

The BOUSSOLE project technical reports; report #7-19, issue 1.

BOUSSOLE buoy deployment & maintenance log.
March 14, 2014 - May 11, 2015

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Foreword

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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 XVI", from March 14 of 2014 to May 12 of 2015.

2. DESCRIPTION OF OPERATIONS

UPPER SECTION PREPARATION (2014-01)

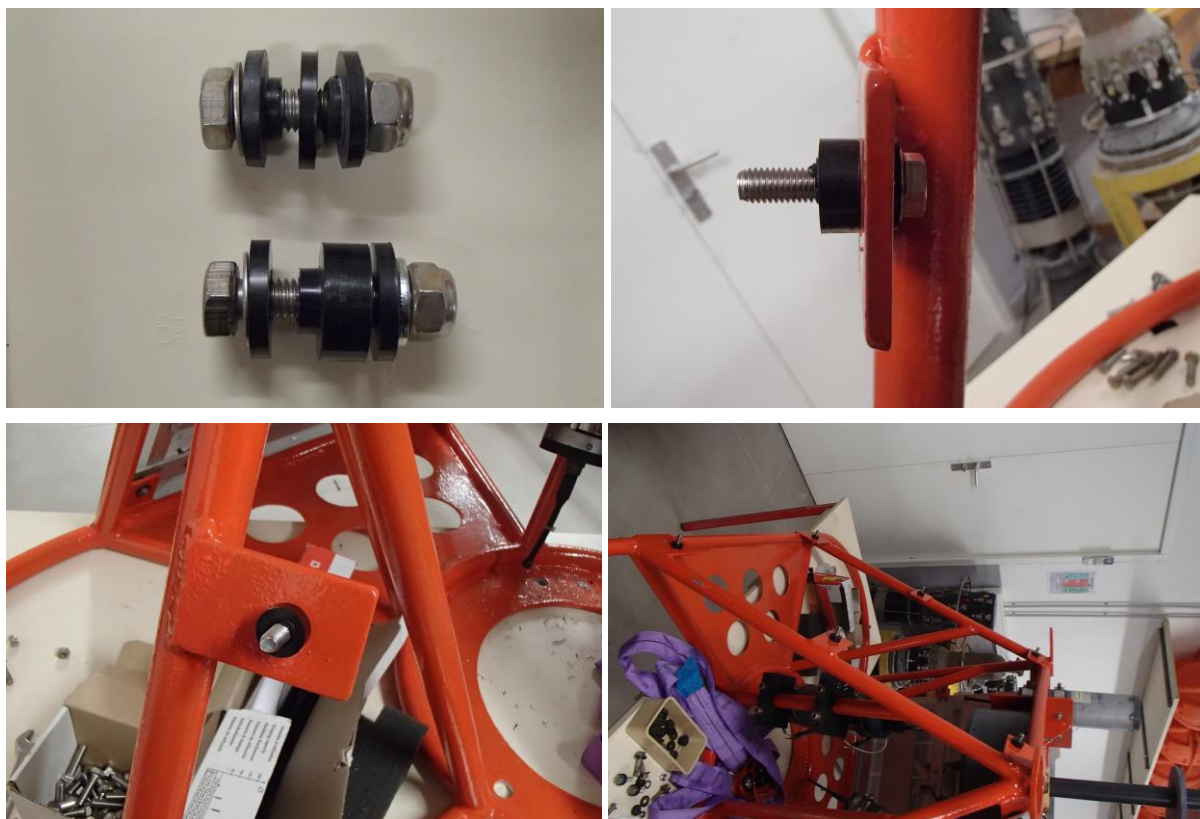
The buoy System (called system #2) was delivered from Satlantic on December 2013, the installation operations started on January 2014. The system was ready to go at sea by January 20 and the deployment took place on 14th March 2014, after a long period of bad weather.

The Buoy was equipped with sensors used for the deployment of the buoy XIV recovered on June 2013. The system was prepared in the renovated CCI local in Villefranche-Sur-Mer. Copper sheets and pieces were again fixed wherever possible to avoid biofouling arising.

A new set of plastic washers was produced for the fixation of the solar panels on the buoy head (see picture at the end of this section). The new shape of the plastic washers will allow an easier exchange of the solar panels on site when necessary.

The system was tested for some days running both with solar panel and battery. No anomalies were observed.

An "in air" data collection was also performed on December 17th to verify the consistency among similar radiometers before deployment (see appendix).

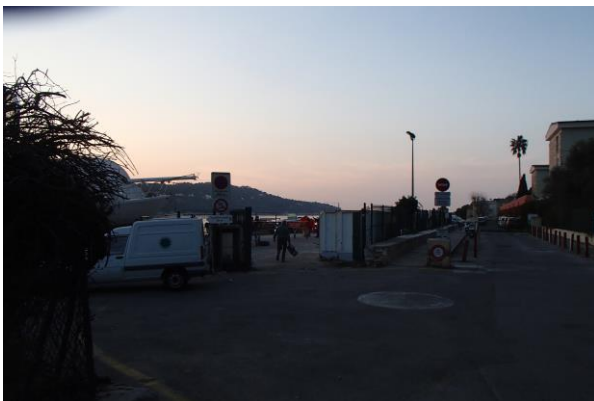




MOORING DEPLOYMENT

2.1.1 Friday 14th March 2014

The upper structure to be deployed was brought to the Rochambeau field at local 06:30 am with the help of 6 people from the LOV. The 4 arms were assembled and connected to the buoy, the helicopter left Carros at about 08:10 am. As usual the go/return trip lasted about one hour. ARGOS messages arrived regularly few hours after. A GOPRO camera was installed on the 4 m arm to take pictures of the buoy flight.





At this date, buoy is equipped with

- DACNet #11
- CLC #004
- Junction Box #002
- Rads set: OCI #048_Eu4m, #050_Ed4m, #163_Eu9m, #164_Ed9m #030_Es, OCR #036_Lu4m and #037_Lu9m, MVDS #062, OCP#040(4m) and OCP#037(9m)
- Hyper spectral units HOCR-RW #276_Lu4m, #277_Lu9m, HOCR-IW #327_Es, HOCR-IW #421_Ed4, #422_Ed9, STOR-X #.
- HS4 #H4080705
- Strain-100 #001
- Transmissometers C-Star #626-PR (4m) and #847-PR(9m)
- ECOFLNTUs #608 (4m) and #609 (9m)
- ARGOS beacon #003 (prog id#26021)
- CTD #37SI 30260-2404
- Strain gauge OML CSSPE00356
- PAR #061

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

2.1.2 Saturday 15th March 2014

This day is part of the B#145 cruise. Data from the new buoy were downloaded.

2.1.3 Saturday-Sunday 12th-13th April 2014

This day are part of the B#146 cruise. The first day divers were on board and when on site they cleaned the optical sensors and placed neoprene caps for dark measurements on IOPs sensors. Divers also dismantled the pCO₂ sensor at 10m and CTP+O₂ sensors at 3 and 10m and brought them on board the *Tethys II*. Here data from the two CTDs were downloaded. Divers reported the presence of covers on the Hyperspectral radiometers at 9m. The two O₂ and the pCO₂ sensors were replaced with new ones and re-installed on the buoy with a second dive (the cable of the pCO₂ sensor was fixed only up to surface). Divers also removed the covers from Hyperspectral radiometers. Data from the two old O₂ sensors were retrieved and instruments turned off. An attempt to recover data from the old pCO₂ sensor was made unsuccessfully. Data from the buoy were downloaded through a nominal CISCO connection. The second day the cable of the 10m pCO₂ sensor was fixed up to the buoy head, however no connection was got with instrument. Data were instead regularly downloaded from the 3m pCO₂ sensor. The ARGOS beacon connector, solar panels and

surface radiometers were cleaned. The ARGOS buoy dispatch started again but stopped again after three days.

2.1.4 Saturday-Sunday 9th-10th May 2014

This days are part of the MOOSE#75 and B#147 cruises. The first day divers were on board to clean the optical sensors and perform dark IOPs measurements. The second day data were partially downloaded on the top of the buoy before losing the connection with the DACNet. The download was completed later through a CISCO connection. Optical sensors, ARGOS and CISCO connectors and solar panels were cleaned. The ARGOS buoy dispatch started after cleaning. Unidentified organic and inorganic objects were found on the top of the buoy, probably transported by birds. Data from the 3m pCO2 sensor were retrieved whereas the sensor at 10 m did not respond (though it might be operational).

2.1.5 Sunday 25th May 2014

This day a cleaning of the buoy sensor was scheduled in combination with the cameramen for the documentary on the *Regalecus glesne*. Unfortunately the location boat, MOGUNTIA in Antibes, had a technical problem and the mission had to be delayed.

2.1.6 Sunday 1th June 2014

This day 1 diver from LOV was on board the MOGUNTIA for the documentary on the *Regalecus glesne* and cleaning of the buoy sensors, connectors and solar panels.

2.1.7 Saturday 14th June 2014

This day is part of the B#148 cruise. When arrived at BOUSSOLE divers went at sea to clean the buoy sensors, to take pictures and to perform dark measurements of the backscattering meter and transmissometers. On the top of the buoy, the above-surface irradiance and PAR sensors were cleaned, as well as the connectors of the ARGOS beacon, solar panels, and CISCO antenna. Buoy data were retrieved via cable connection to the buoy computer.

2.1.8 Monday 23th June 2014

This day 1 diver from LOV was on board the MOGUNTIA for the documentary on the *Regalecus glesne* and cleaning of the buoy sensors, connectors and solar panels. A fishing line was removed from the buoy structure.

2.1.9 Monday 30th June 2014

Data from radiometers and transmissometer at 4 m sent by ARGOS beacon started to be constant. This indicate a probable malfunctioning of the OCP at 4 m, or, less probably, a malfunctioning of a fuse in the DACNET or a cable malfunctioning.

2.1.10 Thursday 17th July 2014

This day is part of the B#149 cruise. When on site, divers went at sea and switched OFF the buoy Battery. Then divers replaced the OCP#040(4m) with the OCP#036(4m), from system #1, recently delivered from factory. The buoy was switched ON and was heard to be working again. However data could not be downloaded since the laptop stopped working and could not be restored. Then the pCO₂ sensor at 10m was exchanged with a new one, whereas the same cable was used for telemetry. Divers also cleaned the optical sensors and performed dark IOP measurements. Connectors and sensors on the buoy head were cleaned too. Later on, buoy data were downloaded through a CISCO connection with a second laptop and the configuration was modified to account for the OCP exchange. A verification of data transmitted showed that the OCP_4m was still not working, indicating a probable burning of the corresponding fuse on the DACNet. However no more diving operation was possible since oxygen bottles were almost empty. When on board, a connection with the recovered pCO₂ sensor was possible: the instrument seemed to work properly however no data was stored on it since its deployment. This probably means that the cable was not operational, and further test in the lab confirmed this hypothesis.

At this date, buoy is equipped with

- OCP#036(4m).

2.1.11 Friday 25th July 2014

This day the private boat NOE from CAP KETOS was rent in Nice to go to the BOUSSOLE site with 3 divers from LOV. When on site divers went at sea to switch OFF the buoy and to dismount the DACNet. On board the DACNet has been opened to verify the status of the fuses. As expected the OCP_4m 1 A fuse had burned and has been replaced with a new one. Then the DACNet was closed and re-installed on the buoy. The buoy was switched on again and restart working regularly, included OCP_4m. Then the recently installed pCO₂ sensor at 10 m was dismounted and replaced by the old one without telemetry cable. Finally optical sensors were cleaned and IOPs dark measurement recorded.

2.1.12 Sunday-Tuesday 9th-12th August 2014

The first day was part of the MOOSE program. Divers were on board and, once completed MOOSE operation, went to the BOUSSOLE site to clean the buoy sensors, to take pictures and to perform dark measurements of the backscattering meter and transmissometers. Divers checked the state of the OCP 9m and the connections between the OCP and the DACNet but they did not found anything anomalous. The instrument and connectors were in a good state. The following days were part of the B#150 cruise. Two CISCO connection were attempted with the buoy on 10th, but failed. The day after, a direct and a CISCO connection were again attempted unsuccessfully. On the last cruise day a direct connection with the buoy was finally

obtained and data retrieved. The clock on the DACNet was mistakenly set on a false date:

2015-07-05 09:30:00 corresponds to **2014-08-12 09:30:00**.

2.1.13 Friday 5th September 2014

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

2.1.14 Tuesday-Wednesday 16th-17th September 2014

The first day a diving on the BOUSSOLE buoy was organized in combination with the MOOSE program on board the *Tethys II*. Divers cleaned the optical sensors and performed dark IOPs measurements. They tried to install new anodes on the buoy lower superstructure but the dimensions did not match. The second day is part of the B#151 cruise. Only two attempts of CISCO connection were feasible. The second one was successful, however the connection was lost soon and very few data were downloaded.

2.1.15 Monday 6th October 2014

This day the private boat NOE from CAP KETOS (Nice) was rent to go to the BOUSSOLE site with two divers from LOV and 1 from the University of Nice. When on site, divers cleaned the optical sensors and performed dark IOPs measurements. They also measured the diameter of the tube where anodes are installed on the buoy lower superstructure (64 mm Ø). In the meantime data were downloaded on the top of the buoy and optical sensors and connectors cleaned. The DACNet clock was synchronized on the correct UTC time. Data from the 3m pCO₂ sensor were downloaded too. The ARGOS message dispatch restarted after cleaning.

2.1.16 Thursday-Sunday 24th-26th October 2014

These days are part of the B#152 cruise. The first day the buoy was immersed for most of the day. The second day a CISCO connection was attempted unsuccessfully. The last day the buoy was again immersed and no operation was possible.

2.1.17 Wednesday-Saturday 12th-15th November 2014

These days are part of the B#153 cruise. The first day the buoy was completely underwater because of strong currents. The last day divers went at sea to clean the buoy sensors, to take pictures and to perform dark measurements of the backscattering meter and transmissometers. They also affixed 2 anodes on the buoy structure.

2.1.18 Wednesday-Saturday 11th-12th December 2014

These days are part of the B#154 cruise. When arrived at the BOUSSOLE site only the buoy head was above surface. Divers went at sea to clean the optical instruments (O2 included) and perform dark IOPs measurements. Then the pCO2 sensors at 3 and 10 m were dismantled. A new pCO2 sensor was then installed at 3 m whereas it was not feasible for divers to install a 2nd sensor at 10 m due to strong currents. Cleaning connectors and sensor on the buoy head was not feasible too as well as data download, the head being submersed with high swell passage. Divers saw the system working. The buoy stayed at this level for the rest of the day. The second day the buoy was slightly higher and a tentative to clean the connectors on the buoy head was made. However the zodiac was cut by the solar panels and the tentative had to be stopped. An estimate of the free space on the Microdrive has been made considering the last successful download was on October 6th. The disk should be able to store data at least until the end of January 2015.

2.1.19 Monday 5th January 2015

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

2.1.20 Monday-Friday 19th-23th January 2015

These days are part of the B#155 cruise. The first day a direct connection on the top of the buoy was established and data downloaded. ARGOS and CISCO connectors were cleaned along with solar panel surfaces. The last day divers cleaned the buoy sensors and performed dark IOPs measurements. They also installed a pCO2 sensor at 10 m with its cable balled-up and fixed at the same depth waiting for the buoy rotation.

2.1.21 Wednesday 11th February 2015

These day is part of the B#156 cruise. Divers cleaned the buoy sensors and performed dark IOPs measurements. A connection with the buoy was obtained (AK connector) and data downloaded.

2.1.22 Saturday 9th March 2015

These day is part of the B#157 cruise. Divers cleaned the optical sensors on the buoy. A connection with the buoy was obtained (AK connector) and data downloaded. The ARGOS and CISCO connectors were cleaned along with solar panel surfaces.

2.1.23 Saturday 28th March 2015

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

2.1.24 Friday-Sunday 10th-12th April 2015

These days are part of the B#158 cruise. The first day divers cleaned the optical sensors and performed dark IOPs measurements. Then O2 sensor at 3 m and 10 m were replaced with new ones. The CTD at 10 m was dismantled to be sent to factory for recalibration. Sensors on the top of the buoy, were cleaned along with ARGOS and CISCO connectors and solar panels. Two attempts of connection with the buoy directly from the buoy (AK connector) were attempted unsuccessfully, indicating a failure of the system. A second dive was then scheduled for the second day. Divers dismantled the DACNet from the buoy. The AK connector was damaged, so it was cut off and isolated from the motherboard to avoid unwanted reboot. Then the Microdrive was replaced with a new one and configured to match the buoy instruments and tested before being mounted again on the buoy. The buoy started to work again. Divers also cleaned the buoy structure from exceeding biofouling. The last day data were downloaded on the top of the buoy during a nominal connection to verify the correct functioning of the system.

2.1.25 Friday 24th April 2015

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

2.1.1 Thursday-Saturday 7-8th May 2015

These days are part of the B#159 cruise. The first day the ARGOS connector and optical sensors were cleaned on the buoy head, the ARGOS dispatch restarted. The second day divers went at sea and dismantled the OCP at 4 m, the pCO2 and O2 sensors and CTD at 3 m. These instruments were later mounted on the new boy, whose deployment was scheduled for May 11th. Then optical sensor on the buoy were cleaned. Data were downloaded on the top of the buoy and radiometers and solar panels on the buoy head were cleaned.

