ADA/ADC Meeting

Introduction

Jean-Pierre Revol

December 19, 2018

AGENDA

ADA/ADC meeting

Wednesday 19 Dec 2018, 15:00 → 18:00 Europe/Zurich

301-R-007 (CERN)

Videoconference Rooms

ADA_ADC_meeting_ — Join

15:00 → 15:20 **Introduction** — 20m

Speaker: Jean-Pierre Revol (Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fer)

15:20 → 15:40 **Status of FDD prototype test** — 20m

Speaker: Christoph Mayer (Polish Academy of Sciences (PL))

15:40 → 16:00 **List of parts to prepare for wrapping FDD modules and procedures** — 20m

Speaker: Ildefonso Leon Monzon (Universidad Autonoma de Sinaloa (MX))

FDD-WRAP.pdf FDD-WRAP.pptx

16:00 → 16:20 **Systematics in diffraction cross section measurements** — 20m

Speaker: Ernesto Calvo Villar (Pontificia Universidad Catolica del Peru (PE))

16:20 → 16:30 **AOB** — 10m

ADA is gone!

Thank you Ildefonso!

AD Upgrade news

- Proposal presented in plenary during the ALICE week by JPR
- Well received by the ALICE Collaboration
  - Technical Coordination still asking to merge FDD with V0+ – We will do things in common as much as possible, how ever, the two detectors are sufficiently different that they require separate DCS, FEE firmware, data format, etc.
  - Luciano Musa pointed out that the pseudorapidity coverage of the upgrade ITS was wrong

Correction

- This table was wrong for the upgraded ITS

Detector	Pseudorapidity_min	Pseudorapidity_max
ADC	-6.96	-4.92
ADA	+4.78	+6.30
T0A+	+3.8	+5.4
V0A+	+2.2	+5.1
T0C+	-3.3	-2.2
MFT	-3.6	-2.45
New ITS (two inner layers)	-2.3 (was -1.75)	+2.3 (was +1.75)

Did anyone check these numbers as requested last week?

ITS acceptance

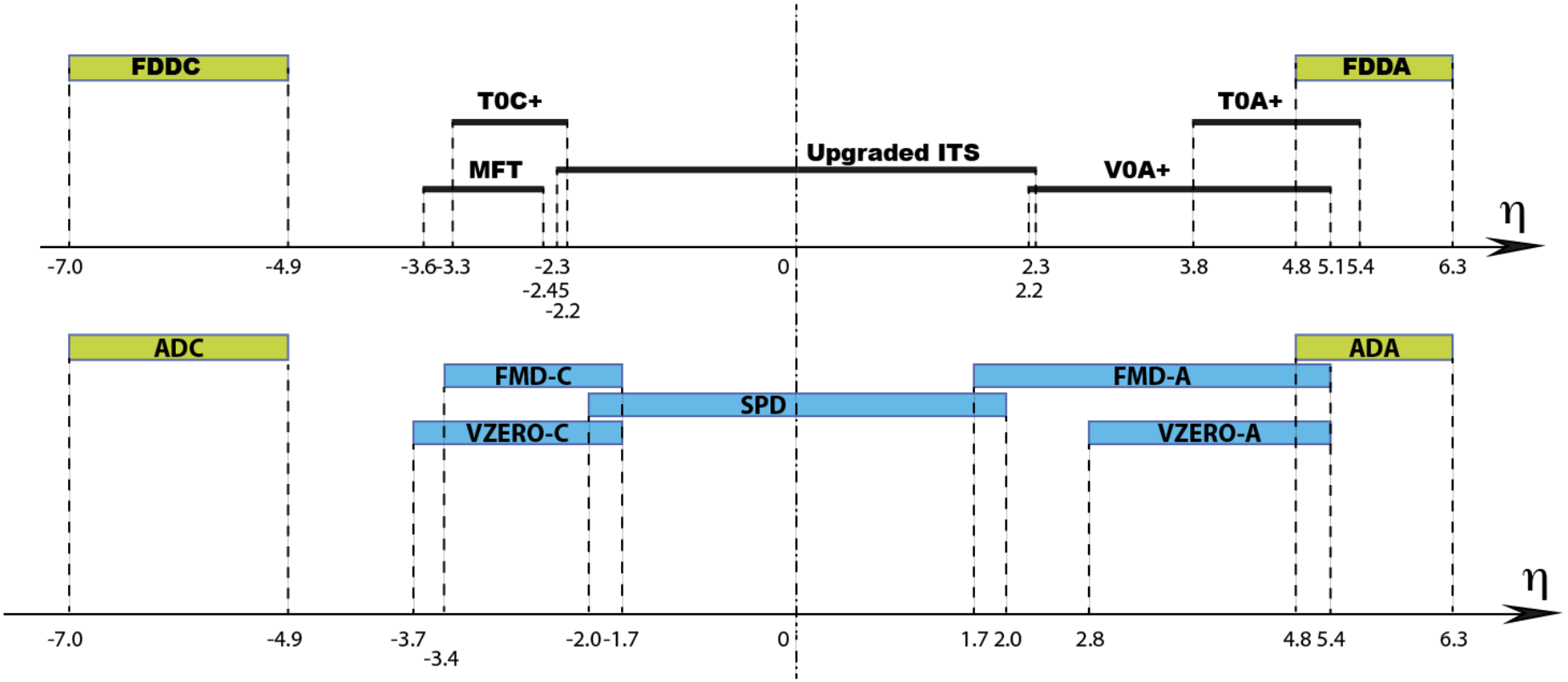
Table 1.1: Geometrical parameters of the upgraded ITS.

	Inner Barrel			Outer Barrel			
	Inner Layers			Middle Layers		Outer Layers	
	Layer 0	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6
Radial position (min.) (mm)	22.4	30.1	37.8	194.4	243.9	342.3	391.8
Radial position (max.) (mm)	26.7	34.6	42.1	197.7	247.0	345.4	394.9
Length (sensitive area) (mm)	271	271	271	843	843	1475	1475
Pseudo-rapidity coverage[a]	±2.5	±2.3	±2.0	±1.5	±1.4	±1.4	±1.3
Active area (cm^2)	421	562	702	10 483	13 104	32 105	36 691
Pixel Chip dimensions (mm^2)				15×30			
Nr. Pixel Chips	108	144	180	2688	3360	8232	9408
Nr. Staves	12	16	20	24	30	42	48
Staves overlap in $r\phi$ (mm)	2.23	2.22	2.30	4.3	4.3	4.3	4.3
Gap between chips in z (µm)				100			
Chip dead area in $r\phi$ (mm)				2			
Pixel size (μm^2)	$(20-30) \times (20-30)$			$(20-50) \times (20-50)$			

[a] The pseudorapidity coverage of the detector layers refers to tracks originating from a collision at the nominal interaction point ($z = 0$).

Corrected figure

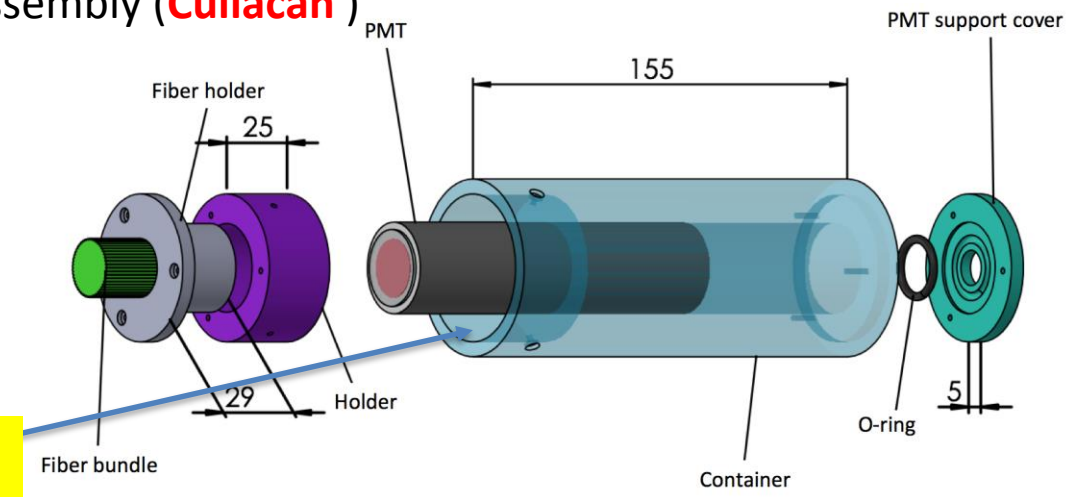
- Using ± 2.3 for the pseudorapidity coverage, to be consistent with what we use for the SPD



Updated in proposal

Organizational matters

- ADA dismounted by Ildefonso
- First meeting in 2019: Wednesday, January 9
- Priority work:
  - Validate PMT design and behaviour in magnetic field
    - Check that we have enough light and fix the simulation to reproduce the AD dada and then predict FDD performance. Do we need a larger diameter PMT?
    - Prepare proper packaging for new PMT (parts were missing for the test of FDD prototype with new PMT!!!) – we need a prototype of each part in the drawing, to make a test assembly (**Culiacan**)

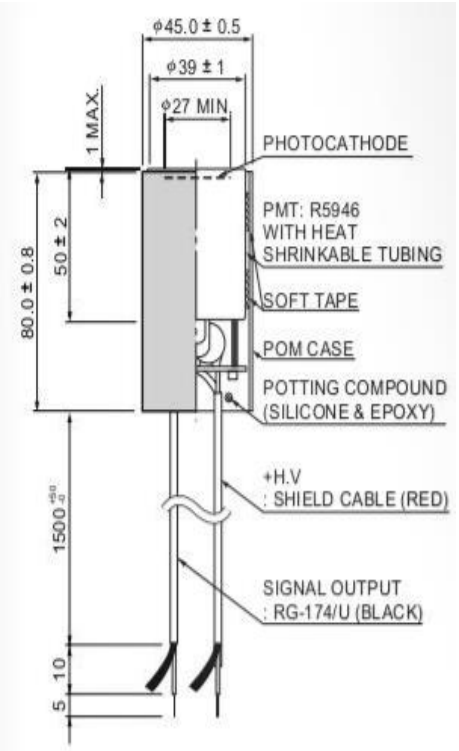


Something wrong here!
PMT in the air??

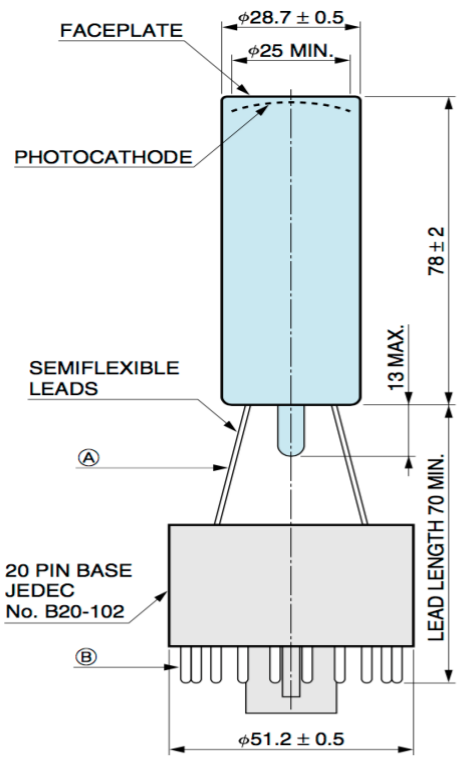
PMT choice

- Is the PMT diameter optimum?

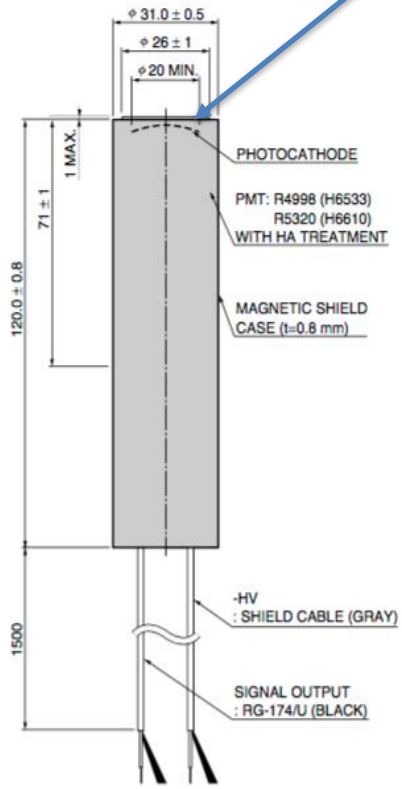
Effect of curved photocathode?

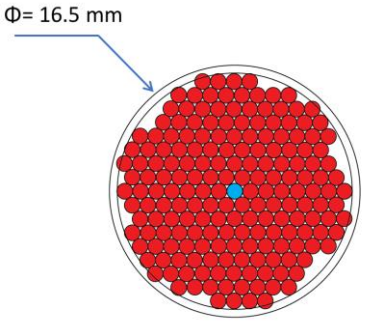


R5946 – H6153-70



R12844



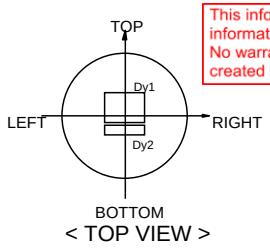


R4998-H6533

Photocathode uniformity

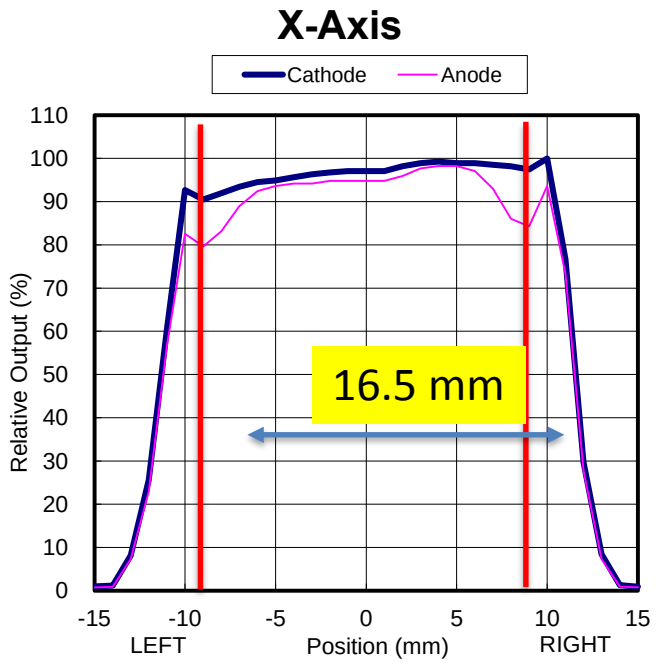
UNIFORMITY

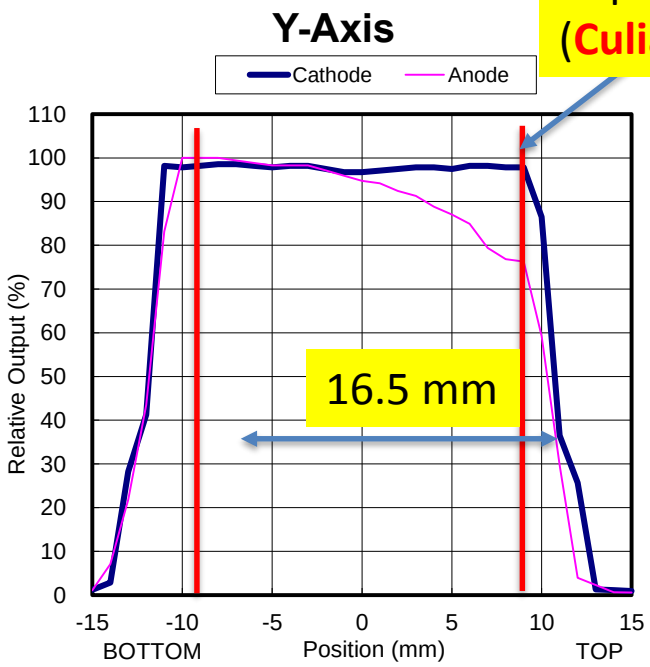
Type No.	: R4998	Spot Diameter	: 1 mm
Serial No.	: sample	Note	: -
Supply Voltage	: -2250 V	Test Date	: 2018/12/13
Wavelength	: 400 nm	Tested By	: k.hirano



< TOP VIEW >

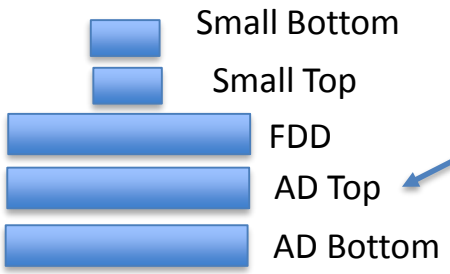
Implement in the simula
(Culiacan)



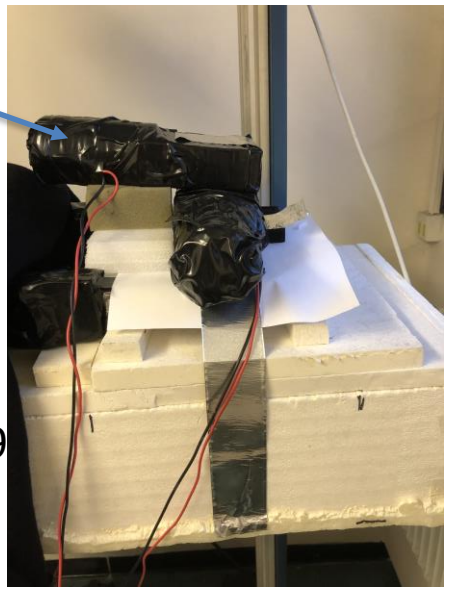


FDD prototype status

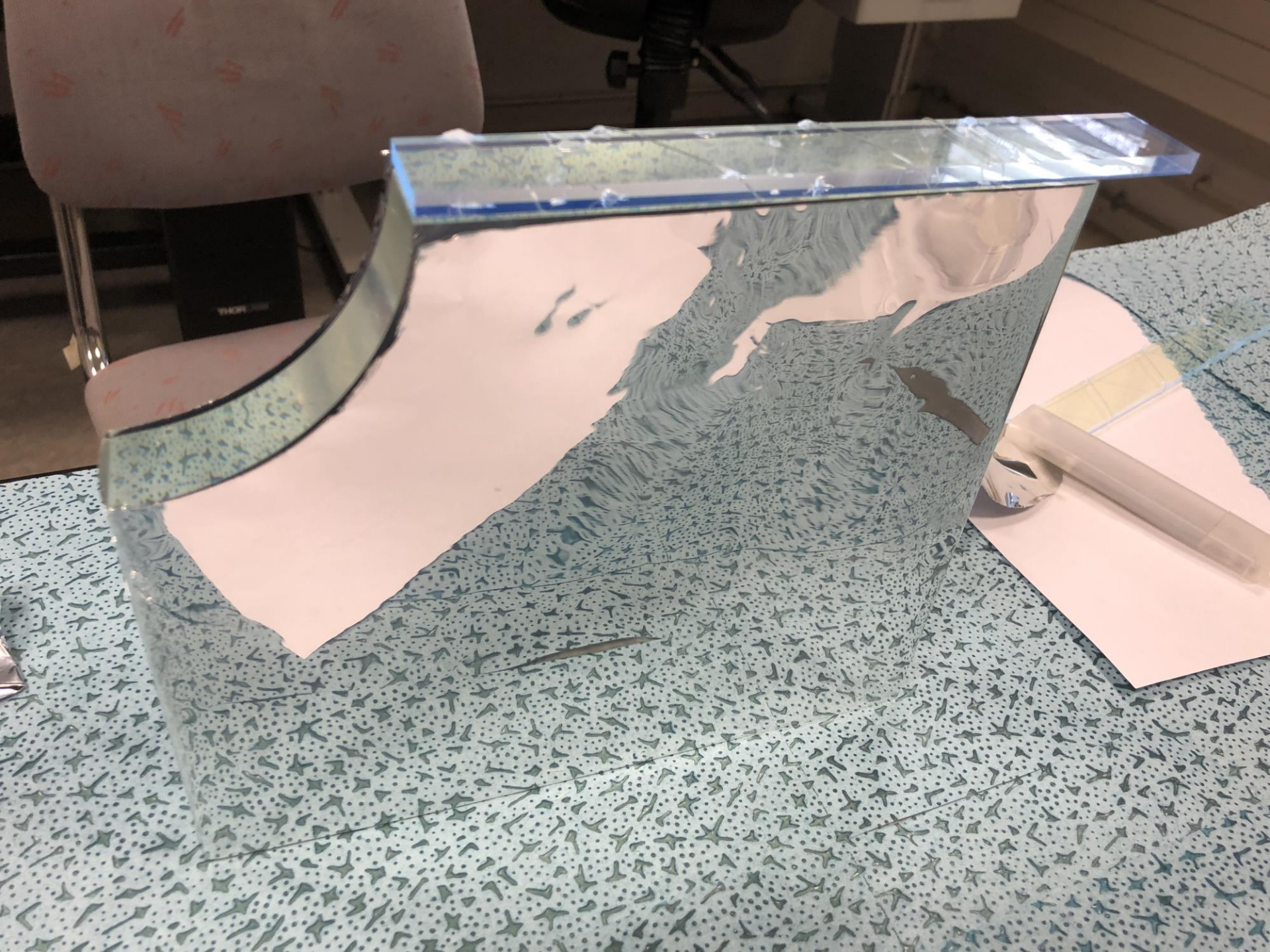
- The FDD prototype was prepared by Ildefonso (BC420 scintillator, new WLS (NOL 38))
  - The LED is installed but not connected
  - The fiber bundle were recovered from the AD! (no information about clear fiber ageing, and dimensions of fiber*). For clear comparison with the AD we need to make a new fiber bundle with unused fibers (**where are they?**), of same length as the AD prototypes.
  - The prototype was equipped initially with an AD PMT stolen from the AD top??
  - Wrong polarity applied to PMTs explaining why no signals!!
  - JPR installed another AD PMT on AD top, but it does not work very well, it has to be replaced!!
  - JPR installed the new (R4998 PMT) on FDD module, and we are plateauing the FDD



