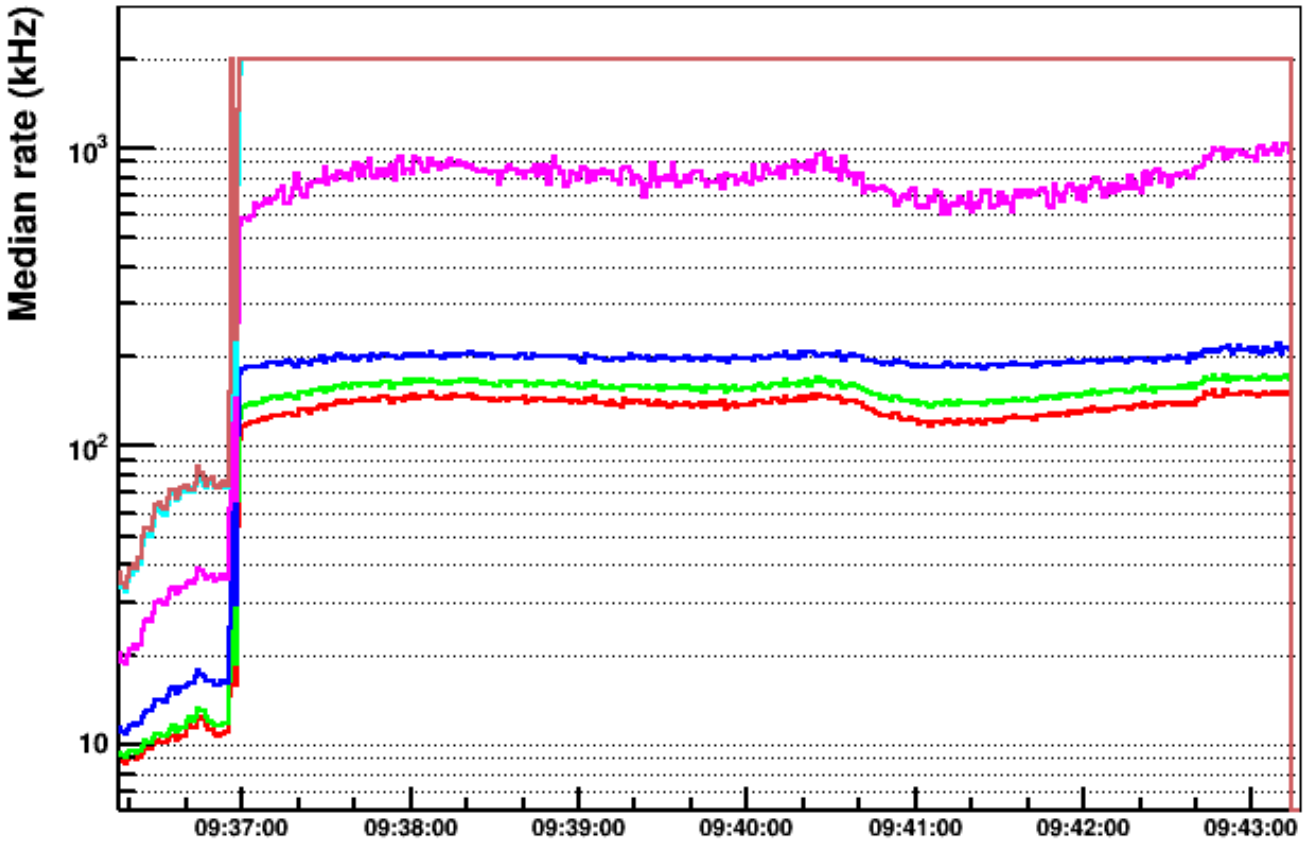


PMT-ROV	R_MC (kHz)	R_ROV (kHz)
0˚-30˚	1700	1540
30˚-60˚	930	910
60˚-90˚	350	295
90˚-120˚	0.5	115
120˚-150˚		65
150˚-180˚		55



PMT angle versus ROV

- ROV at 272m



PMT-ROV	R_MC (kHz)	R_ROV (kHz)
0˚-30˚	4000	2000
30˚-60˚	2200	2000
60˚-90˚	830	780
90˚-120˚	1.5	200
120˚-150˚		150
150˚-180˚		130