2.1.2 Monday 11th May 2013

This day the buoy system was switched off from divers around noon and then the buoy mast dismantled and loaded on-board the GGIX for transport to the Villefranche port. Here the mast was unloaded with the help of the CCI crane at 15h30. The structure was in good conditions but with much biofouling. The buoy was cleaned with the Karcher before being transported into the CCI local where it was dismantled in the following days. Data stored in the DACNet were recovered regularly. Instruments were shipped for calibration on May 26th, whereas the aluminium structure was sent to the BSS on July 6th.

3. QUANTITATIVE SUMMARY

The deployment lasted 424 days among which 21 were without data acquisition due to a hard disk crash.

4. INSTRUMENT SCHEDULE

1 minute acquisition every 15 minutes.

5. ANY PROBLEMS ENCOUNTERED ?

- 1- Hard disk failure.
- 2- Damage of the AK connector.

6. LESSONS LEARNED

- 1- After long deployments labels used to identify cables are almost completely bleached making difficult for divers, for example, DCANet re-installation after repair.

7. APPENDIX

The following page contains a summary of the test made with the radiometers before the deployment, the schema of the buoy, the list of the calibration files and the plots of the multispectral and PAR dark readings.

Radiometer Test

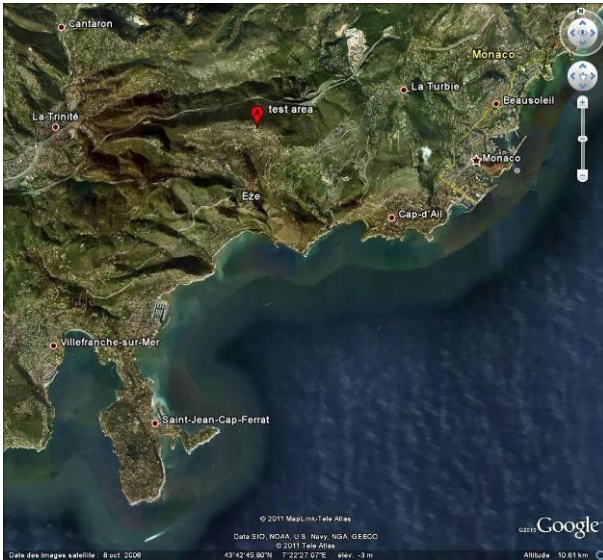
On December 17th 2013 a field campaign to test the buoy radiometers relative performances was organized at the Fort de la Revere. The fort is located at north of the Eze village at about 700m on the sea level (see images below), and near the fort there's a plane field free of obstacles that could cause shadow or glint above radiometers.

All the radiometers used for the buoy were fixed upon a table facing the zenith. The Lu and Eu sensors were covered with teflon caps produced at LOV.

The instruments were all connected as for the buoy deployment (OCPs, DACNet, cables etc.) and powered with a battery. The system schedule was modified to acquire data every 10 minutes instead of 15.

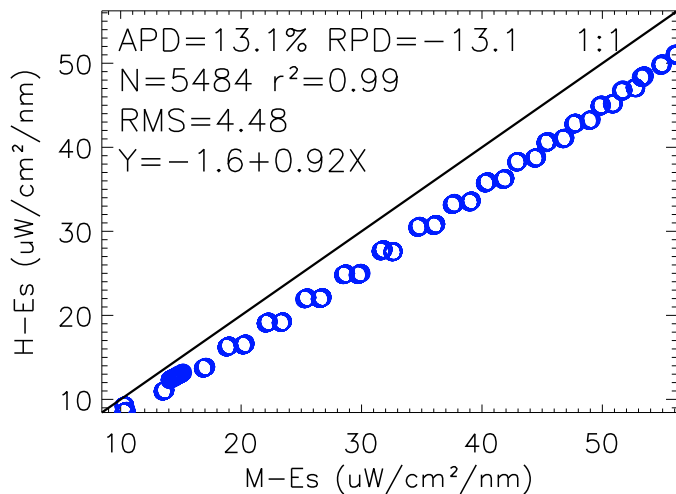
Data were acquired for about 8 hours.

Sky conditions were good. The choice to compare single data by using the TIMETAG variable recorded in data files was maintained.

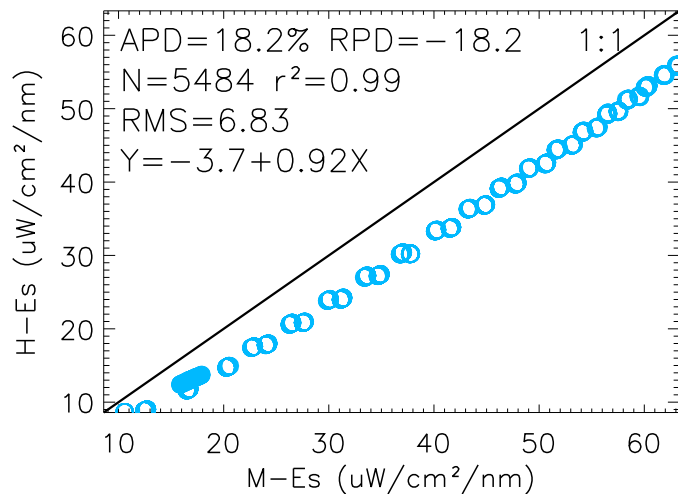


Results of the tests are displayed in the figures below.

