

The BOUSSOLE project technical reports; report #7-18, issue 1.

BOUSSOLE buoy deployment & maintenance log.

June 14, 2011 - March 14, 2014

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Foreword

This report is part of the technical report series that is being established by the **BOUSSOLE** project.

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1. SCOPE OF DOCUMENT

The BOUSSOLE buoy deployment and maintenance log is a record of all events that occur from the deployment to the recovery of one of the two upper sections of the buoy.

The aim is to keep track of all maintenance operations, such as instruments cleaning or rotations, instruments malfunctions, incidents with the buoy structure, if any, biofouling development and so on.

This information is crucial to a subsequent correct interpretation of the data.

Keeping track of these events also allows their analysis in view of the permanent improvement of protocols.

The present report concerns "buoy deployment XV", from June 14th of 2013 to March 14th of 2014.

2. DESCRIPTION OF OPERATIONS

2.1 UPPER SECTION PREPARATION (2013-05)

The buoy System (buoy XV called system #1) was delivered from Satlantic on January. Before the installation all the radiometers and data loggers were shipped to the National Physics Laboratory (NPL, UK) in the framework of the QA4EO program of the ESA. The aim was to have a better characterisation of the instruments and to realise improved calibration files. The installation on the structure began after the instruments were shipped back from NPL on April 26th. The deployment took place on June 14th 2013 in conjunction with the mooring line and floatation sphere rotation.

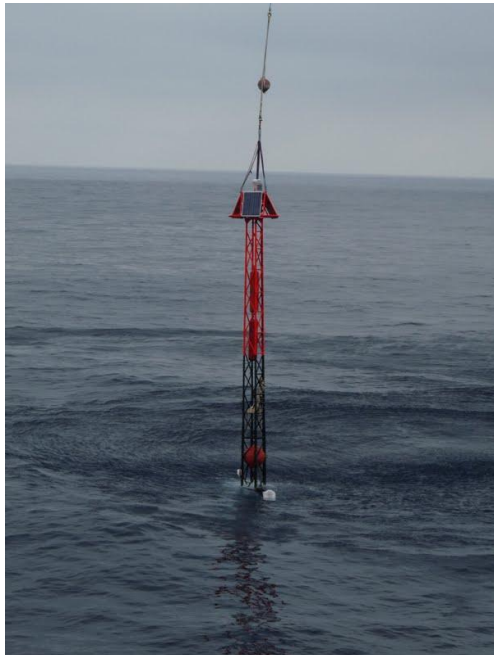
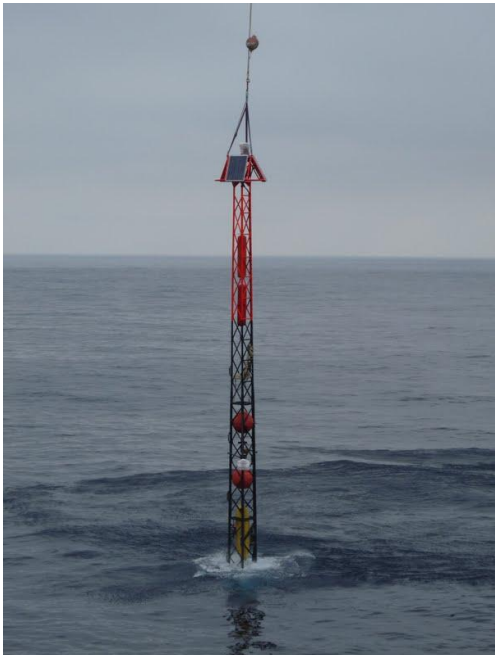
The **OCP #036** had a major problem during test at NPL and had to be shipped back to Satlantic for repair. The **OCP#040** from system #2 will be used as spare.

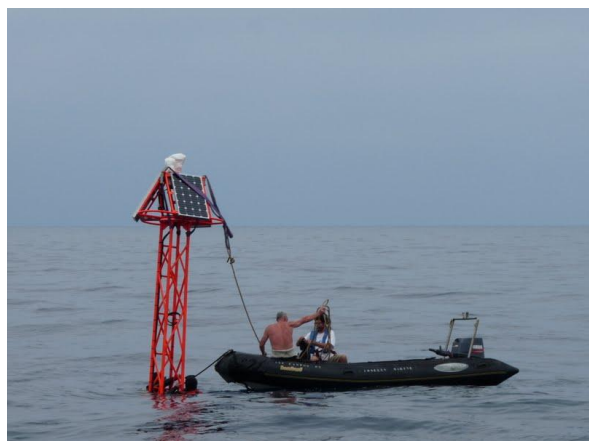
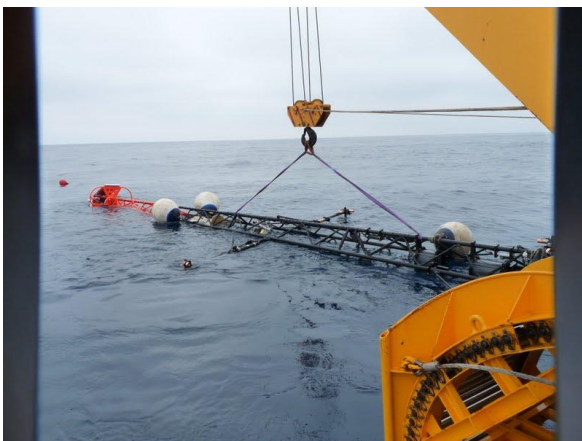
The Buoy was equipped with sensors used for the deployment of the buoy XIII recovered on September 7th 2012. The system was prepared in the CCI local in Villefranche-Sur-Mer and since the 15th of May it was ready for the deployment.

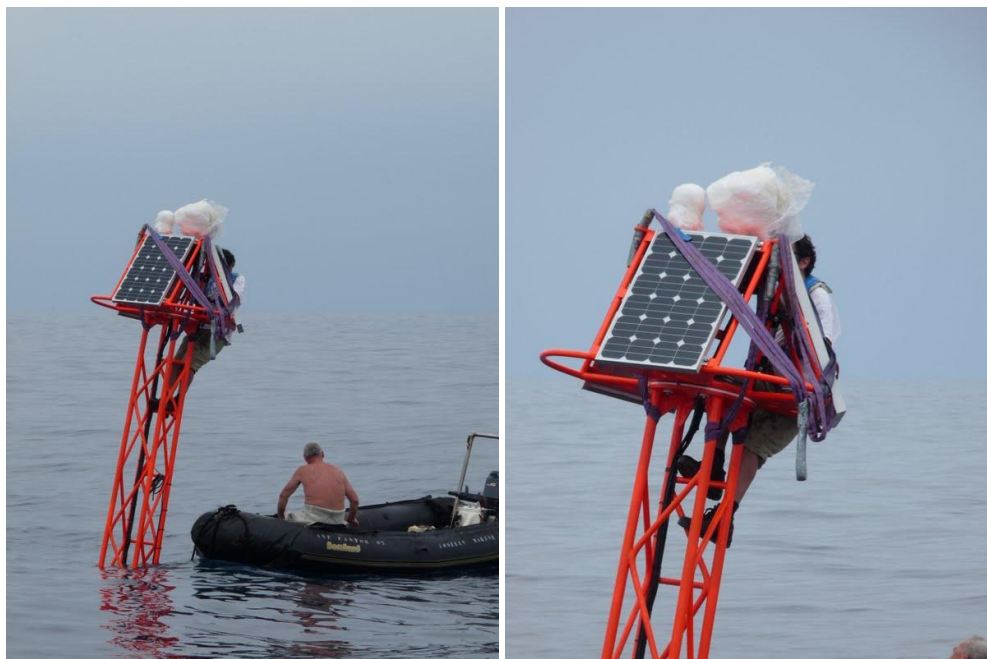
Copper sheets and pieces were again fixed wherever possible to avoid biofouling arising. Aluminium plates (3 mm thickness) have again been fixed on the back side of the solar panels to reinforce them. The suggested schedule from Satlantic was modified, reducing the number of instruments and acquisition frequency at night. The system was tested for some days running both with solar panel or ground alimentation (no OCP at 4 m was available during tests).

An intercalibration of all radiometers was also performed before launch (see appendix).









2.2 MOORING DEPLOYMENT

2.2.1 Friday 14th June 2013

The upper structure to be deployed was brought to the Rochambeau field at local 06:00 am with the help of 5 people from the LOV. The 4 arms were assembled and connected to the buoy. At 07:20 am divers gave the OK for the buoy delivery after 8.00 am. The helicopter was called and arrived at Villefranche-sur-mer at 8:00 am. As usual the go/return trip lasted about one hour. At about 12h30 the ARGOS messages arrived regularly, though they stopped four days later.

At this date, buoy is equipped with

- DACNet #002
- CLC #002
- Junction Box #004
- Rads set: OCI #035_Eu4m, #040_Ed4m, #109_Eu9m, #047_Ed9m #095_Es, OCR #035_Lu4m and #038_Lu9m), MVDS #053, OCP #040(4m) and OCP 041(9m)
- Hyper spectral units HOCR-RW #241_Lu4m, #242_Lu9m, HOCR-IW #279_Es, HOCR-IW #399_Ed4, #405_Ed9, STOR-X #032.
- HS4 #H4070403
- Strain-100 #001
- Transmissometers C-Star #1057-PR (4m) and #1058-PR(9m)
- ECOFLNTUs #726 (4m) and #727 (9m)
- ARGOS beacon #18797 (prog id#26021)
- CTD #37SI 46113-5325
- Strain gauge OML CSCB40K

- PAR #097

The lower part of the buoy is still equipped with the two emergency ARGOS beacons.

2.2.2 Friday-Monday 12-15th July 2013

These days are part of the B#137 cruise. On the first day cleaning of the connections and solar panel on the top of the buoy was performed. Two attempts of CISCO and direct connections with the buoy were made unsuccessfully. The second day two others attempts of CISCO connection failed. The last day divers went at sea for cleaning the optical sensors and perform dark measurements. The pCO2 sensor was exchanged with a new one and an O2 optode was installed at 3 m. A second CTD and optode were installed at 10 m. After 2 CISCO and 1 direct nominal connection attempts a direct connection was obtained through an AK reboot and data were downloaded.

2.2.3 Friday 19th July 2013

This day ARGOS dispatch stopped again. In the previous two days an anomalous increase of the buoy tilt was noticed during very good weather conditions. In the eventuality of a fishing net twisted with the buoy a diving will be organised as soon as possible.

2.2.4 Tuesday 26th July 2013

This day the private boat NOE from CAP KETOS in Nice was rent for going to the BOUSSOLE site with 3 divers from LOV. When on site, divers went at sea for inspecting the buoy. No fishing net was present and the general aspect of the buoy was normal. Then divers cleaned the optical sensors and installed neoprene caps for dark measurements. Then the buoy was switched off, the OCP#040 dismounted and the OCP#036 installed at 4 m. In the meantime, sensors and connections on the buoy head were cleaned. Then the buoy was switched on and data downloaded after a nominal connection attempt. Unfortunately the connection was lost during data download and a second connection was obtained after an AK reboot. Data were regularly downloaded and the configuration of the DACNet was modified to take into account the OCP exchange. Data from the pCO2 sensor were downloaded too. The ARGOS dispatch restarted correctly after its cleaning.

At this date, buoy is equipped with :

- OCP #036 (4m)

In the QC phase of data post-processing a discrepancy in the data temporal series was identified. After accurate analyses the problem revealed to be an wrong re-installation of the OCP. The connection between Lu_4m and Eu_4m sensors and OCP_4m were inverted for error. A consequent exchange of the calibration coefficients in the calibration file was needed to obtain the correct physical values for Eu and Lu.

2.2.5 Friday 23th August 2013

This days is part of the B#138 mission. The first day divers went at sea to clean the optical sensors ant to perform dark measurements.

Connectors and solar panels were cleaned on the buoy head. A direct connection was made and data downloaded.

2.2.6 Friday 13th September 2013

This day is part of the B#139 mission. 3 divers from a private company were on board the *Tethys II*. When arrived at the BOUSSOLE site, divers went at sea for cleaning the instruments and put neoprene caps onto IOPs sensors for dark measurements. In the meantime sensors and connectors were cleaned on the buoy head. A first nominal connection was attempted unsuccessfully, probably because of two DACNet software open windows on the laptop. A connection was then obtained with an AK reboot and data downloaded. Data from the pCO₂ sensors were also downloaded.

2.2.7 Wednesday 9th October 2013

This day divers from private company MARE NOSTRUM went to the BOUSSOLE site for cleaning the optical sensors and to perform dark IOPs measurements.

2.2.8 Thursday 10th October 2013

On this day the ARGOS dispatch start sending constant values. This indicates a stop of the DACNet. However the last strain data are 3000 Newtons lower compared to the nominal values (27000 Newtons). This might indicate an infiltration of seawater into one of the seven floatation sphere compartments or just be a spike in the data flow. As the DACNet stop arrived in the middle of a storm it is preferable to go to visit the mooring with divers to check its state.

2.2.9 Tuesday 15th October 2013

This day the private boat *Lollipop* from private company DARKPELICAN was rent in Villefranche to go to the BOUSSOLE site. Two divers from LOV and 1 diver from MARE NOSTRUM company were on board. The buoy general aspect was good and the floatation level was at the expected position. Divers went at sea to check the conditions of the structure underwater that was found in good conditions too. In particulars divers stroke all over the floatation sphere with a metallic object to hear if there were differences in the sound that could indicate an infiltration of water (negative). Then few attempts to reboot the system through the AK connector were made unsuccessfully. Then the J/BOX and the battery were switched off and the DACNet dismantled. The DACNet microdrive was removed and replaced by a new one (1Gb). The DACNet was then tested on board and the configuration upgraded before being re-installed from divers. The system restarted to work correctly. A second pCO₂ sensor was also installed at 10m and its cable fixed along the structure up to the buoy head.

2.2.10 Saturday 19th October 2013

This day is part of the B#140 cruise. Data were downloaded on the top of the buoy during a nominal connection.

2.2.11 Tuesday 2nd November 2013

This day divers from private company MARE NOSTRUM went to the BOUSSOLE site for cleaning the optical sensors and to perform dark IOPs measurements.

2.2.12 Saturday 9nd November 2013

This day the ARGOS message dispatch stopped.

2.2.13 Thursday 14th November 2013

This day is part of the B#141 cruise. The buoy was found with one solar panel half broken. Data from DACNet and pCO₂ sensors were downloaded on the top of the buoy. Connectors were cleaned and the ARGOS messages dispatch restarted regularly. The Es is not working properly probably due to a problem with the **MVDS #053**. No other operation was possible on the buoy due to bad weather.

2.2.14 Friday 29nd November 2013

This day the private boat NOE from CAP KETOS company (Nice) was rent for going to the BOUSSOLE site. 1 private diver from FIQUEFLEUR was onboard. The solar panel on the buoy was definitively broken and replaced. The **MVDS #053** was exchanged with the **OCP #035 on the top of the buoy**. The last one was configured for being seen from the DACNet as the **MVD #035** thus no need of modification on the configuration of the node was necessary. Optical sensors were cleaned underwater and IOPs dark measurements performed. Connectors and optical sensors were cleaned on the top of the buoy and data downloaded with a direct connection at scheduled time. The verification of the Es data confirmed that the MVDS exchange took effect as expected before departure to Villefranche-sur-mer.