Does not work well

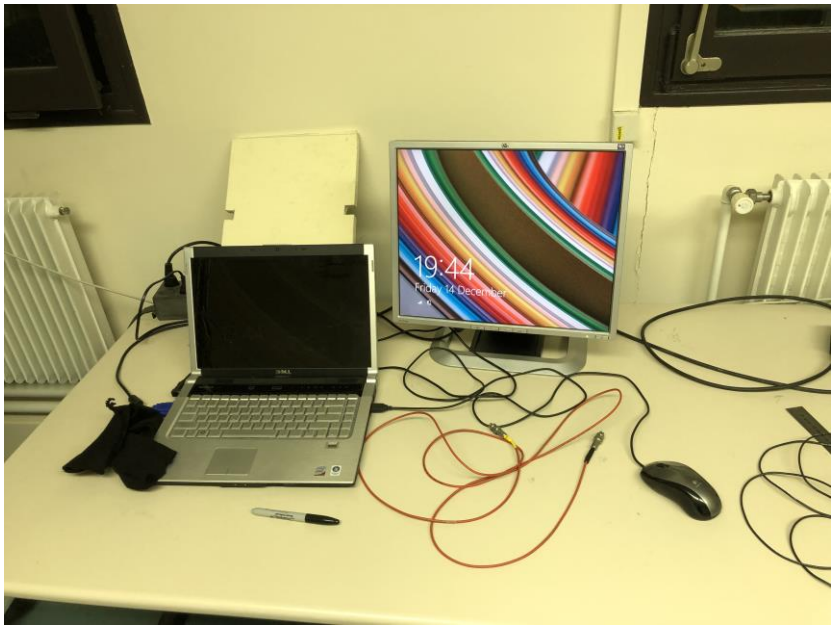


* For AD top the fiber length is 2.833 ns, or 57 cm (201202991.9



Reinstalling the test system

- Big effort with Christoph to get the system to work (There was NOTHING in any logbook on how to do this!!
  - New HV power supply found by Ildefonso (where is the one we had in the test system?)
  - New pulser had to be set up properly (40.078 MHz and 1 Volt amplitude peak to peak, with square wave)
  - The DCS lap top seemed to be dead. It was the screen, so we had to get an external display, and also the DCS software had disappeared, and had to be restored from old backup!! Again, no records of parameters to setup CIU, CCIU, etc.
    Can we buy a proper lap top, this one we have is more than 10 years old! Also it had wrong keyboard setting, making it impossible to type character "#"
  - CIU crate had heating problems, solved with extra fan at the top
  - JPR cleaned up the 595 room, which was a mess!




V0
Detector Control Agent
SAMSUNG
CAEN SY4527LC


CAEN SY4 27LC

Applications Places System

en Sat Dec 15, 15:43:46

V0_DCA

File View Options Permissions

V0
Detector Control Agent

HI running on ada-test with PID 30116

DCA

STANDALONE

FERO status: READY

RUN number: 8789 RUN type: STANDALONE_PULSER

Parameters and Options for STANDALONE runs

HLT mode A | LDC: Local Recording ON | GDC: Event Building OFF

Access rights granted to the DCA

DCS/RUN_CU	HLT	DAQ_RC	LTU
READY / RUN_OK	INITIALIZED	RUNNING	STANDALONE_RUNNING

DCA info: 19:56:28: {V0} Start LTU and take data

V0_SD

LDC status display

LDC name	aloneldc
host	ada-test
Number of equipments	1
Number of triggers	128885
Current Trigger rate	1.4
Average Trigger rate	1.8
Number of sub-events	128886
Sub-event rate	1
Sub-events recorded	128888
Sub-event recorded rate	1
Nb. evts w/o HLT decision	0

DATEV0_DAQ::V0_CONTROL

Status updated

V0
DAQ - Run Control

HI running on ada-test with PID 4098
RC running on ada-test with PID 27301

Disconnected Configuration	Connected Run Parameters	Ready to start	Data Taking
Define	Define	Start processes	Start
Show	Show	EDM	Stop
		HLT: mode A	Fast Stop
		LDC: Local Recording ON	Abort
		GDC: eventBuilding OFF	
		Full EOR	

RUN NUMBER : 8789 Run Control Status : RUNNING

(64-bit)

untitled folder

Quit Archive Filters Export

Severity Level Date Time 0 decimals Host Role Pid

Severity	Time	Host	Facility	ErrCode
Info	19:56:28	ada-test	runControlHI	
Info	19:56:28	ada-test	runControlHI	
Info	19:56:28	ada-test	runControlHI	
Info	19:56:28	ada-test	runControlHI	
Info	19:56:28	ada-test	runControl	
Info	19:56:28	ada-test	DCA	
Info	19:56:30	aco-vme	LTU_V0	
Info	19:56:30	aco-vme	LTU_V0	
Info	19:56:30	aco-vme	LTU_V0	
Info	19:56:30	aco-vme	LTU_V0	

Time Level Severity Hostname Rolenam

min. max. daq match exclude

Online

Browse errors: << < > >>

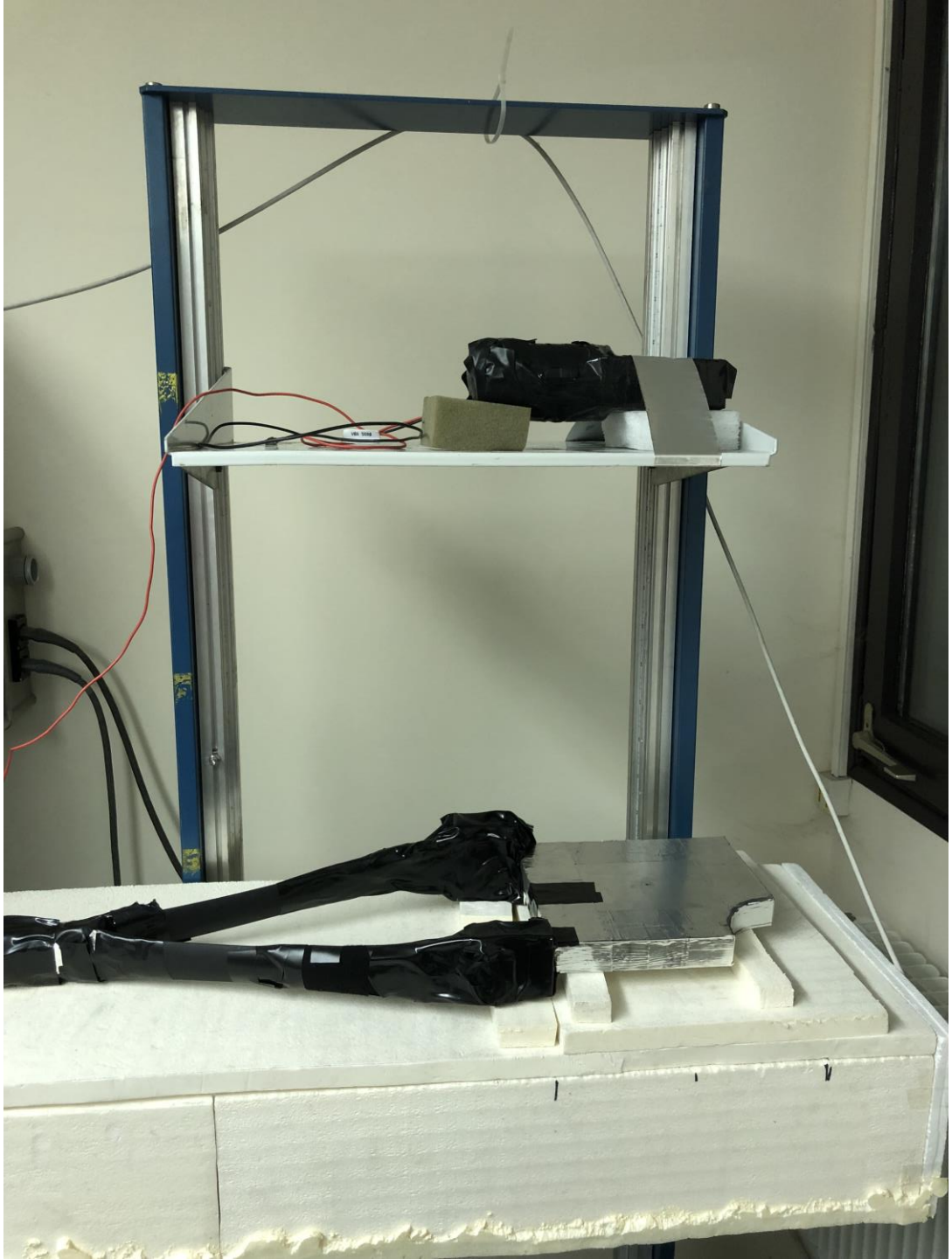
Messages: Clean now Auto scroll Auto clean

CONCLUSION

- We now have a working system to study properties of the FDD
- We plan to run it with cosmics during the Christmas period
  - Plateauing FDD to get it under optimal conditions
  - Studying properties with one MIP particles
- Next checks to validate BC420, NOL 38, PMT R4998
  - Timing comparisons to be made in January in collaboration with Christian Joram, using a precise LED
  - **We need to have the full system to mount and dismount the new PMT. Can Culiacan do this urgently ? Check the tolerance for the cylindrical holder diameter, it should not be too lose or too tight**
  - Magnetic shielding to be designed and built by JPR and tested using the test system in a magnetic field in building 21
  - Christian Joram to measure the properties of the two BC420 modules (A type) received from Russia (attenuation length, and emmission spectrum) – They also have to be polished

New modules from Russia

- With these modules we can make new prototypes with new WLS
  (5 times and 10 times less dopant)
- So we will have a full comparison to validate WLS



Organizational Matters

- **Status of proposal**:
  - Sent out to the Collaboration
  - Federico Antinori scheduled a presentation at the ALICE Week on Tuesday 11 December at 11:30, for 45' + discussion.
  - We plan to make a final update on Friday December 7, after we get comments from
    - Guillermo Contreras Nuno (Czech Technical University, Prague)
    - Alberto Gago Medina (Pontificia Universidad Catolica del Peru, Lima)
    - Gerardo Herrera Corral (Cinvestav, Mexico City)
    - Alexeii Kurepin (INR, Moscow)
    - Christoph Mayer (Polish Academy of Sciences, Krakow)
    - Ildefonso León-Monzón (Universidad Autonoma de Sinaloa, Culiacan)
- If someone else wants to read it, just send me a request. The document is not public until it bis released as final.
- Most likely a presentation at the LHCC will be required, if the ALICE Collaboration approves the request

Organizational Matters

- We will combine dismounting of the ADA with the test of the FDD module:
  - **We need a list of all material needed to prepare the prototype module…**
- Good news, Christoph will be present at CERN, so he can help wioth the test

List sent by Ildefonso

List of materials
scintillator
WLS Bars
fishing line
Glue
Mylar
silicon
aluminum cover(with one dark face)
Kapton tape
LED
Scalpel knife
Gloves without dust

Updated list by JPR & Ildefonso

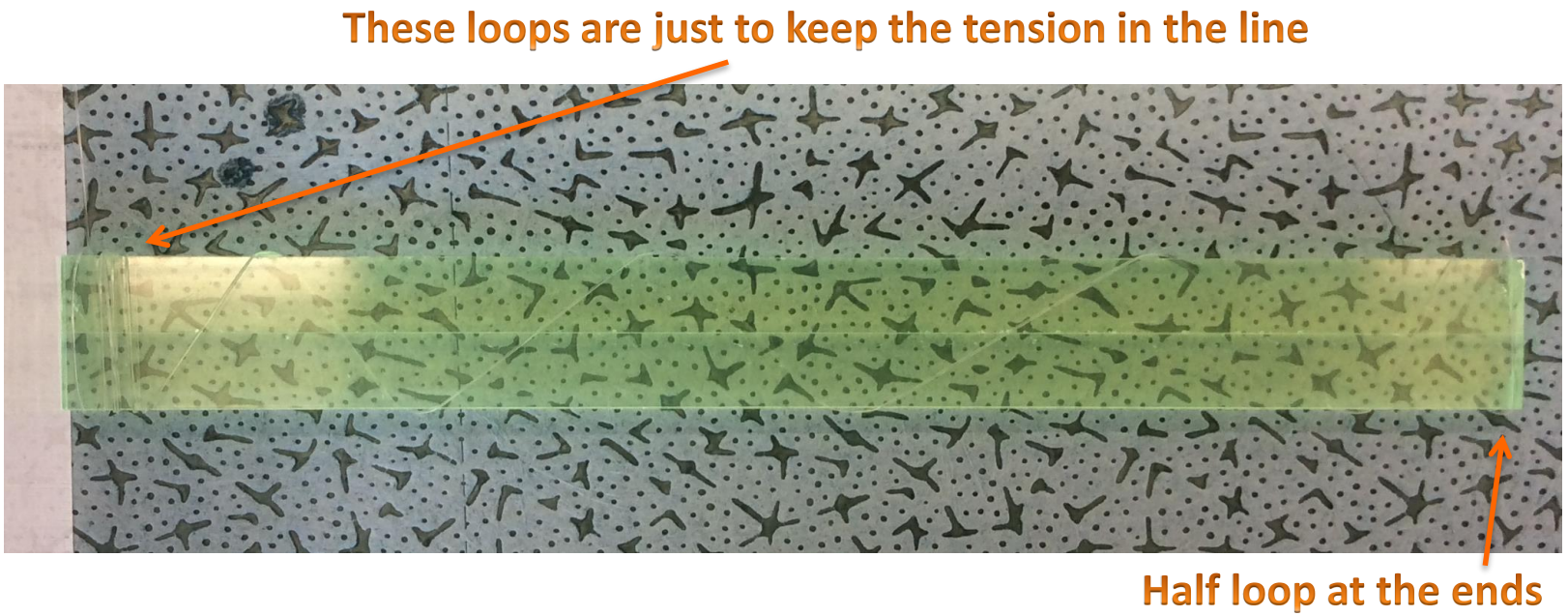
List of materials
scintillator (BC 420)
WLS Bars (NOL 38)
fishing line (**diameter?**) **0.4 mm**
Glue (EJ500)
Glue for fishing line (**specification?**) **37.25.30.152.3 - RESINE EPOX.ARALDIT 2011 2X140ml**
Mylar
Silicon (what is this?) **This was used to fix an small rectangular piece of mylar at the end of the WLS bar, the silicon will fix this reflector.**
aluminum cover (with one dark face) **What is this? Is it the aluminum foil for wrapping the module? What was the thickness?** **This material has two faces: One Black and another aluminized. AD shows only the Aluminized face, the black face is inside, in contact with Mylar.**
Kapton tape: **One tape is enough. 04.94.70.100.3 - SELF-ADHESIVE TAPES FOR ELECTRONICS – KAPTON (Name at CERN store)**
LED (**please find out if there are better LEDs we can use? The peak light in BC420 is at 390 nm**) **Already ordered, the model selected is UV3TZ-395-30, follow the next link : https://www.mouser.mx/datasheet/2/50/UV3TZ-XXX-XX-881014.pdf**
Scalpel knife
Gloves without dust
Black Tivek
Teflon tape
Dielectric tape
Connectors between WLS and Fiber bundles (**Do we have some left over from the AD? If not can you machine them in Mexico?)** **We have two of these connectors in Mexico city, I will look for this next monday.**

Pad and WLS-bar preparation

- Wrapping will be in the scintillators workshop
- The use of gloves is mandatory
- Clean WLS bars and scintillator, with water and soft soap to remove grease.
- Air flow to remove any dust.
- AVOID the use of alcohol in acrylic pieces. One piece of acrylic was cracked when alcohol was applied.

WLS bars

- Once the WLS bars are cleaned, place fishing line and fix it with a small drop of glue.

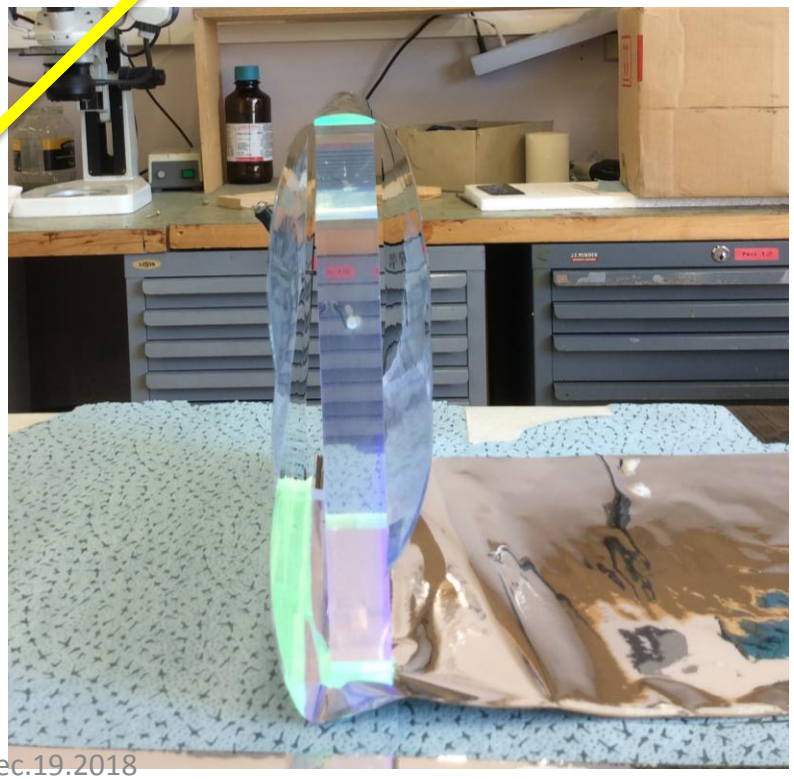


It may take 24 hours to dry.

