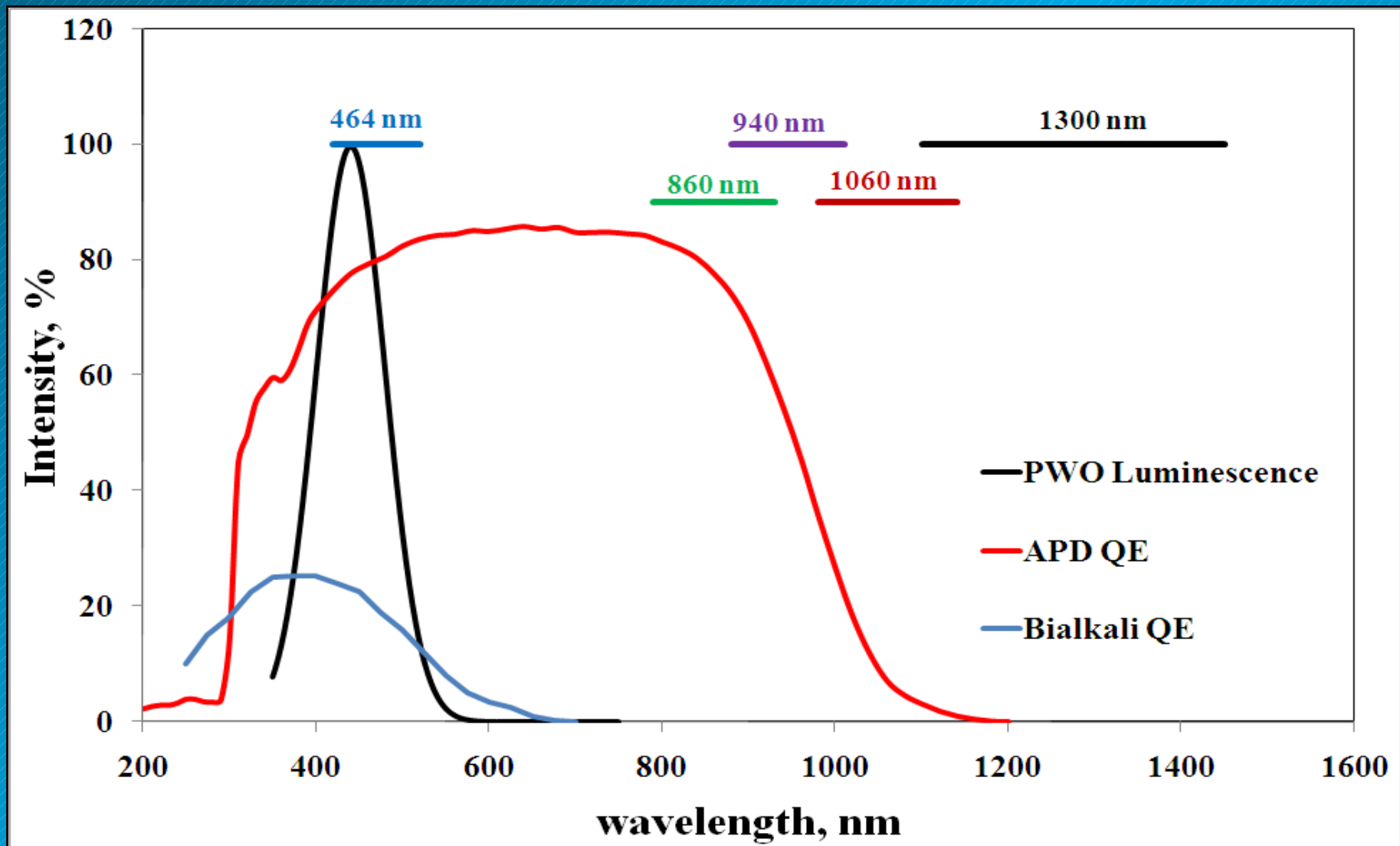
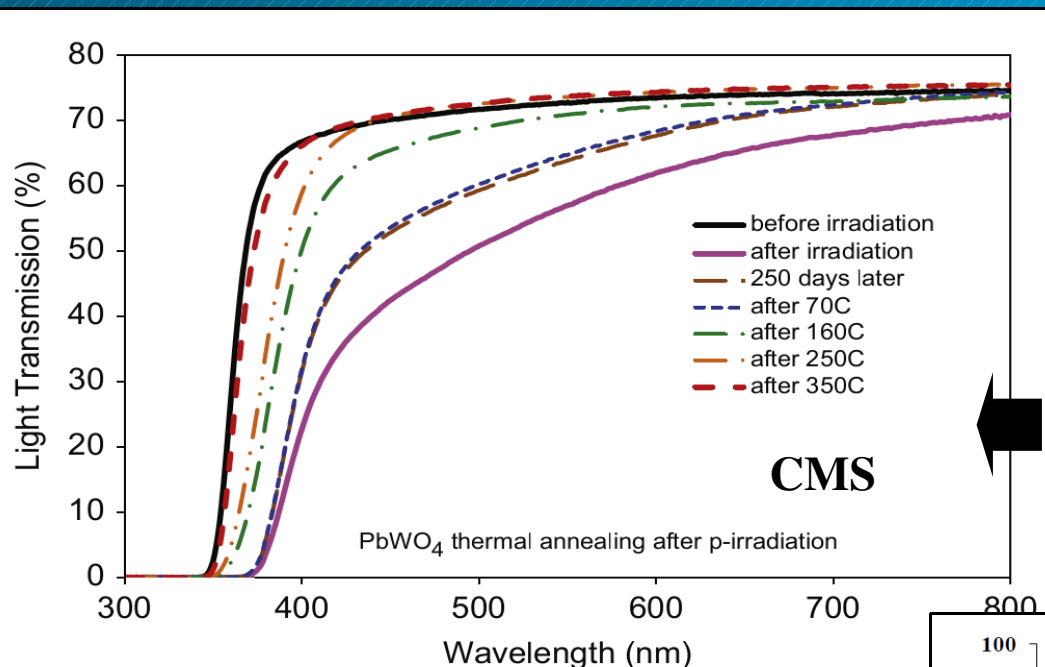