2.2.15 Wednesday-Saturday 12th-14th December 2013

These days are part of the B#142 cruise. The second day divers were on board and cleaned the optical sensors. The DACNet, which was suspected to be stuck, was dismantled and the microdrive exchanged (a 3 Gb drive replaced the 1 Gb previously on board). Then DACNet was dismantled. The last day a broken solar panel was replaced with a good one. Connectors on the buoy head were cleaned.

2.2.16 Tuesday 7th January 2014

This day divers from private company MARE NOSTRUM went to the BOUSSOLE site for cleaning the optical sensors and to perform dark IOPs measurements.

2.2.17 Thursday 23rd January 2014

This day is part of the B#143 cruise. When arrived at the BOUSSOLE site divers went at sea to clean the optical sensors and to perform dark measurements on IOPs. An attempt of data download from the 3m pCO₂ sensor was made unsuccessfully. Then the pCO₂ sensor at 3m was dismantled and successively re-installed for retrieving the telemetry cable to be used the new buoy. A direct connection with the buoy was established and data downloaded. Data from the 10 m pCO₂ sensor were downloaded too. Connectors on the buoy head were cleaned, however the ARGOS message dispatch stopped few days after.

2.2.18 Wednesday 12rd February 2014

This day is part of the B#144 cruise. A direct connection on the top of the buoy was established and data downloaded. CISCO and ARGOS connectors, optical sensors and solar panel surfaces were all cleaned.

2.2.19 Friday 21rd February 2014

This day divers from private company MARE NOSTRUM in nice went to the BOUSSOLE site for cleaning the optical sensors and perform dark measurements.

2.2.20 Friday 14th March 2014

The buoy was turned off September in the early morning and dismantled from the lower structure from Léo Gimenez and other divers with the help of the GGIX ship from IXSURVEY. At about 09h00 the helicopter delivered the structure that was in good condition and with limited fouling. The buoy was then cleaned with Karcher on the Rochembau site and then transported into the CCI local. The buoy was dismantled in the following days and instruments were shipped for calibration on March 21th and arrived to the different companies within few days. The aluminium structure was sent to the BSS company in Biot on June 4th.

3. QUANTITATIVE SUMMARY

The deployment lasted 243 days, among which 4 days were without data due to a failure of the microdrive.

4. INSTRUMENT SCHEDULE

1 minute acquisition every 15 minutes. The timing of the schedule was: light 03:00:00 to 21:00; dark 21:00:00 to 03:00:00. Store-X and CISCO were again cut off during night.

5. ANY PROBLEMS ENCOUNTERED ?

- 1- The strain gauge showed problem of stability in the measurements after few months of utilisation.
- 2- The ARGOS dispatch stopped several times.
- 3- The CISCO connection often didn't work.
- 4- The microdrive failed once.
- 5- Solar panels brake.
- 6- The MVD stopped working during deployment.

6. LESSONS LEARNED

- 1- Analysis of stability of 1 minute Strain Gauge measurements may help identifying instrument drift that can be confused with a buoy sink.

7. ACKNOWLEDGEMENTS

The BOUSSOLE project has been set up thanks to the work of numerous people, and thanks to the support and funding of several Agencies and Institutions. The latter are listed in the foreword of this report. Specifically, the following contracts are acknowledged : the French Space Agency CNES provided funds through the TAOB and TOSCA scientific committees, ESA through ESTEC contract N°14393/00/NL/DC, including CCNs #1, #2 and #3, ESRIN through contract N° 17286/03/I-OL, and NASA through a "Letter of Agreement". Funding has been also obtained from the French CSOA committee and the "Observatoire Océanologique de Villefranche".

The crews and Captains of the following ships are also warmly thanked for their help at sea: the Castor-02 vessel from the Fosevel Marine company (buoy/mooring operations), the INSU R/V Téthys-II and Georges Petit (regular monthly cruises), the GG-IX from the Samar company and the Nika-III (on-demand short operations on site). Pilots and crew members of the Valair and Commerçair helicopter companies are also thanked for their willingness in accomplishing for us unusual survey missions above the BOUSSOLE site. Emmanuel Bosc, Maria Vlachou, Guillaume Lecomte, who have occasionally provided some help in collecting data, are also thanked for their help.

The French institute IFREMER and the Norwegian Marintek company are also thanked for their help and fairness in the engineering studies that were ordered to them after the major failure of the buoy in spring of 2002.

The data that are collected for several years near the BOUSSOLE site by the French weather forecast Agency, "Meteo France", and which are provided in real time on the internet, have been of great help in the day-to-day management of the monthly cruises.

Two companies have largely contributed to the BOUSSOLE project, namely the ACRI-in/Genimar company, Sophia Antipolis, France (buoy conception) and Satlantic Inc., Halifax, NS Canada (buoy centralized acquisition system and radiometers); their help is specifically acknowledged here.

8. APPENDIX

The following page contains the schema of the buoy and the list of the calibration files.

Radiometer Test

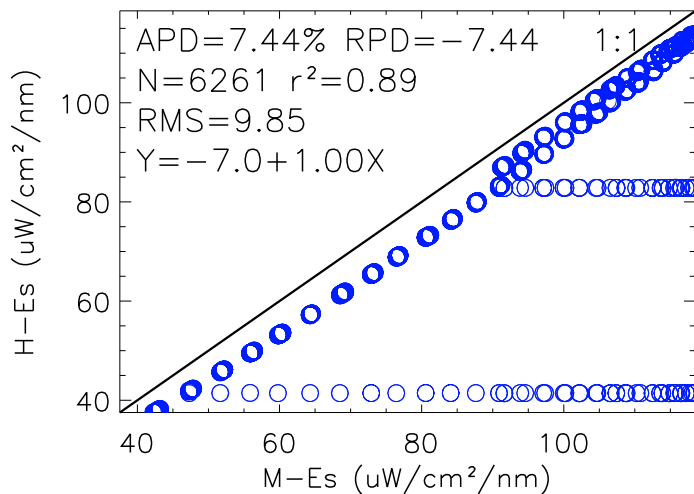
On April 24th 2013 a fielded campaign to test the buoy radiometers relative performances was organized at the Fort de la Revere. The fort is located at north of the Eze village at about 700m on the sea level (see images below), and near the fort there's a plane field free of obstacles that could cause shadow or glint above radiometers.

All the radiometers used for the buoy were fixed upon a table facing the zenith. The Ed Lu and Eu sensors were covered with new Teflon covers fabricated at LOV to avoid saturation and better reproduce a highly diffuse radiant field. The instruments were all connected as for the buoy deployment except the PAR (who was disconnected by mistake) and OCP. Only 1 OCP was available at the moment and had to be used alternatively for the 4 m and 9 m radiometer set. The schedule was modified to acquire data every 10 minutes instead of 15.

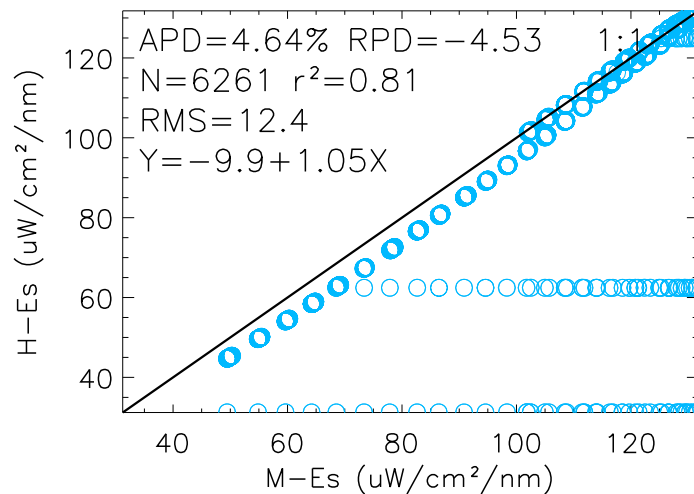
Data were acquired for about 8 hours.

Sky conditions were very good and stable. Single data were compared by using the TIMETAG variable recorded in data files.