Not optical glue rather Fast irondy

Scintillator Pad and WLS bar

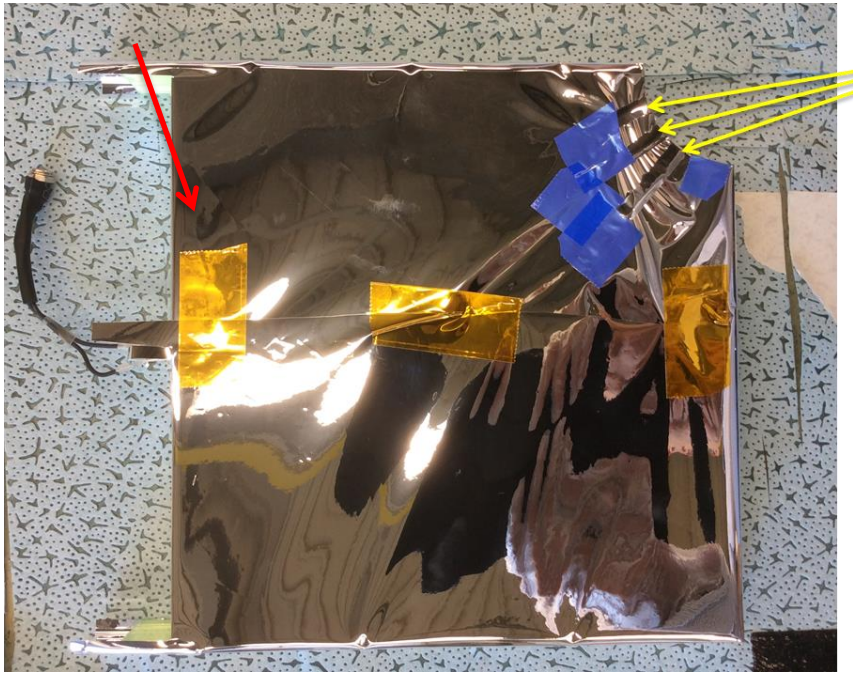
- Glue WLS bars with the Pad with a small drop of glue.
- Glue the LED
- It may take 24 hours to dry



Module wrapping

- The scintillator should be wrapped first with aluminized Mylar, - from the scintillators workshop -.
- The special Mylar supplied by Jean-Pierre was placed on top and bottom of the WLS bars.

LED connector



small pieces of Mylar were used as tensioners.

improve

The wrapping in the circular face is difficult

Black cover

- Wrapping with a black cover.

Connector for the WLS bars

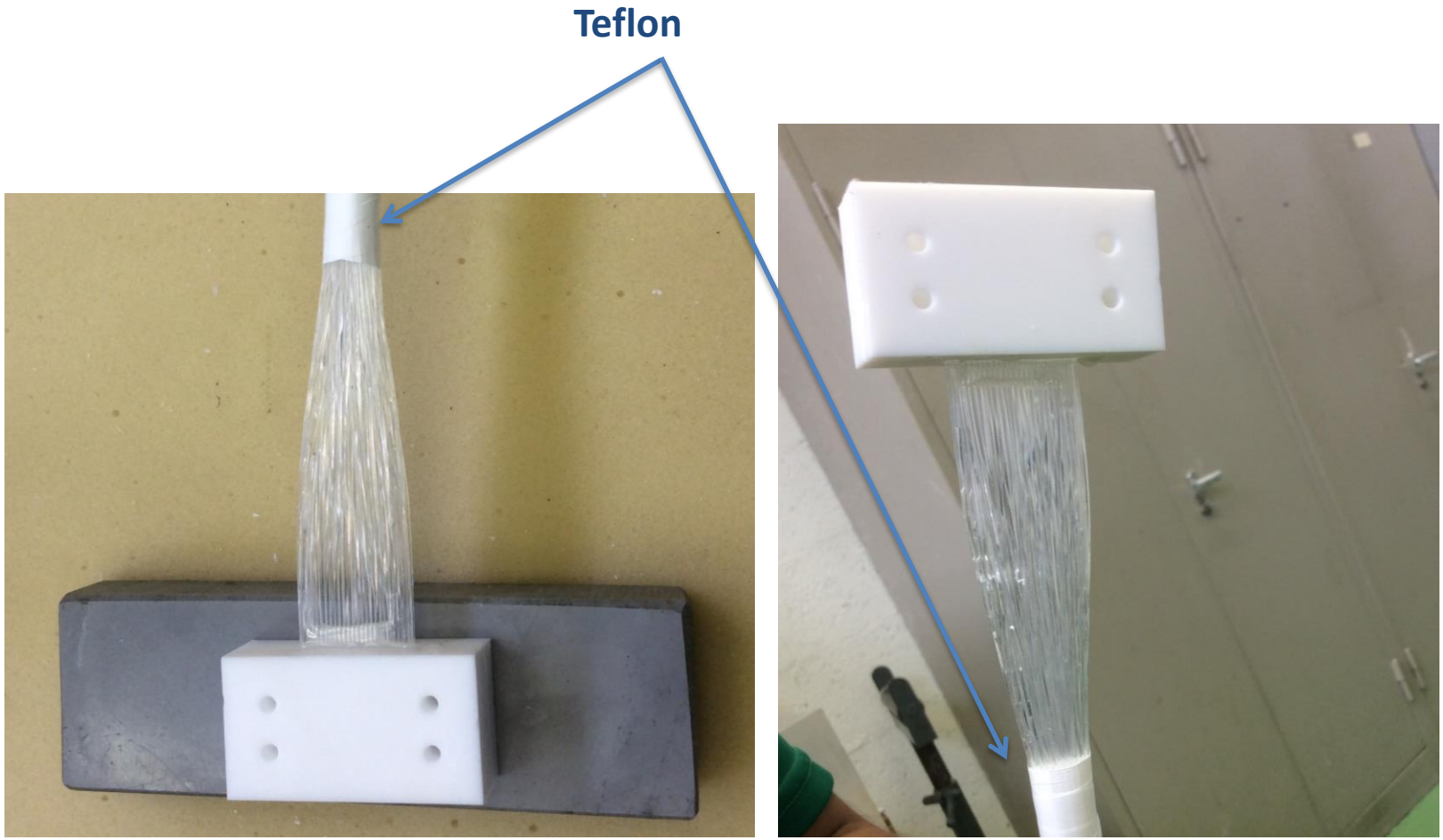
connectors production, each one with 96 clear fibre

The Teflon mould use to accommodate the fibres. Fill with optical cement (EJ-500) from Eljen, the space between fibres.

- 24 hours to dry -

Fibers wrapping reflection

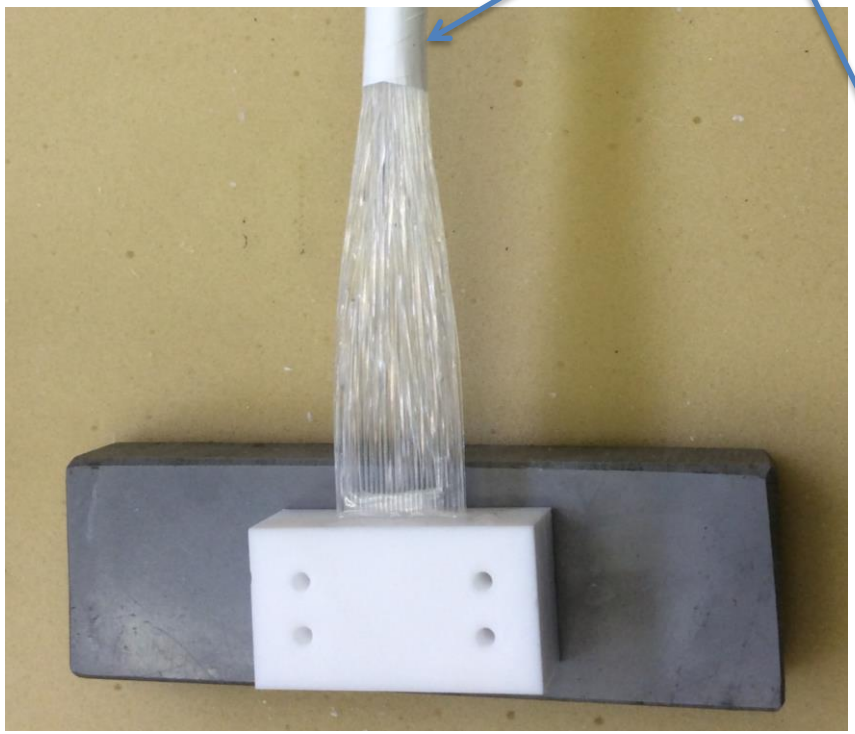
Teflon wrapping of the fibers



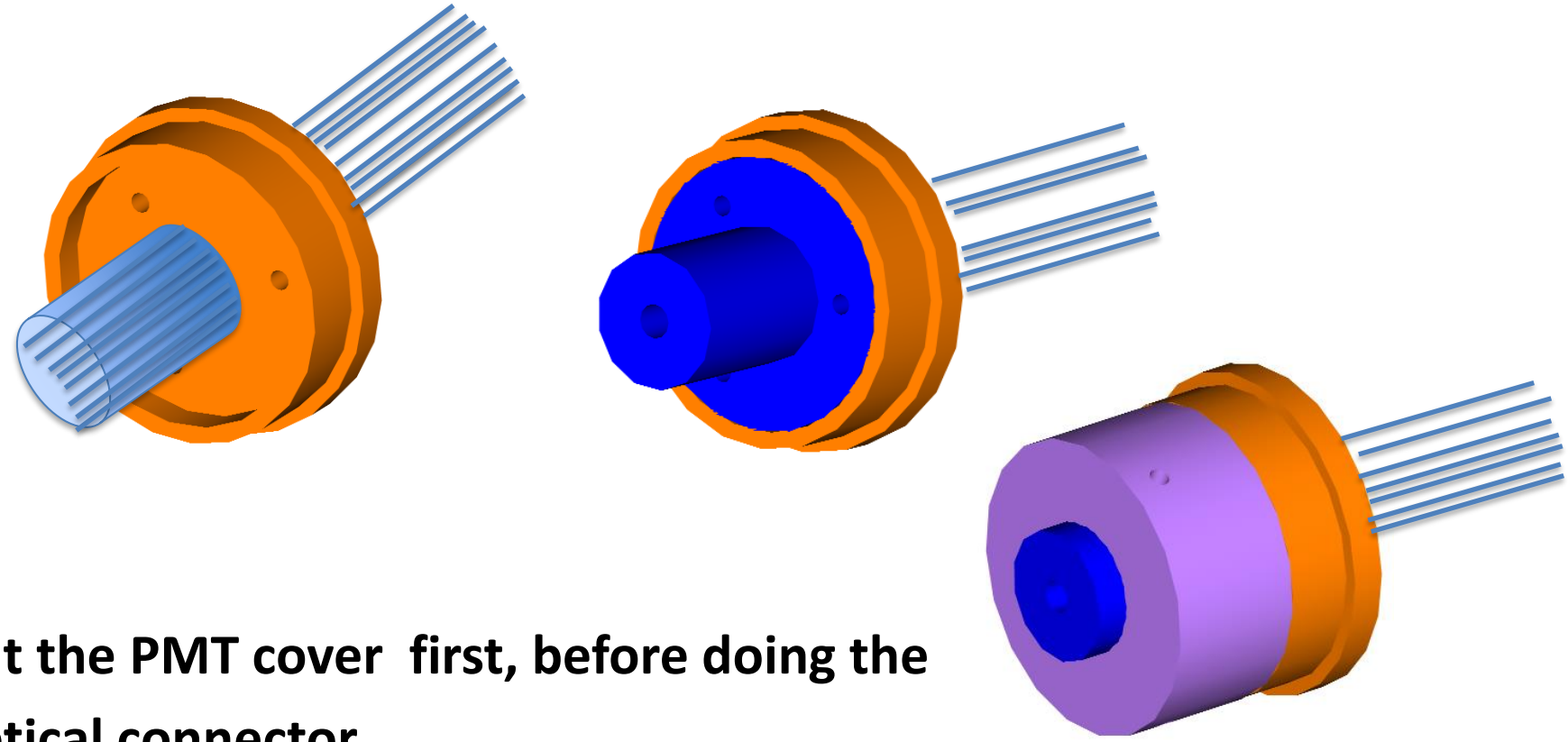
Fibers wrapping black

Teflon wrapping of the fibers

Black tape



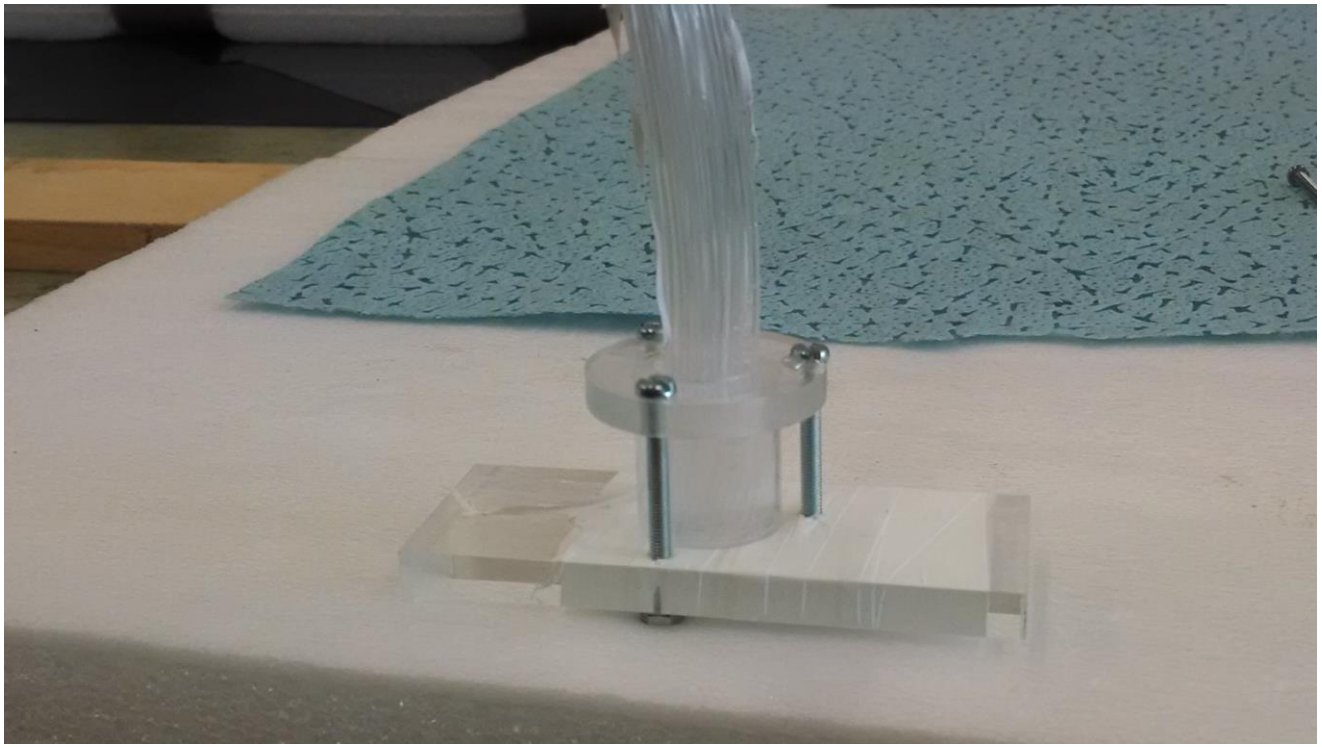
Previous to connector for the PMT



Put the PMT cover first, before doing the optical connector

IMPORTANT !!!!!!

Connector for the PMT



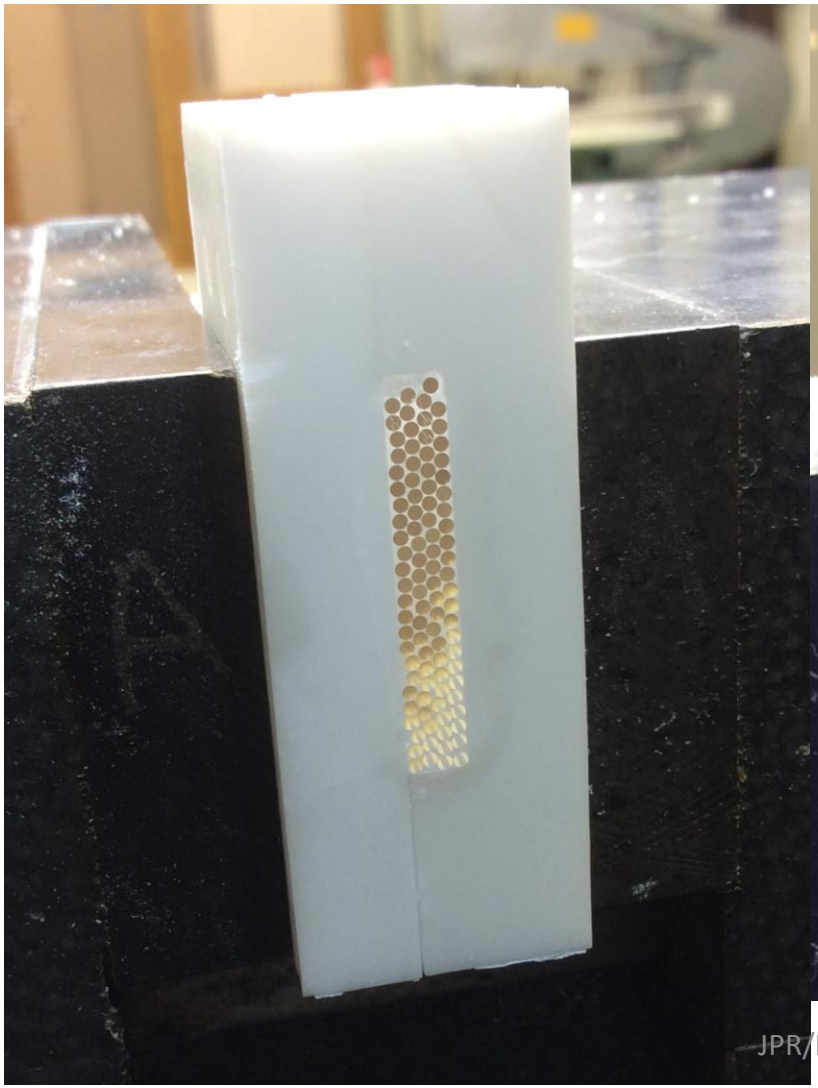
Put 96 fibres into the center of the acrylic connector