# implications for EMC operation



# observation of severe radiation damage due to hadrons



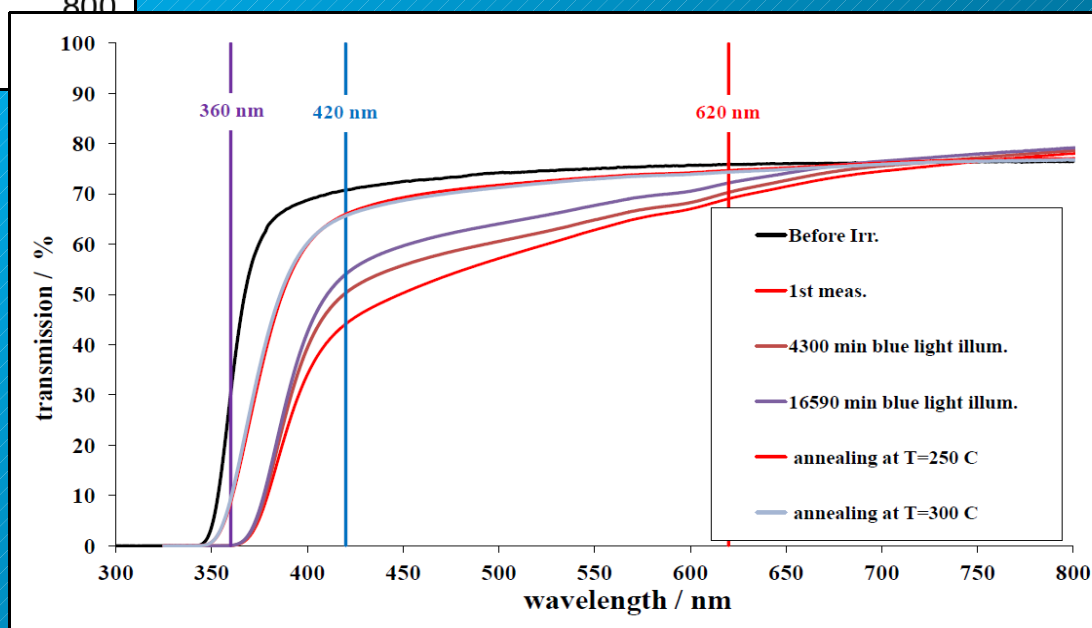
G. Dissertori et al., NIM A684 (2012)57

**24 GeV/c protons**

**fluence:  $(1.32 \pm 0.11)10^{13}\text{cm}^{-2}$**

**thermal treatment up to  $T=350^\circ\text{C}$**

measurements and treatments @ GI  
started several months after irradiation:  
**stimulated recovery + heating**