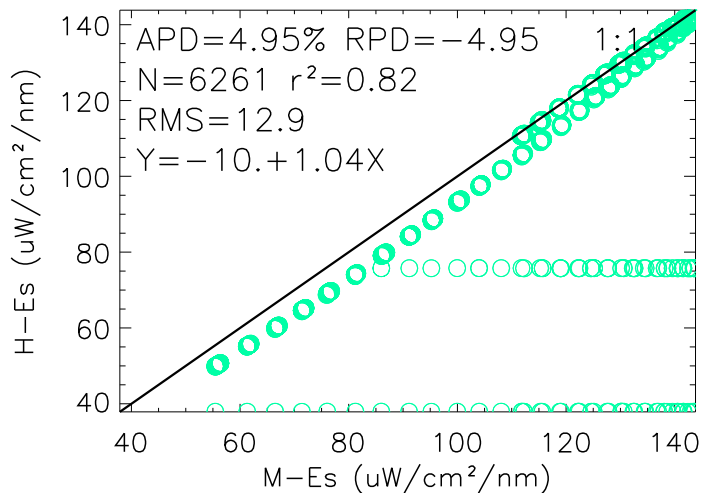
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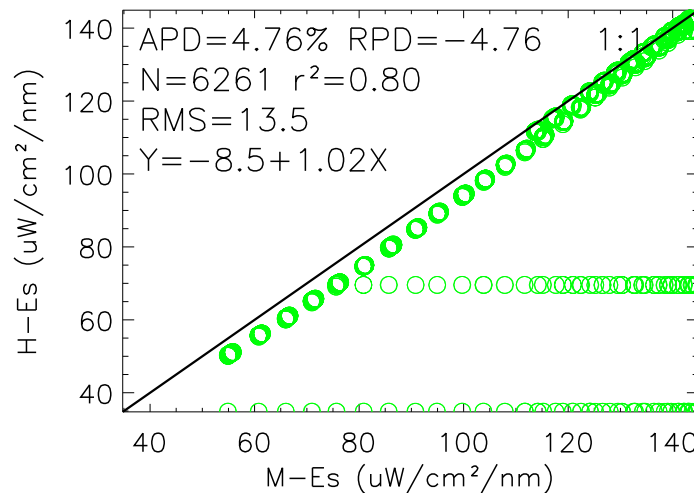
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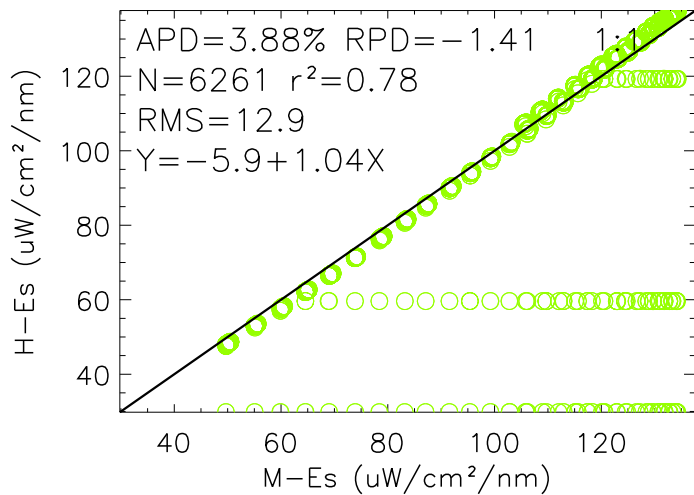
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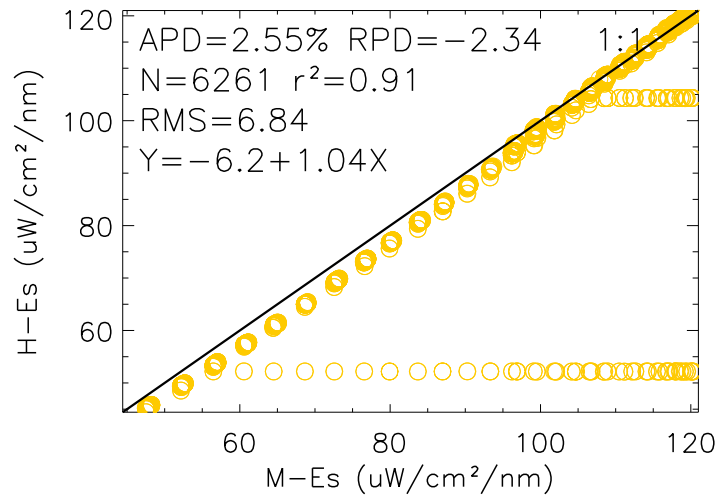
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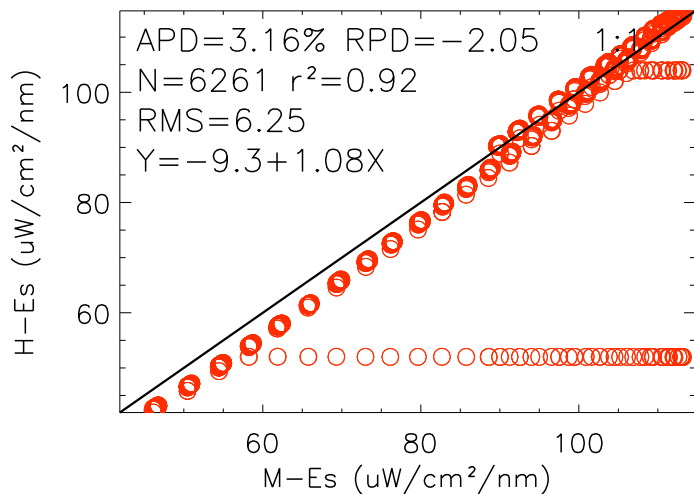
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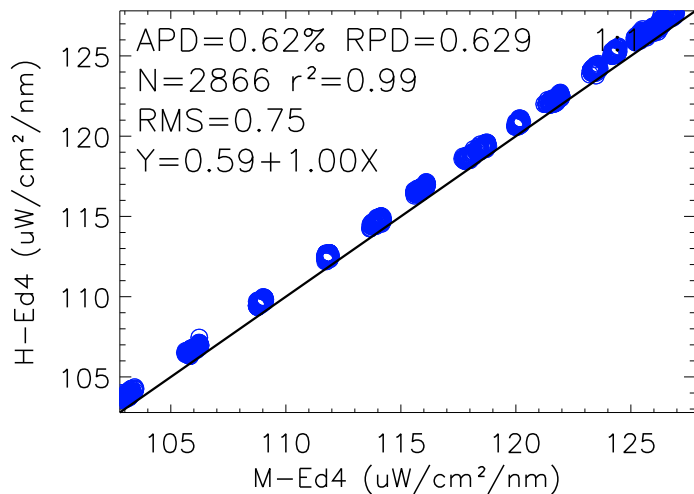
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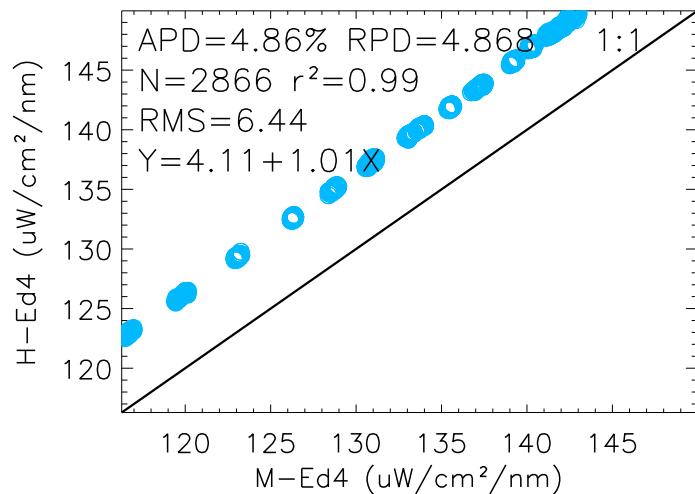
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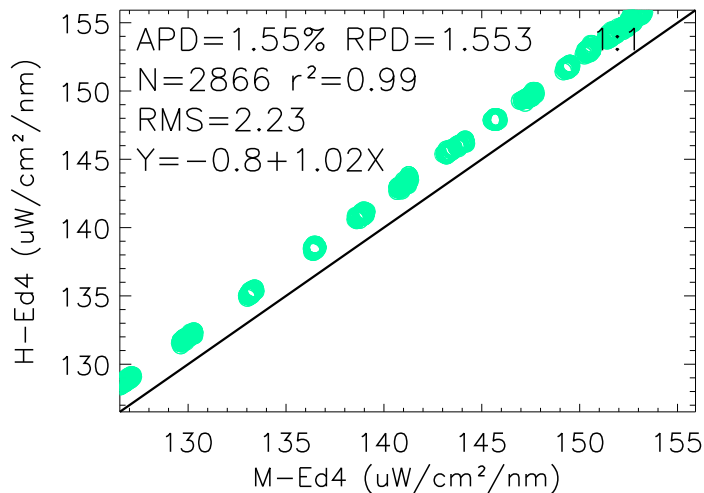
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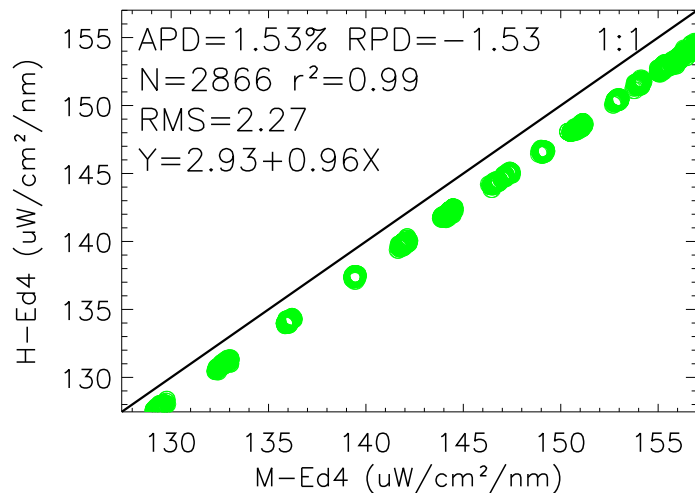
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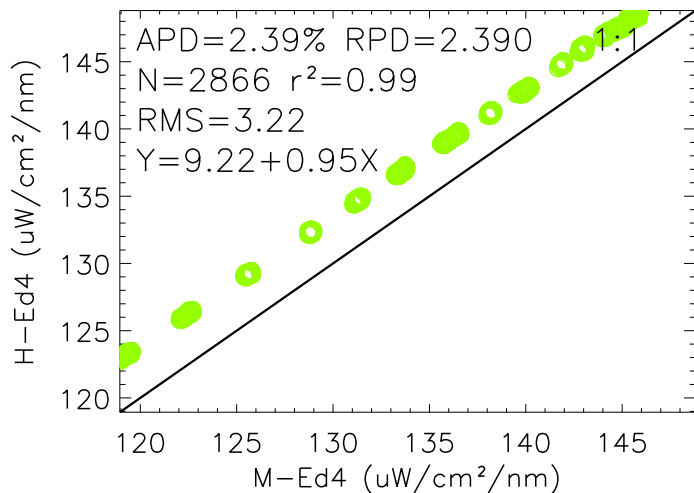
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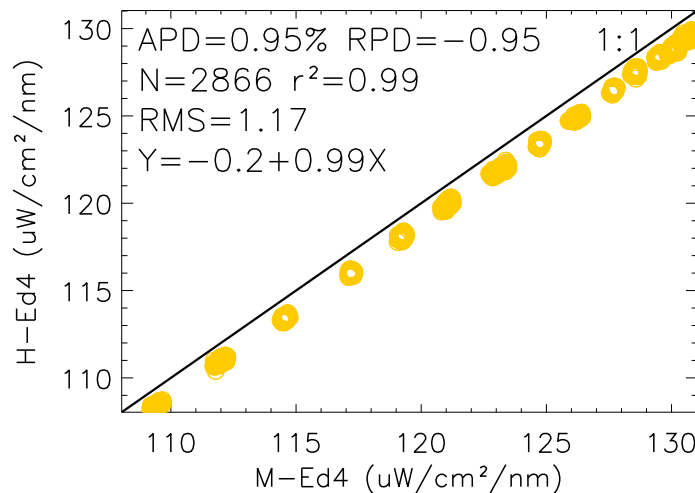
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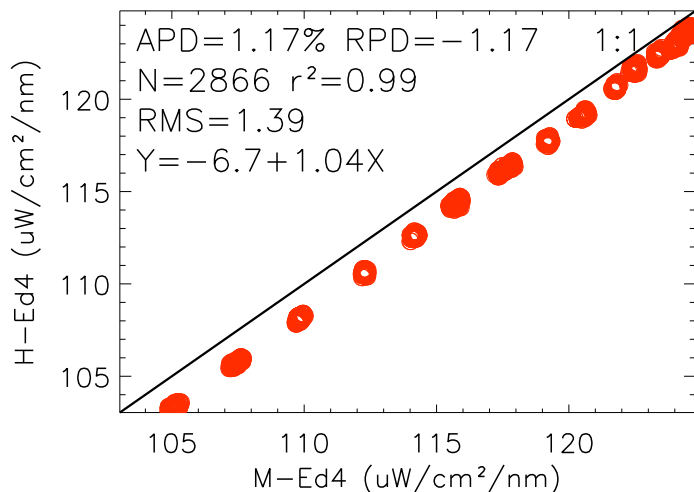
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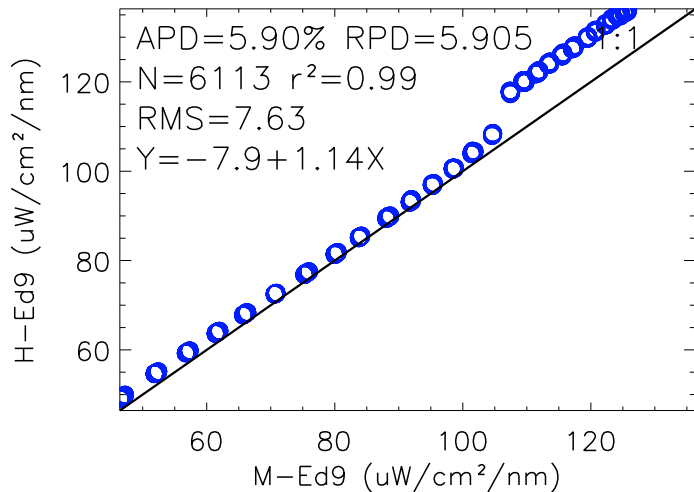
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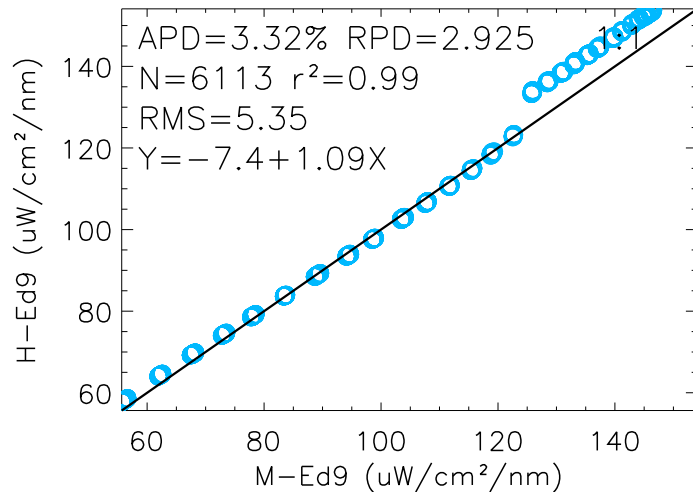
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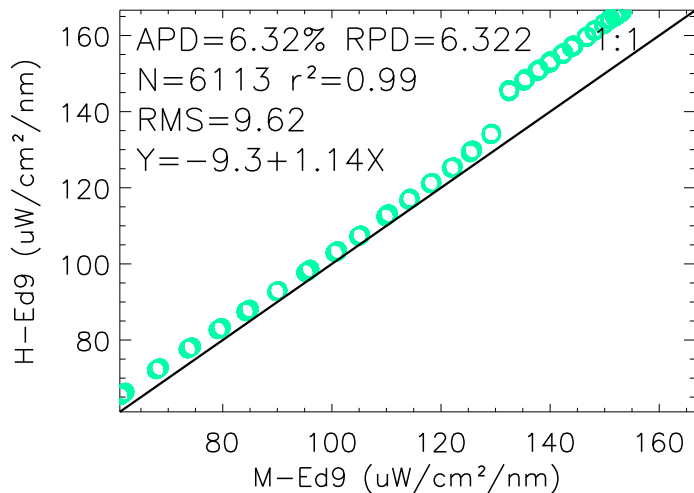