Fill with optical cement the space between fibres and connector

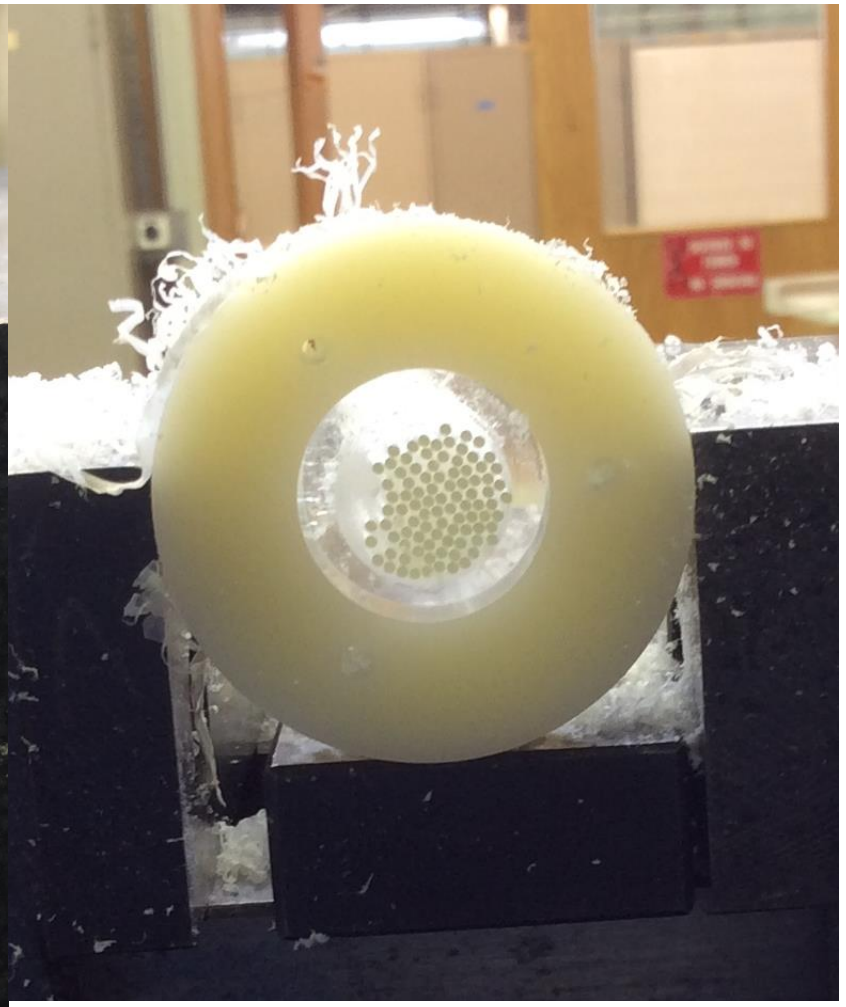
- 24 hours dry -

Connectors after machined

WLS bar connector

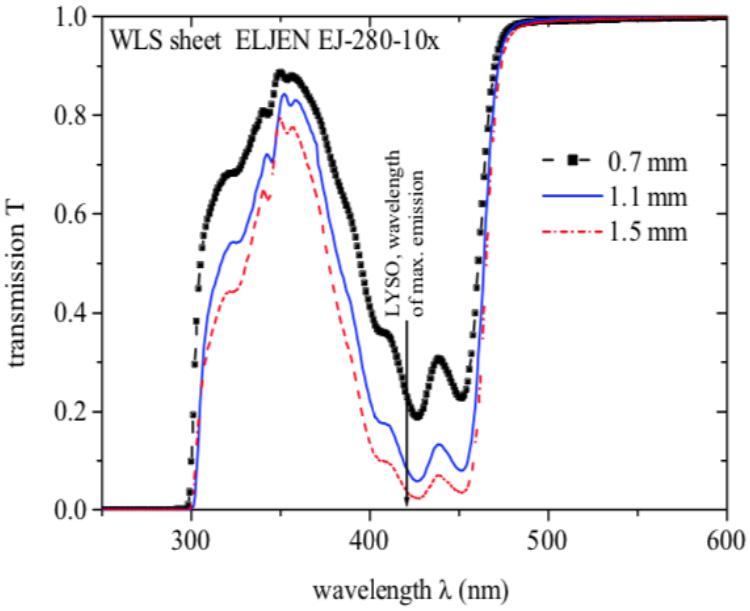


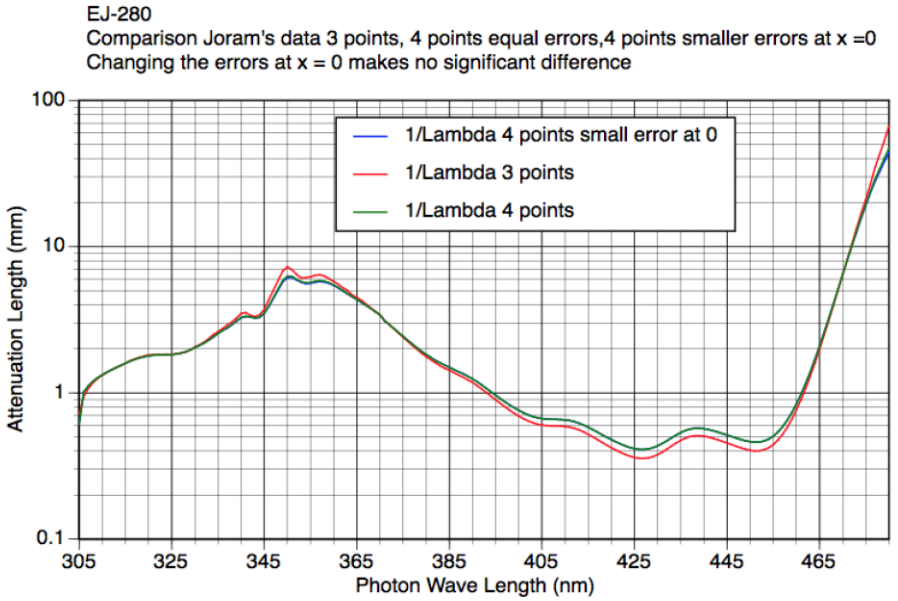
PMT connector



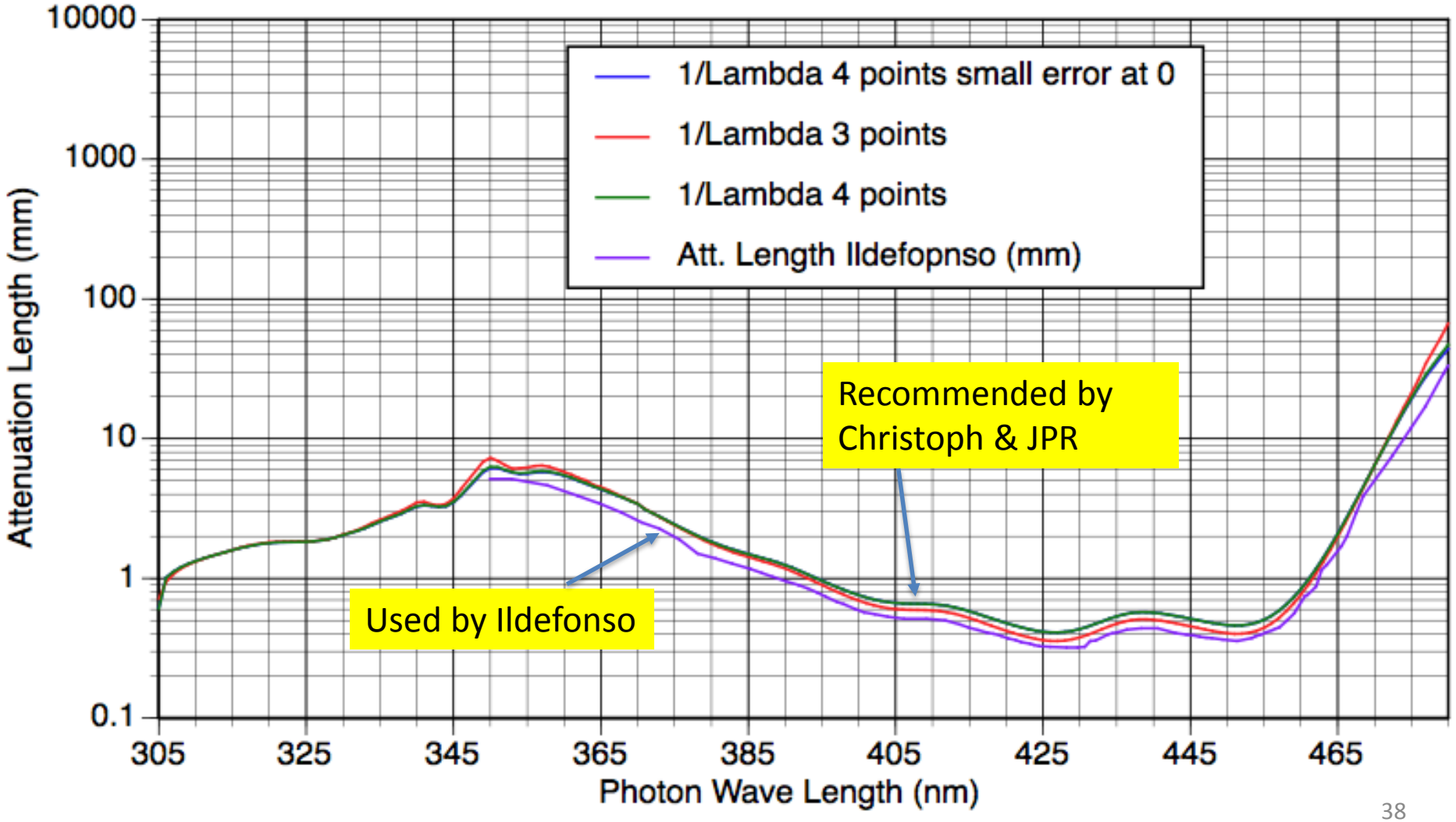
Absorption length in WLS

- For EJ-280! It is based on a measurement from Joram et al.
- Ildefonso to check the sensitivity of results to the variation of the fits (should be available today)



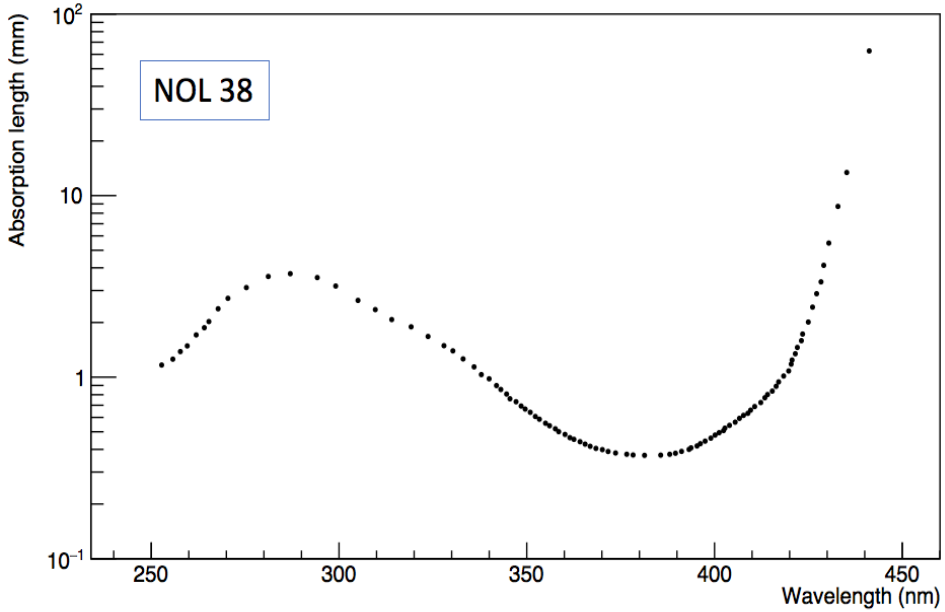


Absorption length in WLS



Absorption length in WLS

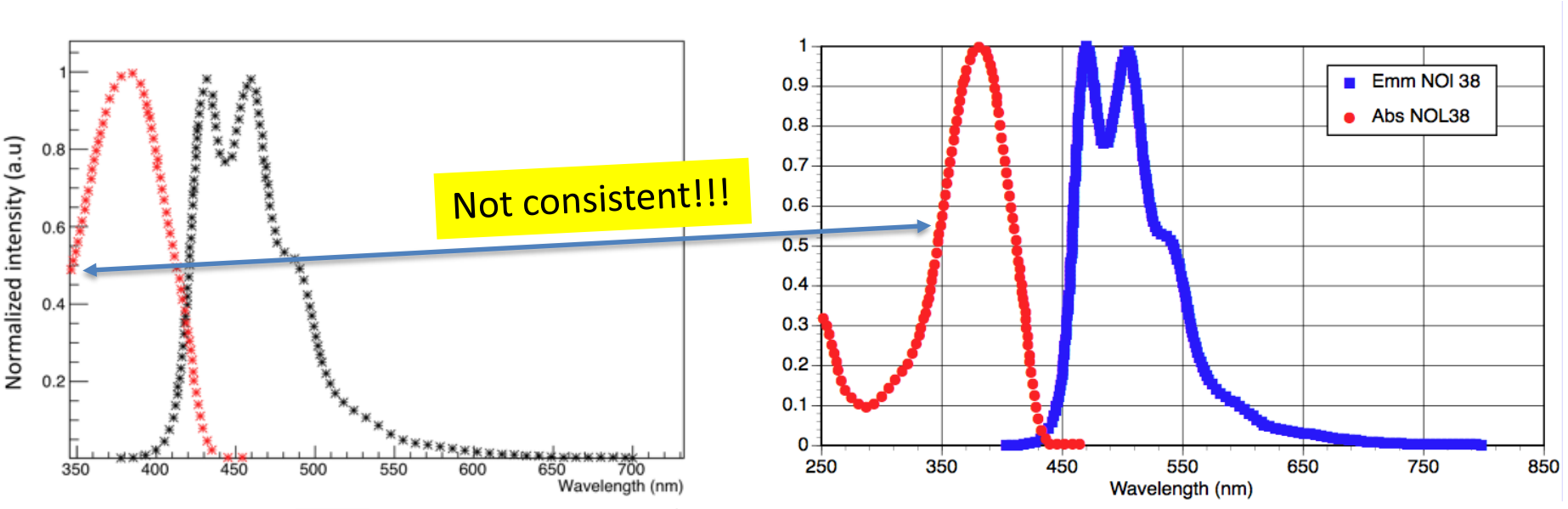
- For NOL 38 we still need some check that the data are correct as they are significantly different from EJ 280
- Joram's group is measuring it, using the WLS prototypes. Results by the end of this week.
- In order to cross check their measurements they will also re-measure the absorption length in the EJ 280



Other issues concerning NOL 38:
– reduce the dopant concentration as the absorption length seem to be 10 times smaller than for EJ 280, which is not
– check explicitly the effect of reabsorption in the overlap region

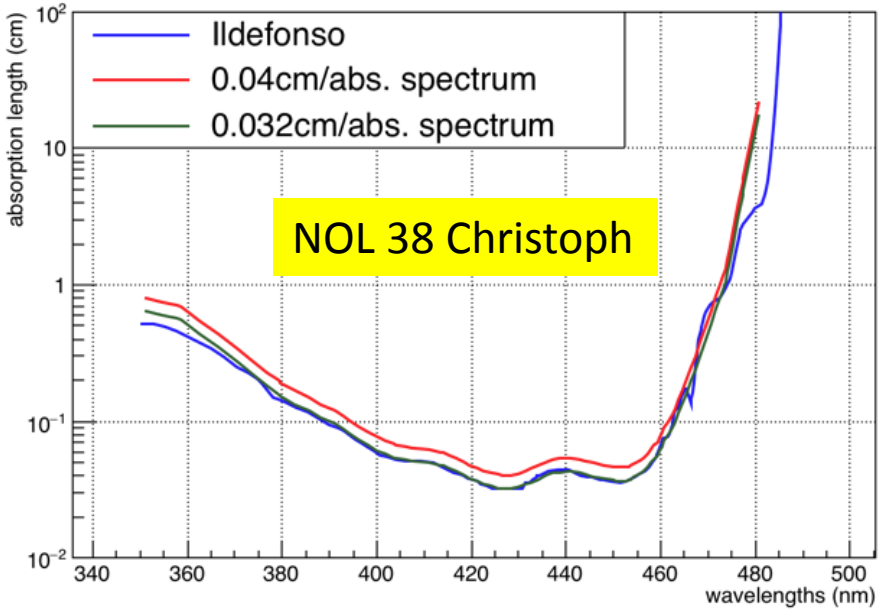
Absorption length in WLS

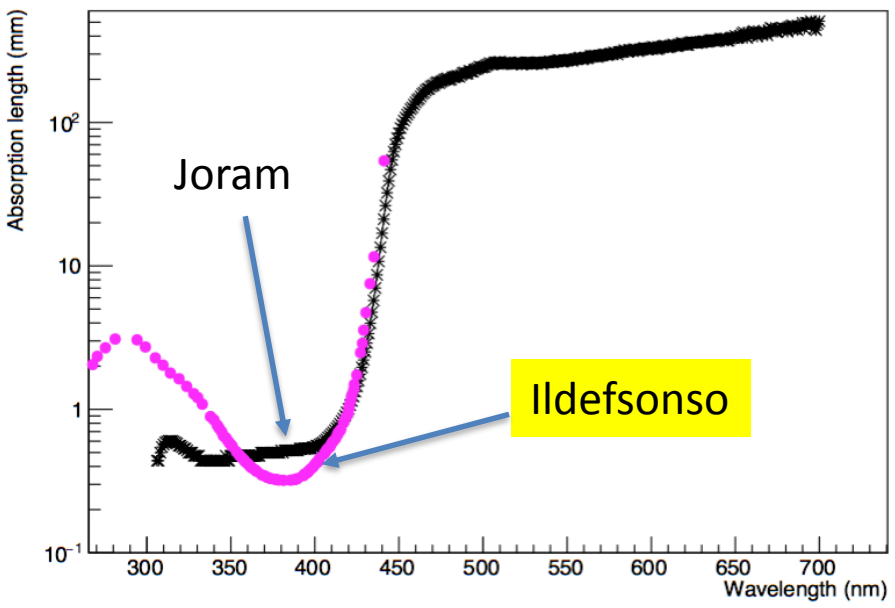
- I asked Ildefonso to send me the numerical values for this, but he did not send it!!
- All I have is the old wrong one.
- The issue of overlap is crucial, so we must make sure the right data are used.
- We want to reproduce the method that Ildefonso says he used!



Absorption length in WLS

- We understood that since there is no measurement for NOL 38, ildefonso inverted the previous absorption curve and normalized it at 420 nm at the same value as for EJ 280
- We requested, as a check of procedure to check if it worked on EJ 280 – Still no news on this! So I asked Christoph to do it.





Ildefonso's results

- There must be a problem in the simulation or in the measurement:
  - AD, in test system what length of fiber bundle assumed?
  - JPR digitization: is it the one we recommended, because it is a better fit of Joram's data?
  - Ildefonso digitization: which one?
  - What assumptions are used or BC404?
  - Difference between PMTs not significant

Absorption length digitised by J.P

Results (Last data)	Photoelectrons
Simulation (R5946)	52.96
Simulation (R4998)	46.16
Measurements in AD setup in 595 (R5946)	64.79
Measurements in AD setup in 595 (R4998)	66.87

Absorption length digitised by Ildefonso

Results (Last data)	Photoelectrons
Simulation (R5946)	70.64
Simulation (R4998)	61.55
Measurements in AD setup in 595 (R5946)	64.79
Measurements in AD setup in 595 (R4998)	66.87

We need to see a comparison of all the results using each of the curves of figure (p18) so that we can better understand how the system behaves

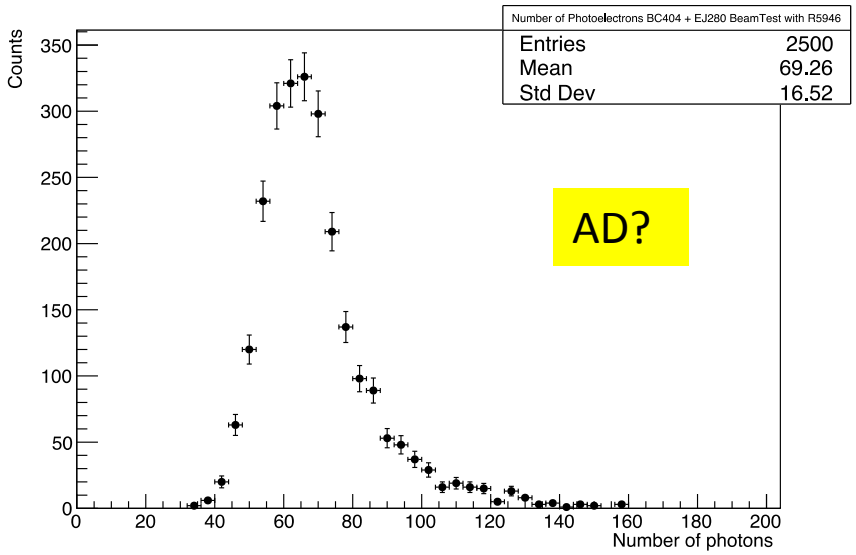
Properties of scintillators

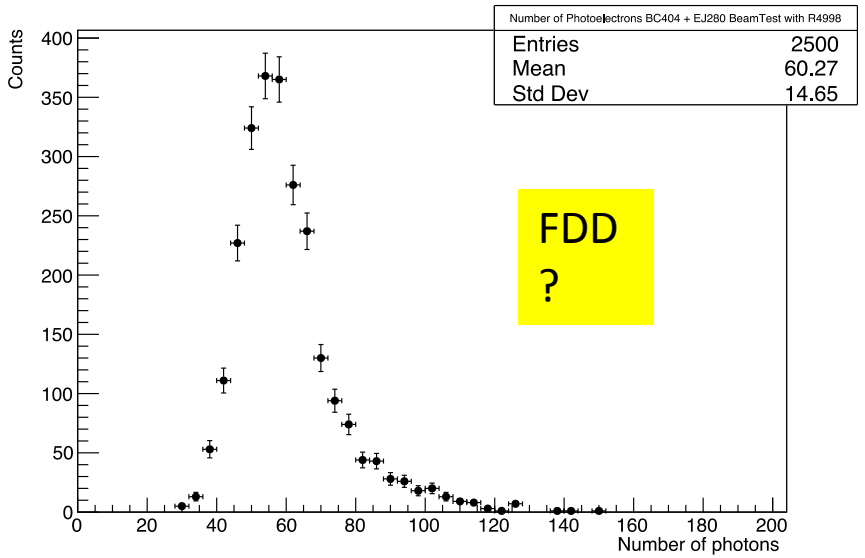
- According Ildefonso: The attenuation length in the scintillator, averaged over the scintillation light spectrum, is 140 cm both for BC-404 and BC-420.
- Is it consistent with Table 6?
- How does Ildefsonso calculate the attenuation length in the scintillator, averaged over the scintillation light spectrum?
- Why is it different from what St Gobain calls “Bulk light attenuation”?