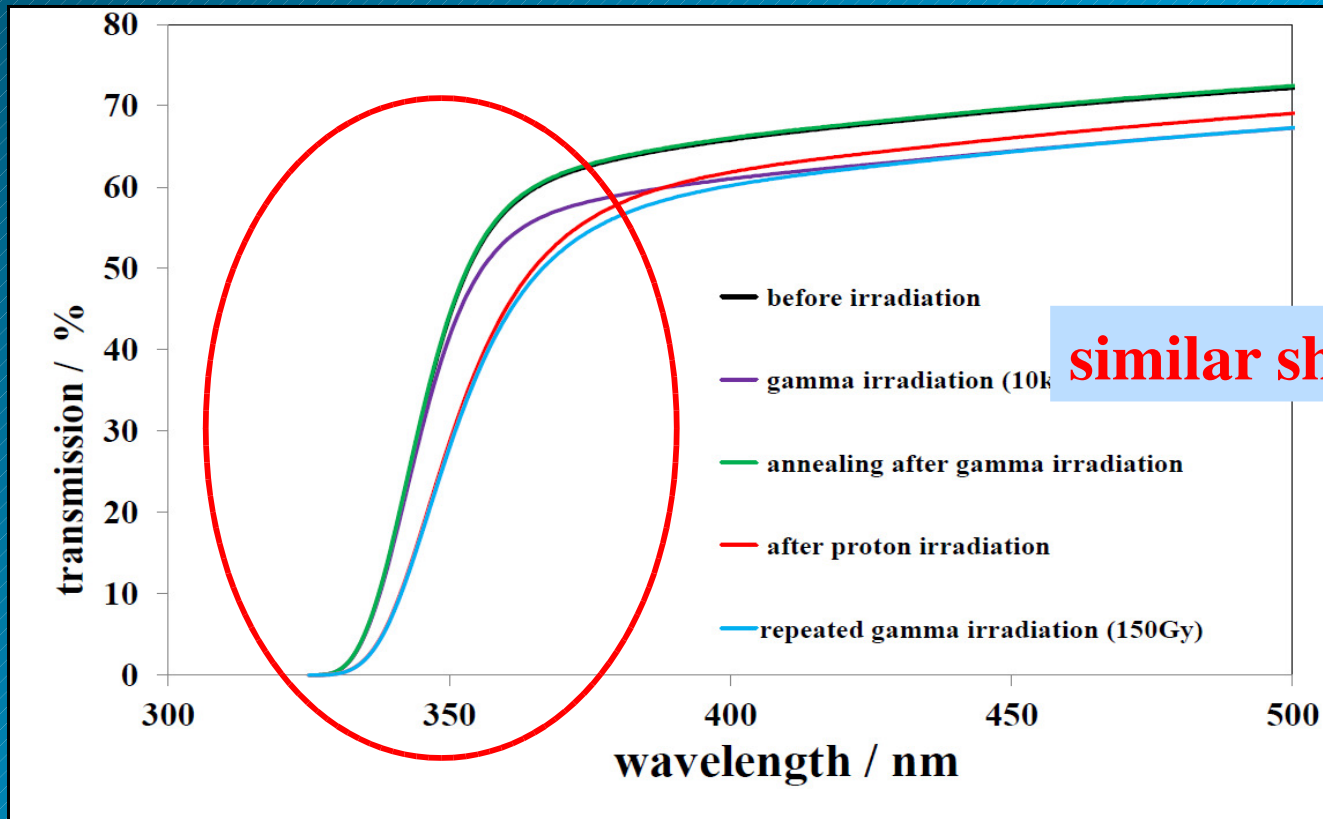


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# similar observation for 150MeV protons