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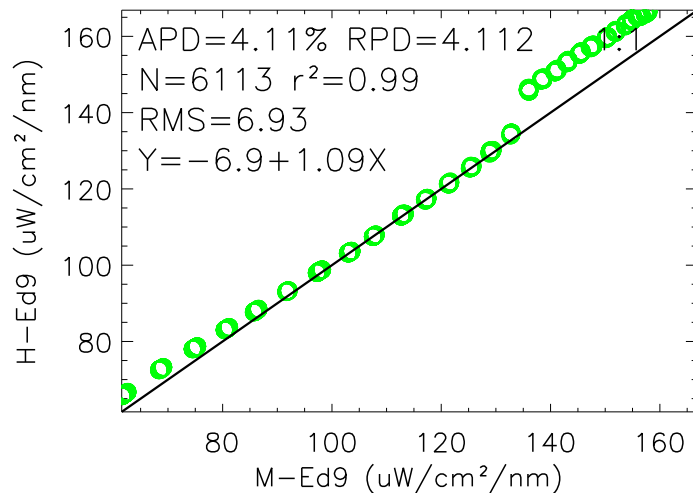
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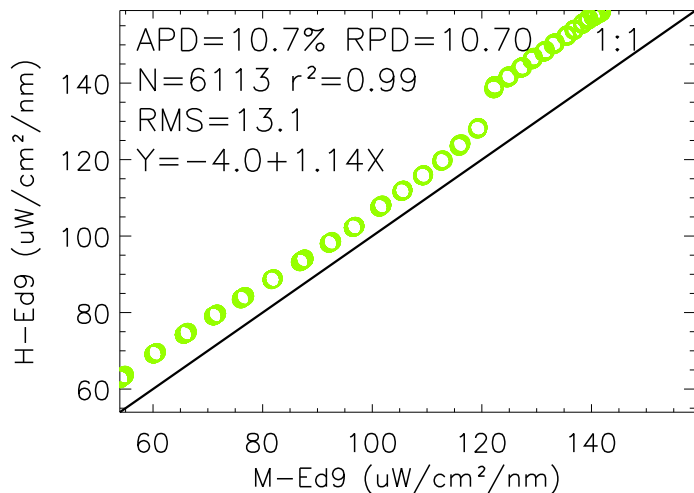
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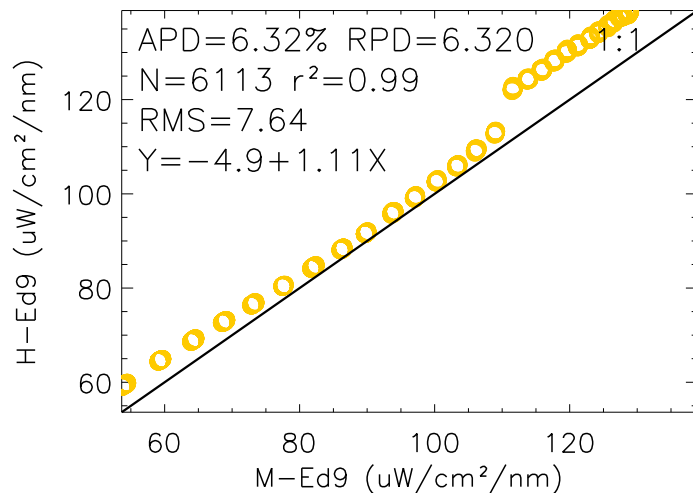
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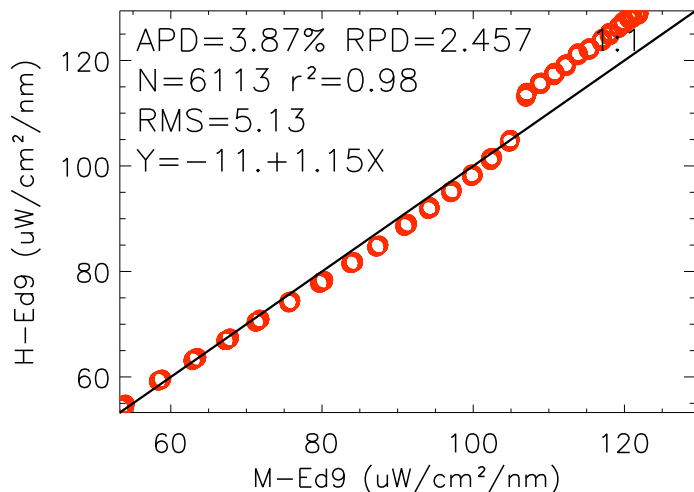
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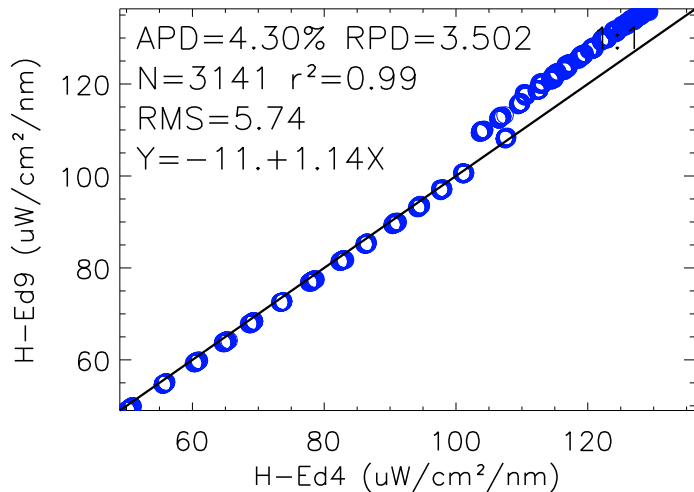
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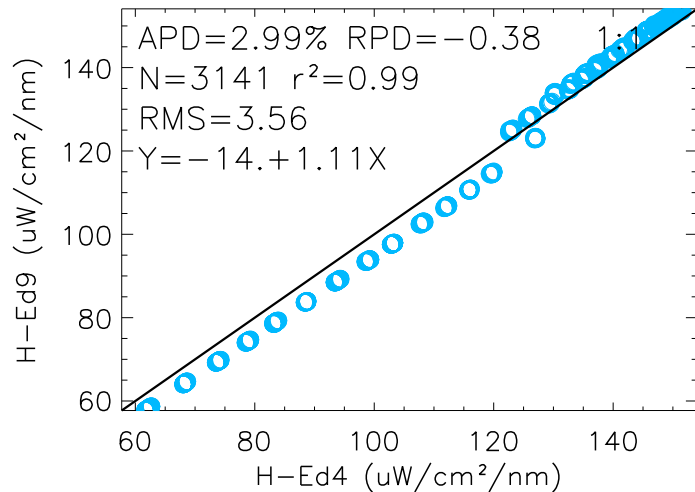
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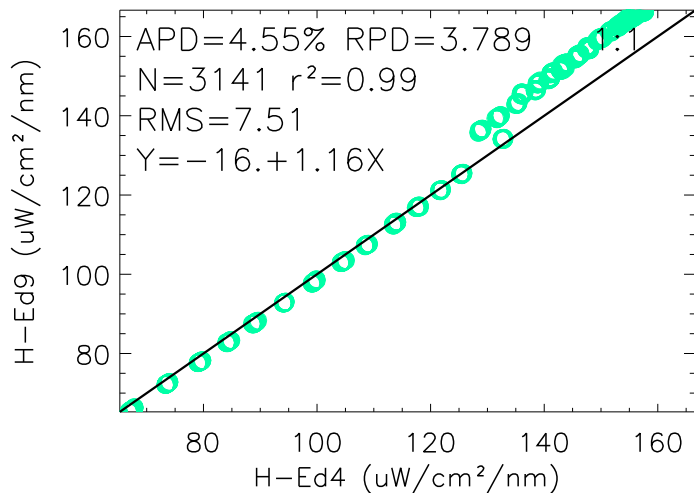
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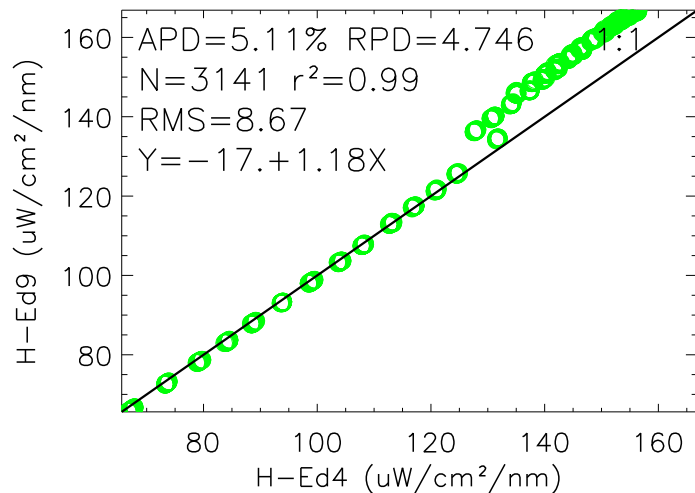
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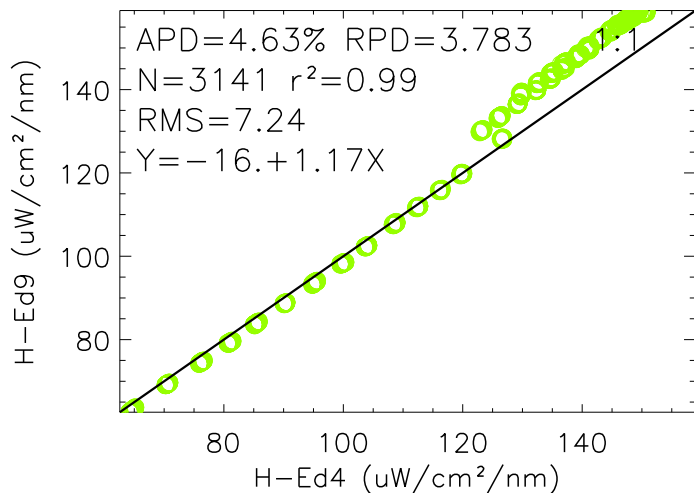
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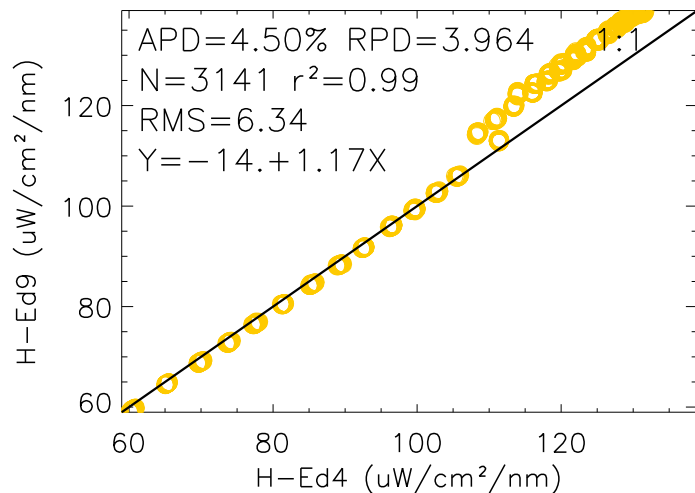
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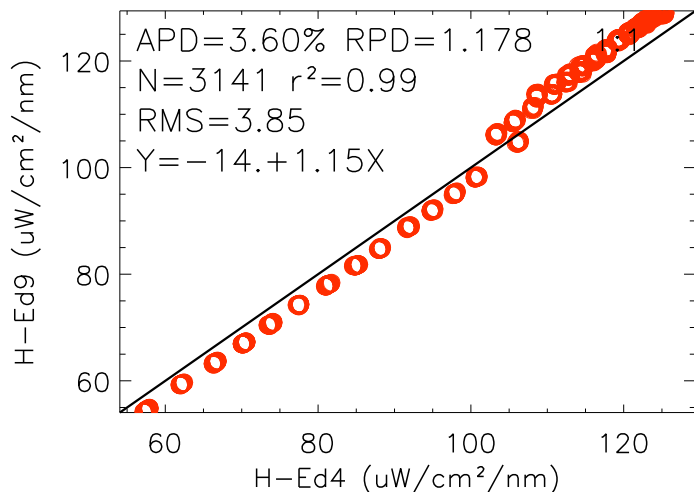
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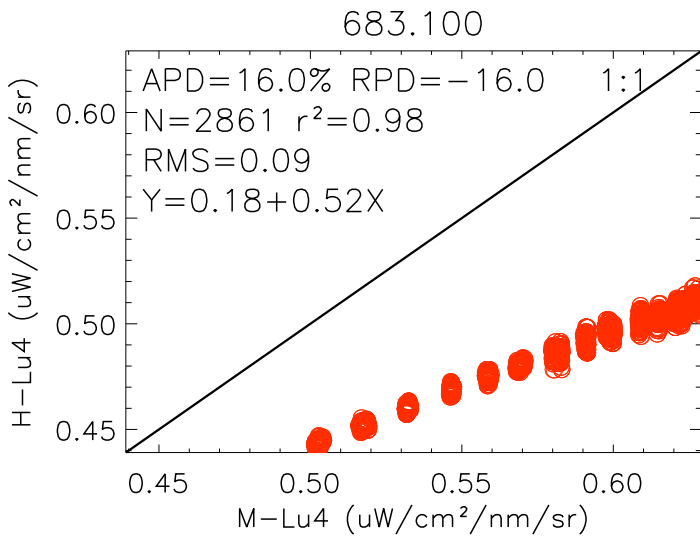
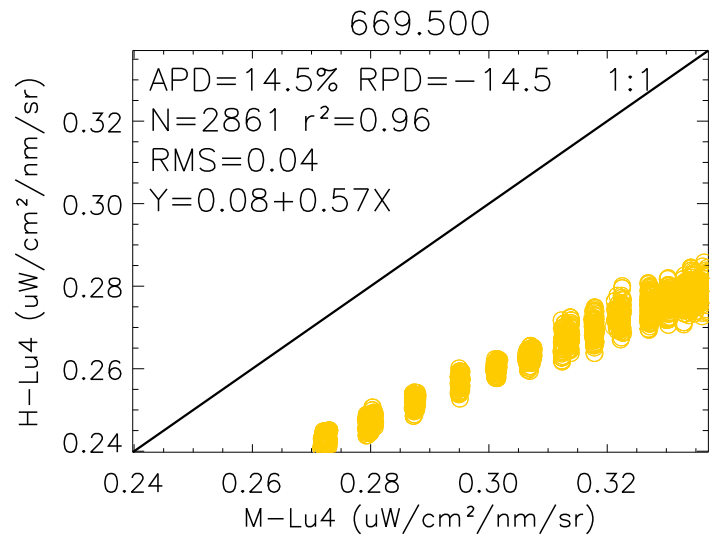
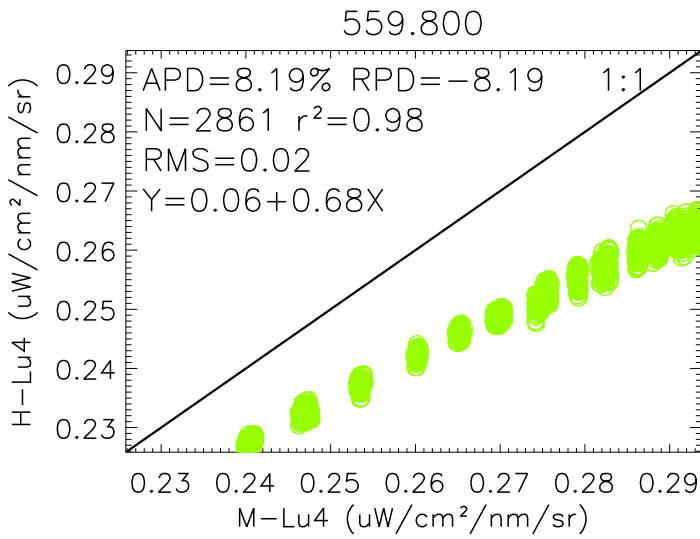
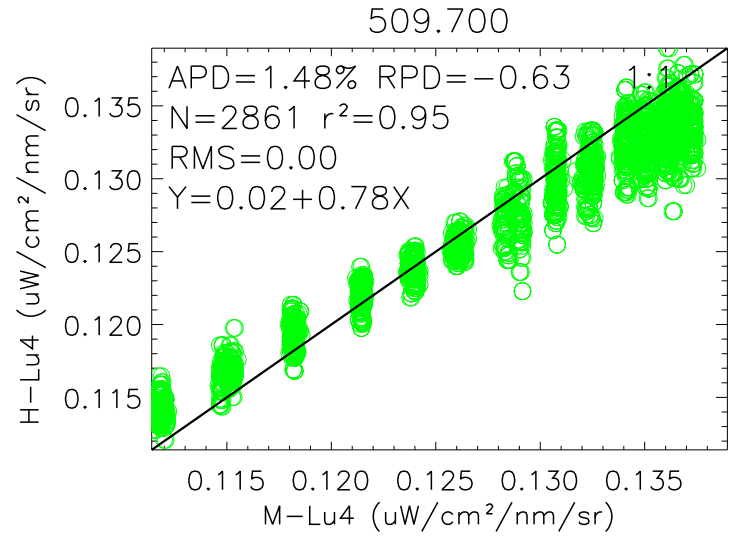
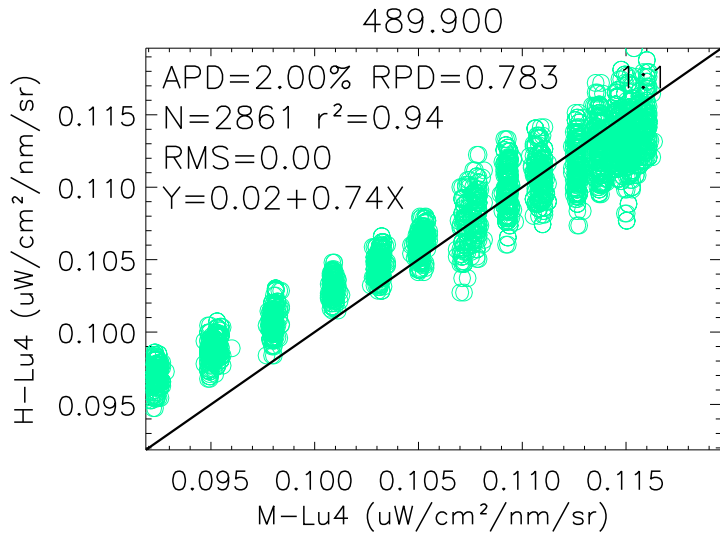
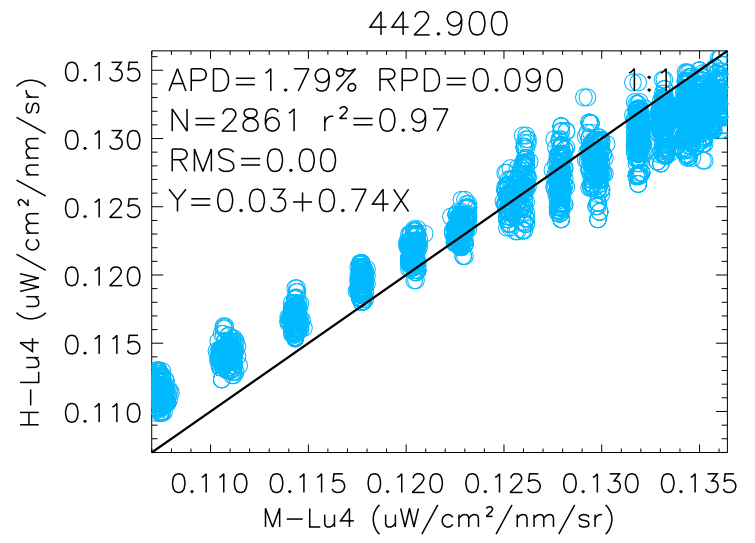
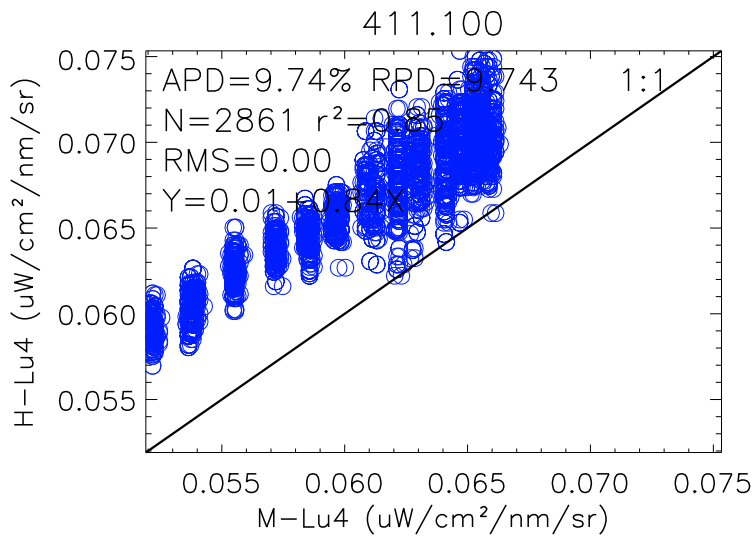