Reference	Light output with respect to anthracene (%)	Wavelength at maximum emission (nm)	Decay constant (ns)	Bulk light attenuation length (cm)	Refractive index	H/C ratio	Density (g/cm^3)
BC-404	68	408	1.8	**160**	1.58	1.107	1.023
BC-420	64	391	1.5	**110**	1.58	1.102	1.023

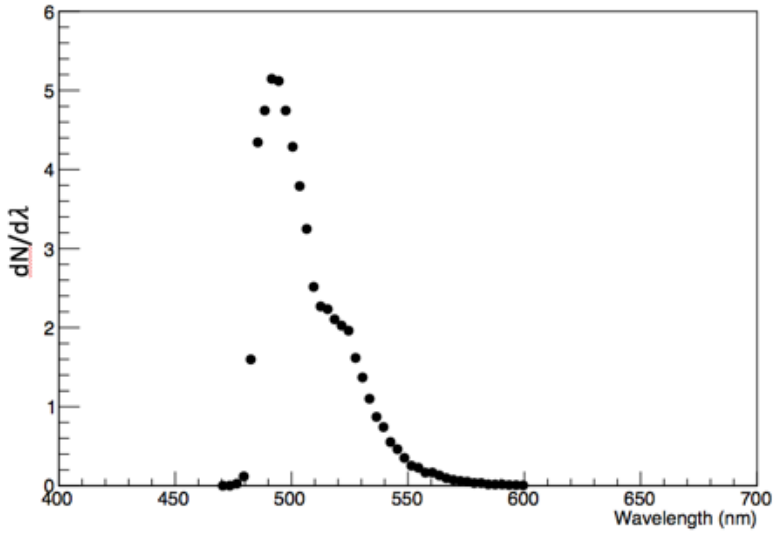
Number of photoelectrons

- Latest plots from Ildefonso – What has changed?





The average numbers are 69 for AD and 60 for FDD?
But in the proposal we have different numbers!!!



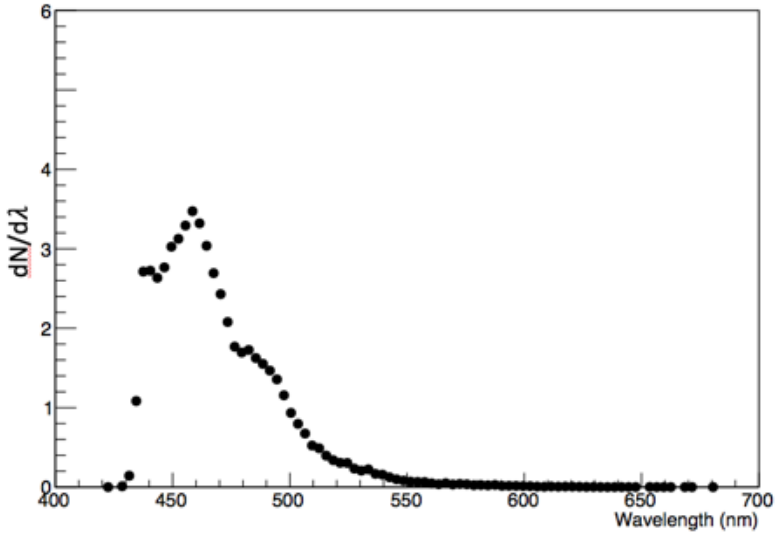


Figure 73: Distribution of the number of photoelectrons as a function of incoming photon wavelength. For the AD (left) and for the FDD (right), assuming the same fine mesh PMT R5946 quantum efficiency, for the sake of a comparison. In the AD case, the total number of photoelectrons is 59 and for the FDD 58.

Ildefonso this morning: "I checked the numbers and look OK. The number of photoelectrons expected for C side must be lower compared to the setup in 595. And this is the case."

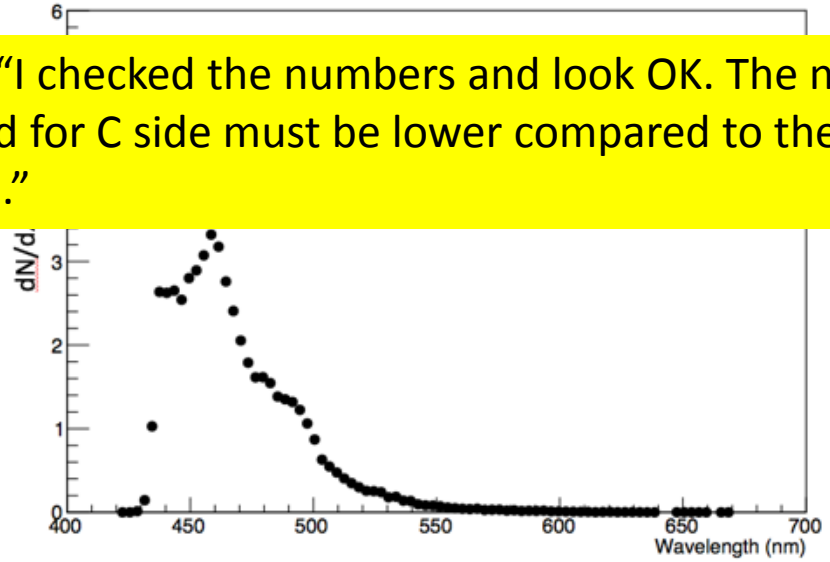
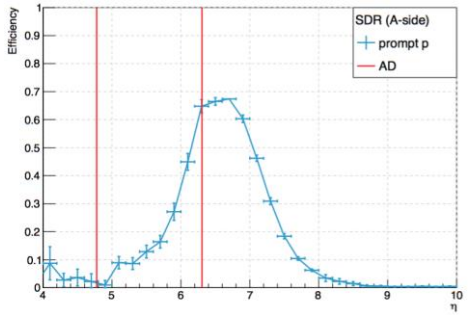
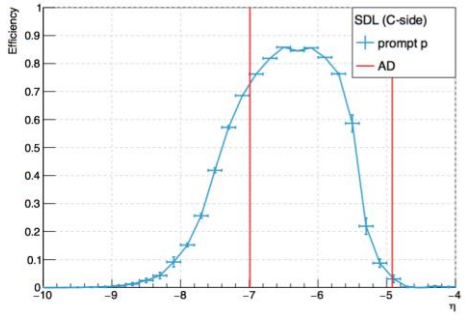
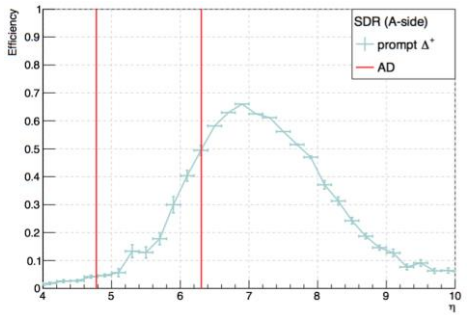
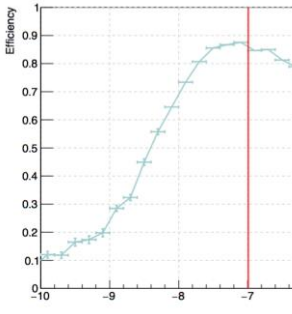


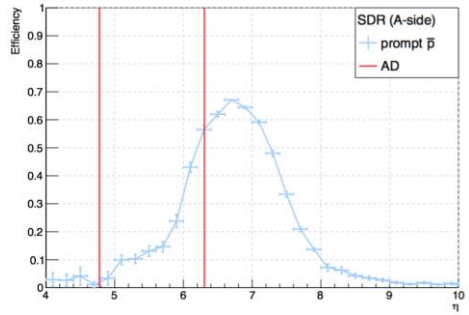
Figure 74: Distribution of the number of photoelectrons as a function of photon wavelength, for the FDD with PMT R4998. The total number of photoelectrons is 54.

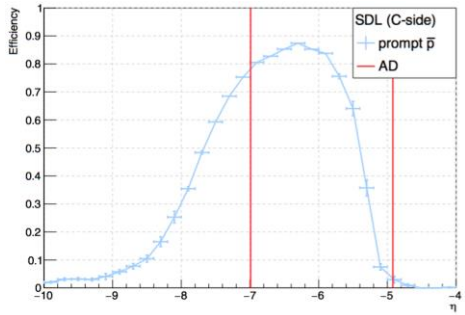


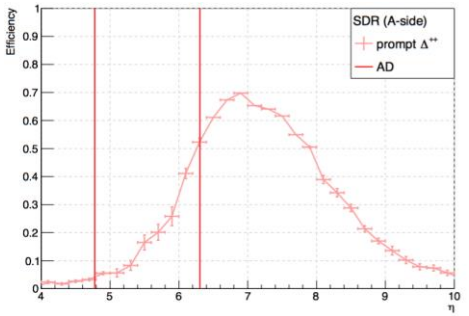


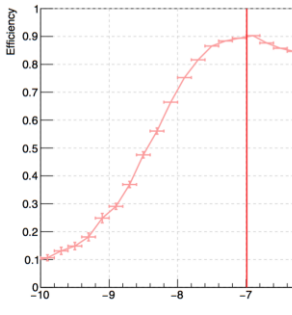


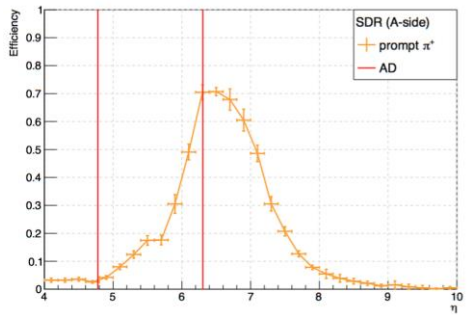


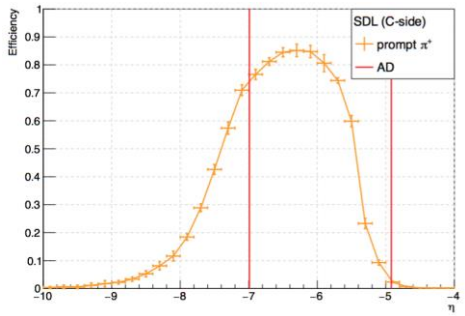


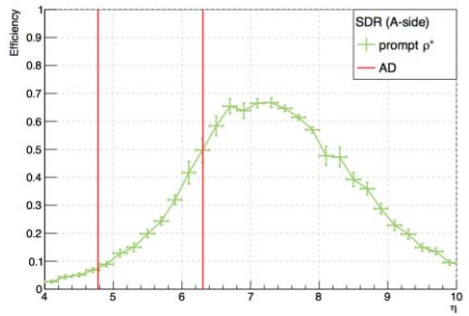


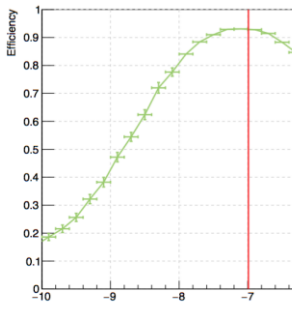


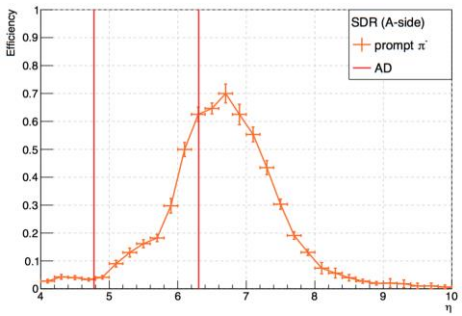


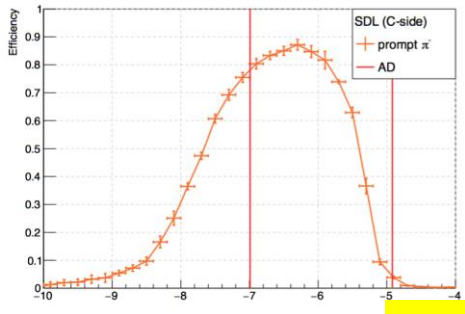


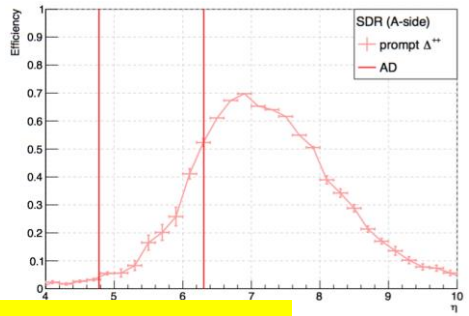


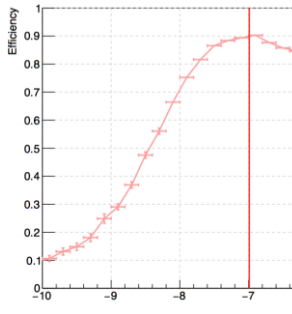












New version of figure 20
Why so pale??

Check of simulation

- We have some data provided by Ildefonso, which can be used to calculate the absorption length of the light as a function of wave length for EJ-280

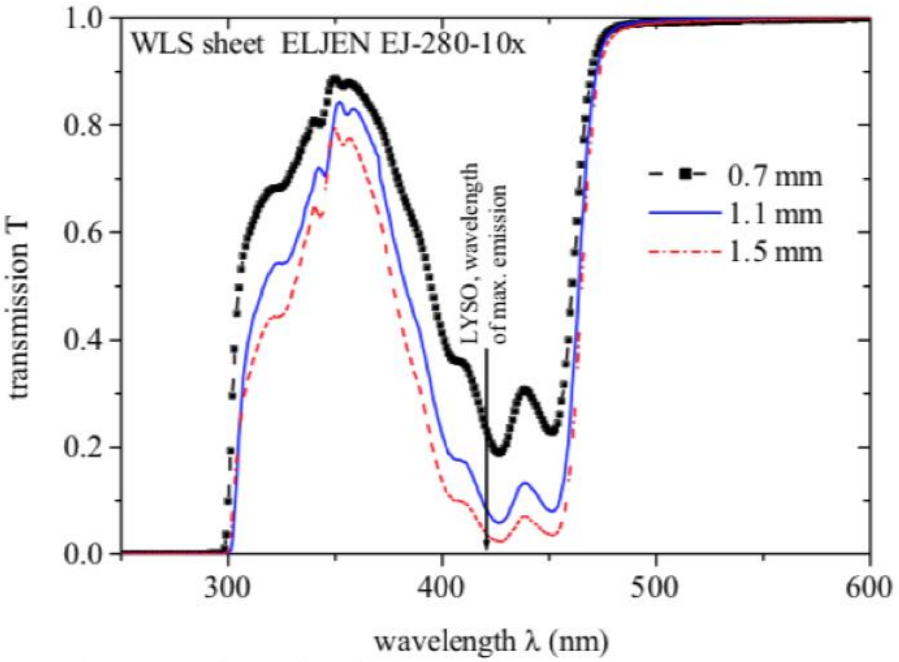
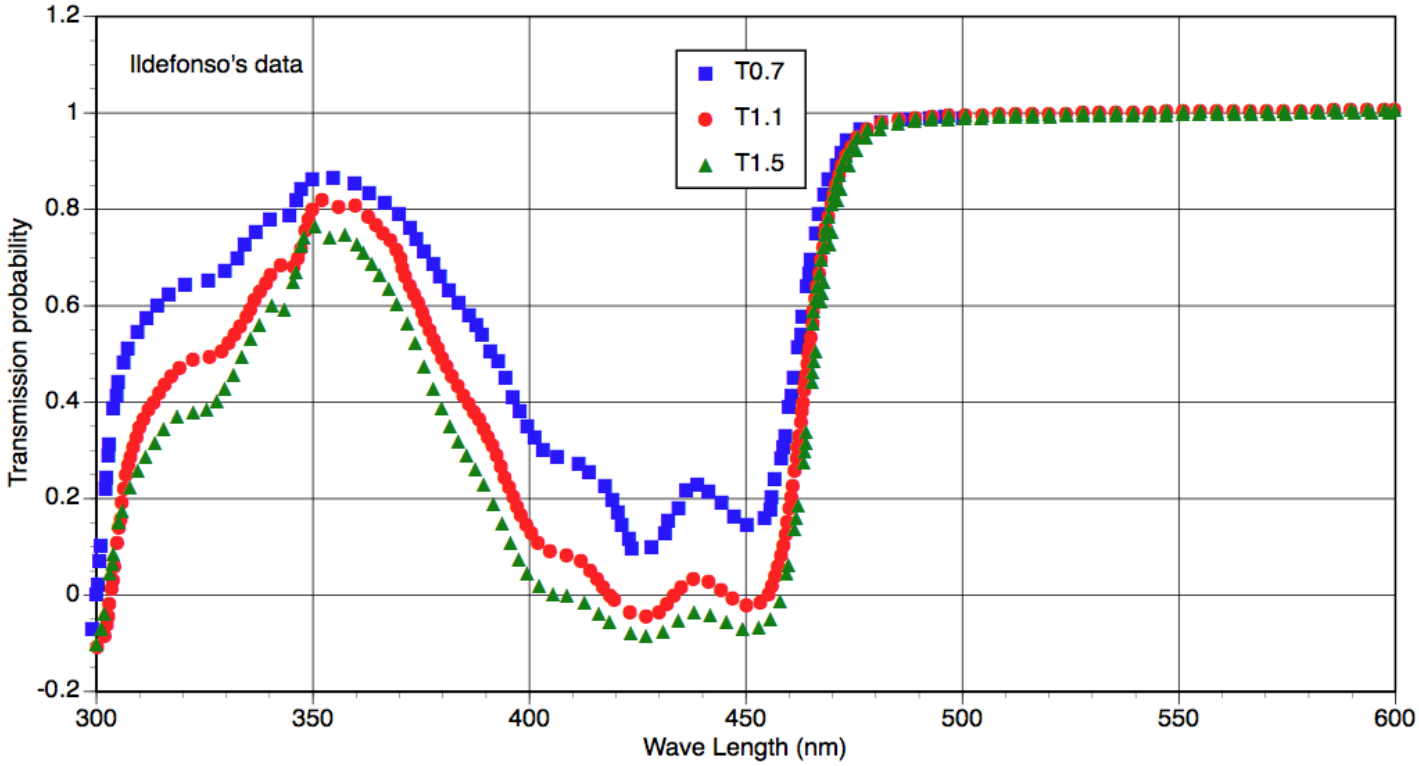


Figure 61: Transmission coefficient in the wavelength shifters as a function of wavelength. The WLS bars in the AD correspond to the red line. The absorption length for 420 nm is 0.35 mm [34].