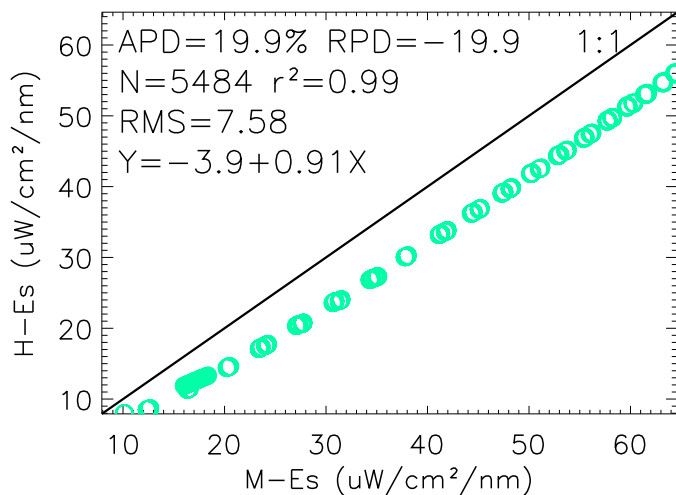
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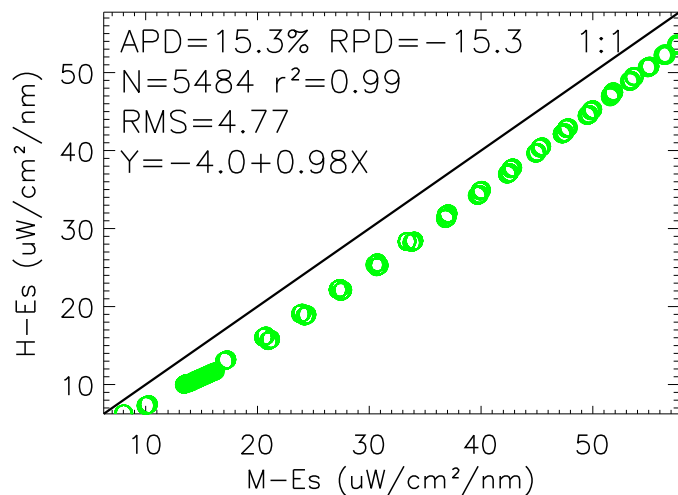
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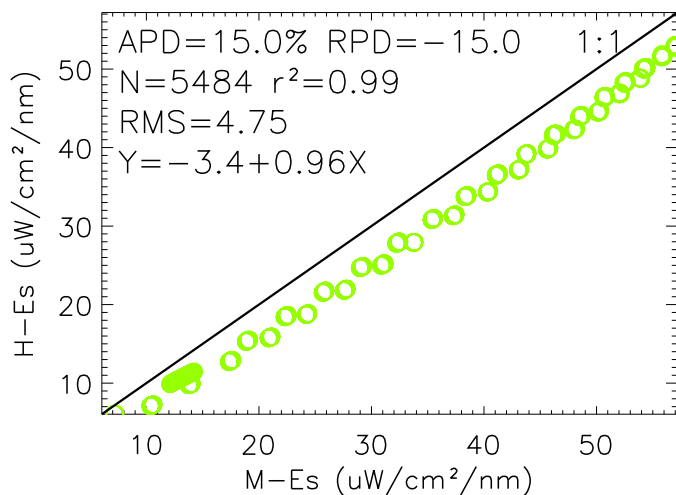
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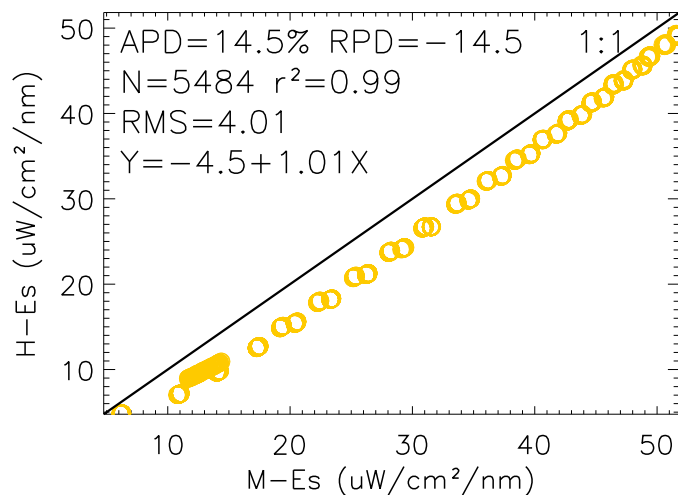
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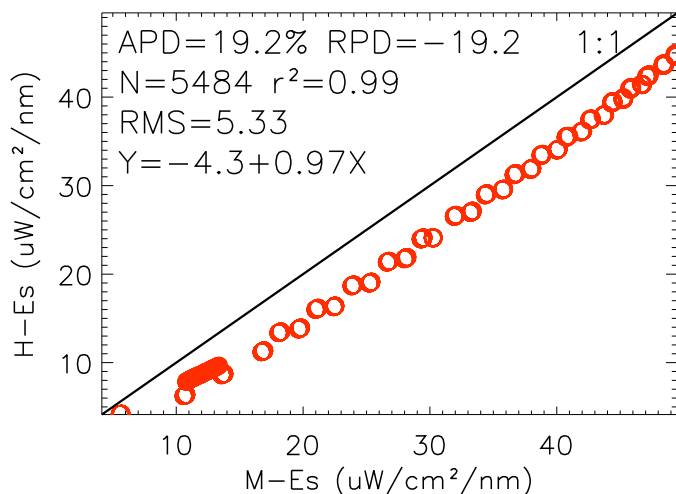
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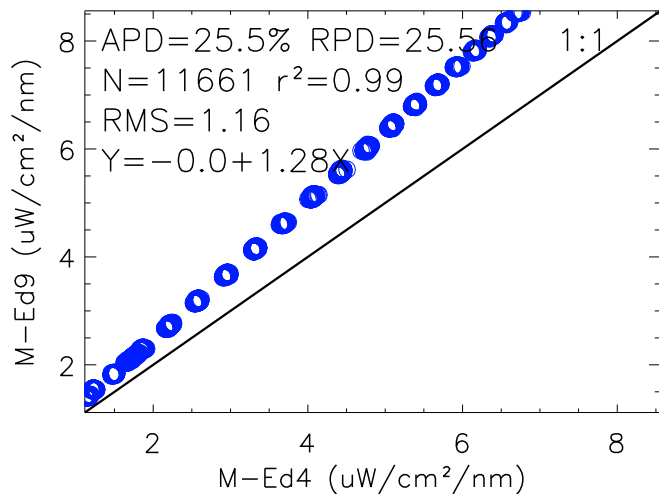
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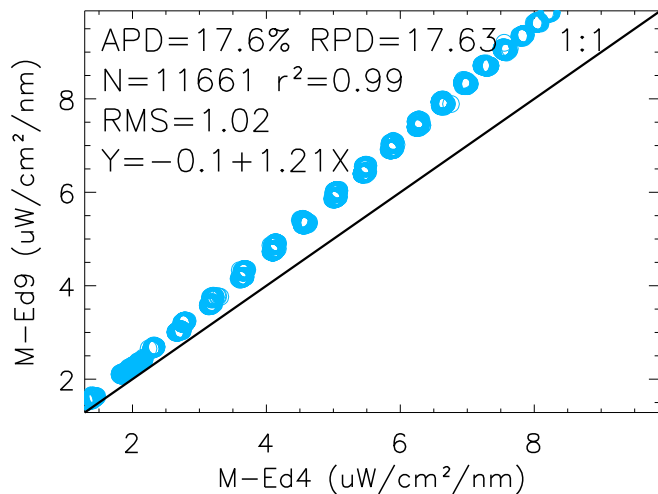
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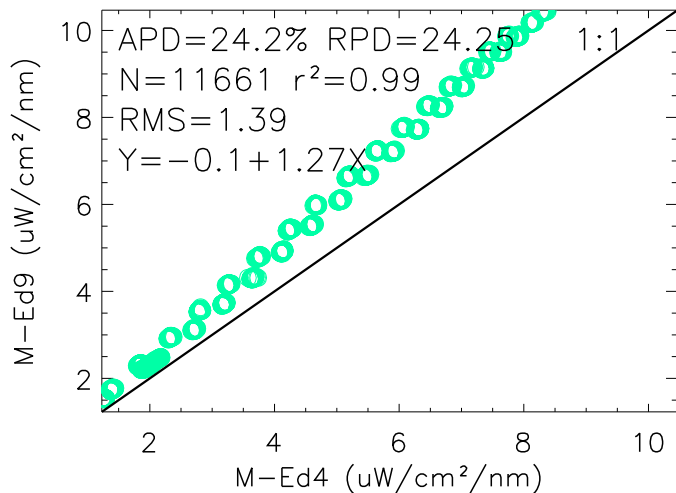
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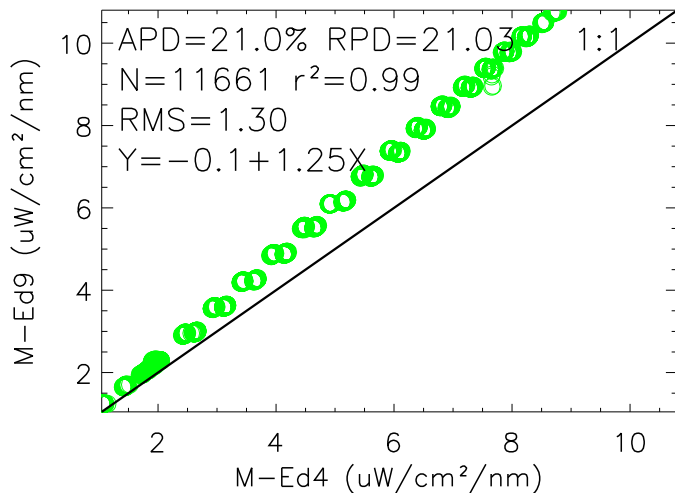
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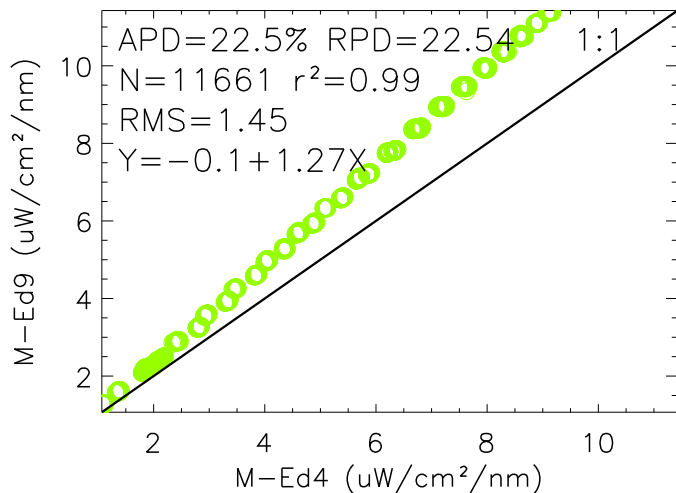
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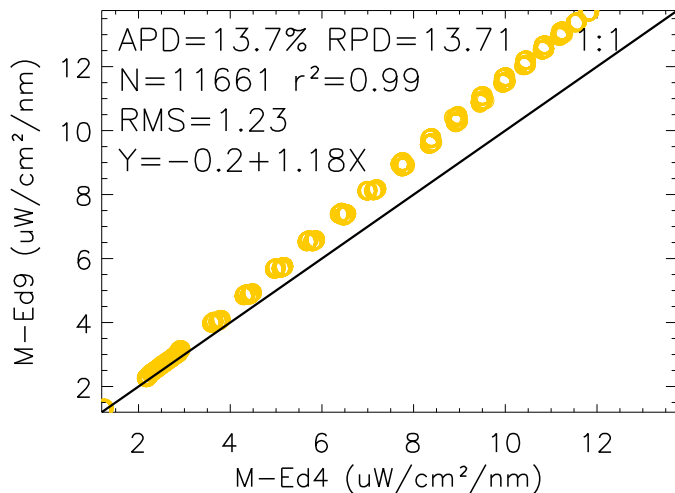
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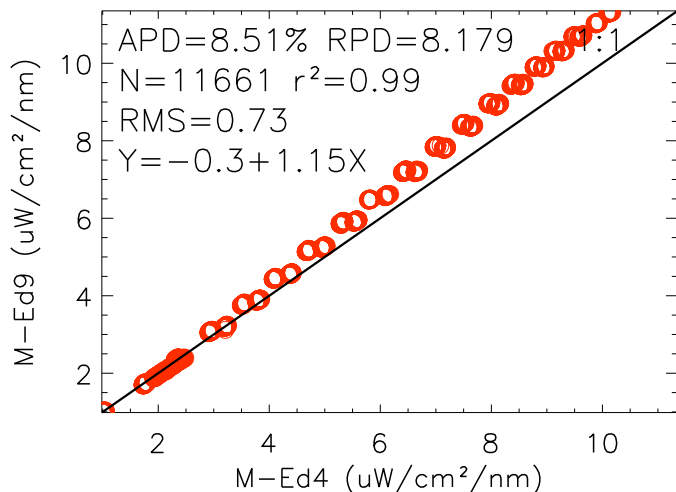
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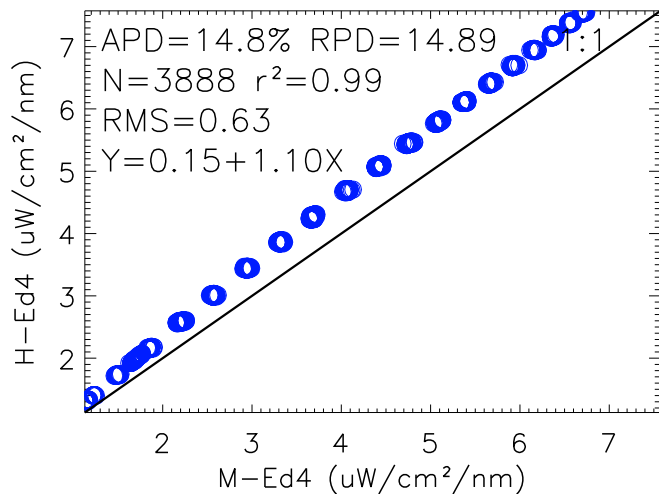
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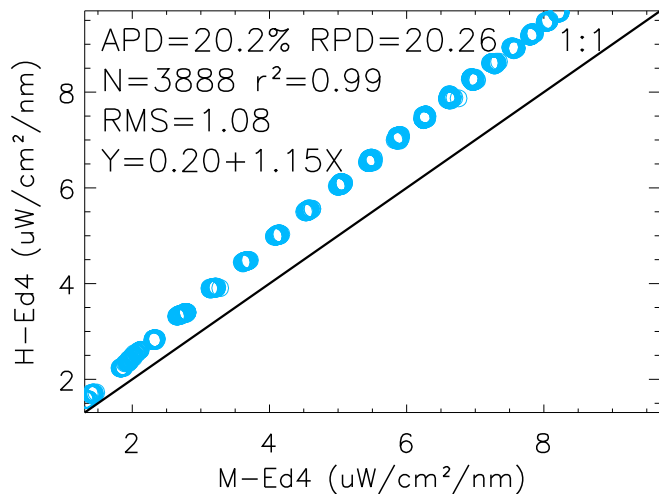
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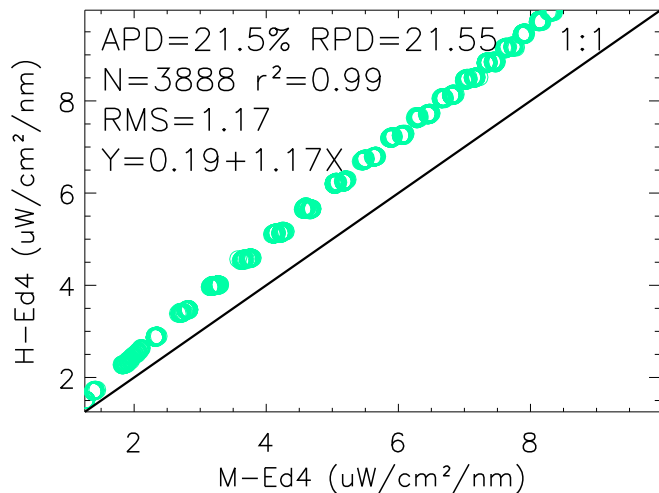
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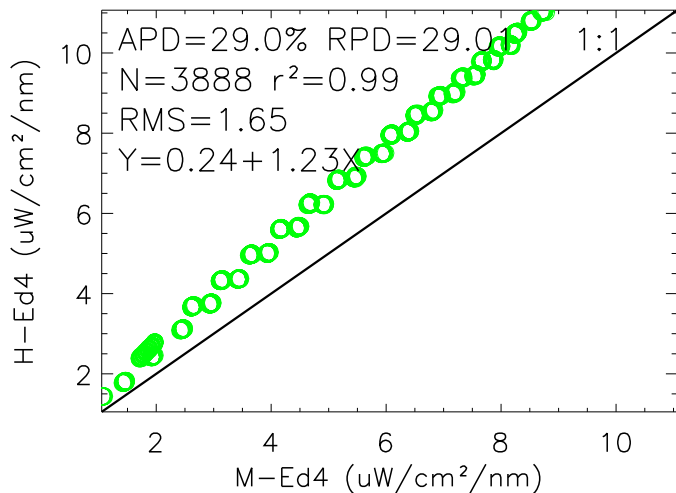
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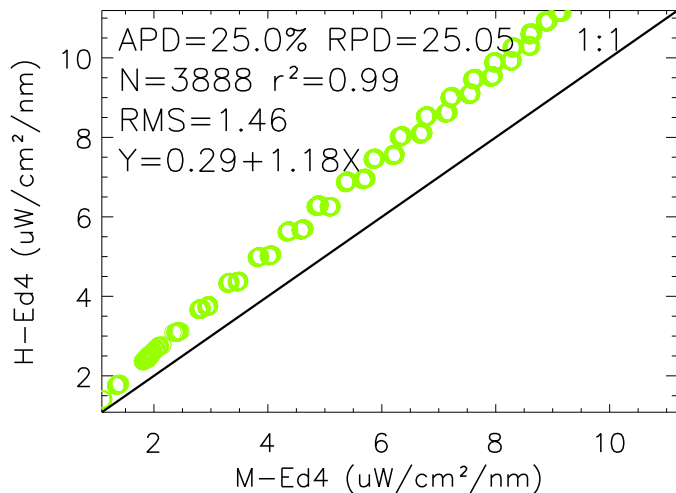
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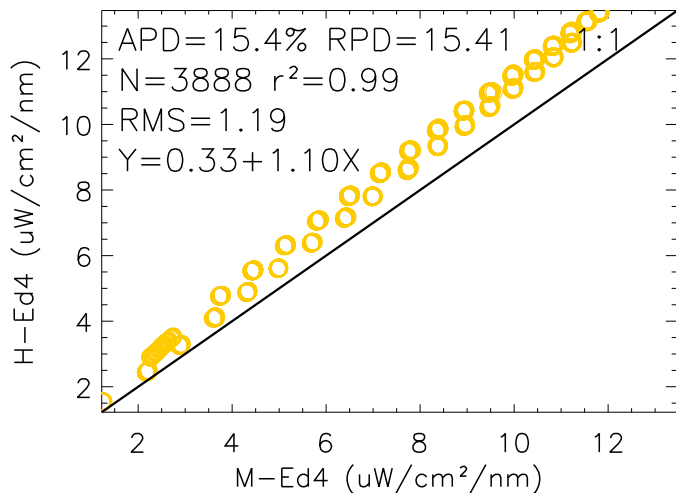
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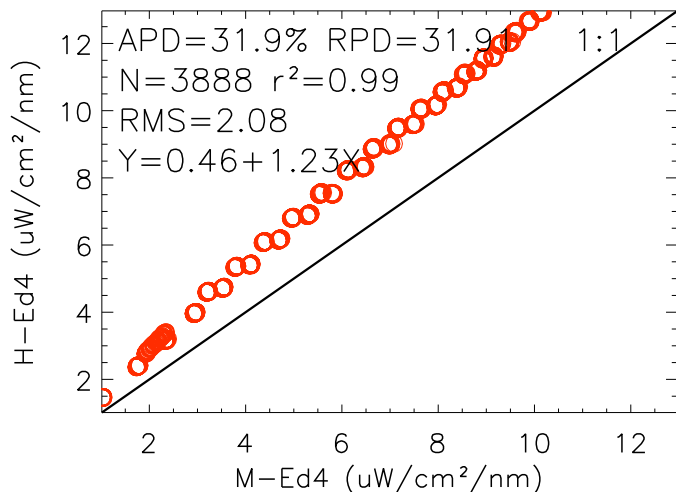
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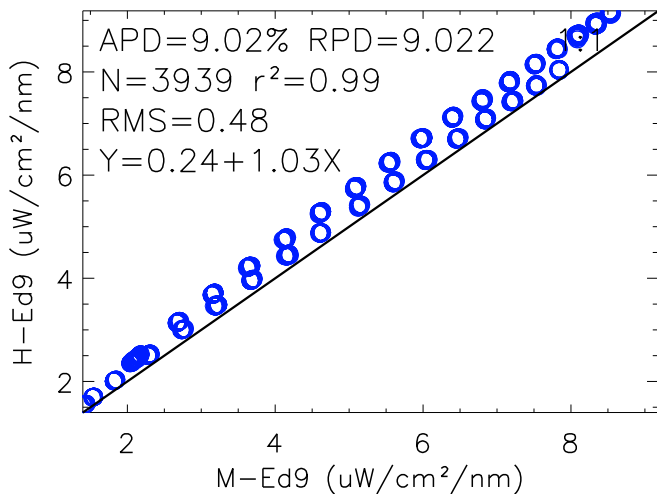
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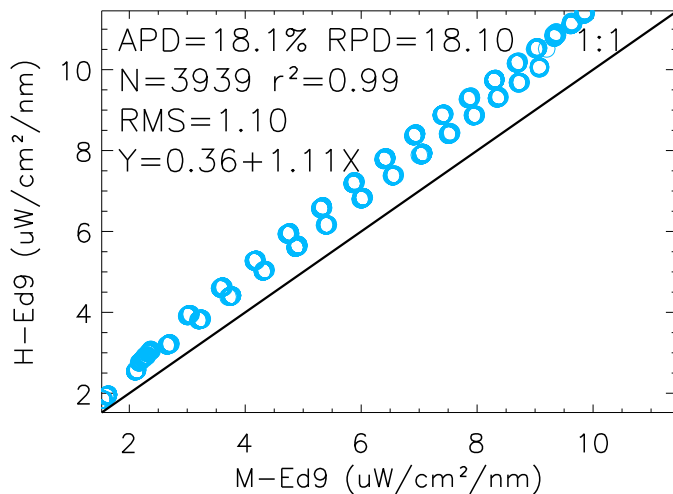
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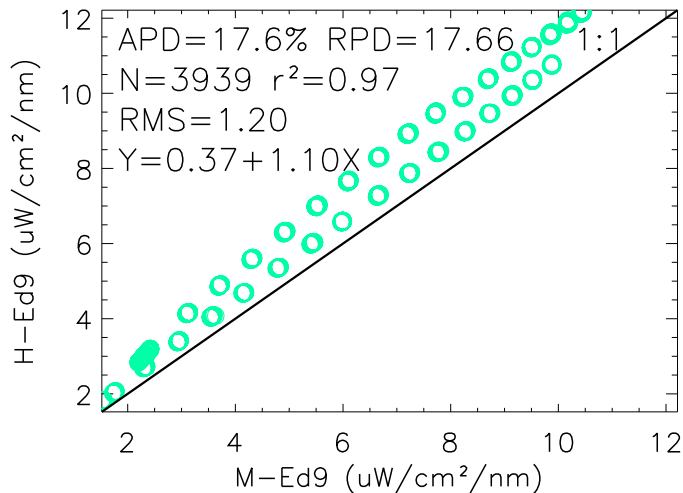
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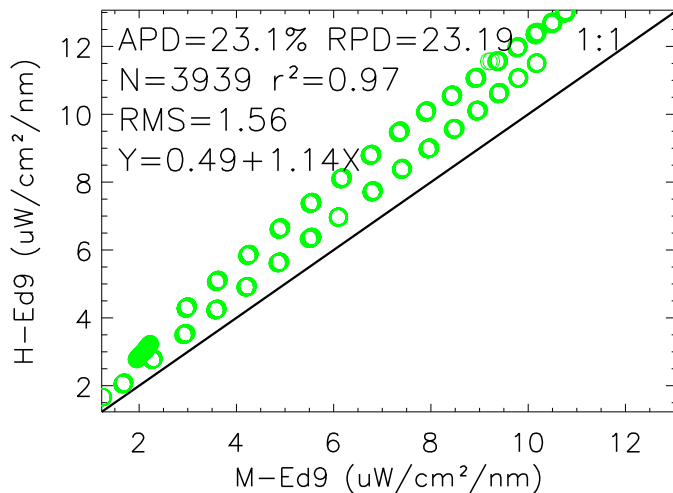
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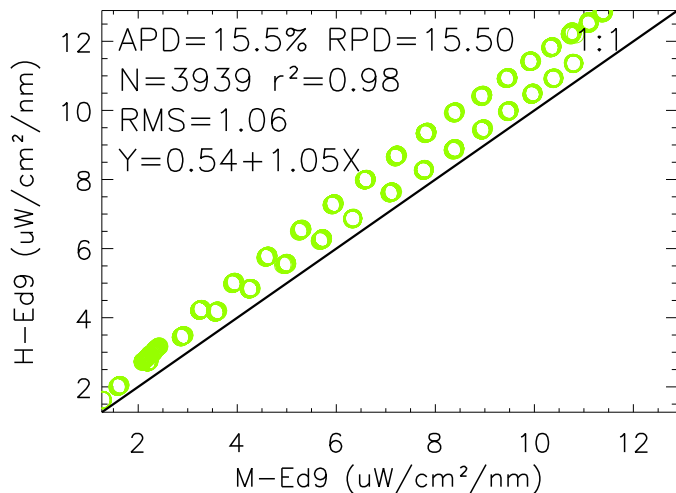
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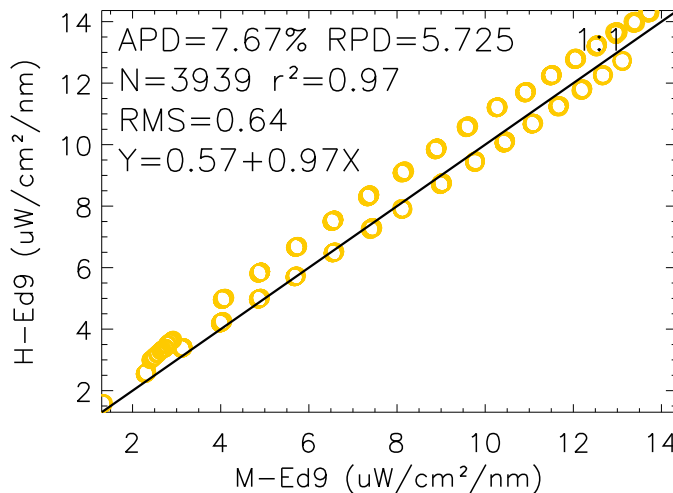
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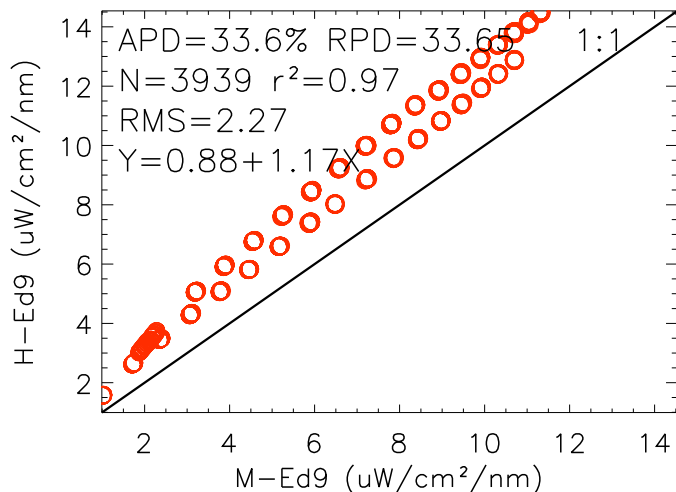
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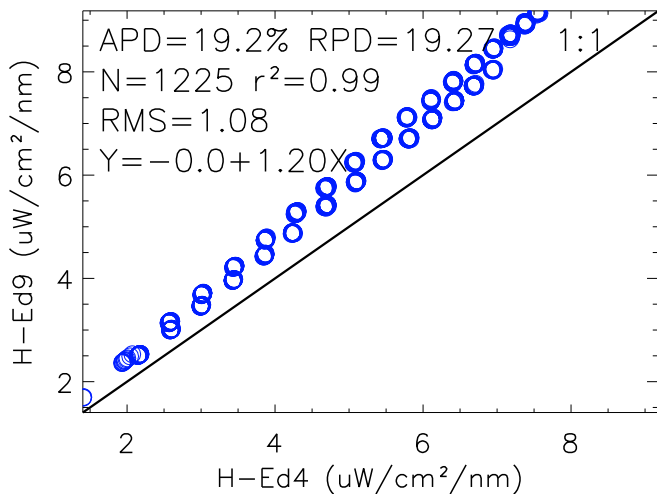
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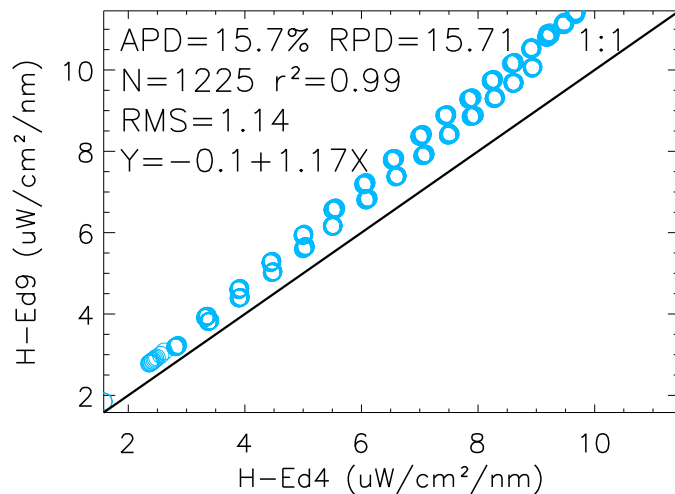
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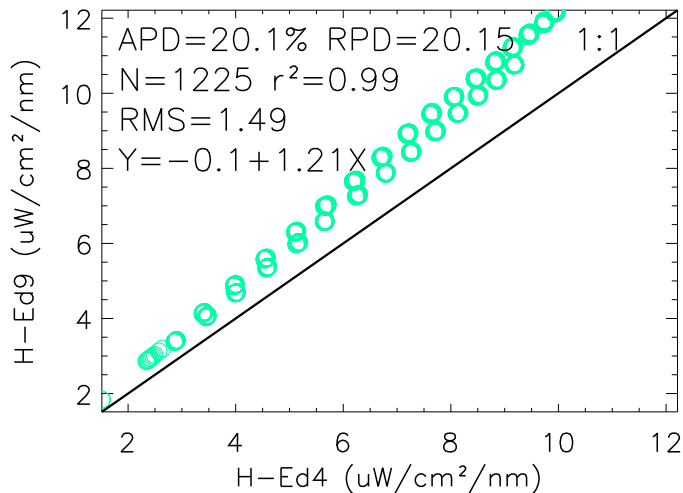
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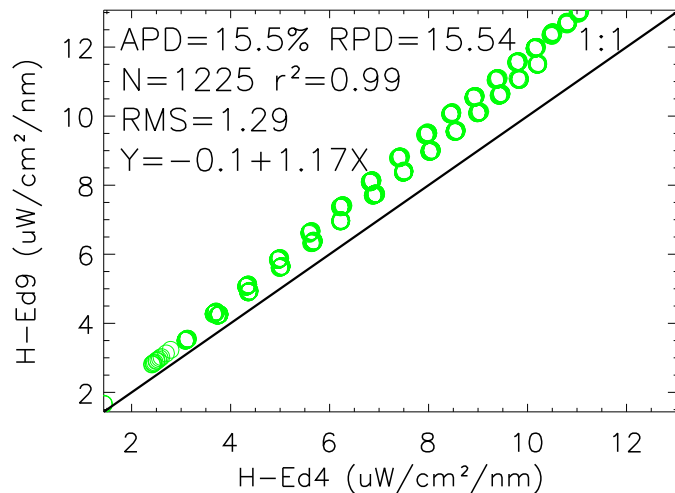
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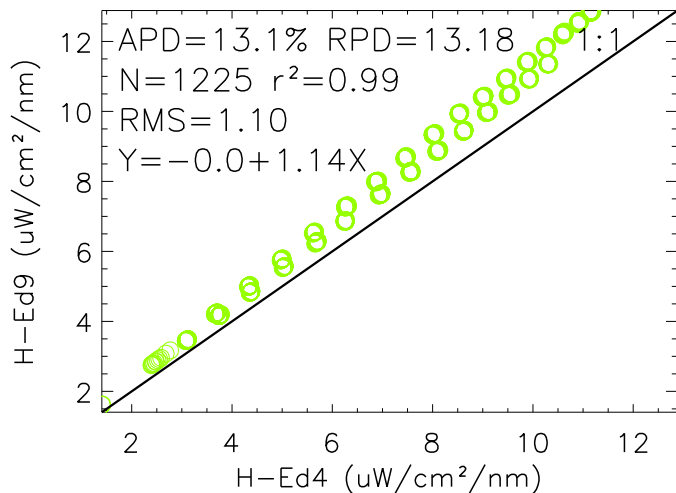