669.500

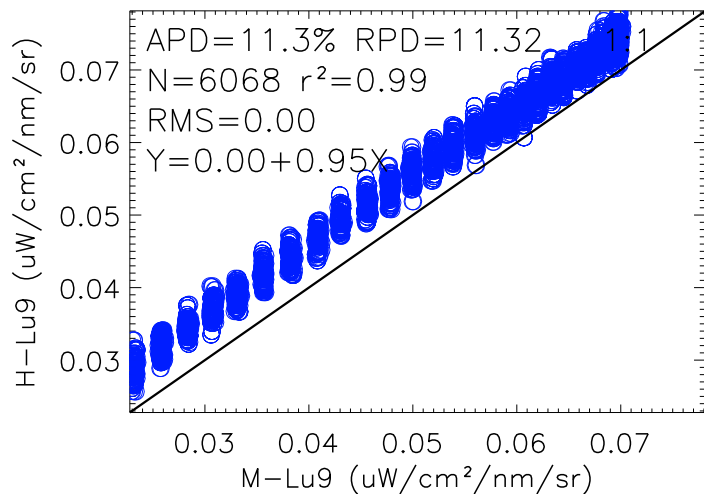


682.300

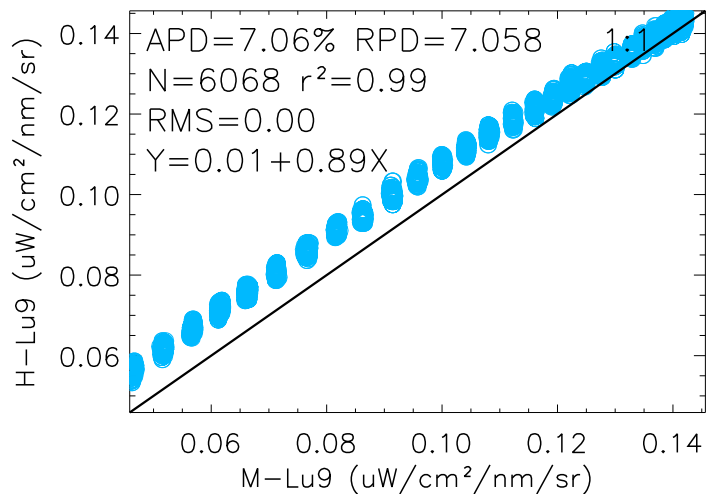




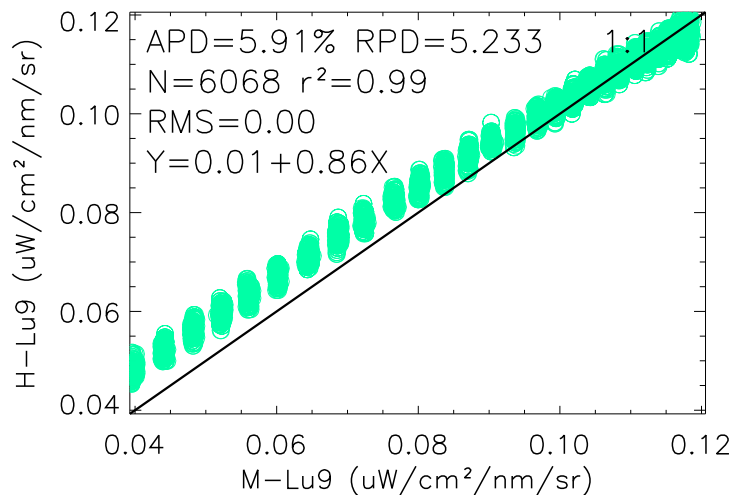
411.100



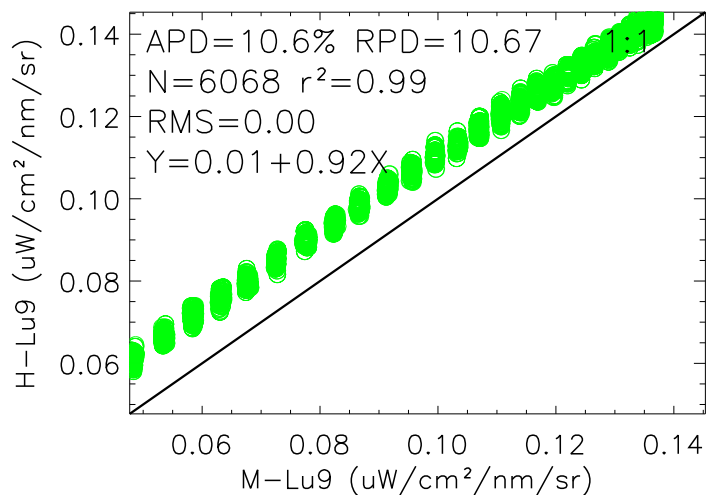
442.900



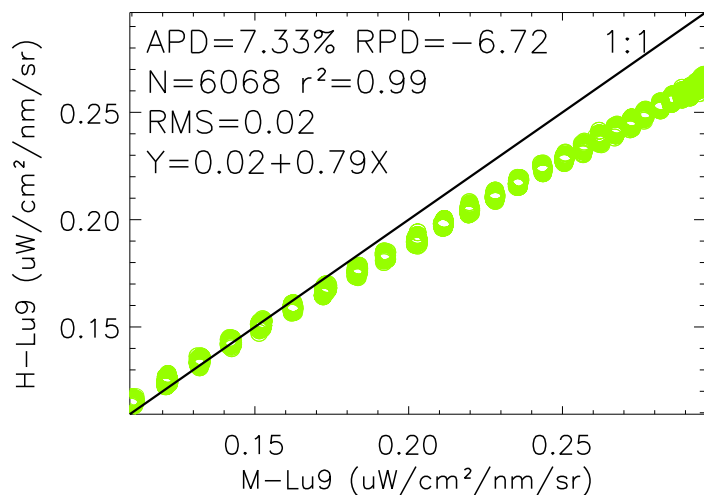
489.900



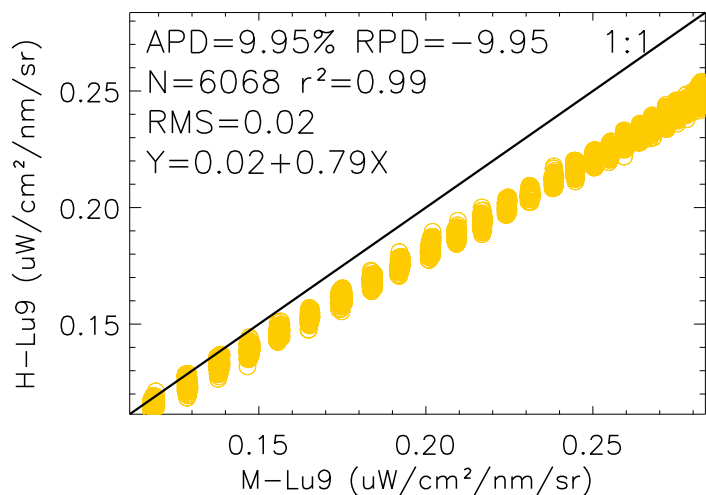
509.700



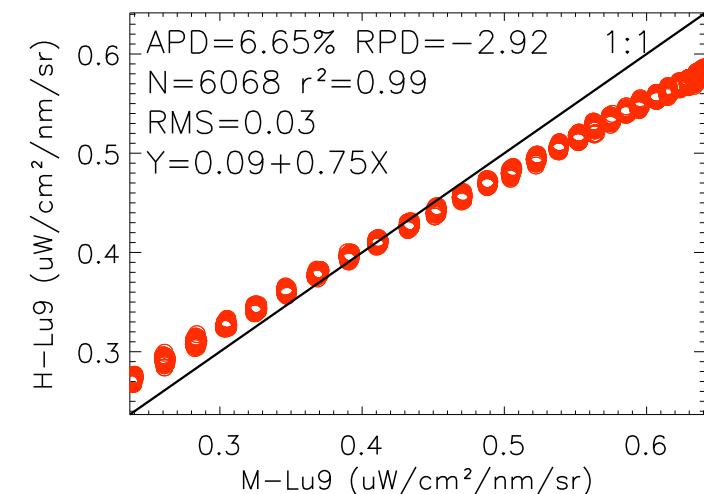
559.800



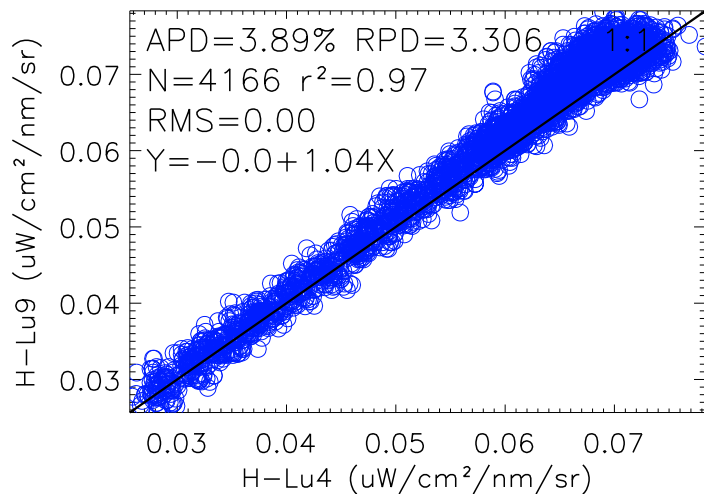
669.500



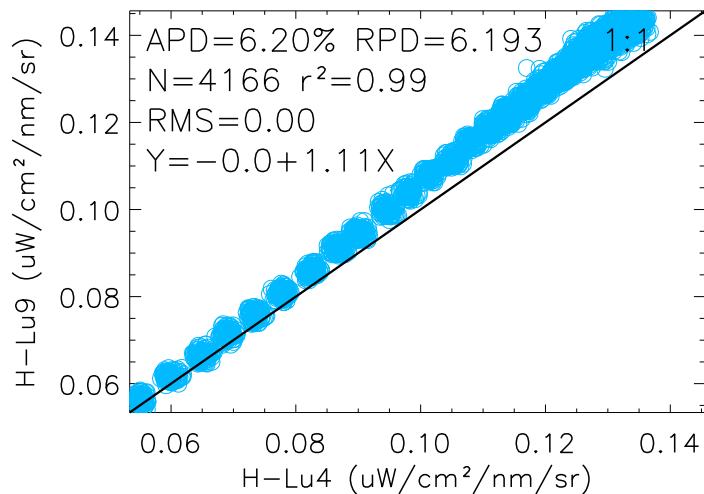
683.100



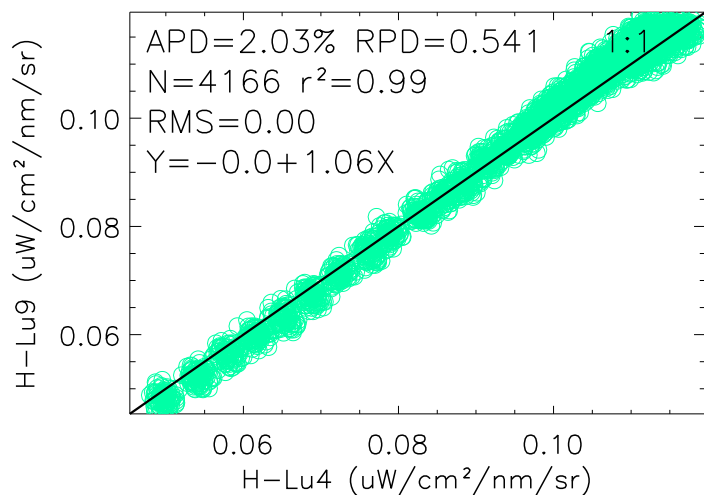
411.100



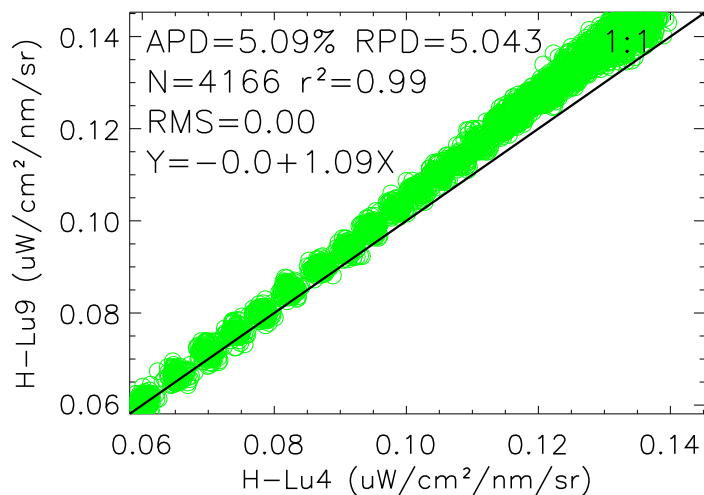
442.900



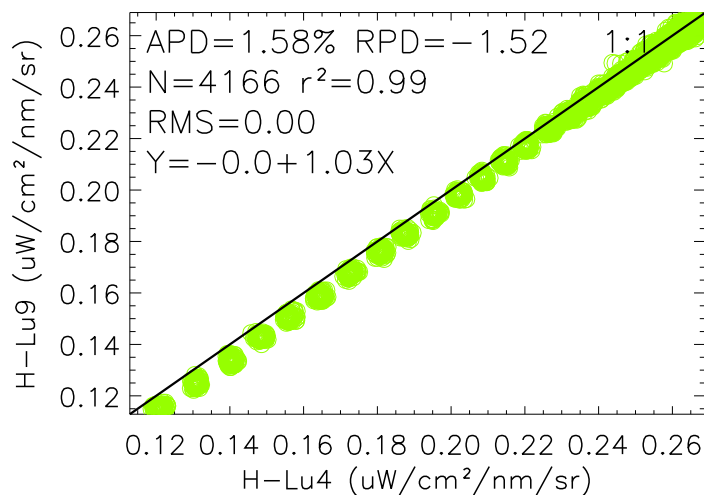
489.900