fluence:  $1.8 \times 10^{13} \text{p/cm}^2$

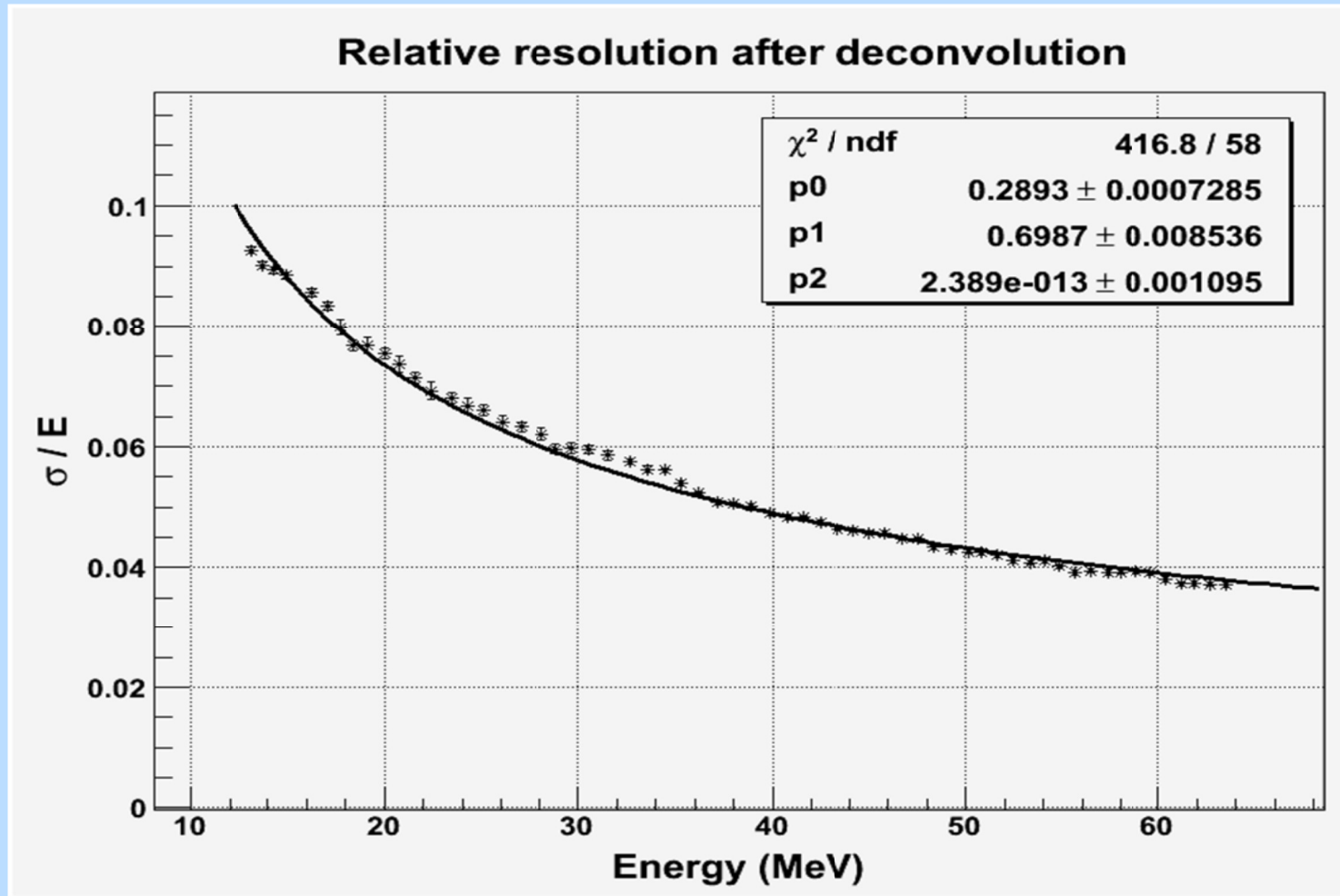
**similar shift like at 24GeV/c**

- **strong radiation damage due to protons at high fluence**  
severe damage due to highly ionizing secondaries  
clusters of color centers due to ion displacements