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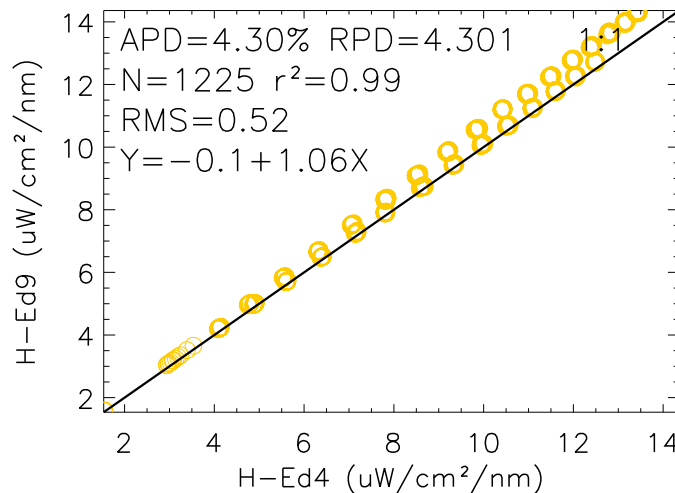
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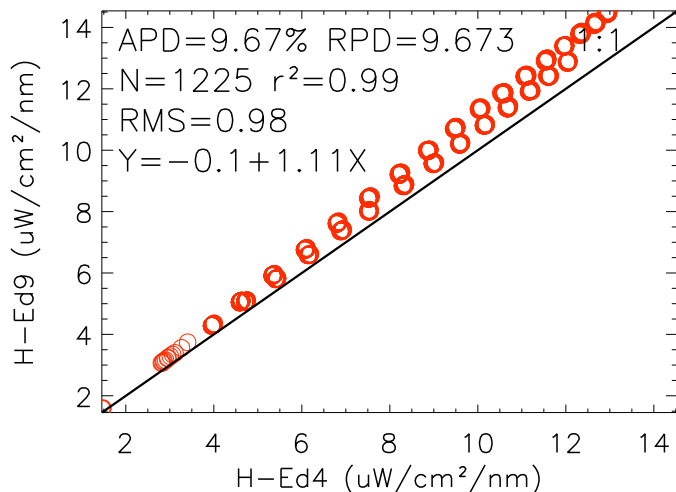
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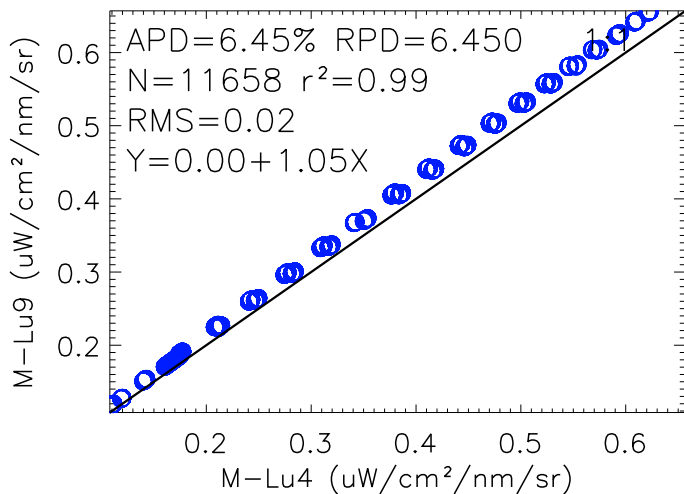
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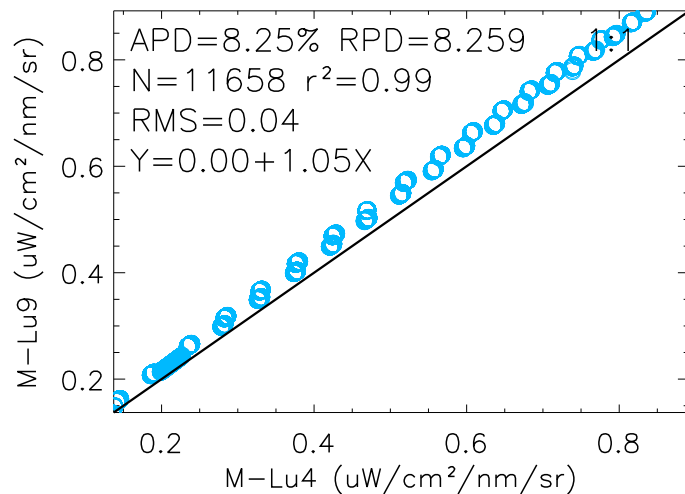
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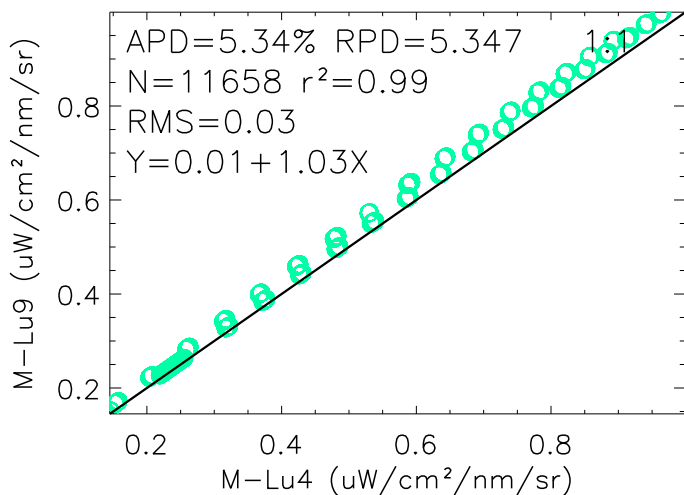
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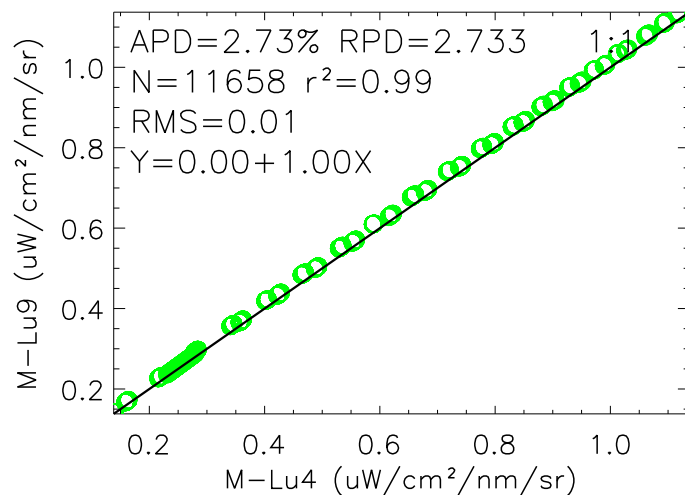
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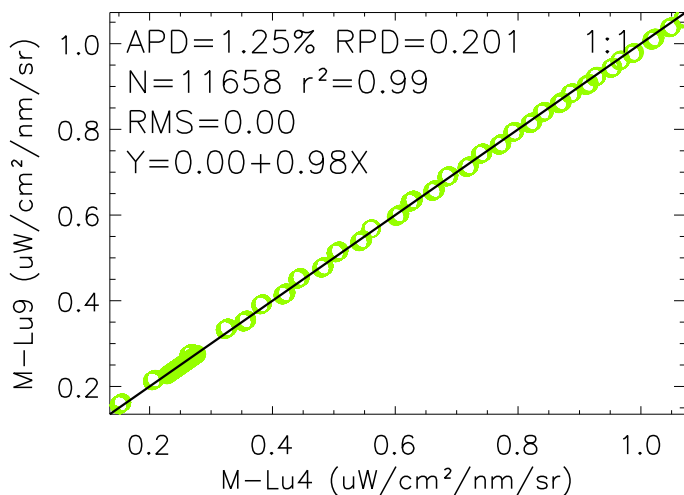
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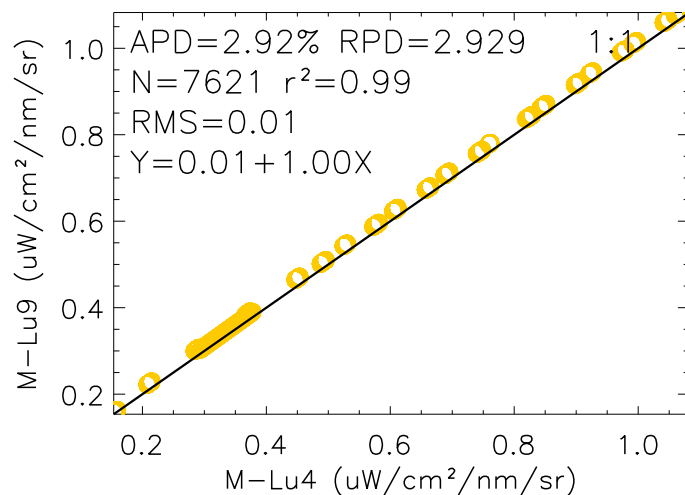
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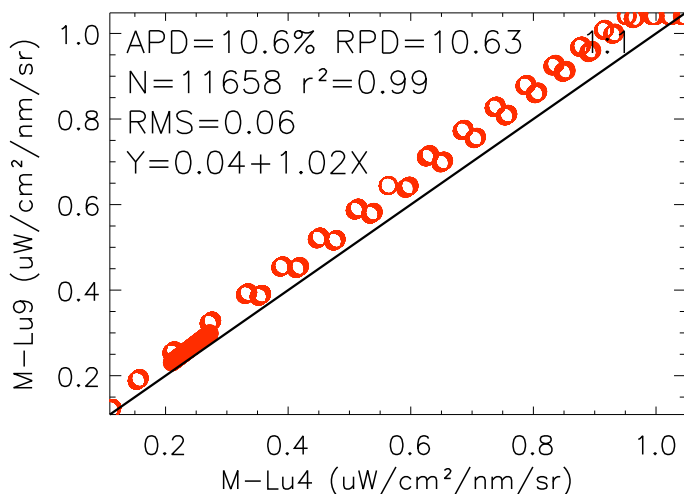
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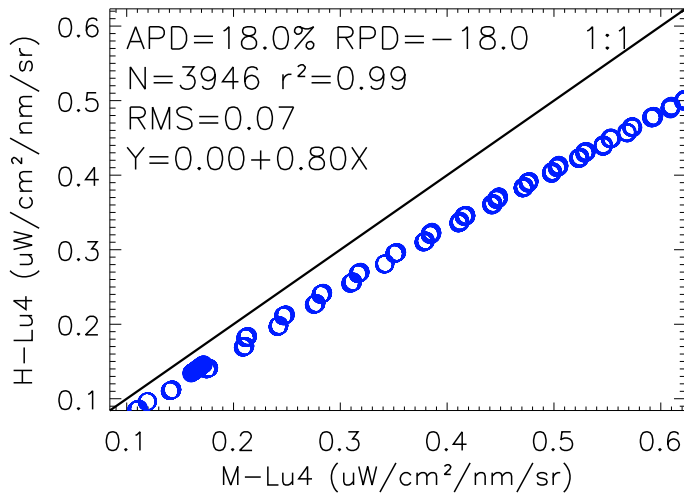
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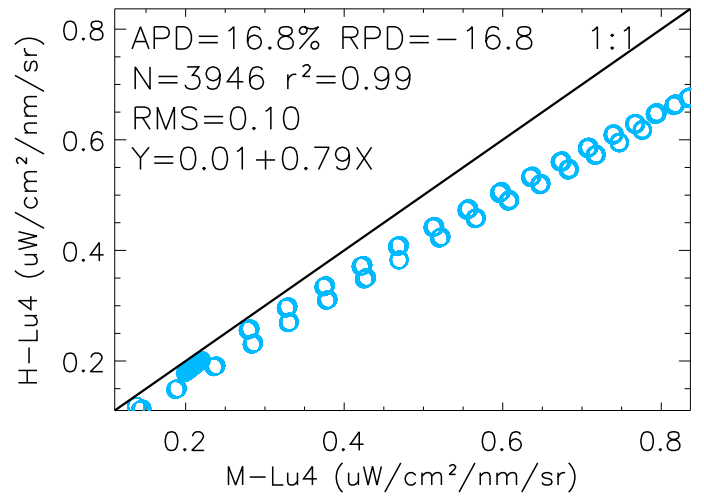
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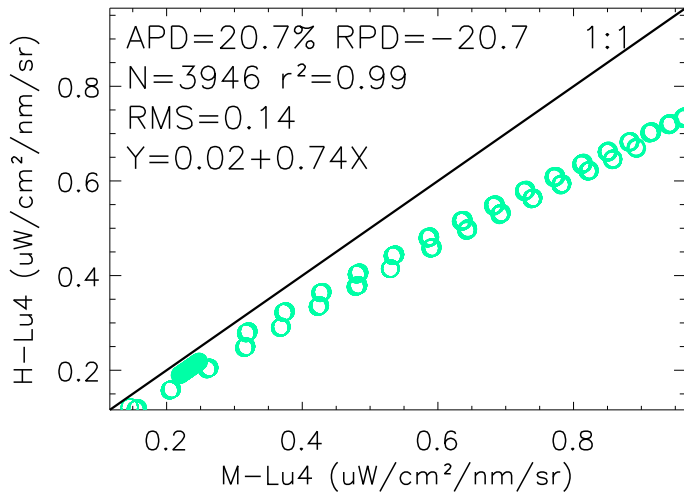
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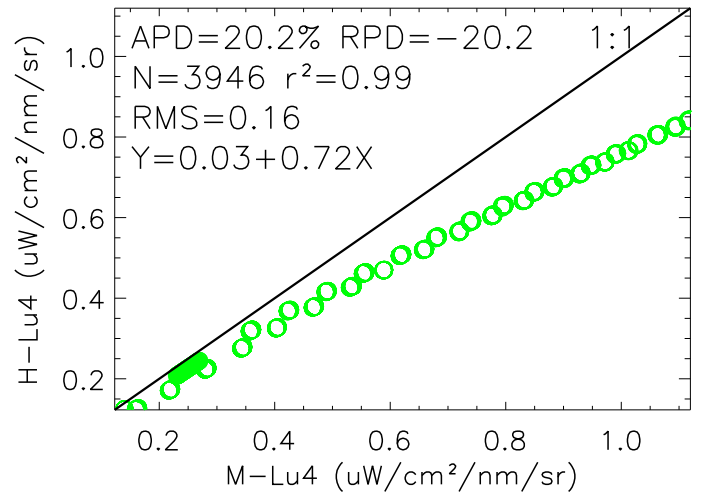
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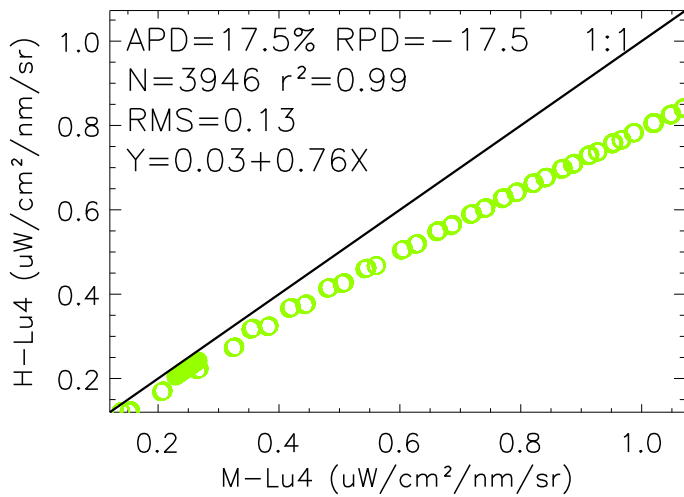
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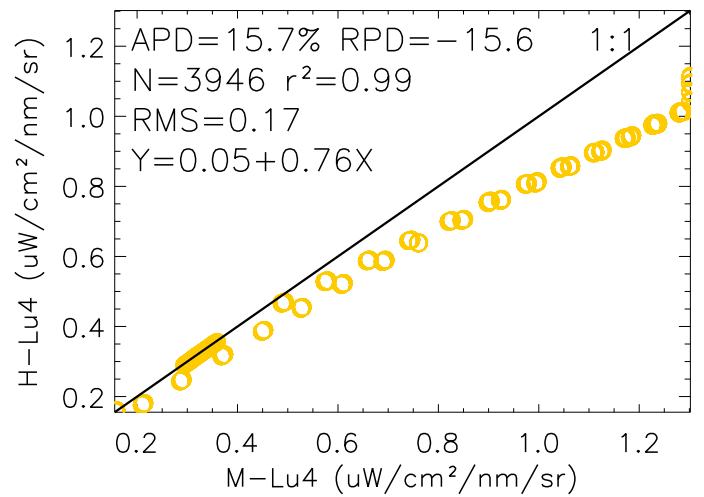
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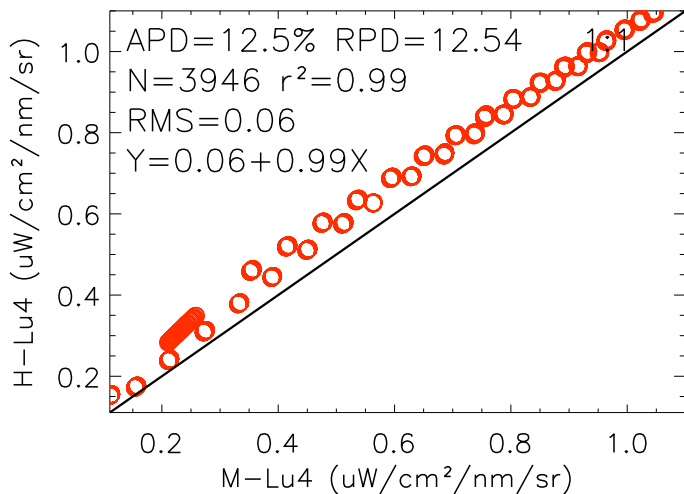
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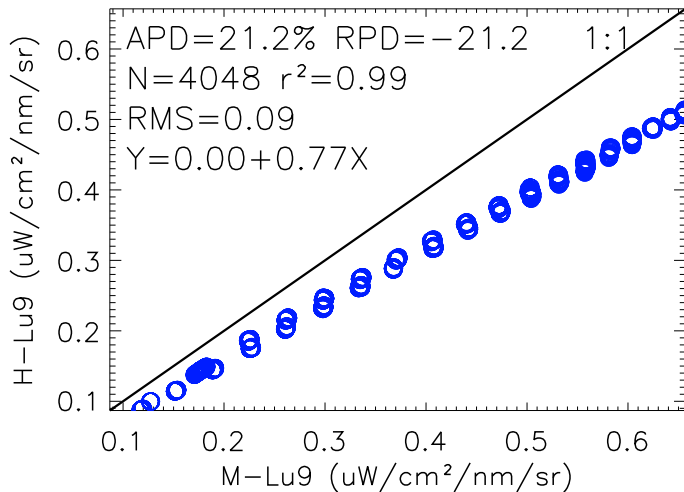
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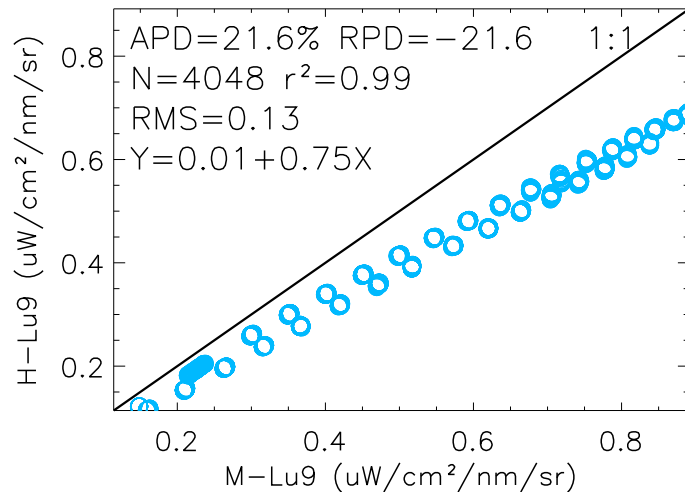
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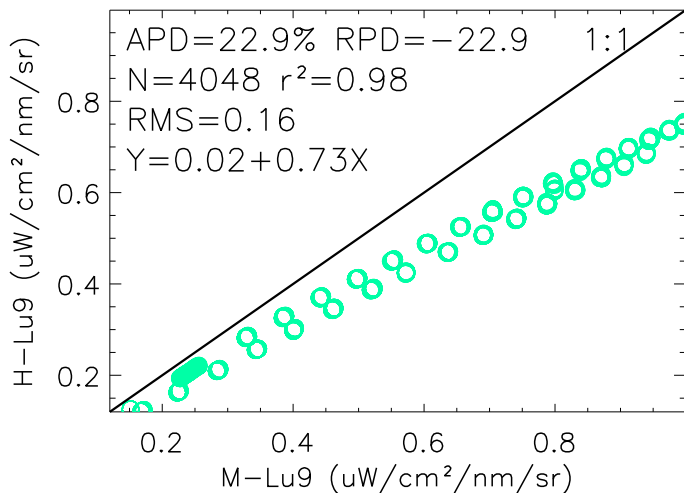
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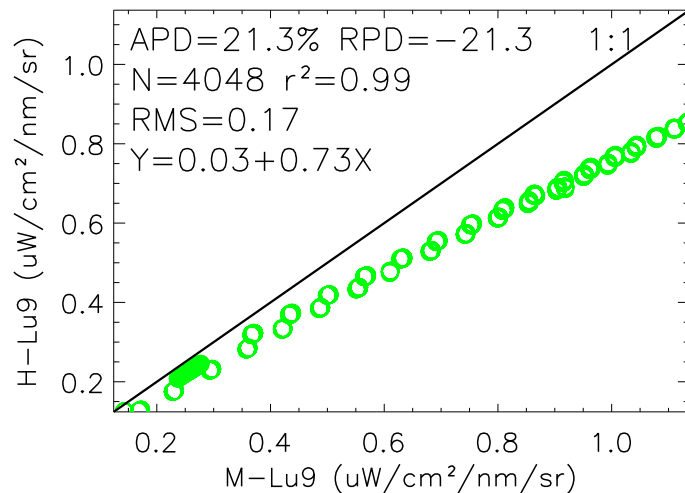
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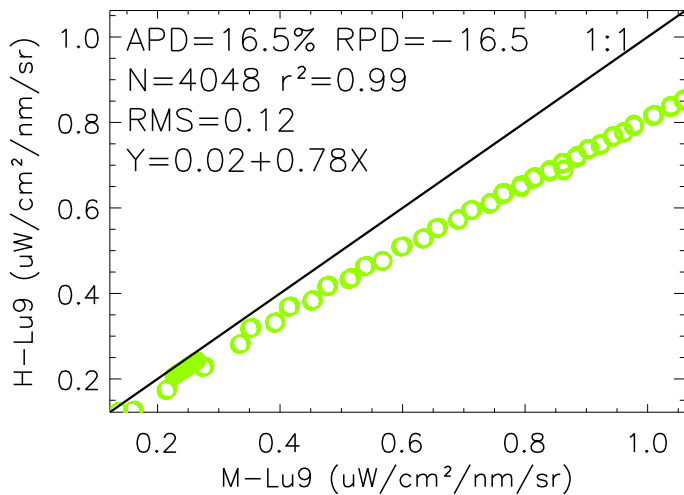
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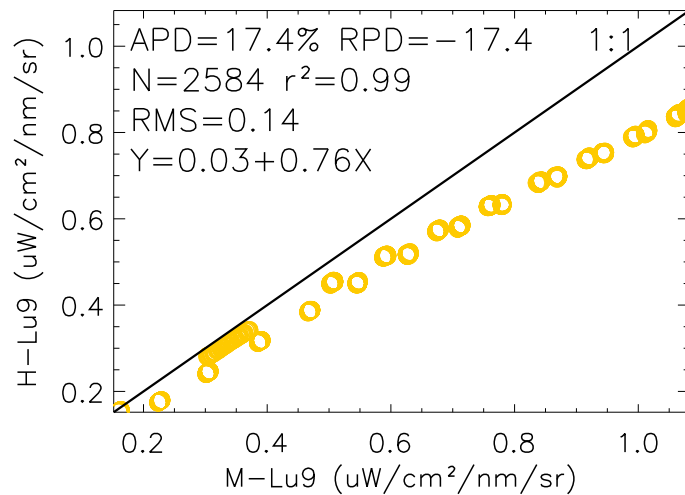
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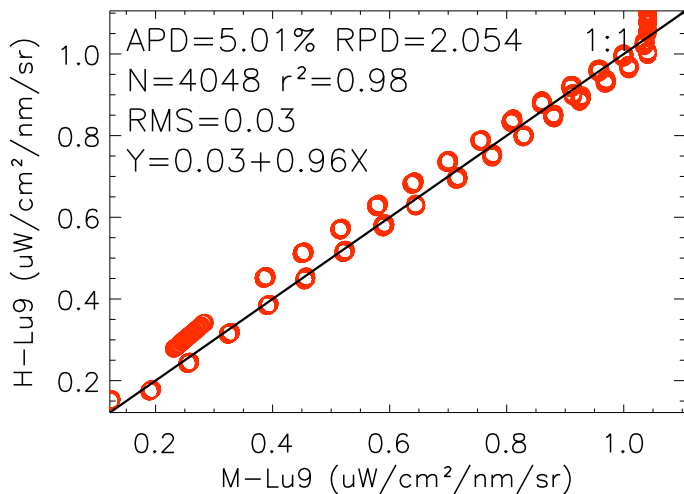
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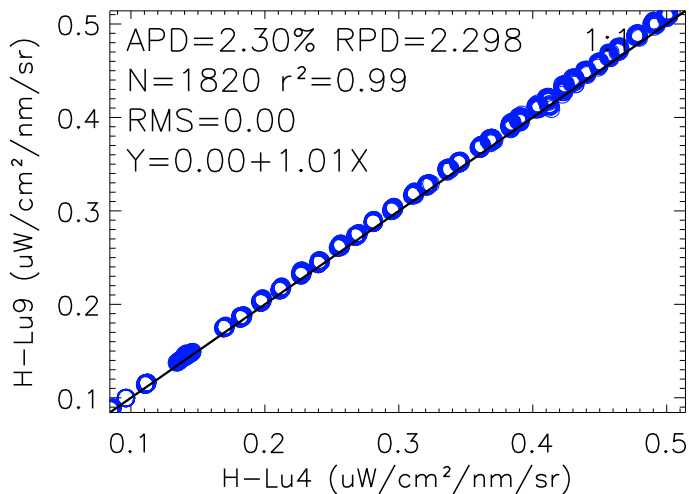
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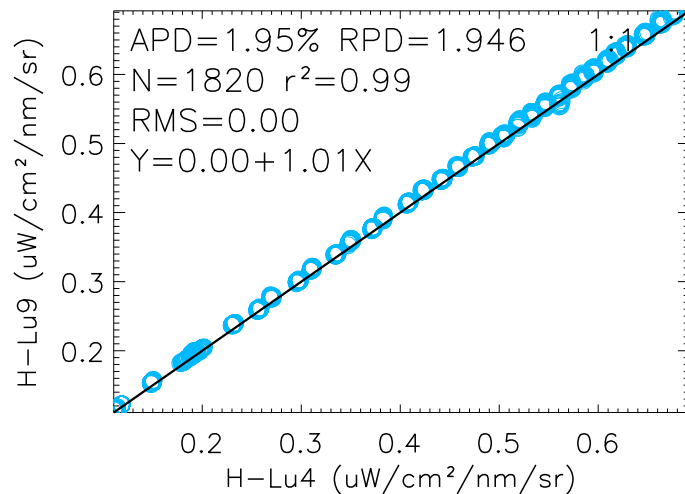
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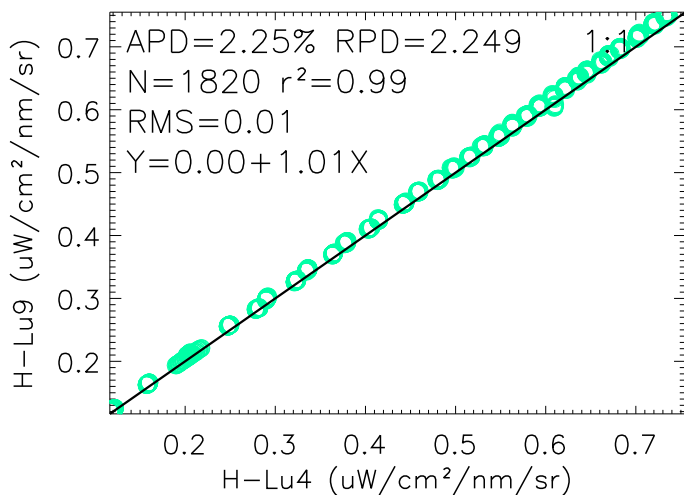
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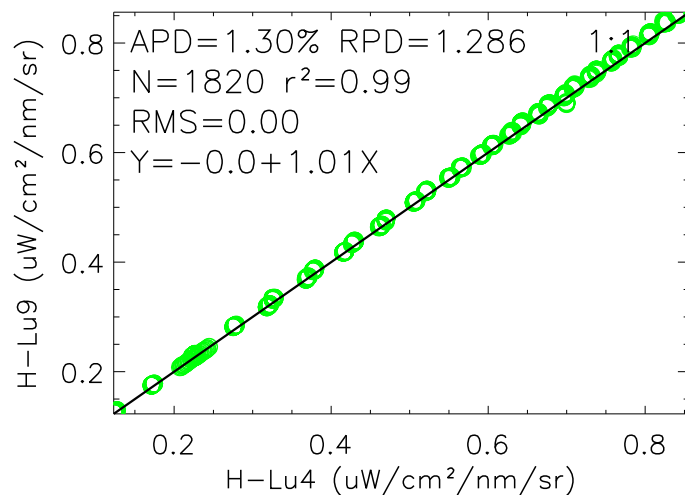
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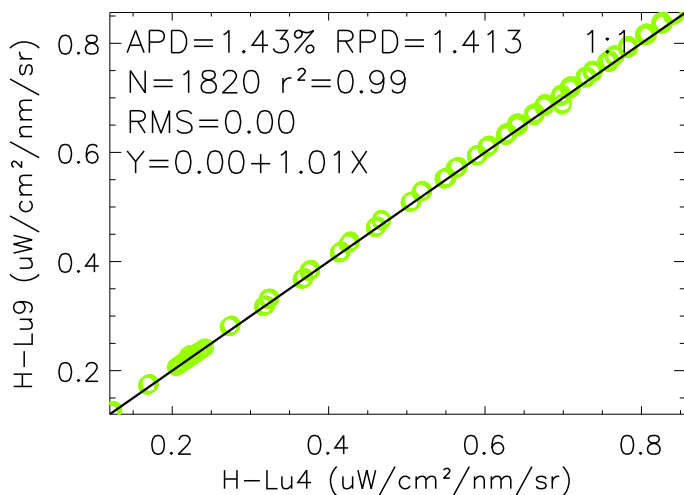
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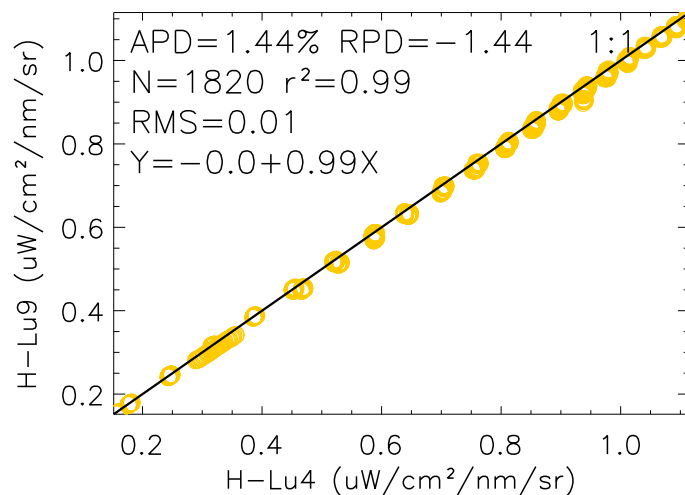
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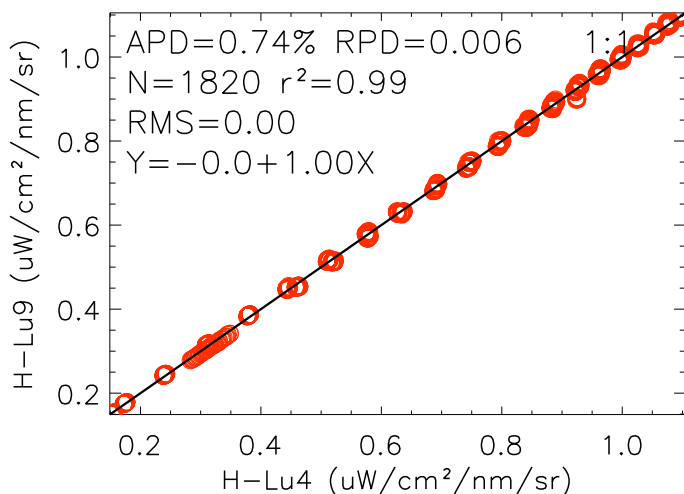
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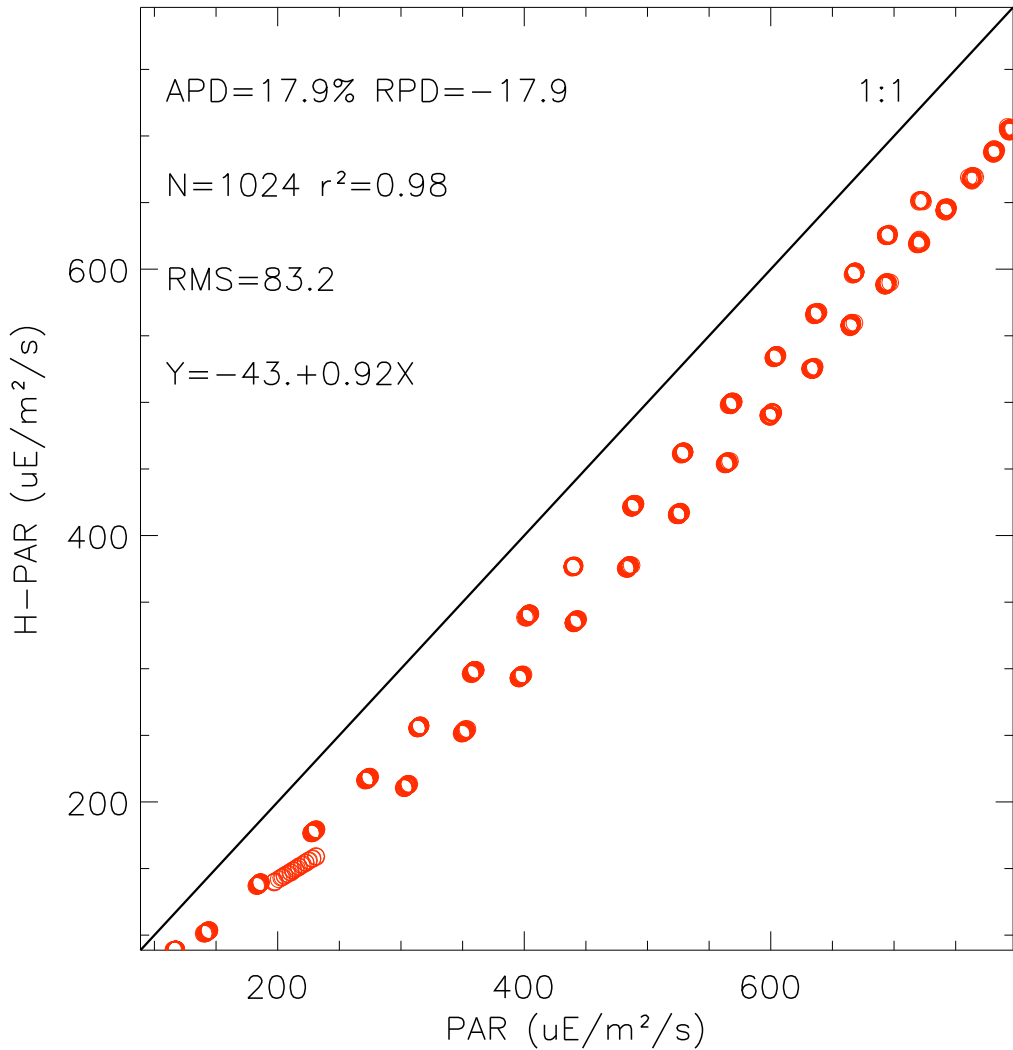