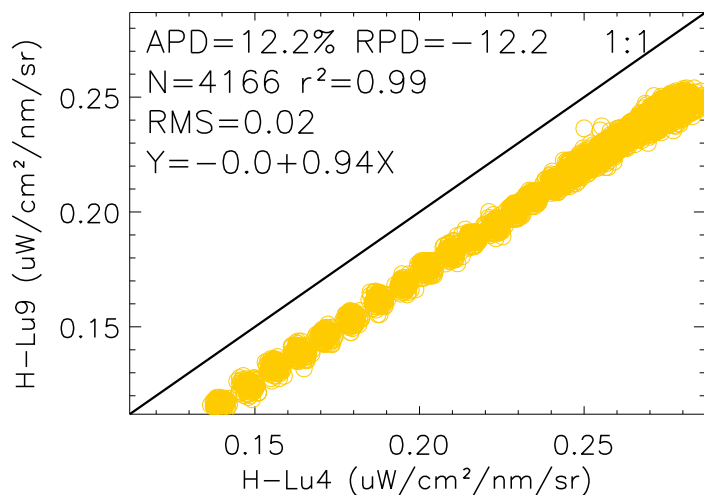
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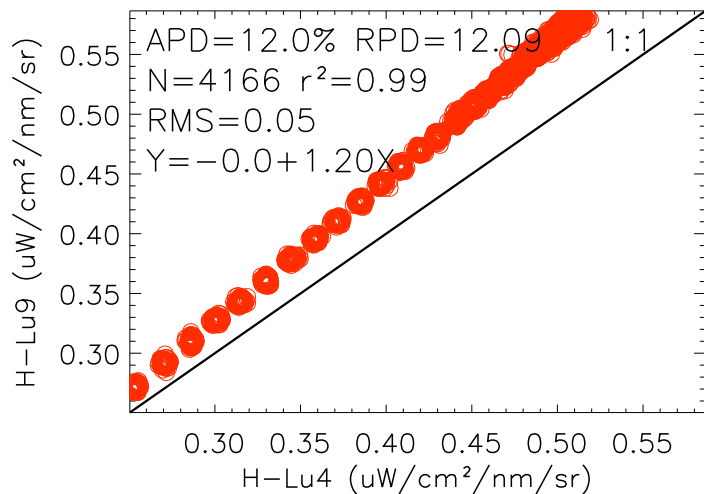
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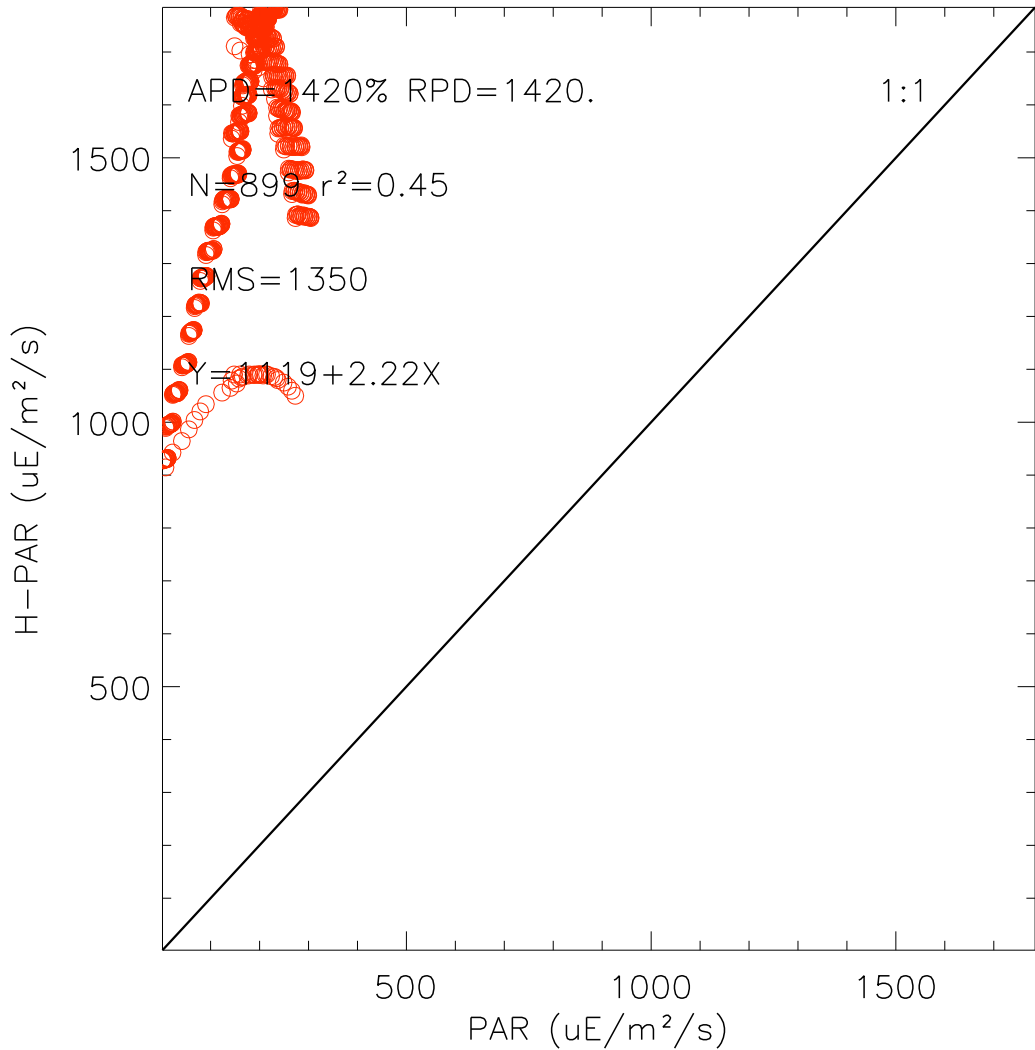


669.500

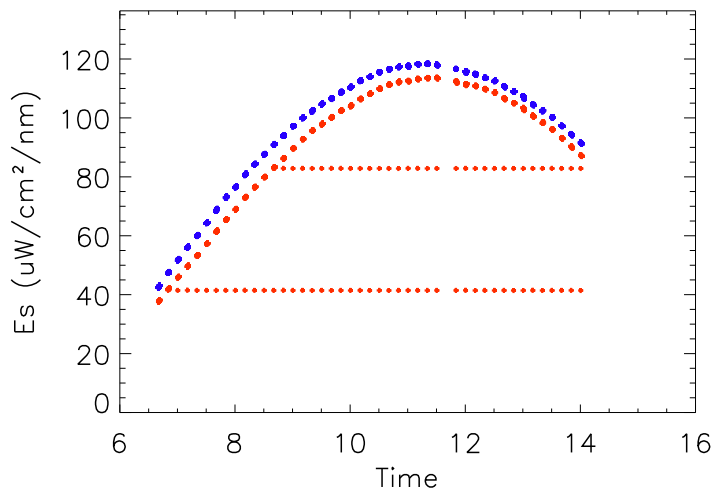


683.100

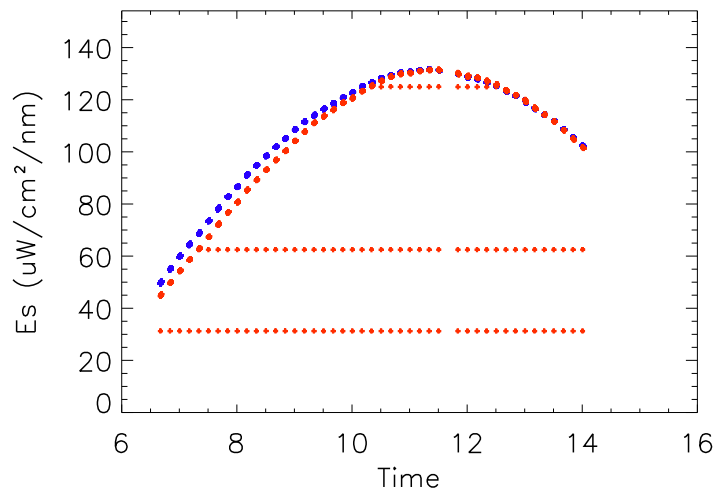




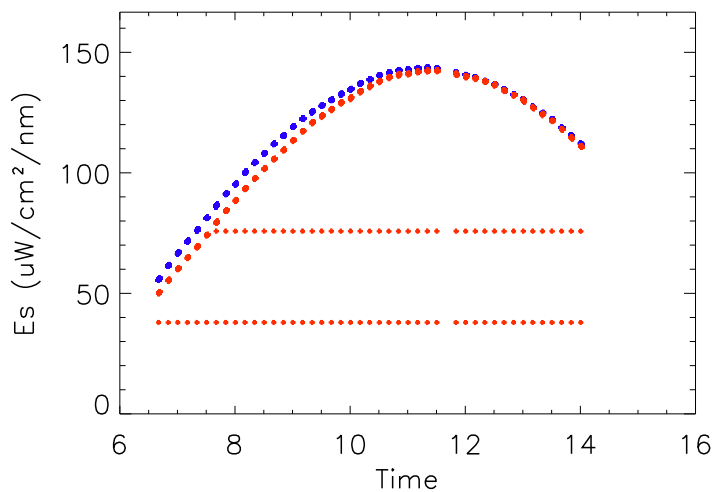
412.300



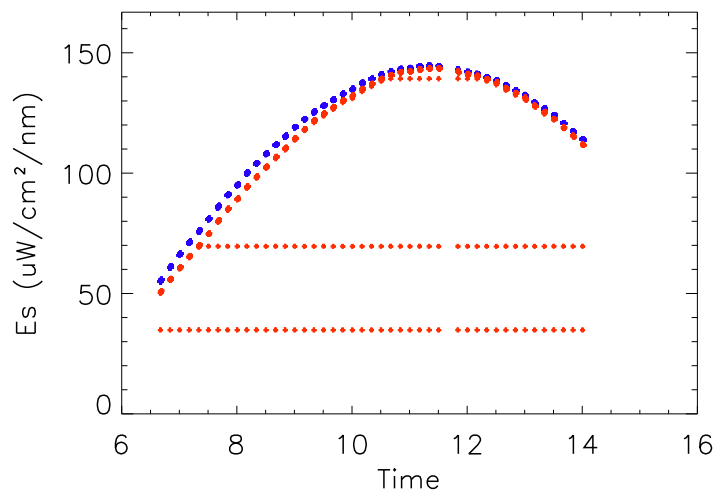
442.300



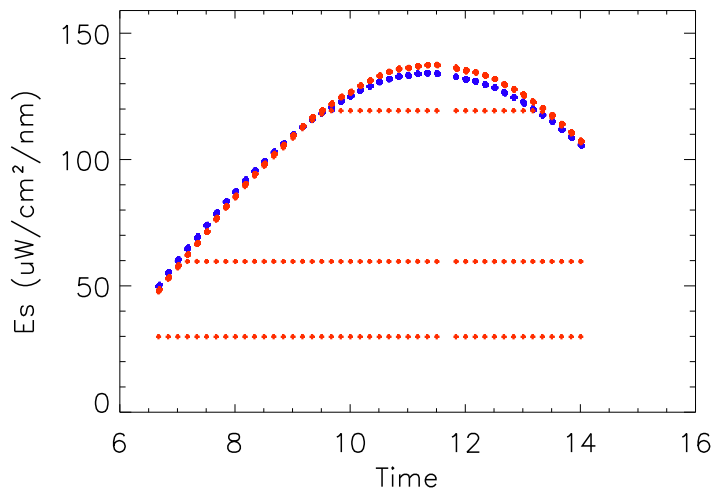
489.500



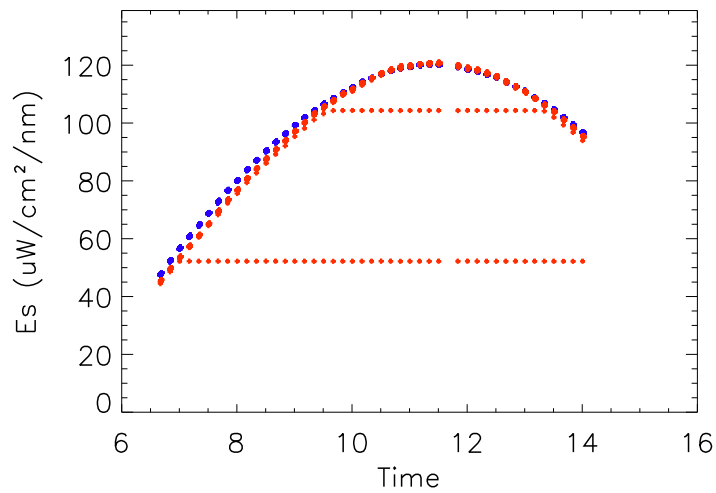
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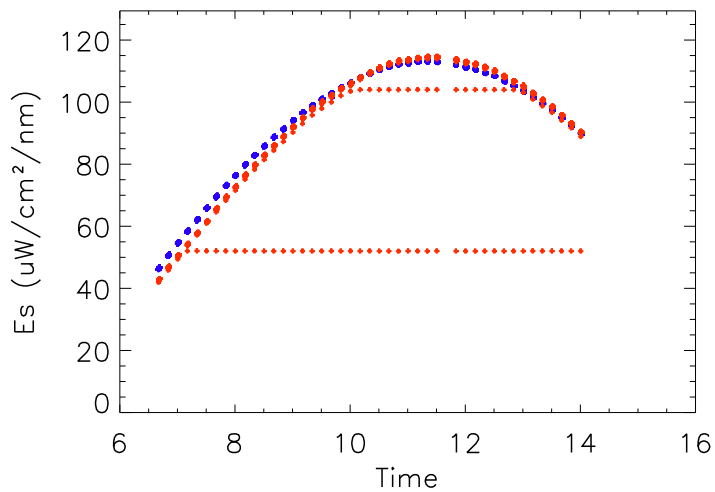
560.200