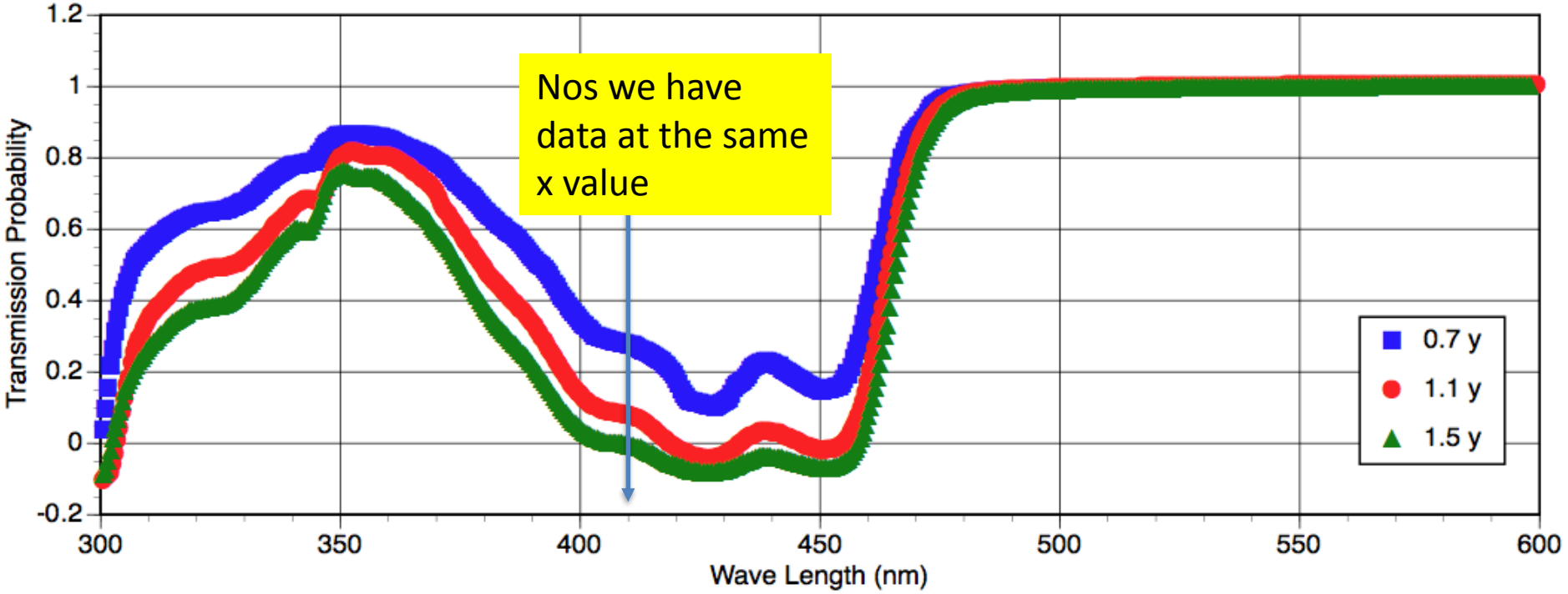
Digitization of figure by Ildefonso

- After some data clean up by hand …
- Problem: data are not given at the sames values of wave length ...



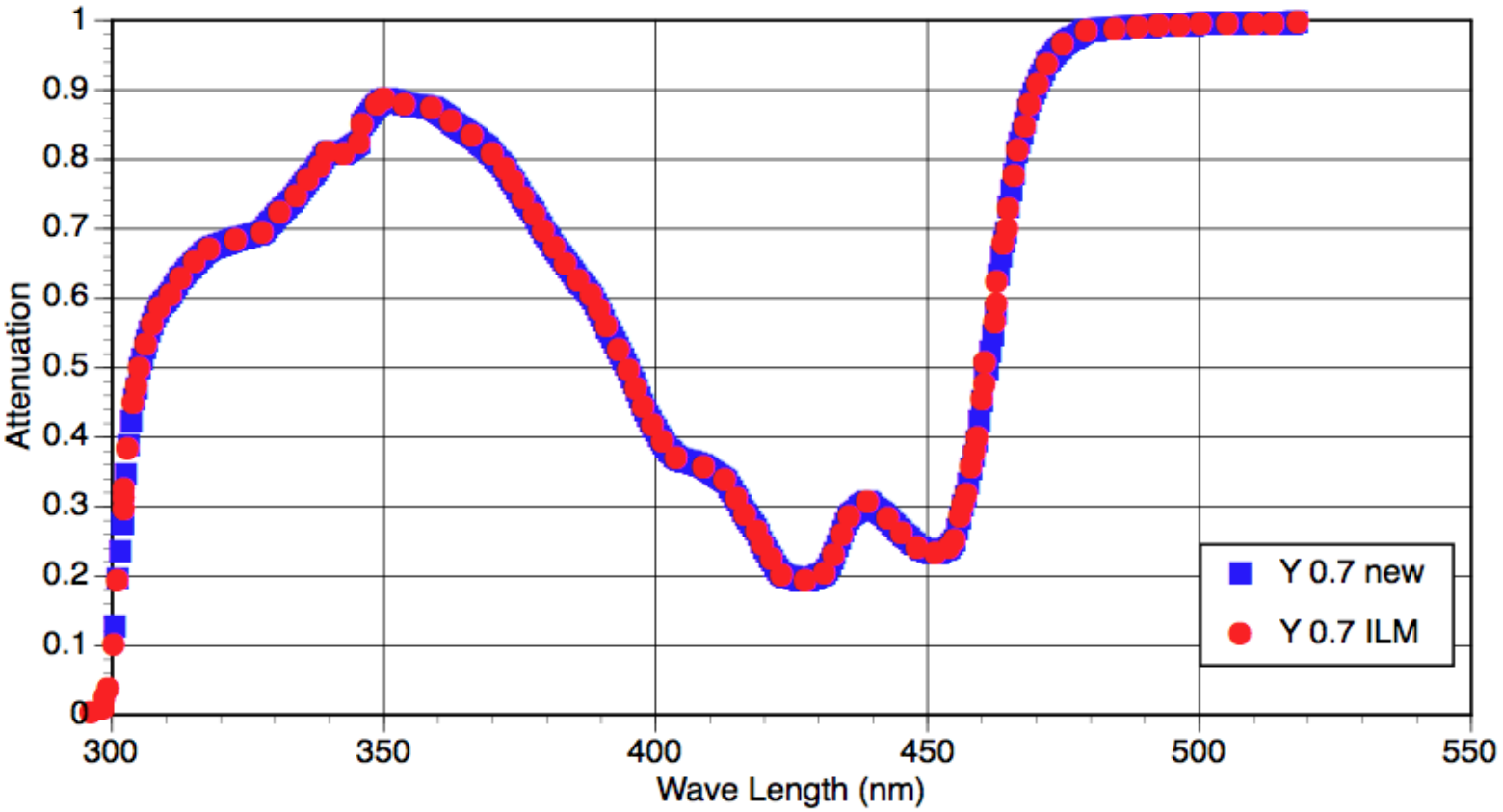
New digitization by JPR

- From 300 to 600 nm in steps of 0.5 nm



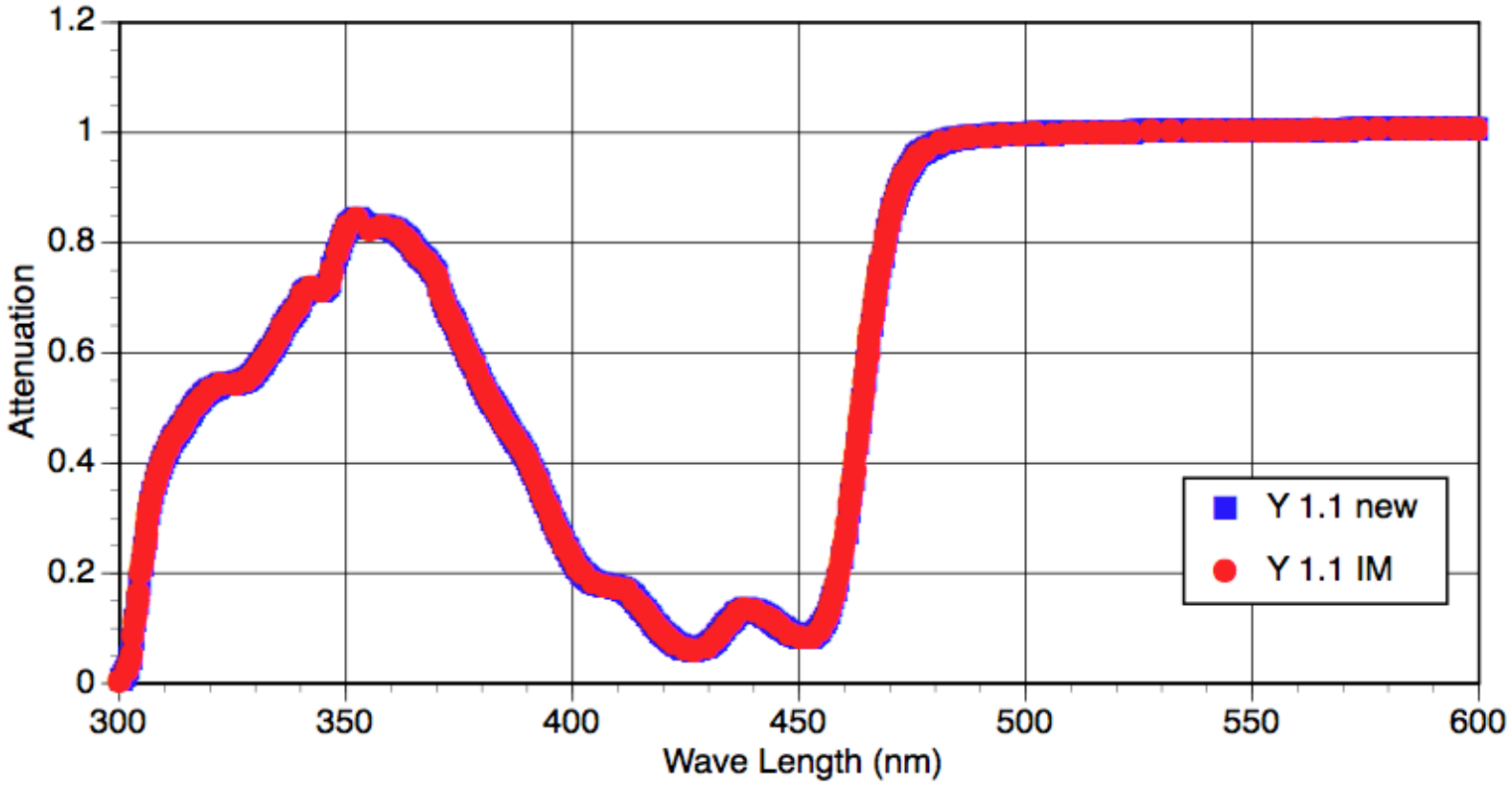
Check: data at 0.7 mm

- Always important to check !



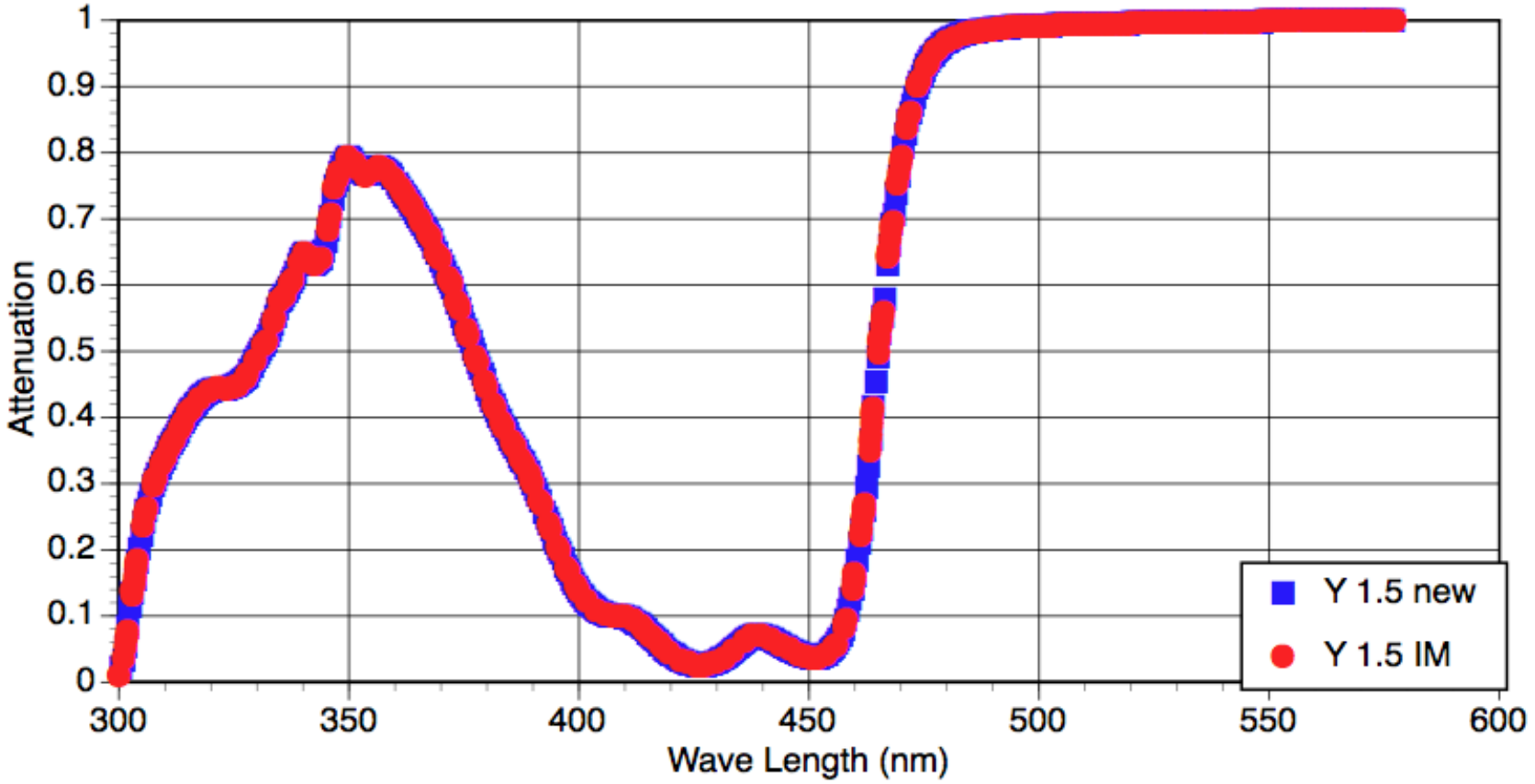
Check: data at 1.1 mm

- Always important to check !



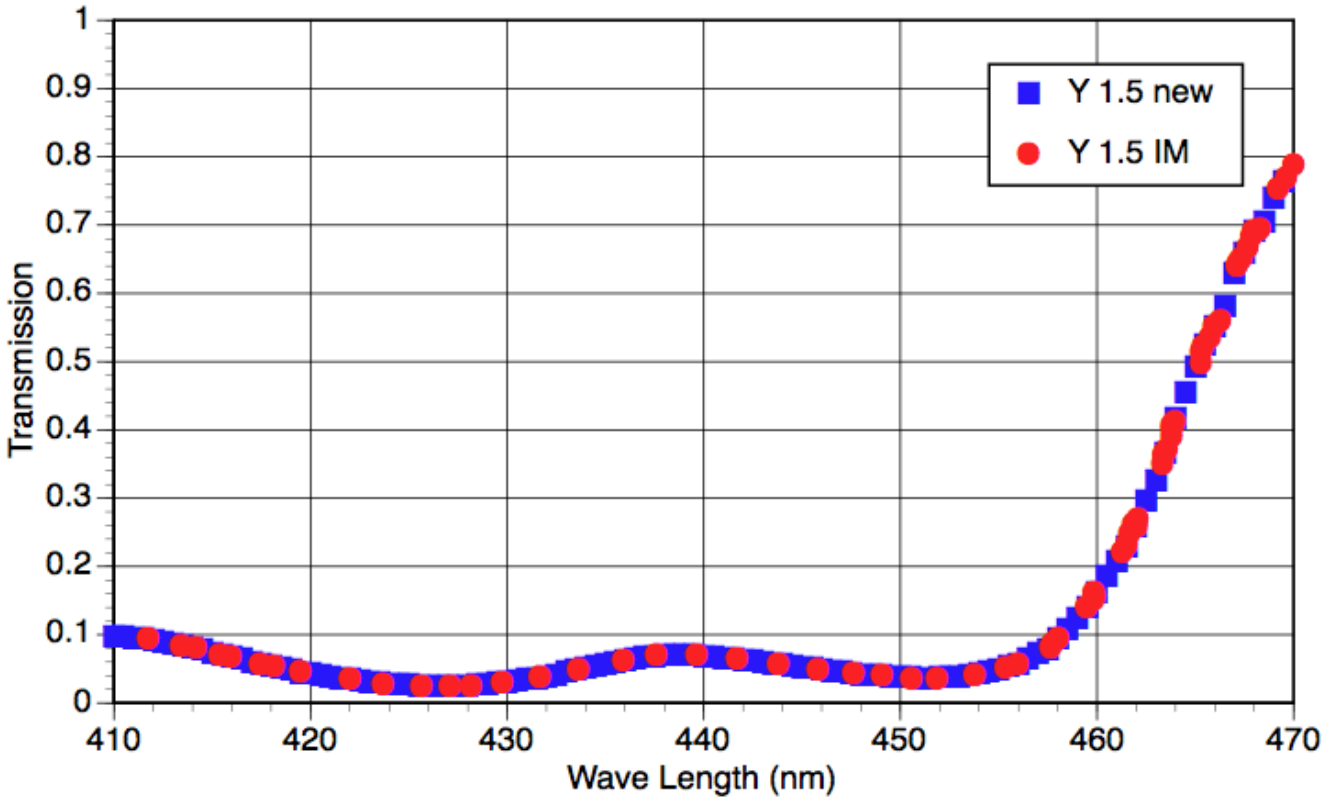
Check: data at 1.5 mm

- Always important to check !