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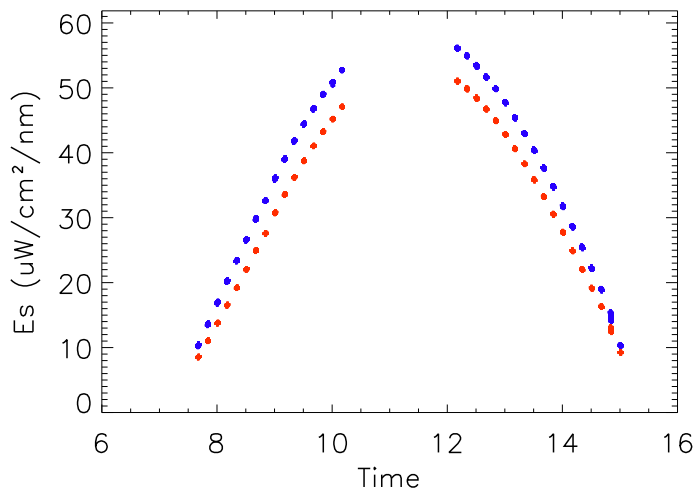


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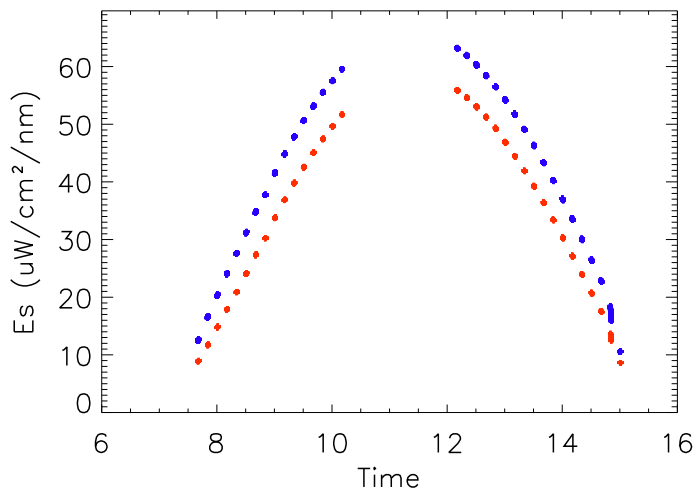