- **damage due to  $\gamma$ -rays: stimulated recovery**  
**proton damage: annealing by heating**

# prototype performance

- optimized light output: PWO-II
- cooling: operation at  $T=-25^{\circ}\text{C}$

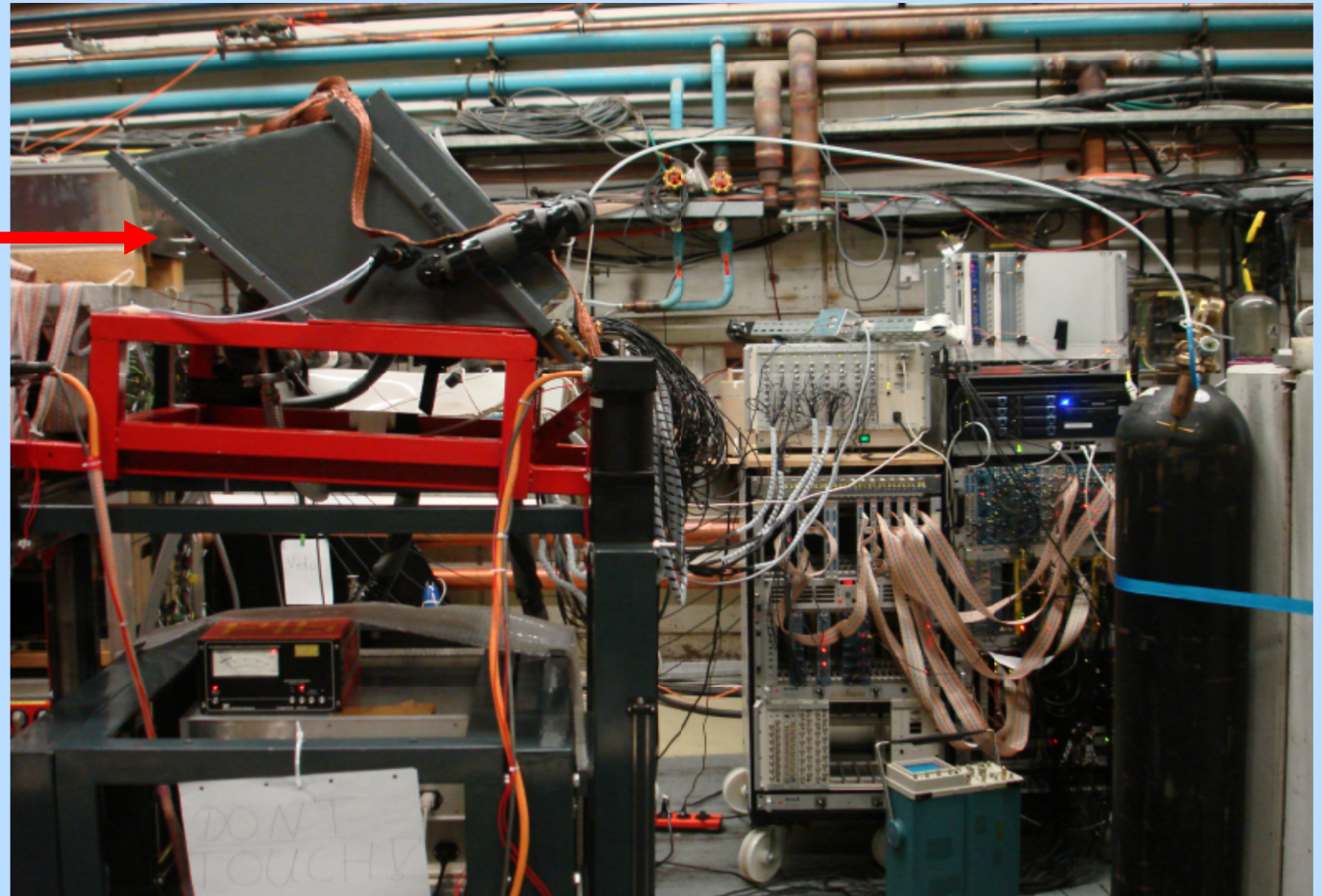
extension to energies  $< 50\text{MeV}$  @ MaxLab