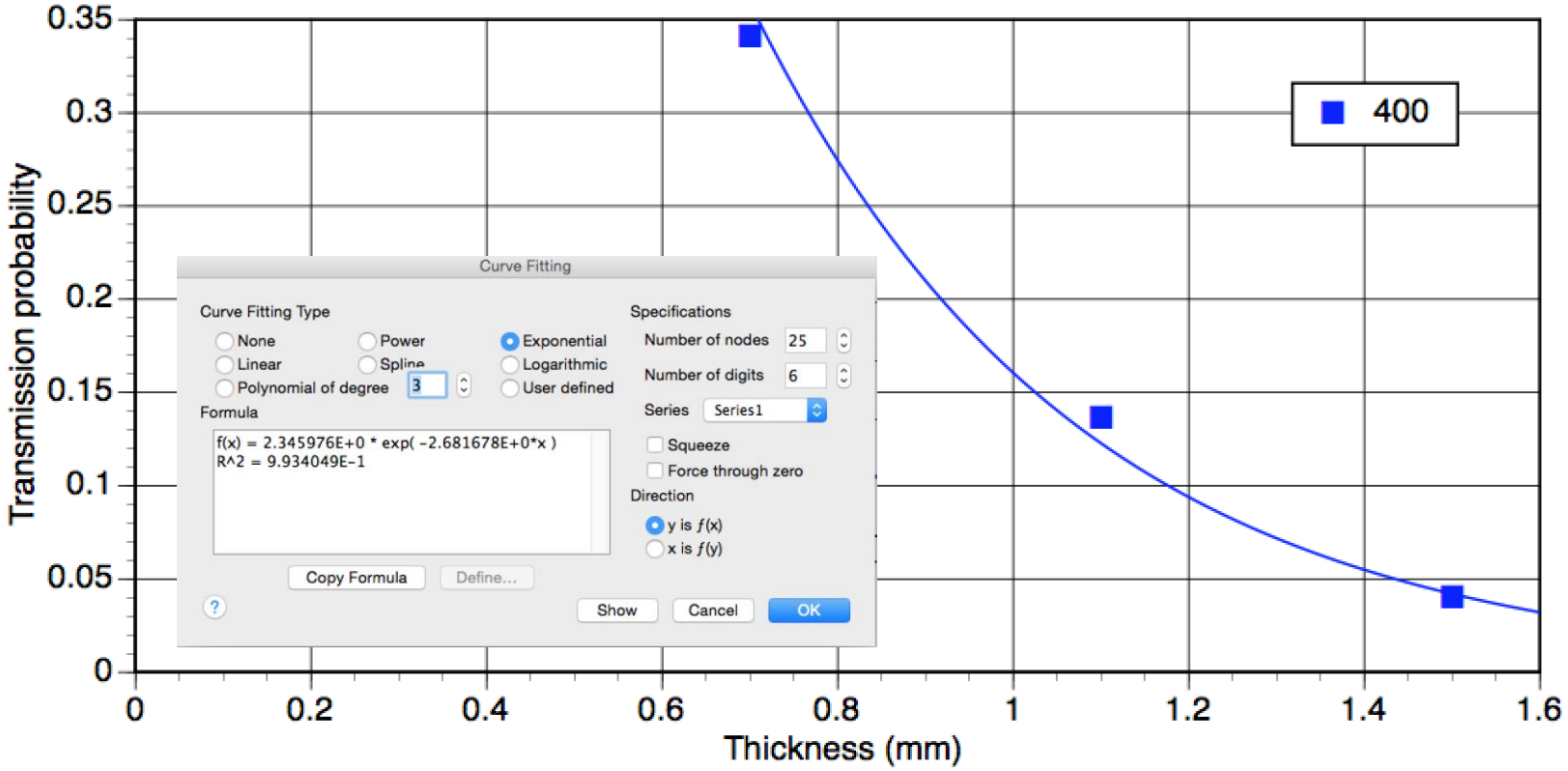
Check: details at 1.5 mm

- Always important to check !



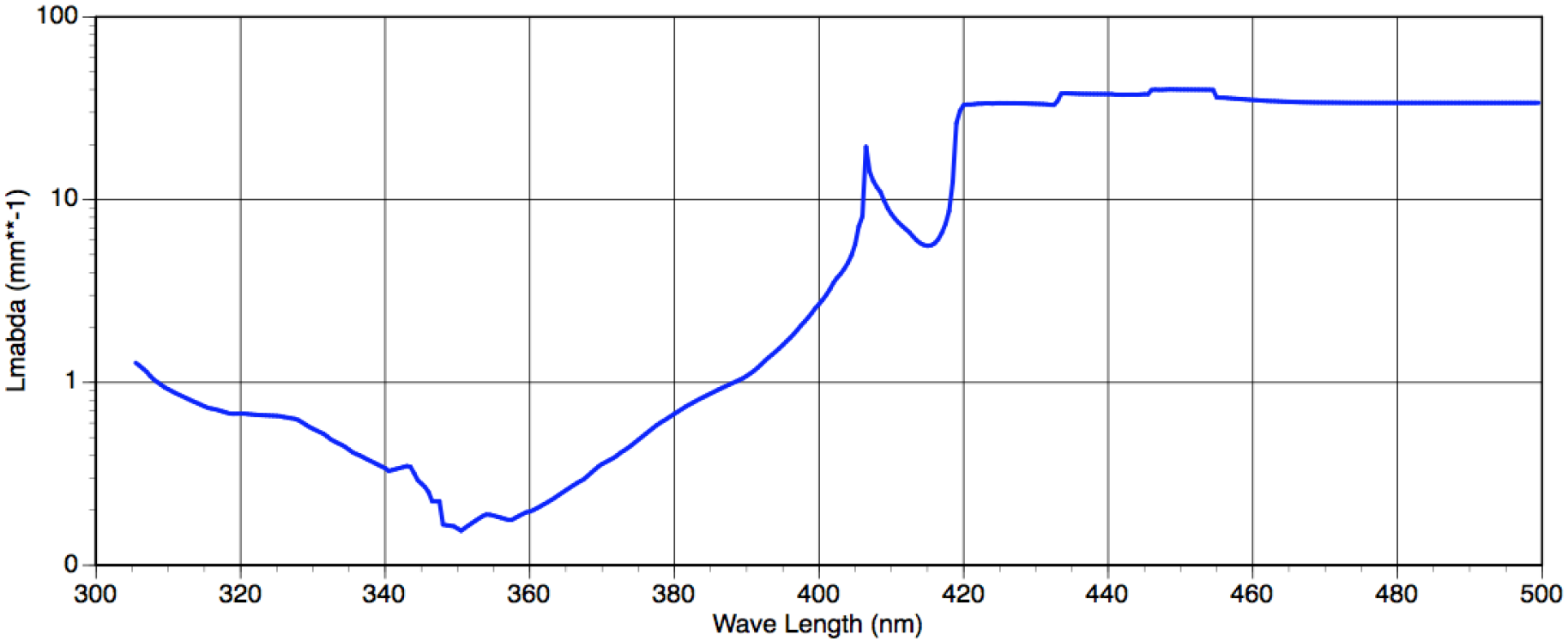
Principle

- Fit an exponential with the three data points at each wave length:
  - Two parameter fit: $y = ae^{-\lambda x}$



Results

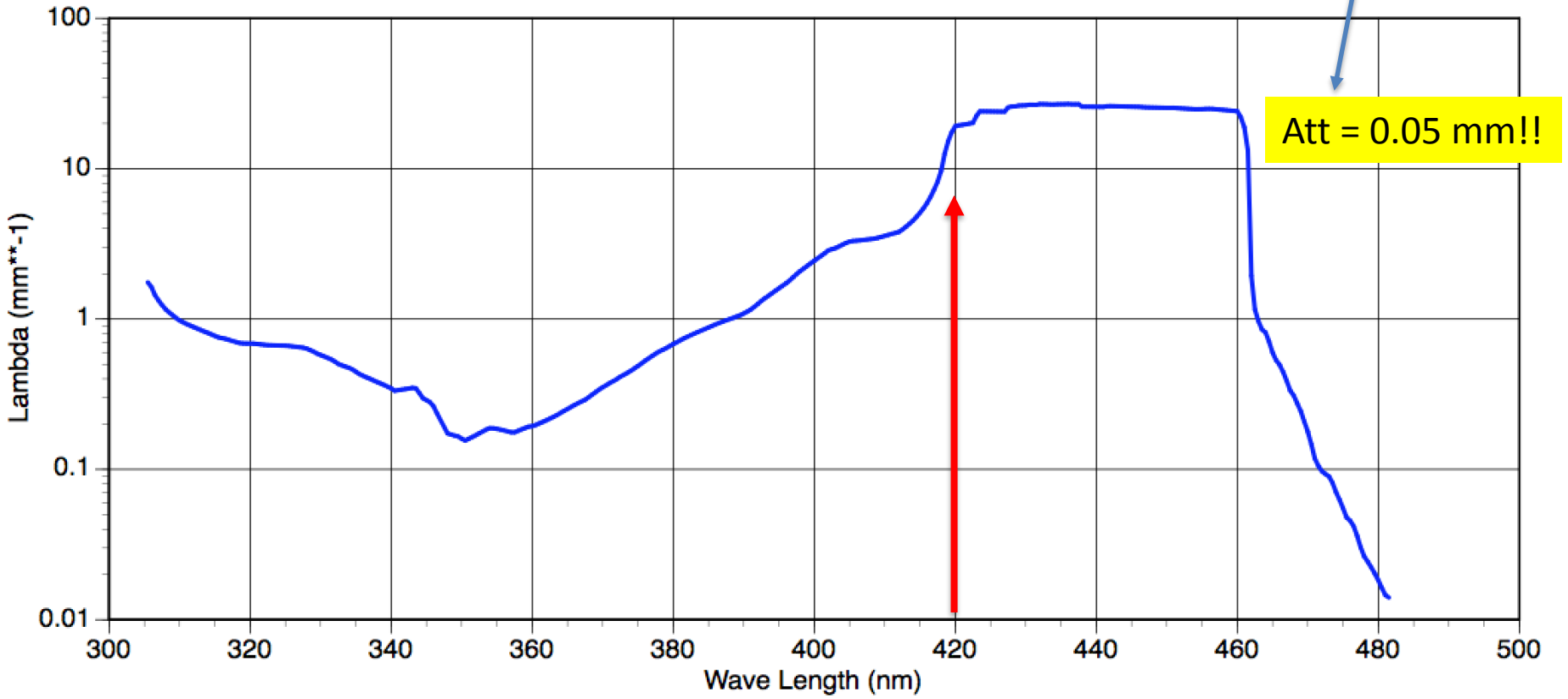
- Do it for all wave length using MINUIT (CERNLIB) –
  - Strange structure



Results

- Do it for all wave length using MINUIT (CERNLIB) –
  - Adjusting errors (constant) cleaning up data

WL	a	λ
417.5	68.8050219440834	8.19189174122753
418	185.306761711779	9.65560669154359
418.5	1342.47476522481	12.53543200567
419	8463.92580929749	15.2172827841487
419.5	38298.9701058681	17.4472760146401
420	117923.595535971	19.1407239011875
420.5	132263.077238839	19.4075114378892
421	133056.680337488	19.5560756813843
421.5	138133.346200232	19.7292548475717
422	149129.147007451	19.9469140068122
422.5	155860.605962521	20.1271512305398



Results

- The number does not check with expectations!

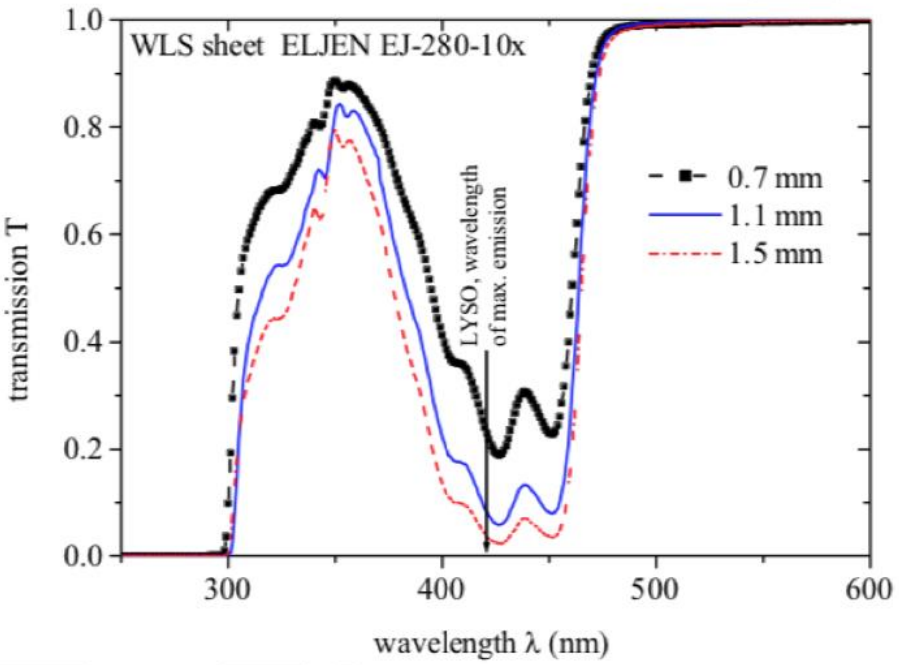
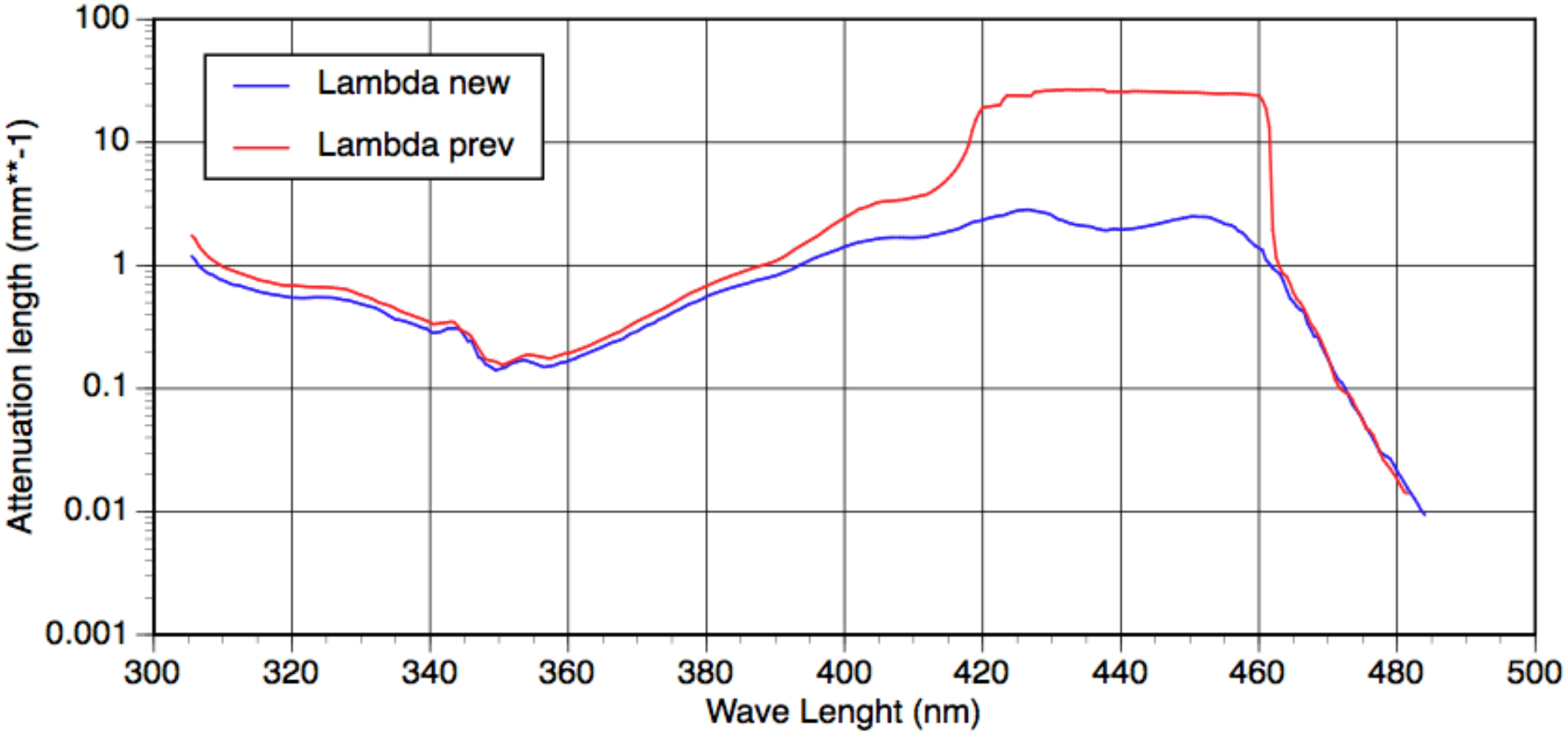


Figure 61: Transmission coefficient in the wavelength shifters as a function of wavelength. The WLS bars in the AD correspond to the red line. The absorption length for 420 nm is 0.35 mm [34].

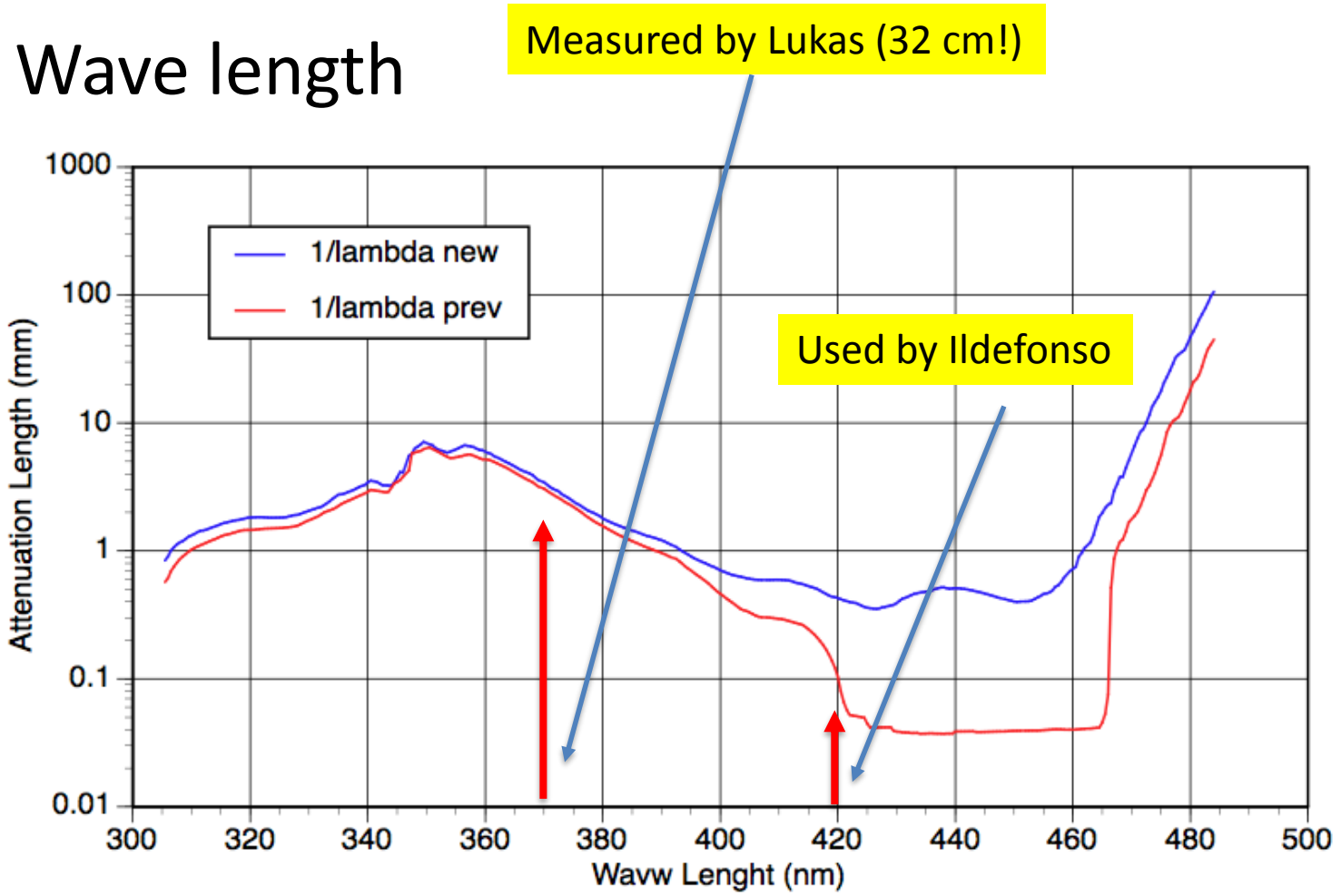
Results

- Ildefonso made a new digitization
  - Results are not different in the range 400 to 460 nm!!