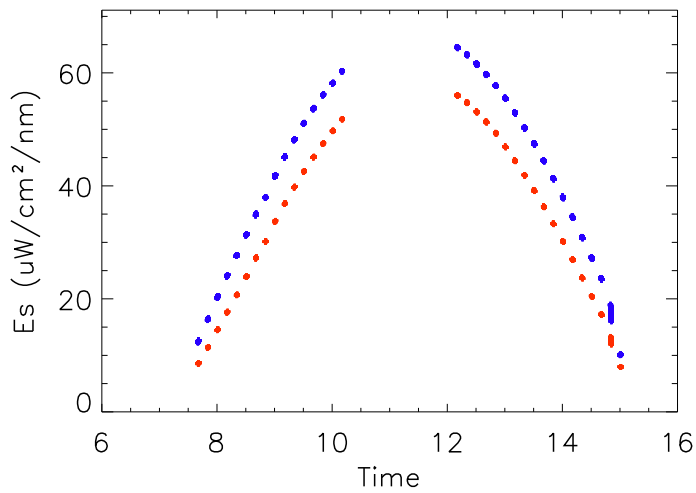
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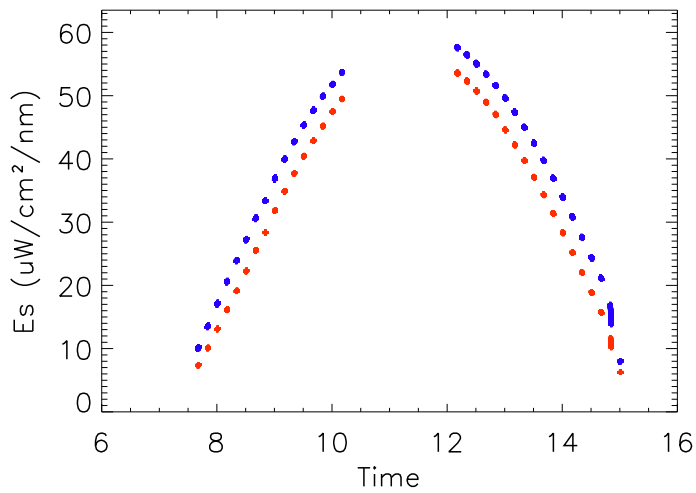
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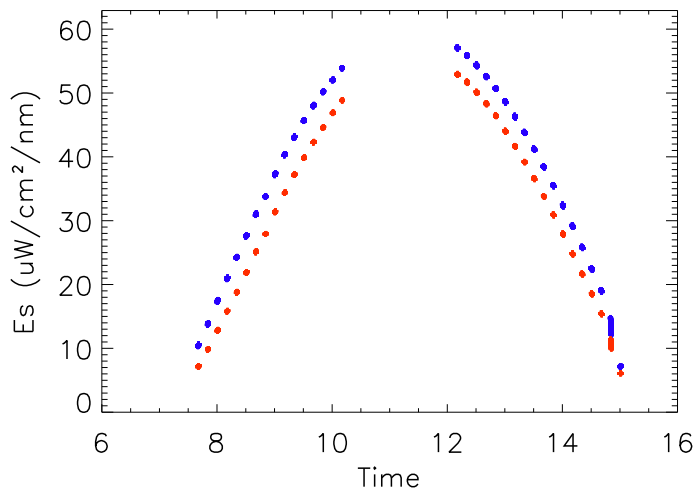
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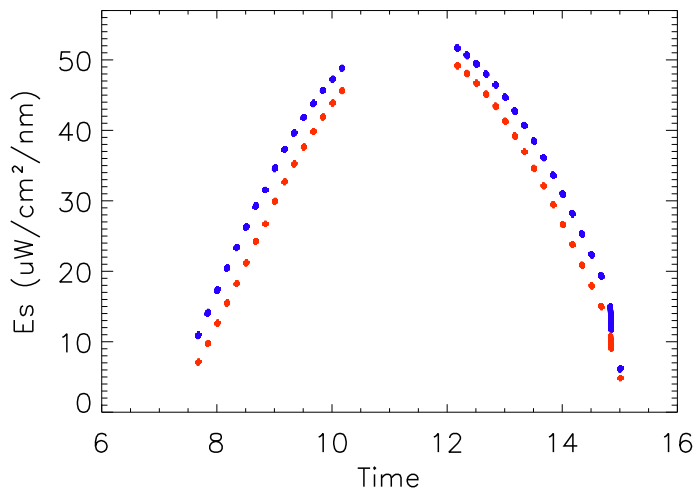
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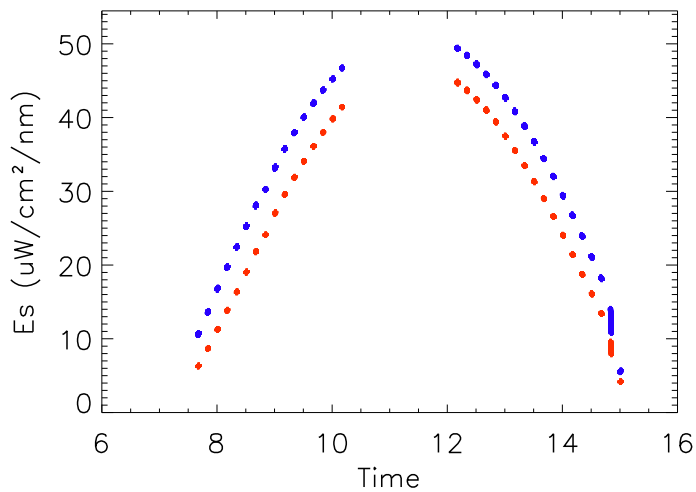
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665.200



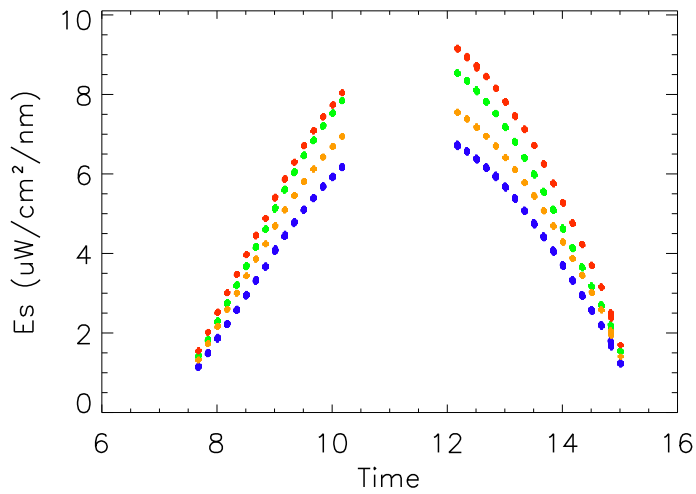
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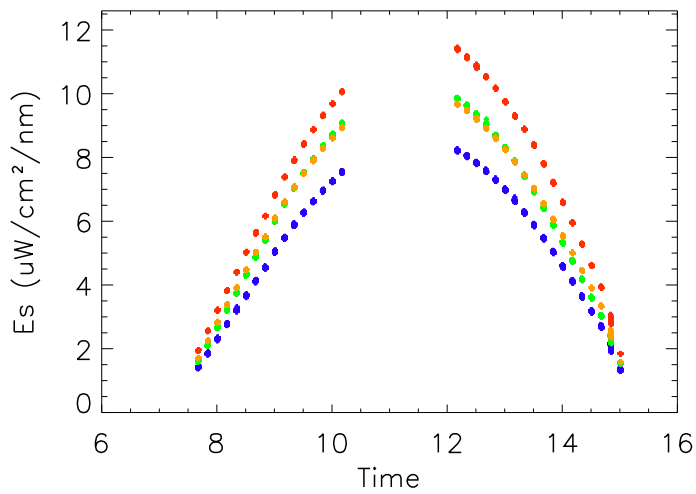
Multi-Es