# prototype performance PROTO 60

photon beam

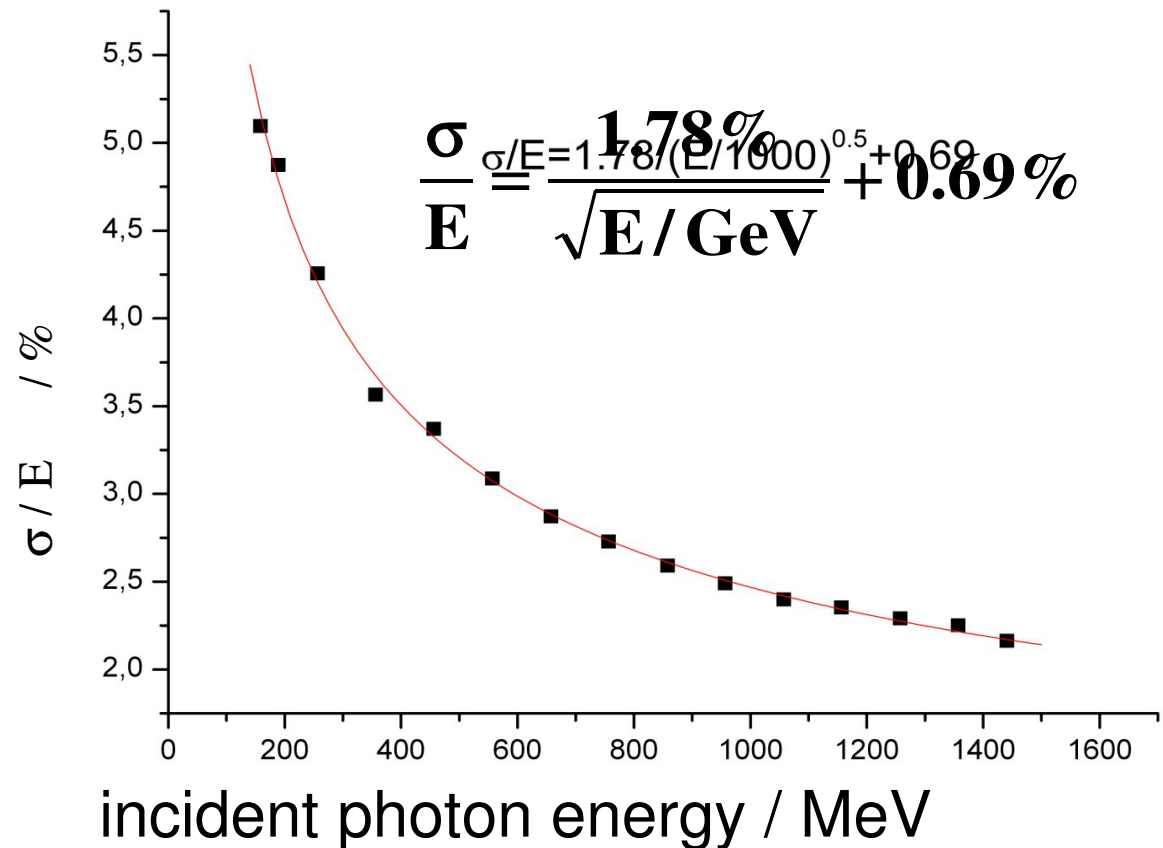
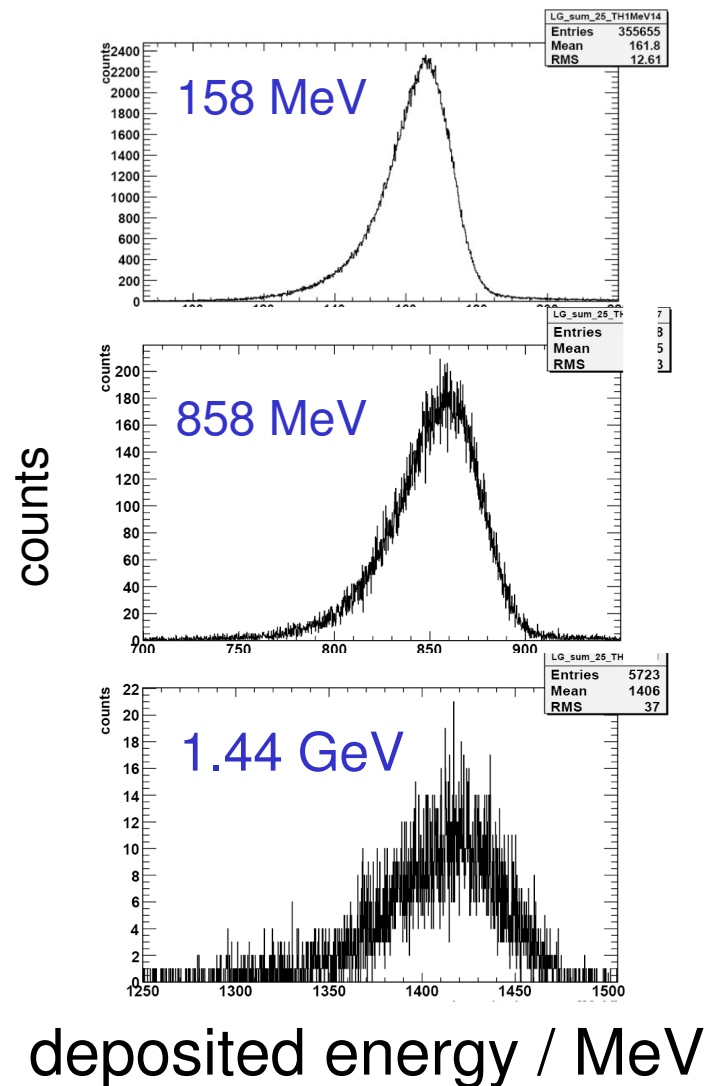