Results

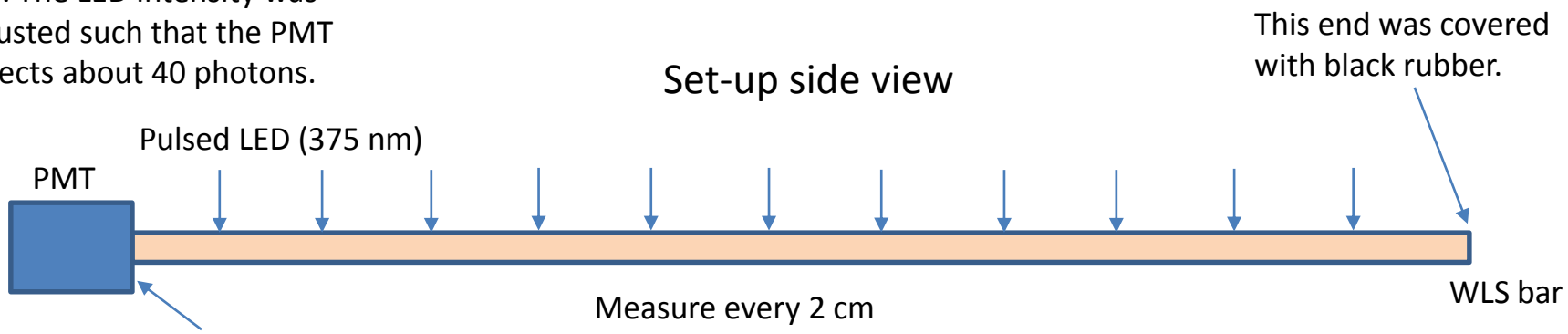
- Wave length



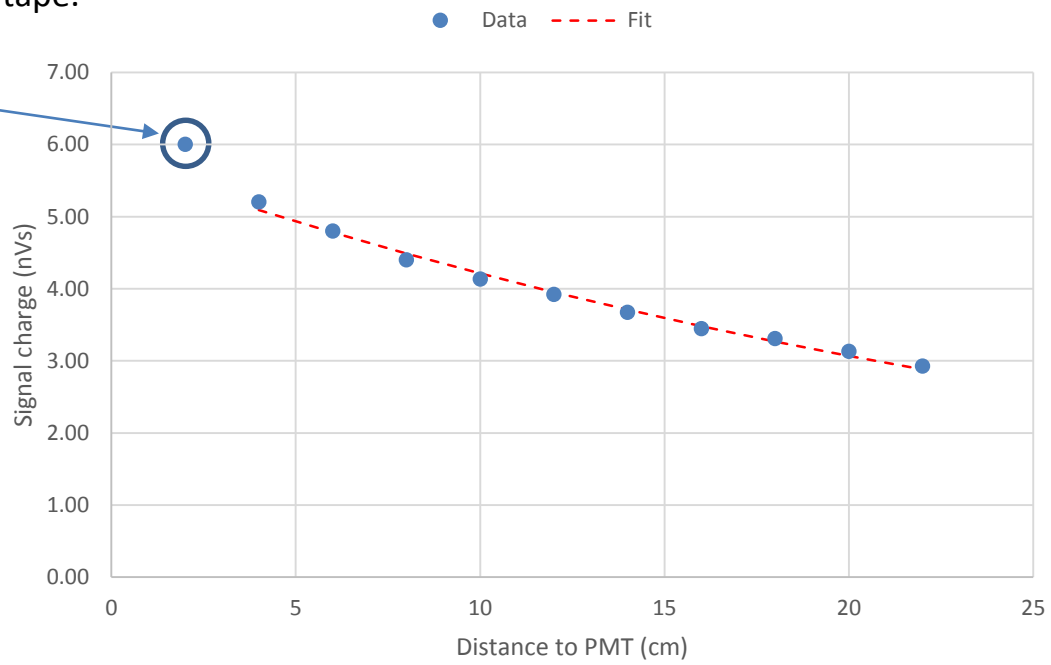
Attenuation length (WLS bar ALICE AD)

L. Gruber

N.B. The LED intensity was adjusted such that the PMT detects about 40 photons.



Not included in the fit (contribution from direct light)

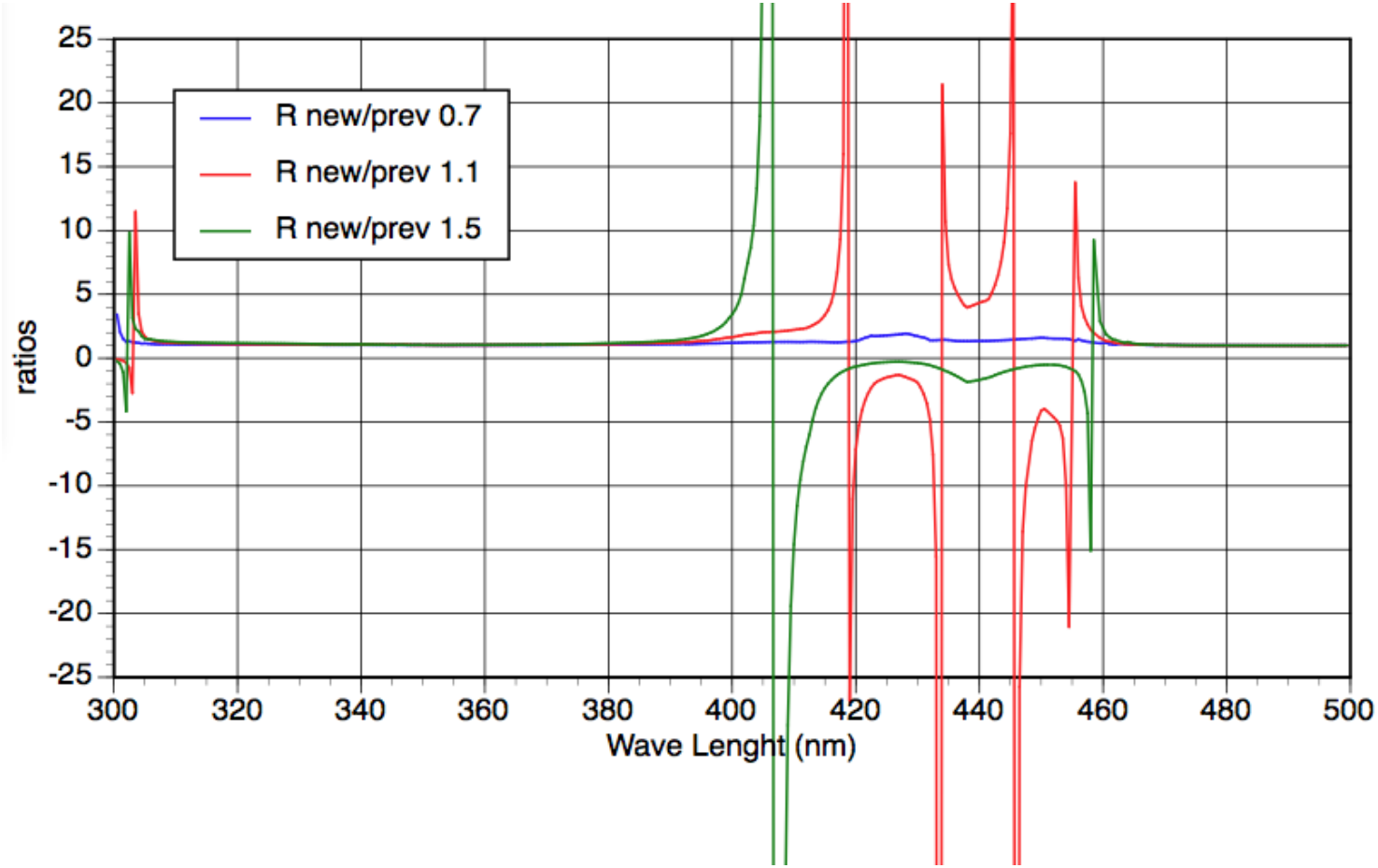


$\Lambda = 32$ cm

The rather short AL may be also due to suboptimal surface quality.

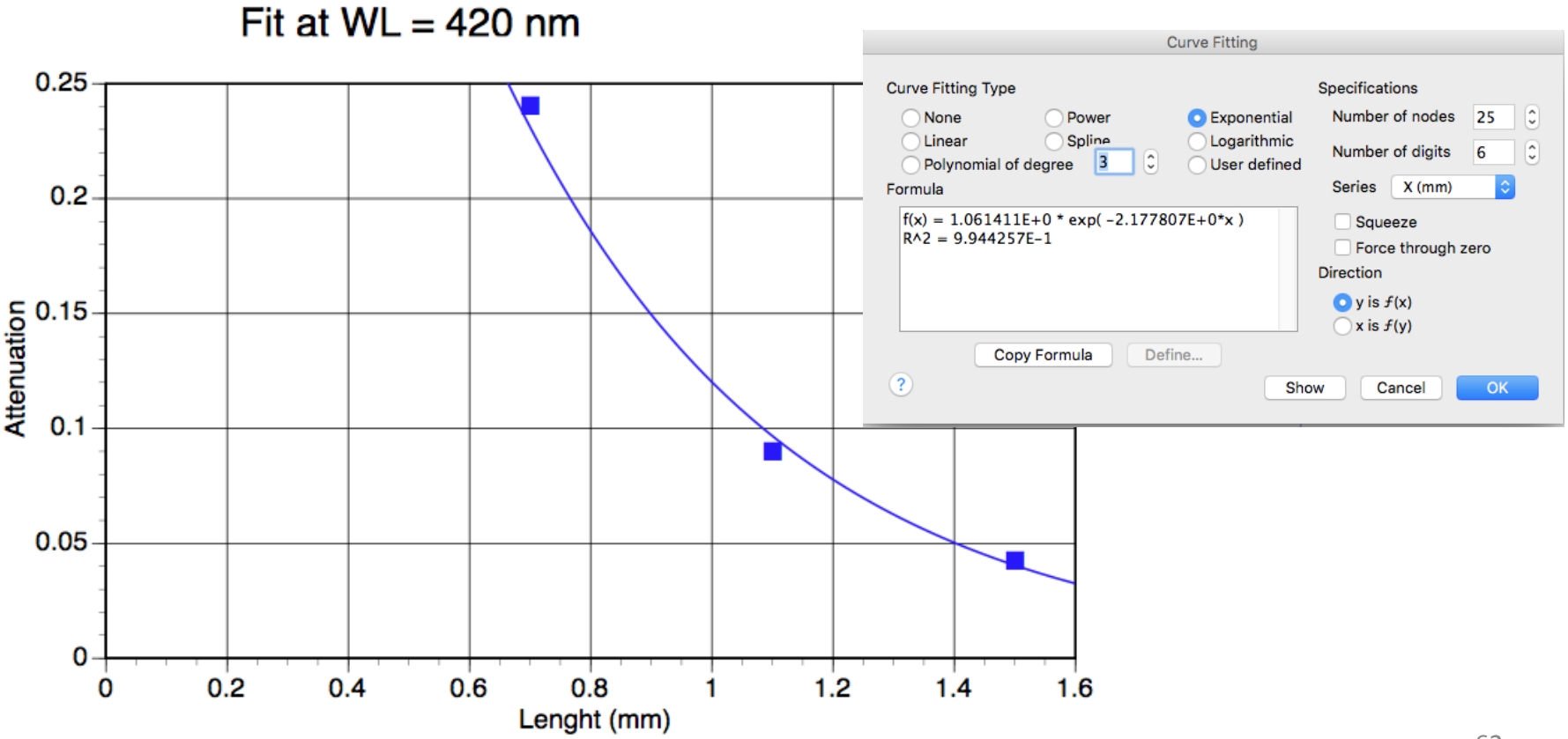
Comparison of input data

- Ildefonso made a new digitization
  - Indeed the two sets of input data are different in the region of interest!



Fit at 420 nm

- Fit by hand: 1/lambda = 0.45 mm
- Ildefonso uses 0.35 mm OK! The value is rather close. What about the other wave lengths? Agreement is better if we change the definition of absorption length:
- Lambda.L = ln2 => L = 0.31 which is closer to the Ildefonso value



WLS

- C. Joram asked for a quote from the company on the production of WLS – 20 long bars, 11 Short A, and 11 short C – BC-499-90 very fast blue to green shifter – about the same price as for the AD

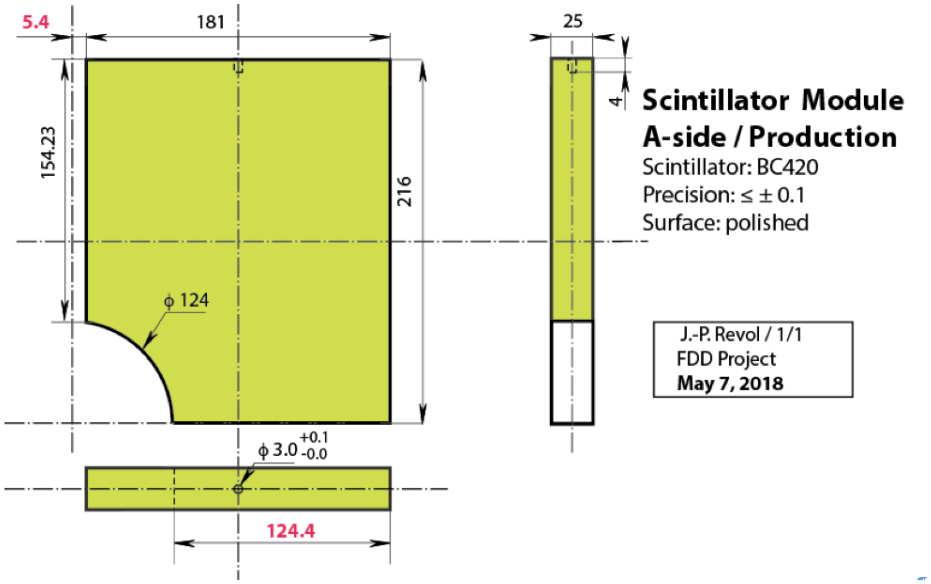
ITEM	QTY	U/M	DESCRIPTION	PART NO.	UNIT PRICE	TOTAL PRICE
1	20	EA	BC499-90, 242 x 25 x 4mm, DM *Estimated Lead Time: 12 Weeks	TBD	$173.00	$3,460.00
2	11	EA	BC499-90, 207 x 25 x 4mm, DM *Estimated Lead Time: 12 Weeks	TBD	$170.00	$1,870.00
3	11	EA	BC499, 182 x 25 x 4mm, DM *Estimated Lead Time: 12 Weeks	TBD	$164.00	$1,804.00
*Lead times are based on our current workloads. A firm delivery date will be provided at the time of order.						

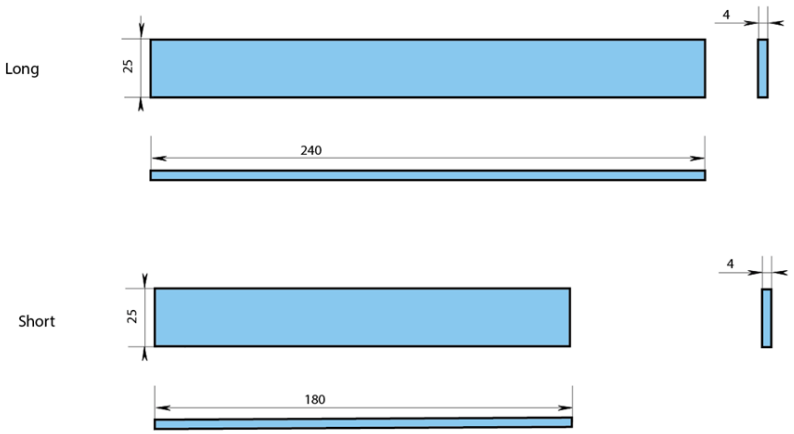
BC420

- C. Joram asked for a quote from the company on BC420 for prototype – the machining is expensive. We asked for a quote for raw scintillator piece, which we will machine at CERN.
  - BC-420, 220 X 190X 25 mm DM
  - In inches: BC-420, 8.67" X 7.49" X 0.99"
  - Faces as-cast, Edges Diamond Milled, as per Saint-Gobain standard tolerances
  - Typical lead time : 8-10 weeks
  - Unit price, for 1pce : $702
  - Unit price, for 2-4pces : $591 each
- **Saint Gobain would make us the fully machined scintillator for 917 $.**
- Machining at CERN not possible. No answer from Risto Orava
- Still expecting information from Nikolay on the possibility that the scintillator be provided by Russia **!!!**

Dimensions of scintillator for FDD prototype

- It has to match the WLS we already received

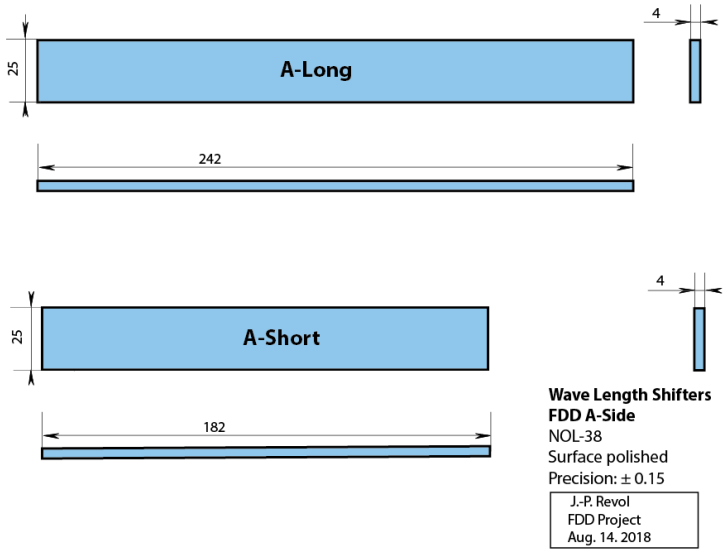


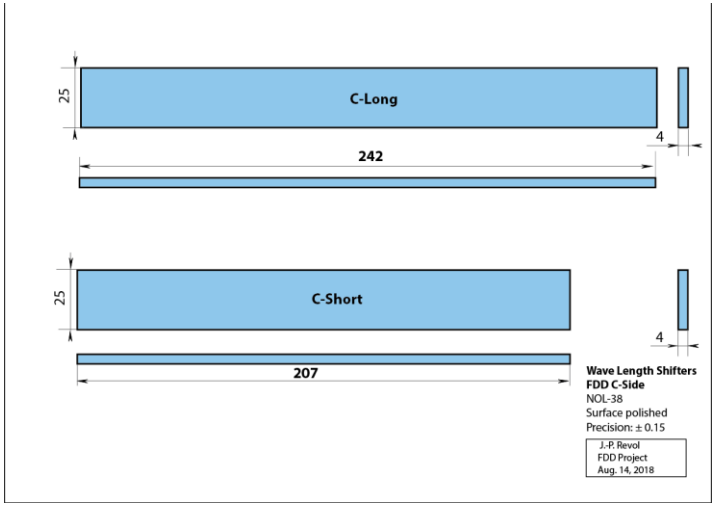


We have two WLS of each size, so we could make two modules

Wave length shifters for the FDD

- Execution drawings for NOL 38 bars are ready
- We asked the company for an offer for 20 long bars, 11 Short A, and 11 short C (9 modules of each type + 2 spare bars of each type)





Test System and procedures

- The test system must be operational with a cosmic trigger? (Abraham)
- We need to define a careful procedure in order to guarantee the reliability of the results – light yield is the most important:
  - Basic measurements with present module recording a… …n particular PMT gain taking care of ageing effects, so PM… …econd module for relative calibrate)
  - Compare timing and ti…
  - Anything el…
- W… …care of the preparation of the new module – does …equip the present scintillator with new WLS, as WLS does …tch scintillator:
  - Make a list of material needed – most urgent is to order one piece of BC420 scintillator – C. Joram could lend us a technician when al the material is ready.
  - Rather urgent as this is a key in the construction of the FDD

Do we have the money to buy the few things rented from the CERN pool? (< 10 kCHF)

This is straight forward but requires extreme care – we need someone who takes the responsibility for module construction and test

Test at CERN

- Is Ildefonso finally coming to CERN next week?
- What can be tested without the scintillator?
  - Compare properties of present PMT with the prototype we have here
  - Do a comparative ageing test