Hyper-Es

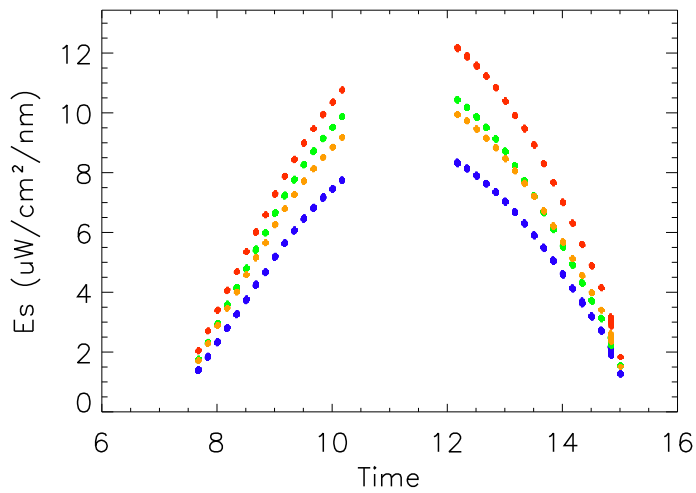
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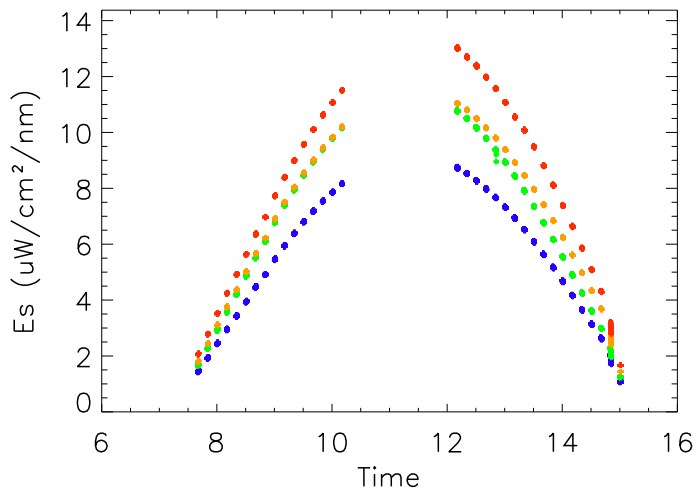
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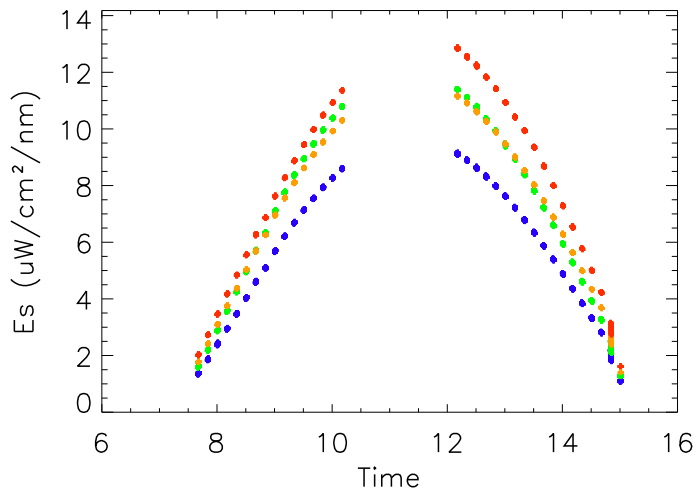
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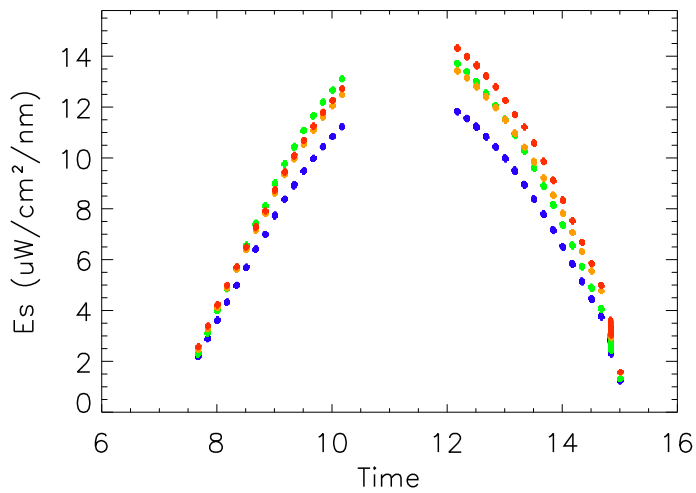
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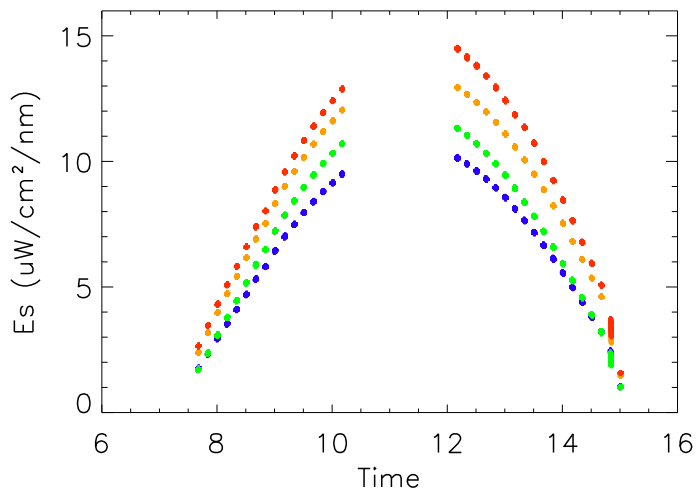
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665.200



683.700



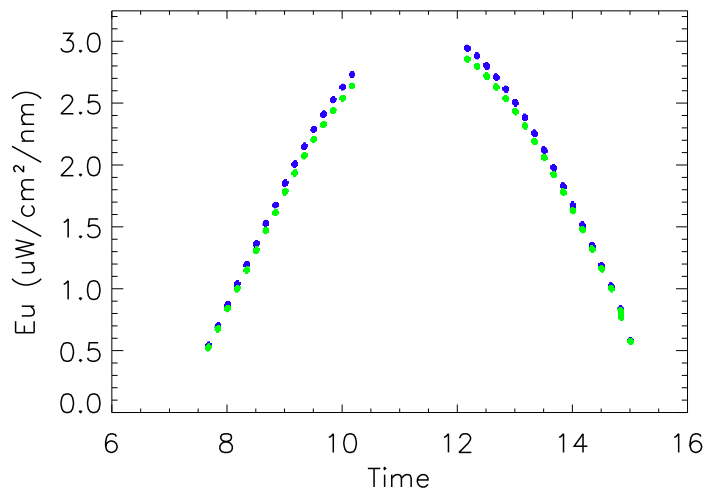
Multi-Ed4

Multi-Ed9

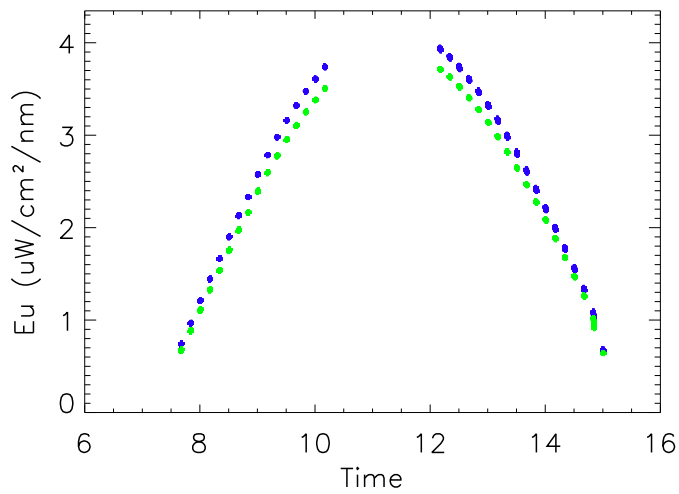
Hyper-Ed4

Hyper-Ed9

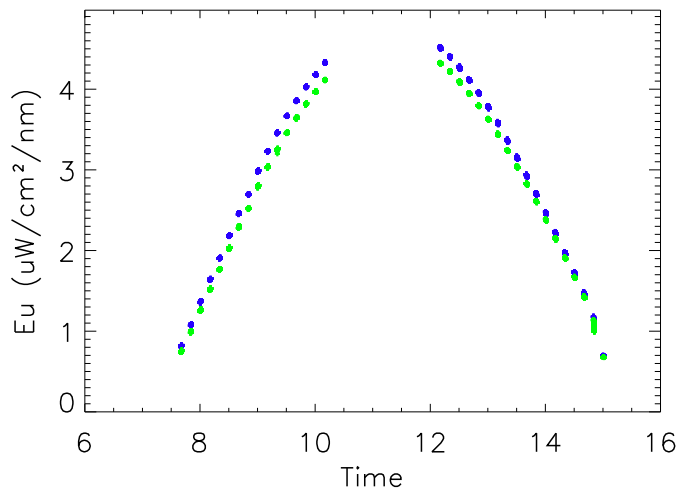
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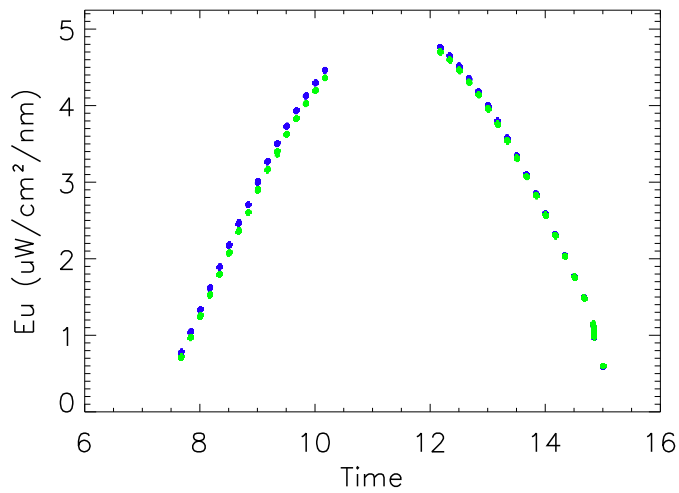
489.900



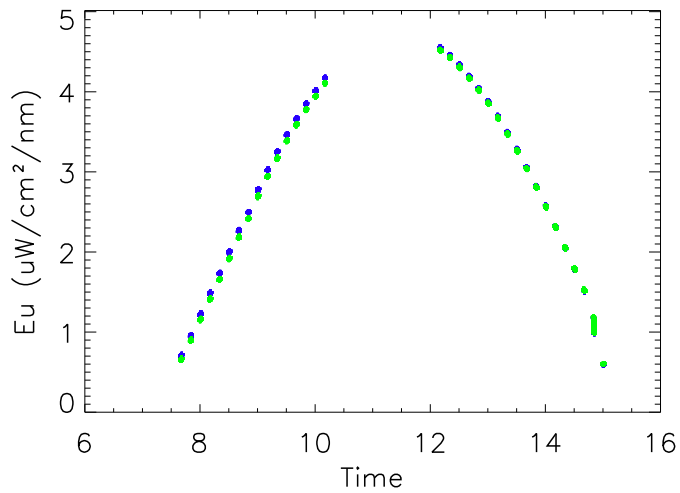
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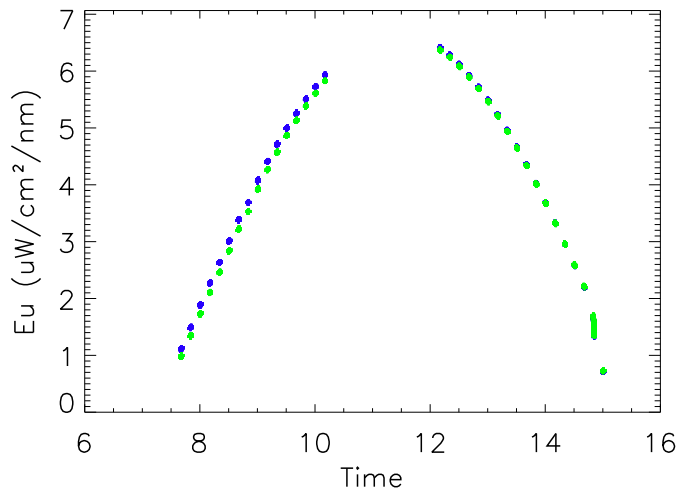
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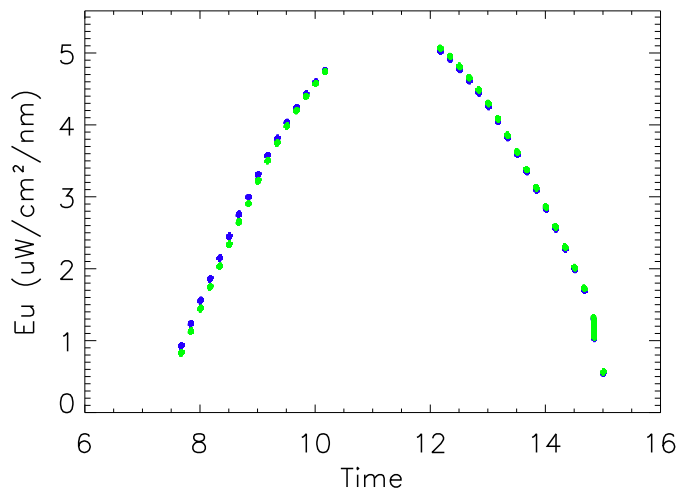
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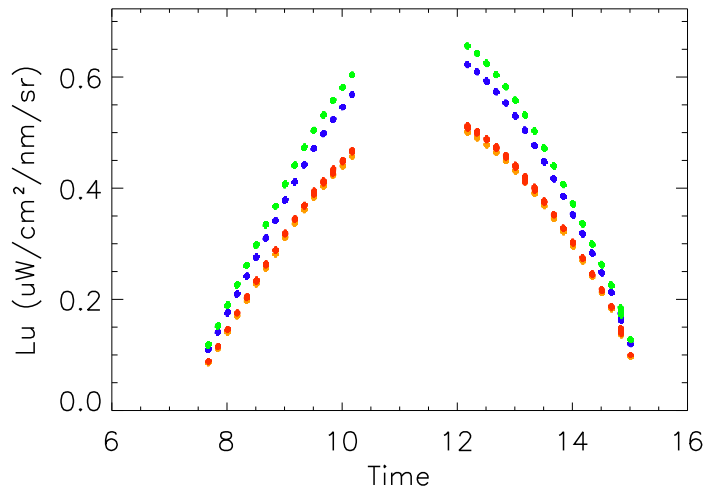
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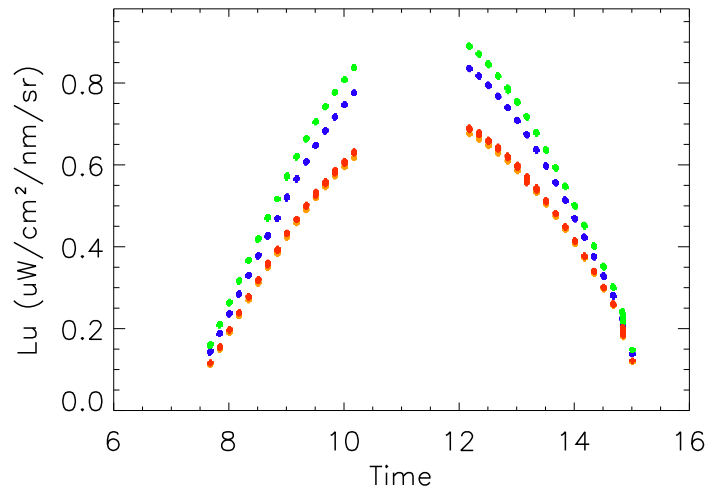
Multi-Eu4

Multi-Eu9

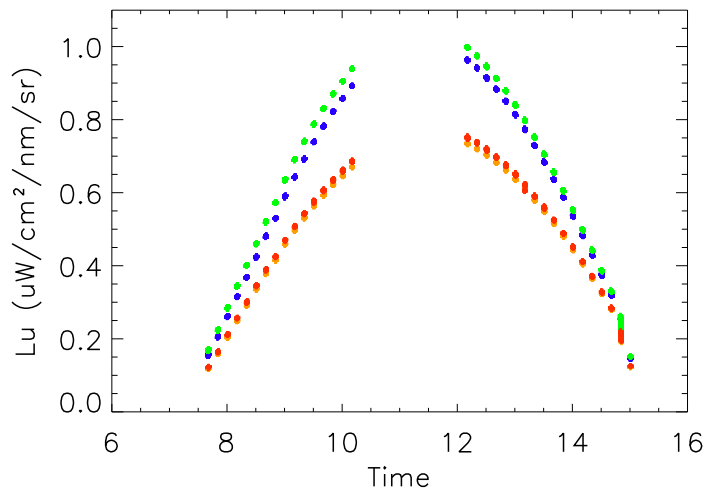
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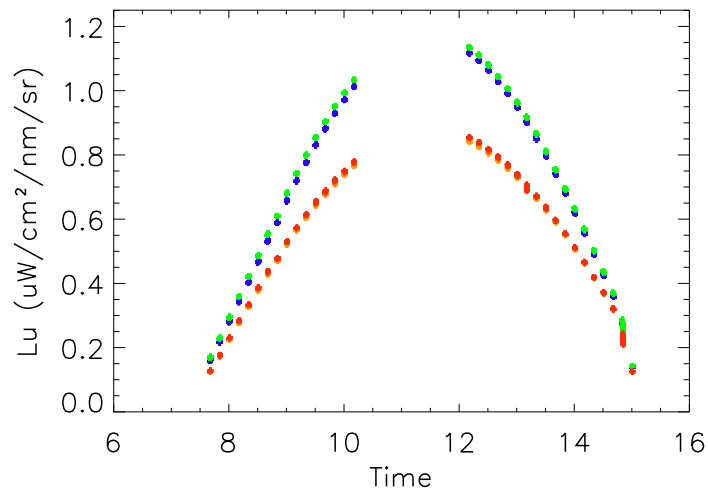
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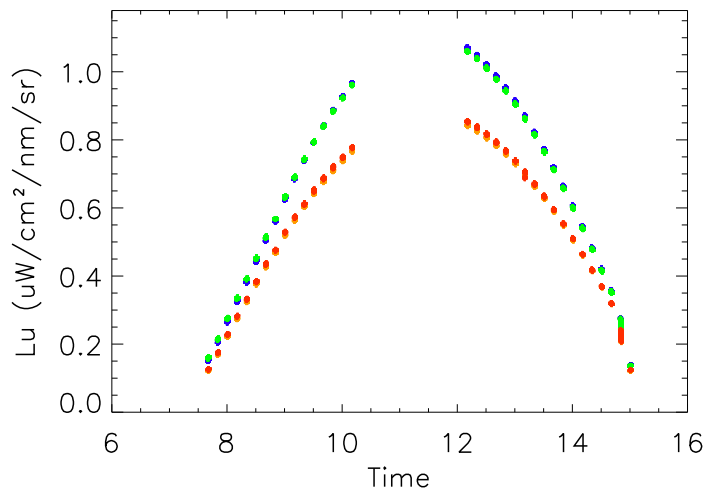
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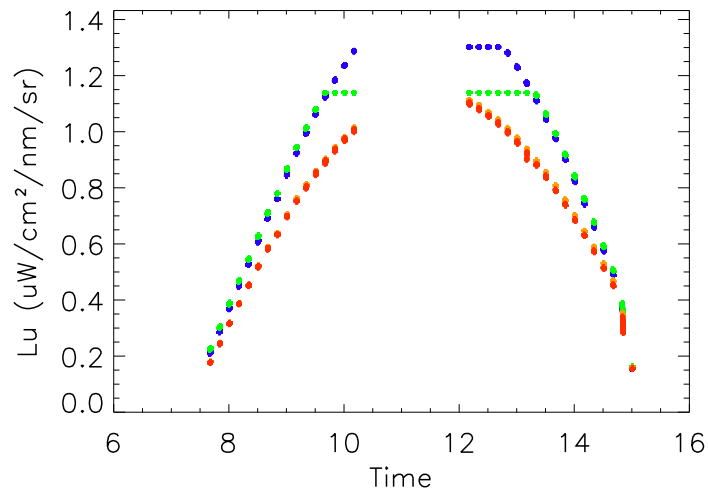
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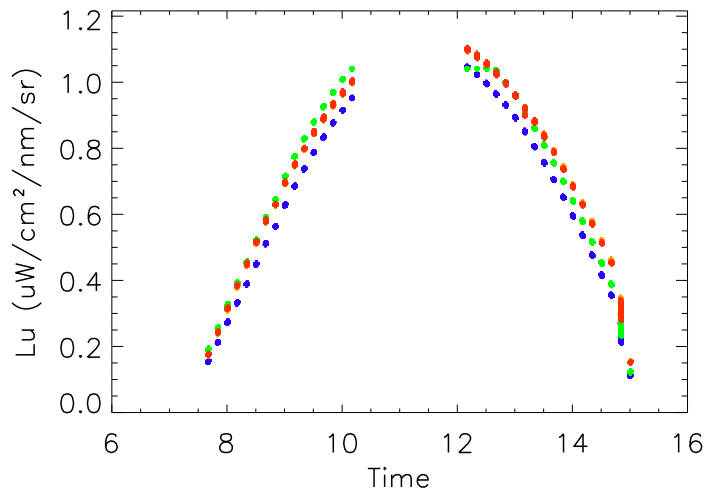
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665.300