669.500

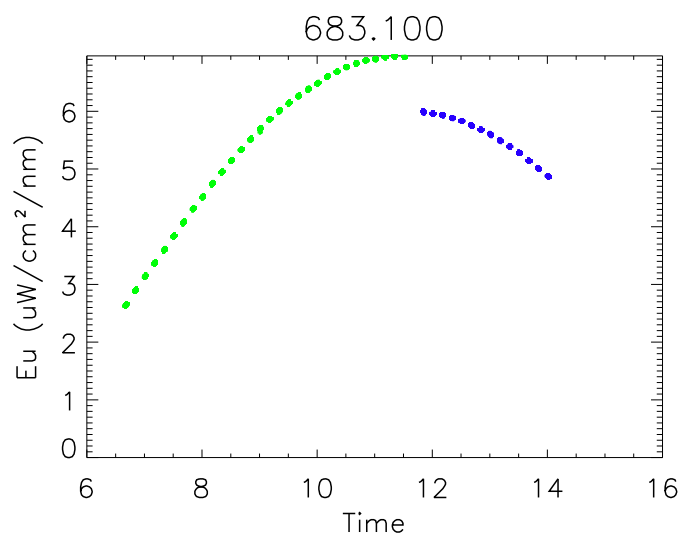
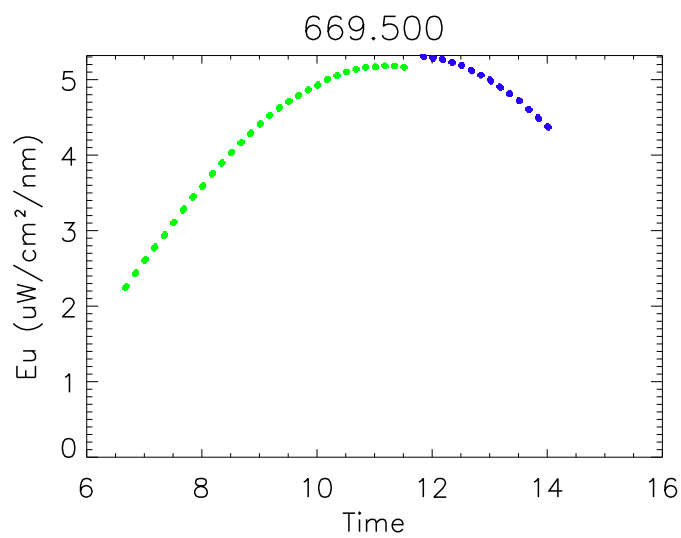
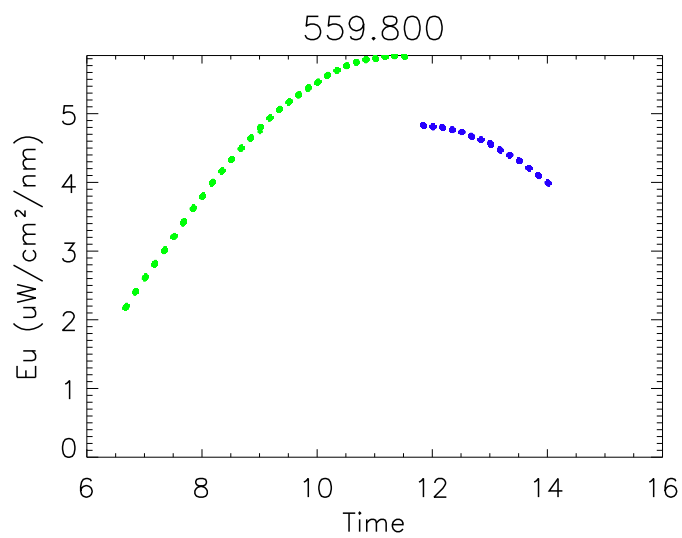
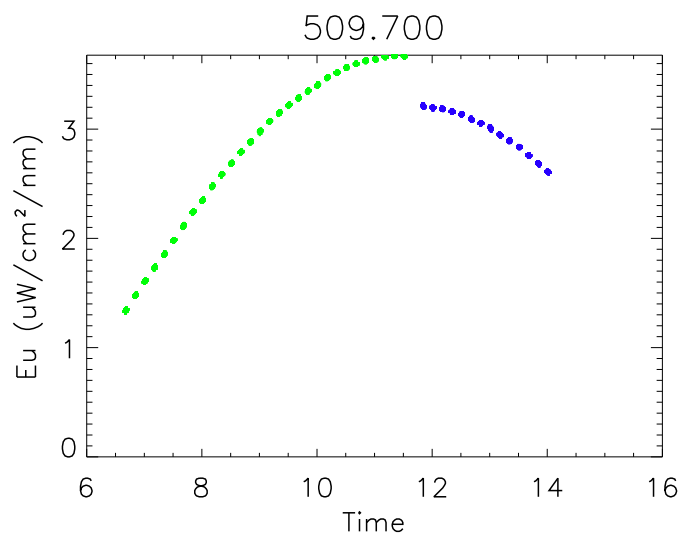
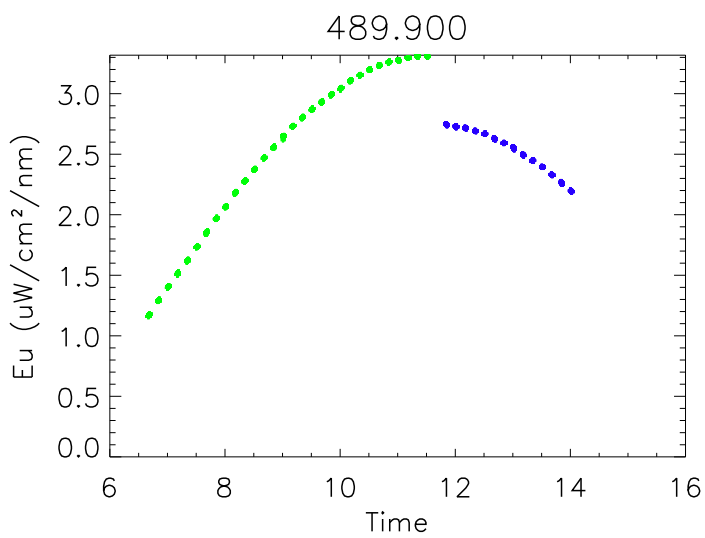
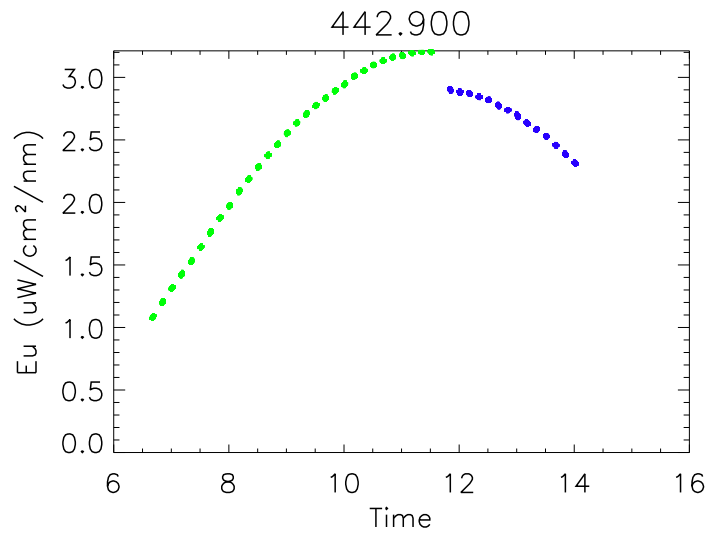
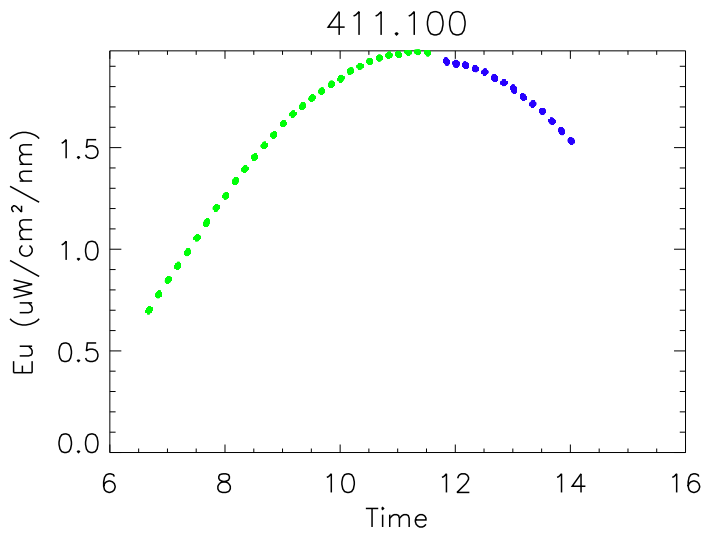


682.300



Multi-Es

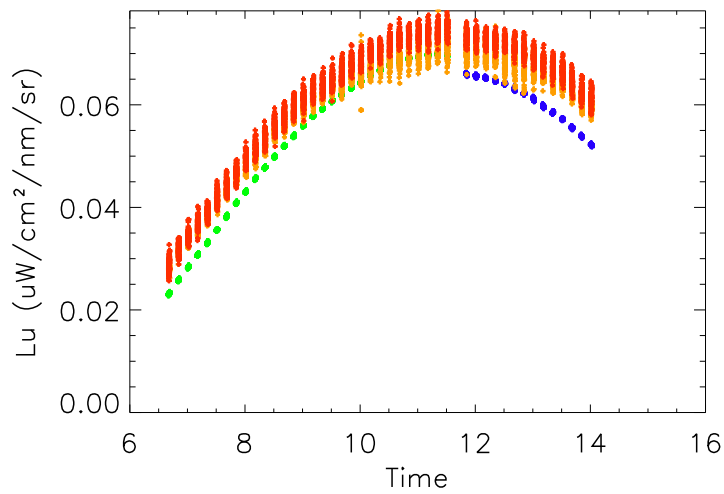
Hyper-Es



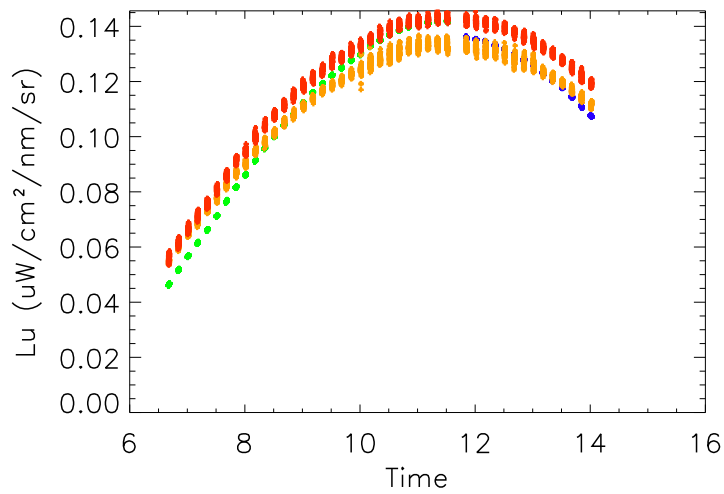
Multi-Eu4

Multi-Eu9

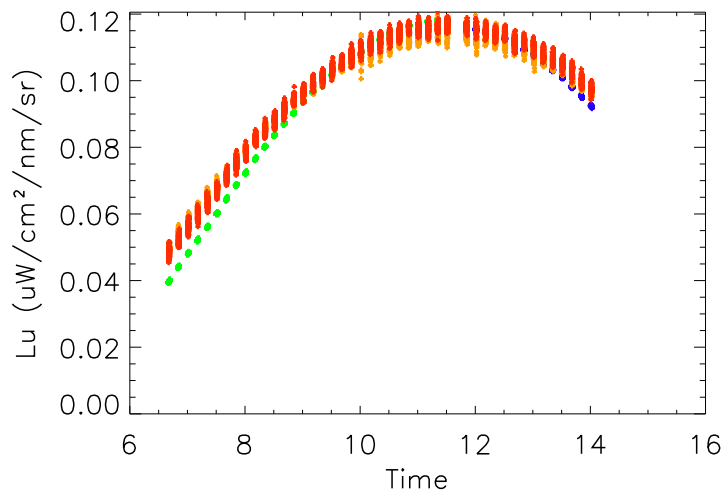
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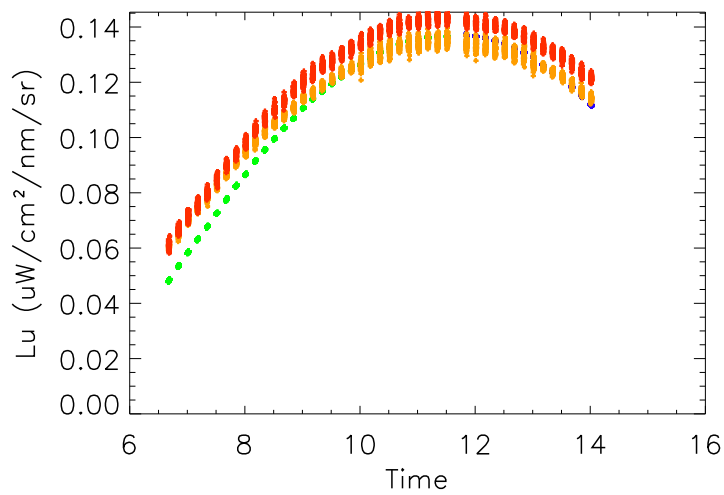
442.900



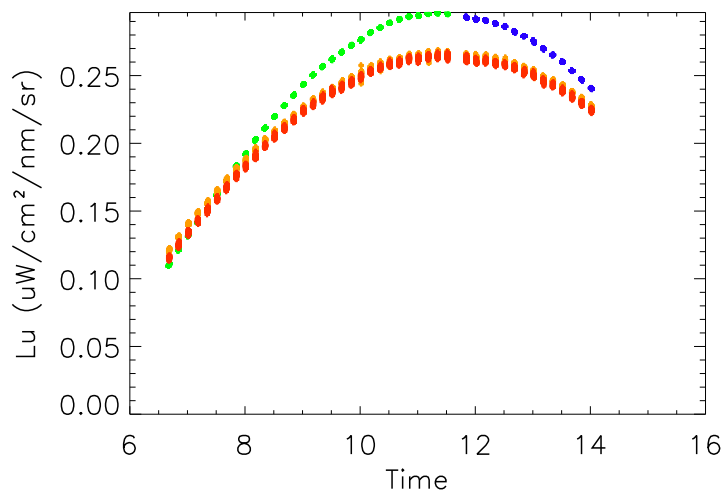
489.900



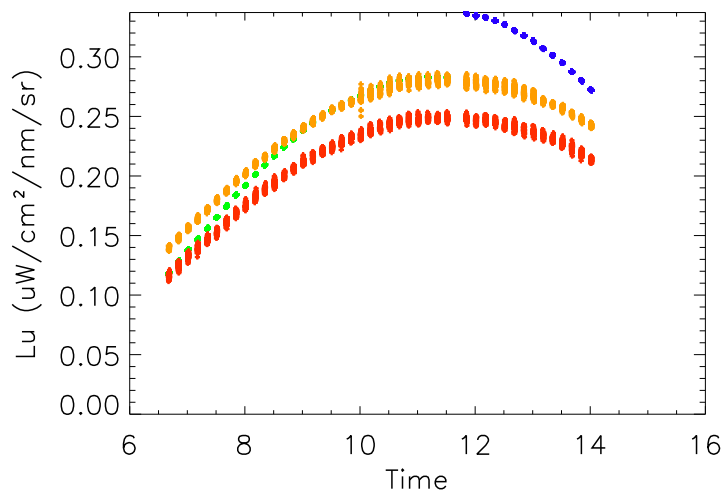
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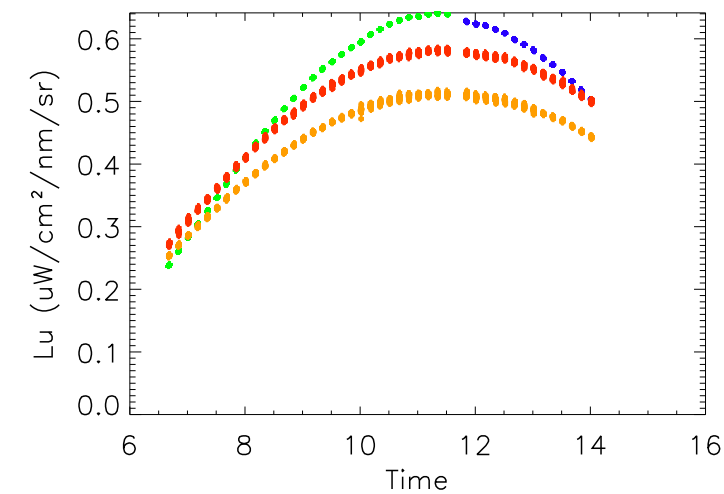
559.800