683.800

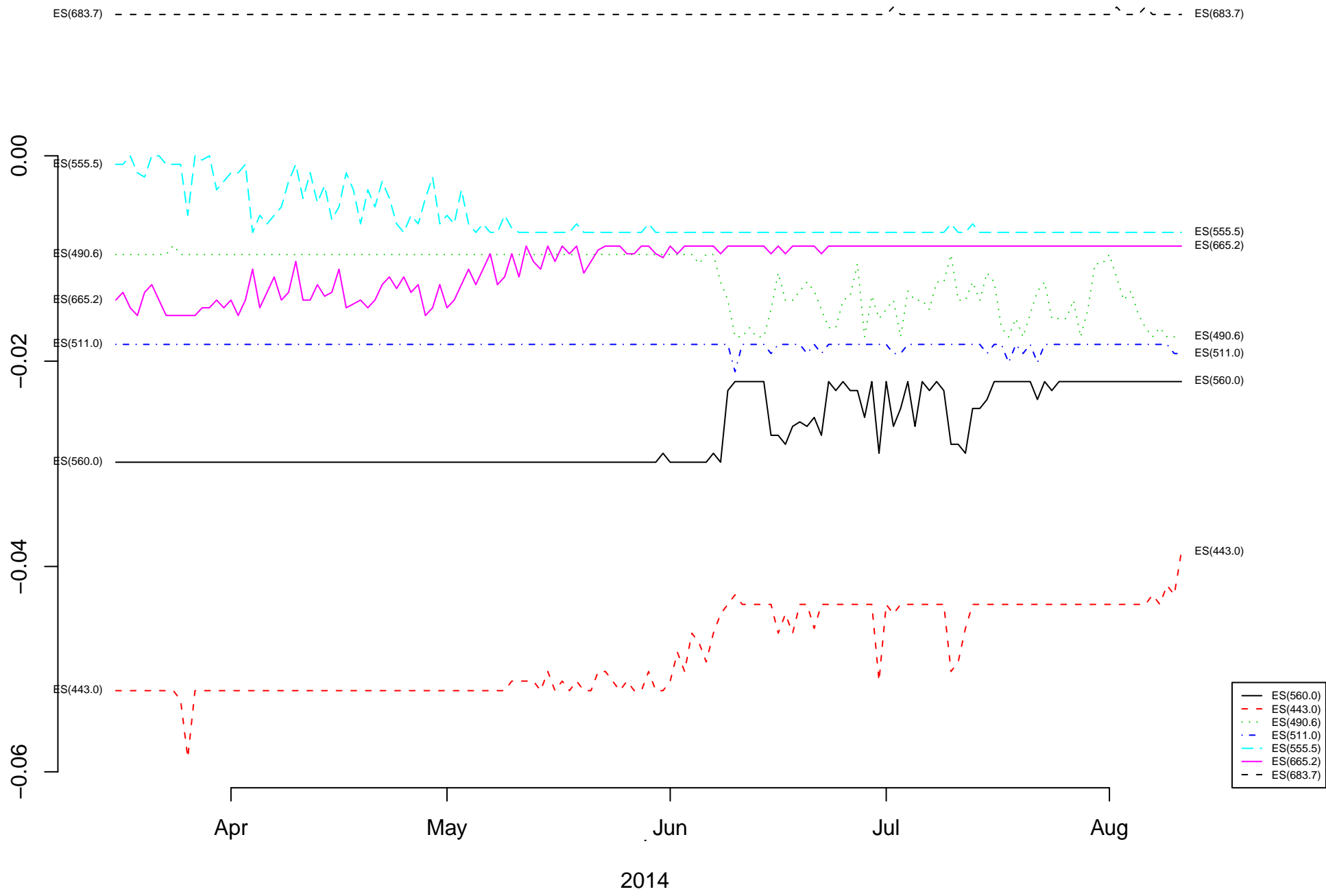


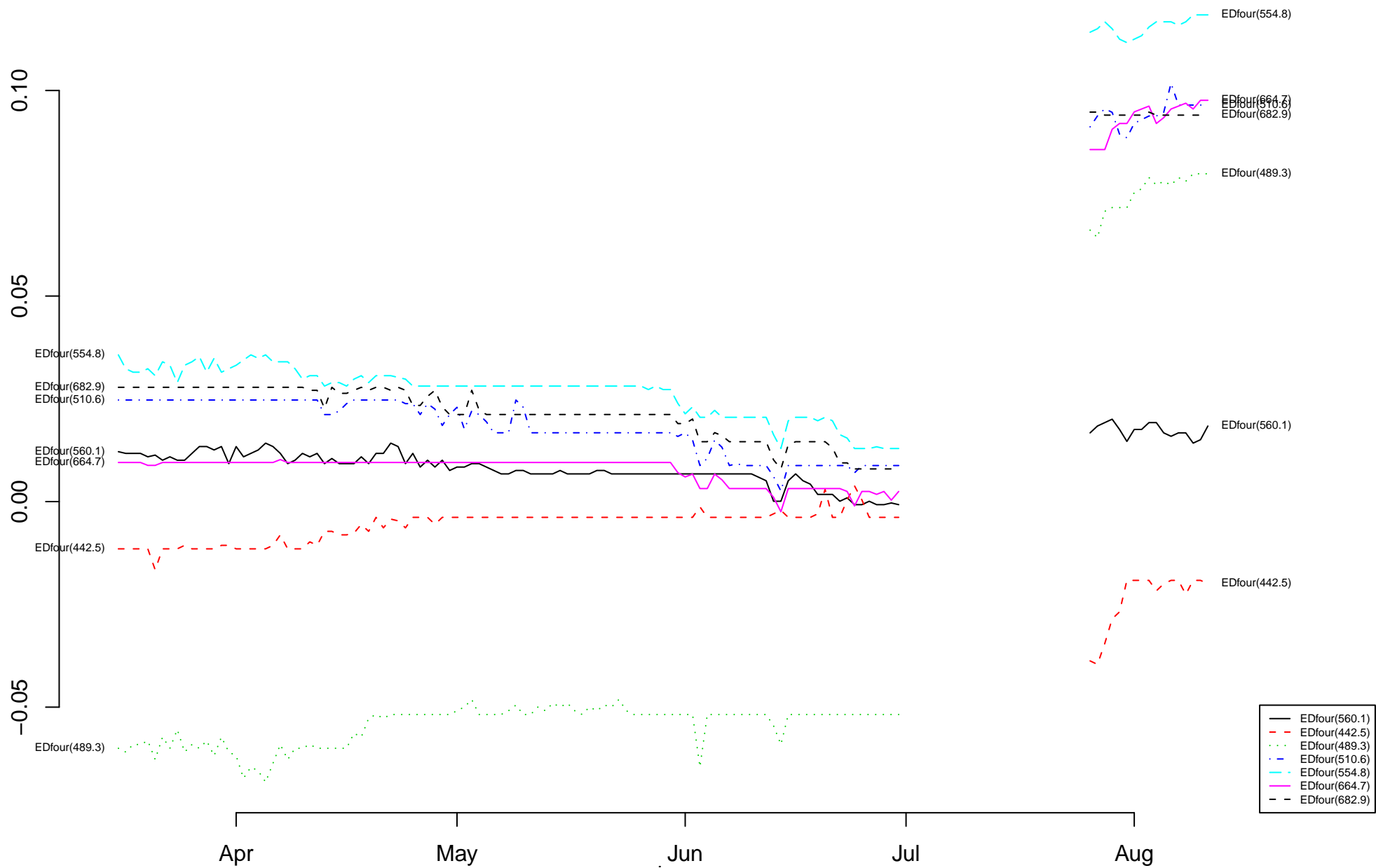
Multi-Lu4

Multi-Lu9

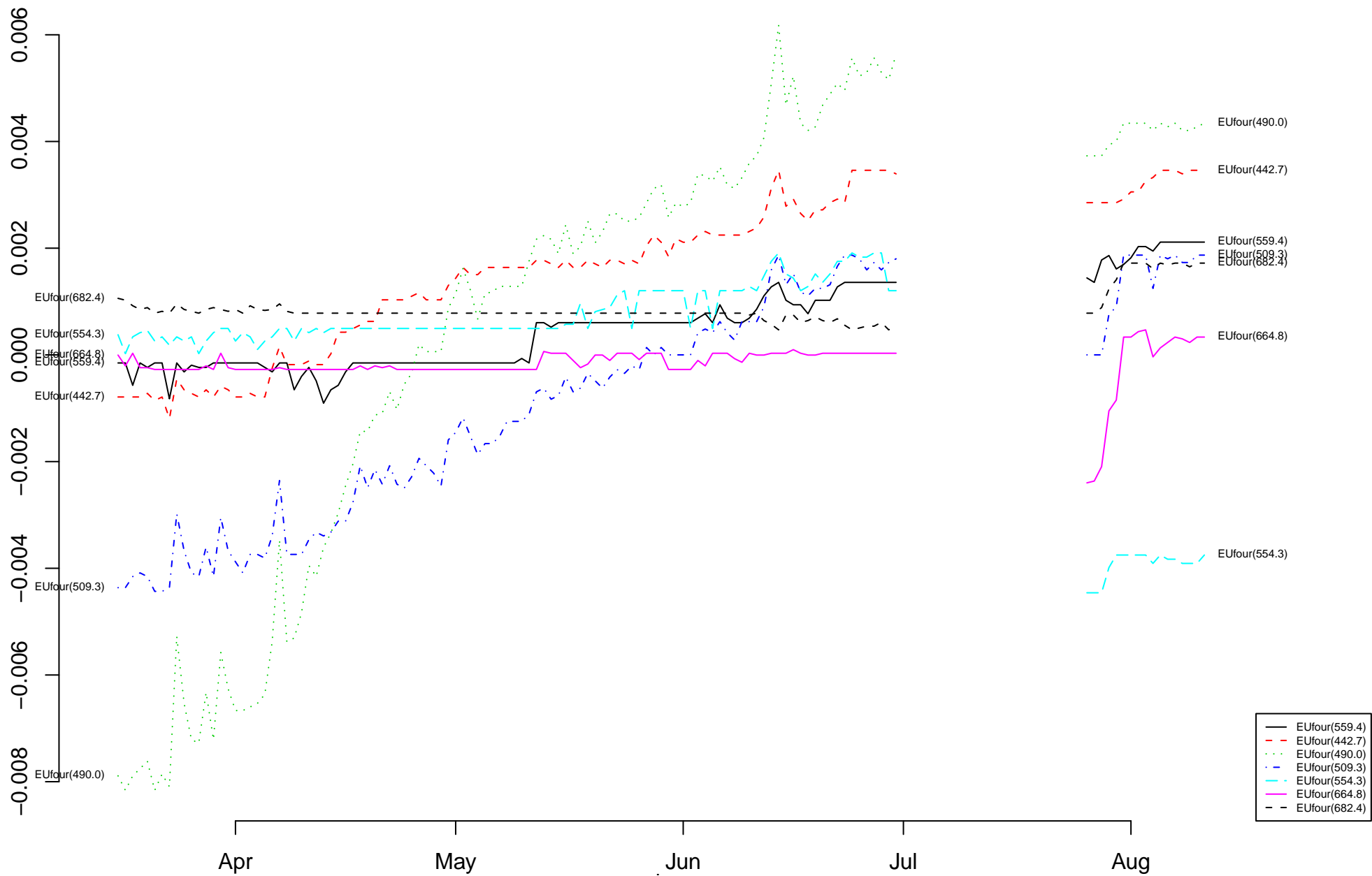
Hyper-Lu4

Hyper-Lu9

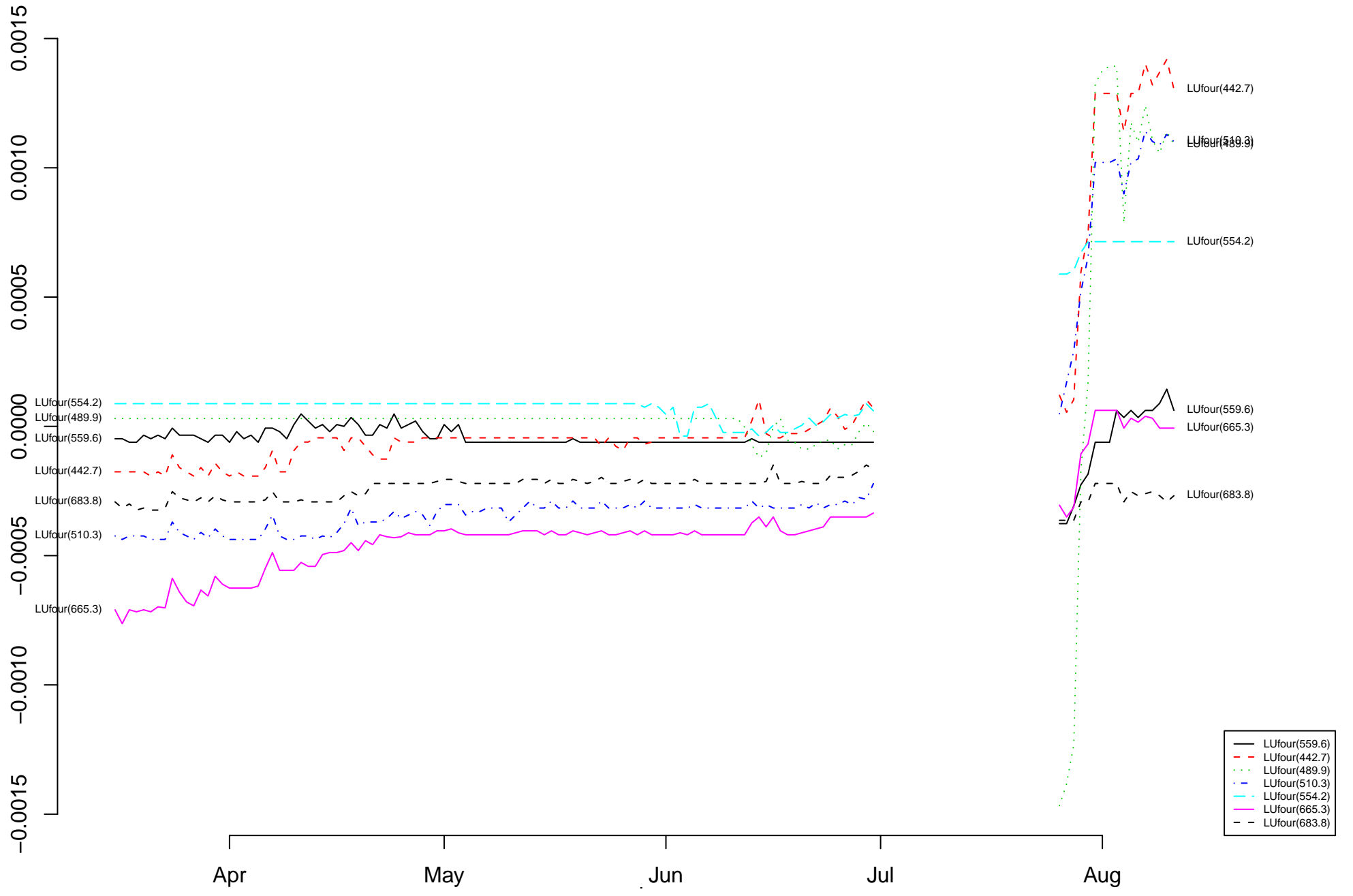




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