669.500



683.100

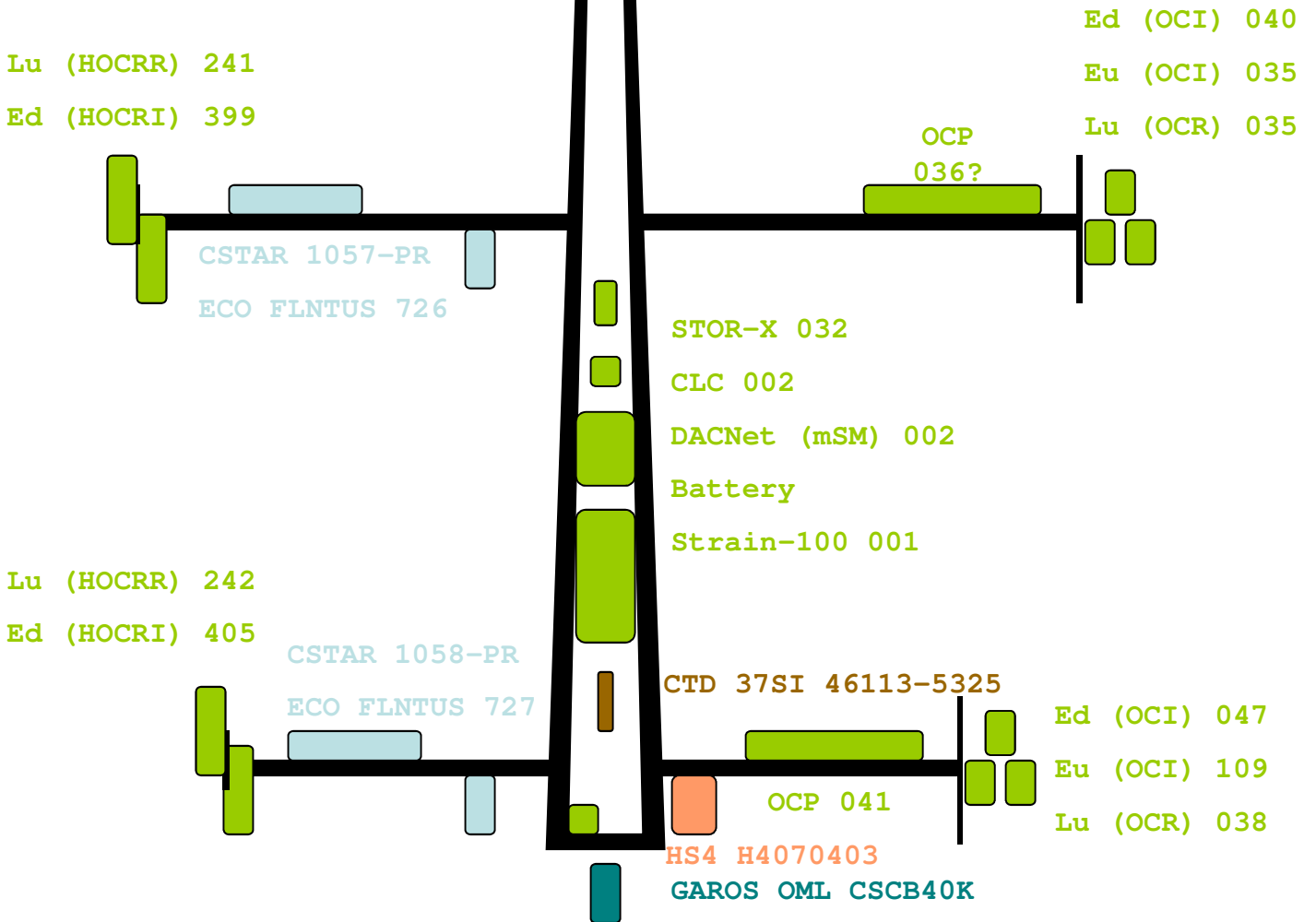


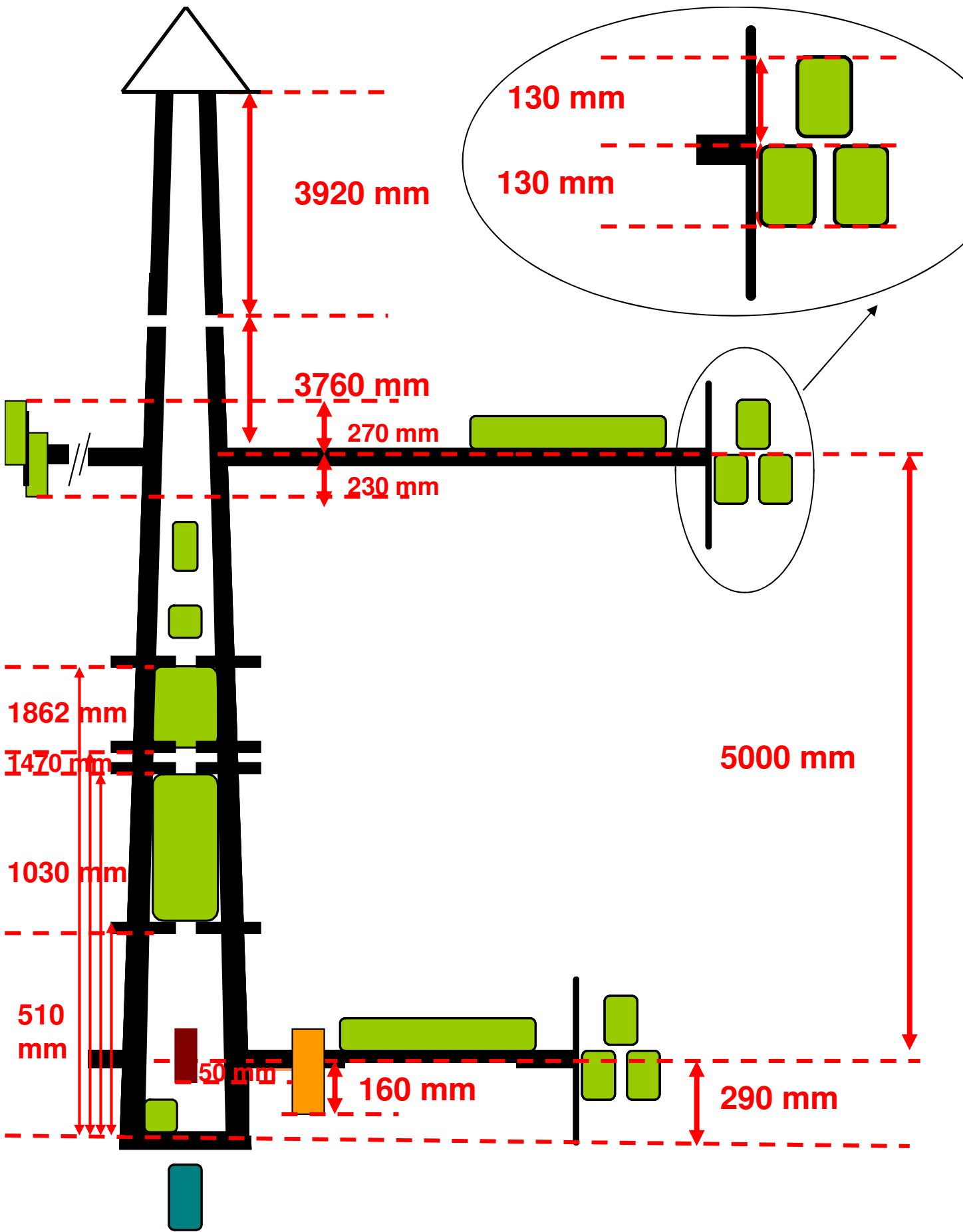
- Multi-Lu4
- Multi-Lu9
- Hyper-Lu4
- Hyper-Lu9

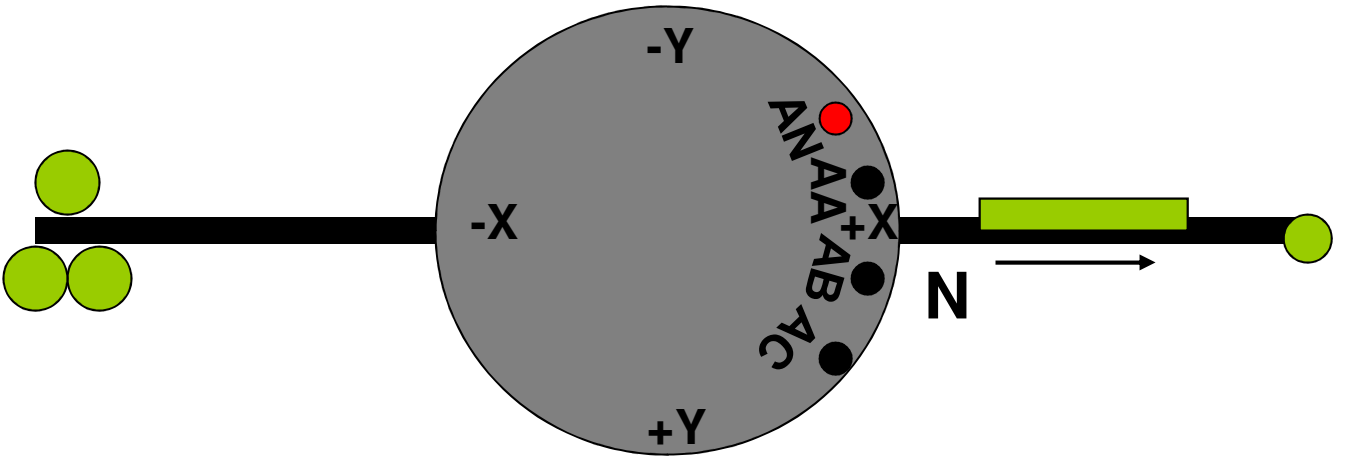
- SATLANTIC
- HOBILABS
- WETLABS
- SEABIRD
- GARROS

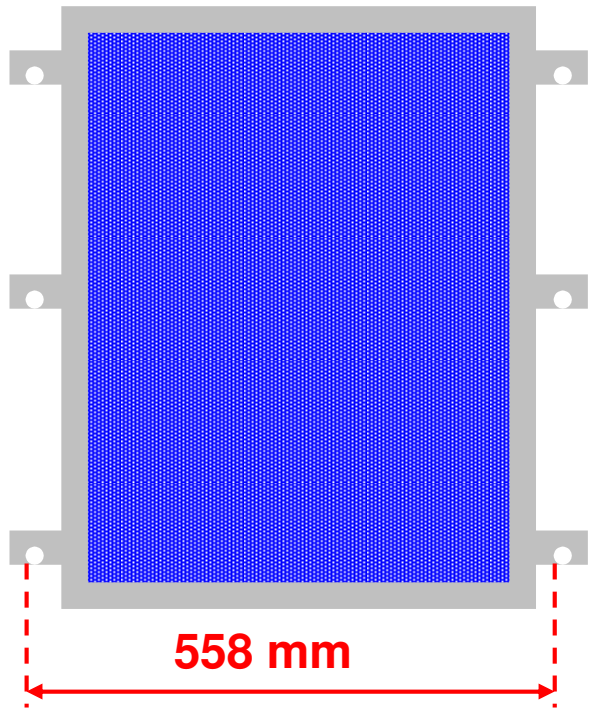
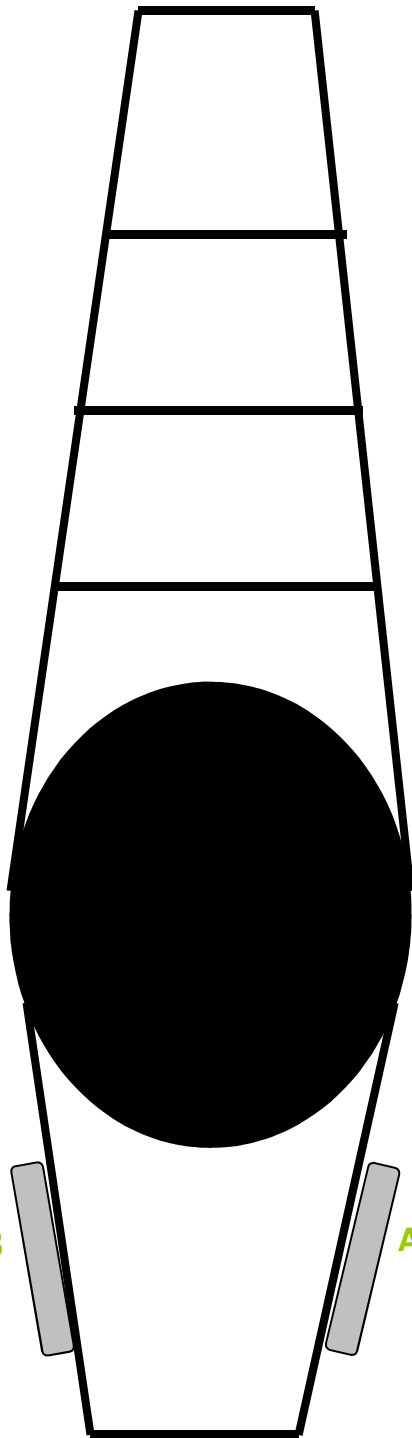
MVD (OCI) 095
 ARGOS 17152 (18797)
 Es (HOI) 279
 Junction Box SJB 004
 MVDS 053
 PAR 097

Feux:
 Solar Panels:







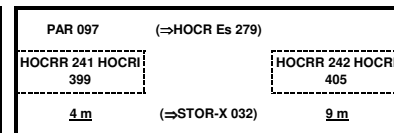
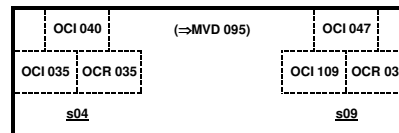
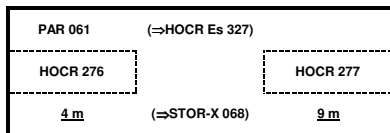
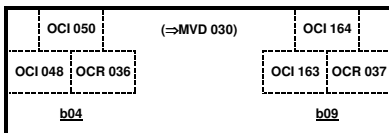


ARGOS 5433

ARGOS 74605

2013																							
JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
04-Jan	26-Jan	14-Feb	22-Mar	14-Apr	02-May	22-May	08-Jun					15-Jul	26-Jul	23-Aug	13-Sep	9-Oct	15-Oct	2-Nov	14-Nov	29-Nov	12-Dec		
		(only rads cleaning)																					
4 m		ocp040l.cal								ocp036p_ocp040_temp.cal		26-July		ocp036p.cal									
		CST-626PR 608_2012-01-10		HPL276H.cal & PLD276H.cal HPE421A.cal & PED421A.cal										CST-1057PR 726_2013-01-15		HPL241j.cal/PLD241j.cal HPE399E.cal/PED399E.cal							
9 m		ocp037m.cal												ocp041L.cal									
		CST-847PR 609_2012-01-10		HPL277F.cal & PLD277F.cal HPE422A.cal & PED422A.cal										CST-1058PR 727_2013-01-15		HPL242j.cal & PLD242j.cal HPE399E.cal & PED399E.cal							
MVD		mvd062l.cal												mvd053n.cal									
		HED327J.cal & HSE327J.cal												HED279k.cal & HSE279k.cal									
		H4080705 2011-11-13.cal												H4070403 2012-10-6.cal									
		Strain100_001b.cal												Strain100_002b.cal									
		SATSTX0068d.cal												SATSTX0032f.cal									

buoy XV deployment (2013-06-14, vf1)



2014

JANUARY FEBRUARY MARCH APRIL MAY JUNE JULY AUGUST SEPTEMBER OCTOBER NOVEMBER DECEMBER

4 m

07-Jan 23-Jan 21-Feb
 (only rads cleaning)
 ocp036p.cal
 CST-1057PR HPL241j.cal/PLD241j.cal
 726_2013-01-15 HPE399E.cal/PED399E.cal

12-Apr 9-May

9 m

ocp041L.cal
 CST-1058PR HPL242j.cal & PLD242j.cal
 727_2013-01-15 HPE399E.cal & PED399E.cal

buoy XVI deployment (2014-03-14, v12)

MVD

mvd053n.cal
 HED279k.cal & HSE279k.cal

H4070403 2012-10-6.cal
 Strain100_002b.cal
 SATSTX0032f.cal

OCI 040	(⇒MVD 095)	OCI 047
OCI 035	OCR 035	OCI 109 OCR 038
s04		s09

PAR 097	(⇒HOCR Es 279)
HOCRR 241 HOCRI 399	HOCRR 242 HOCRI 405
4 m	(⇒STOR-X 032) 9 m

OCI 050	(⇒MVD 030)	OCI 164
OCI 048 OCR 036		OCI 163 OCR 037
b04		b09

PAR 061	(⇒HOCR Es 327)
HOCR 276	HOCR 277
4 m	(⇒STOR-X 068) 9 m