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# prototype performance PROTO 60

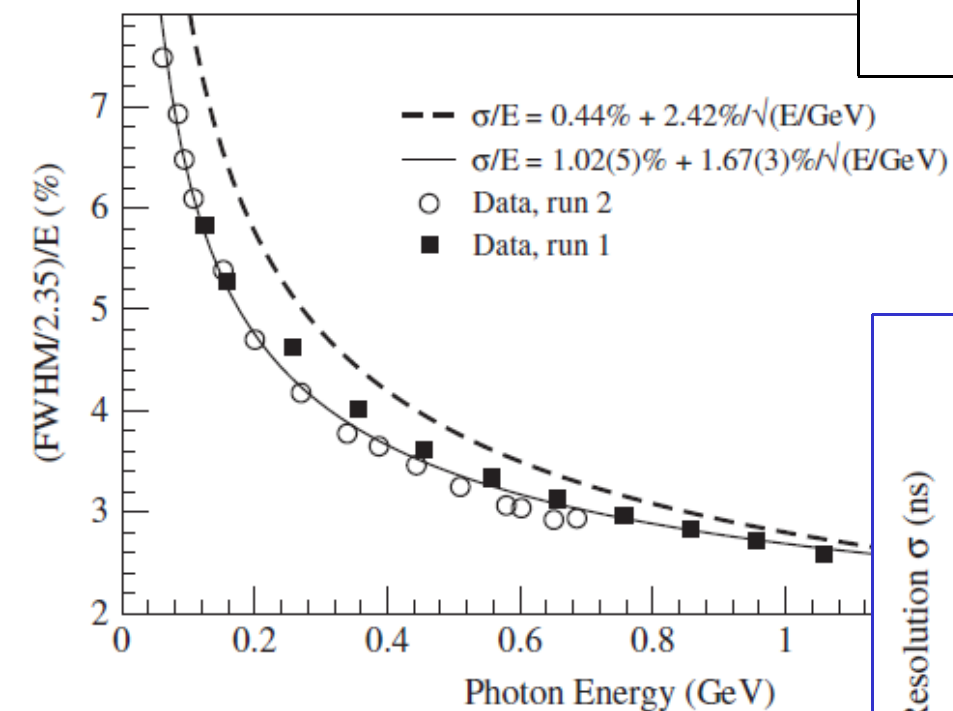


- digitization:  
shaping /peak-sensing ADC

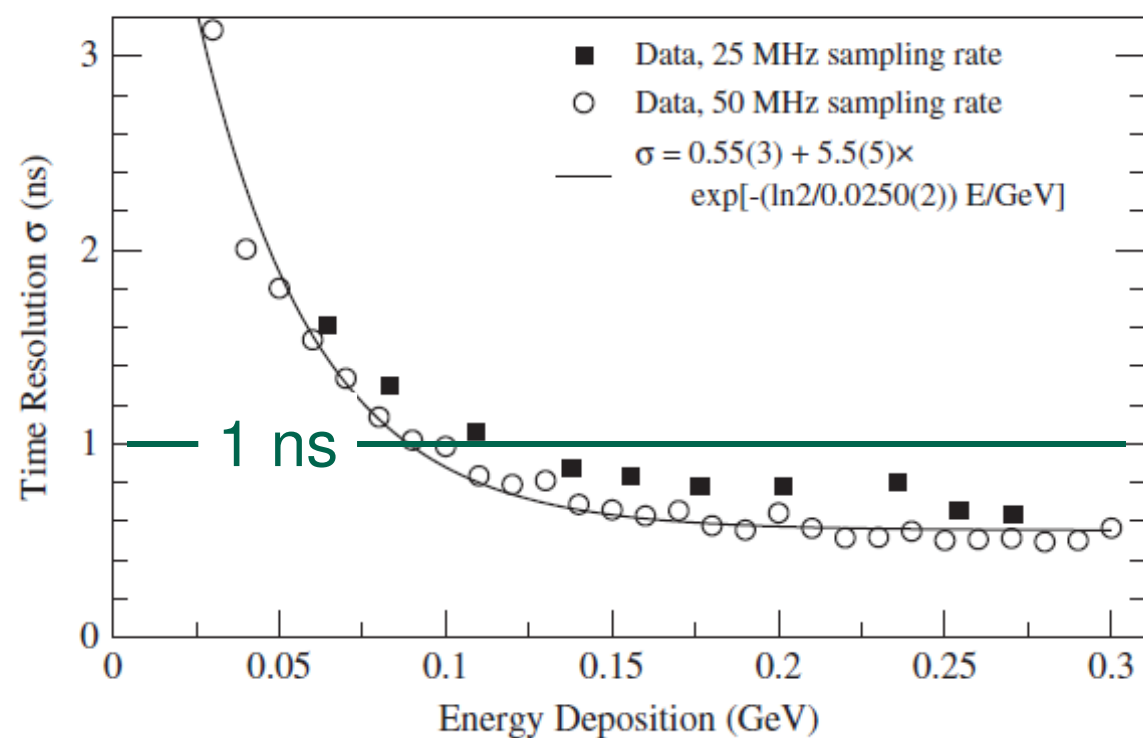
# readout via SADC:

# further improvement

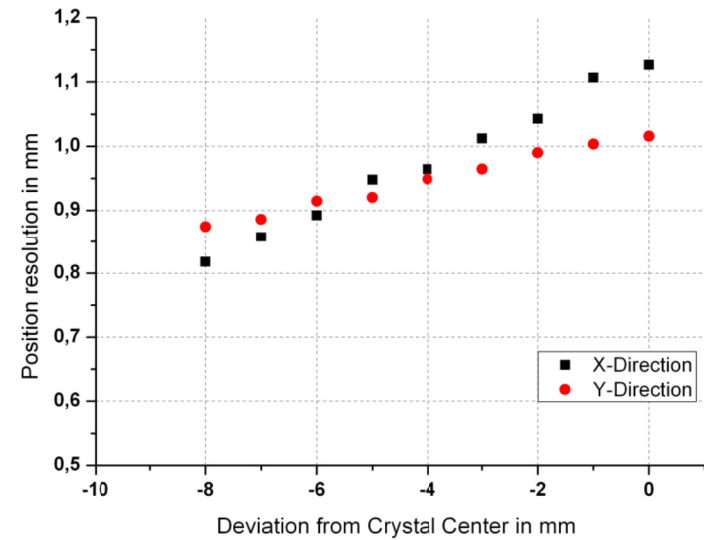
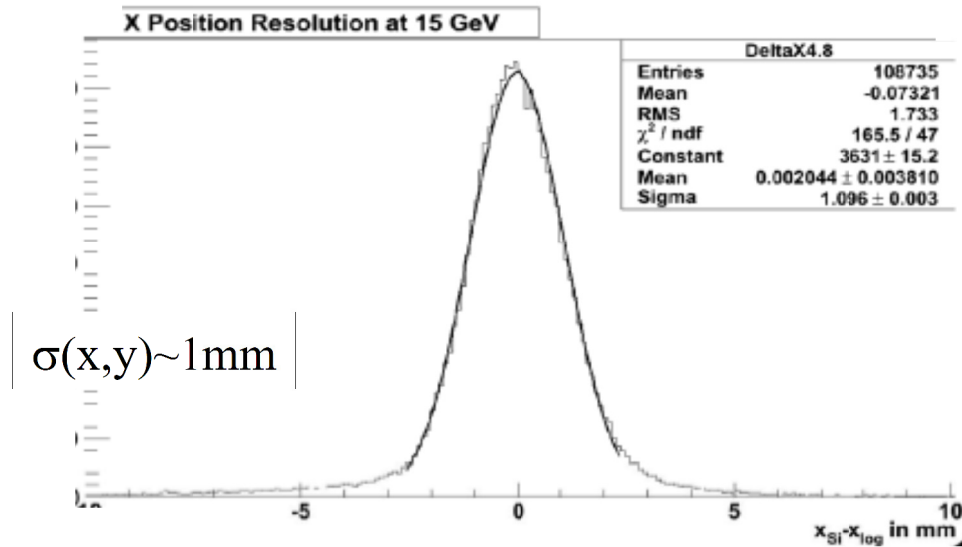
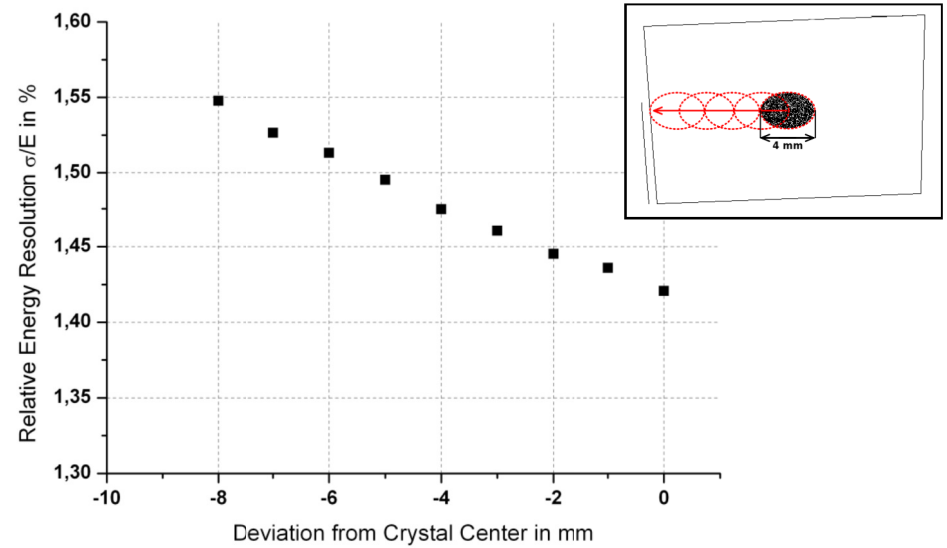
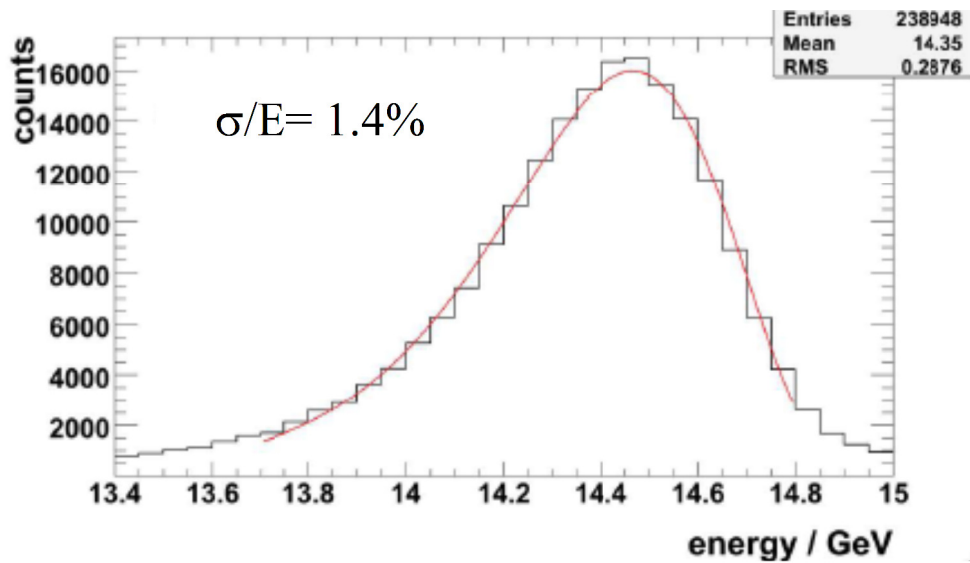
energy-resolution  
( 3x3 matrix )



time resolution

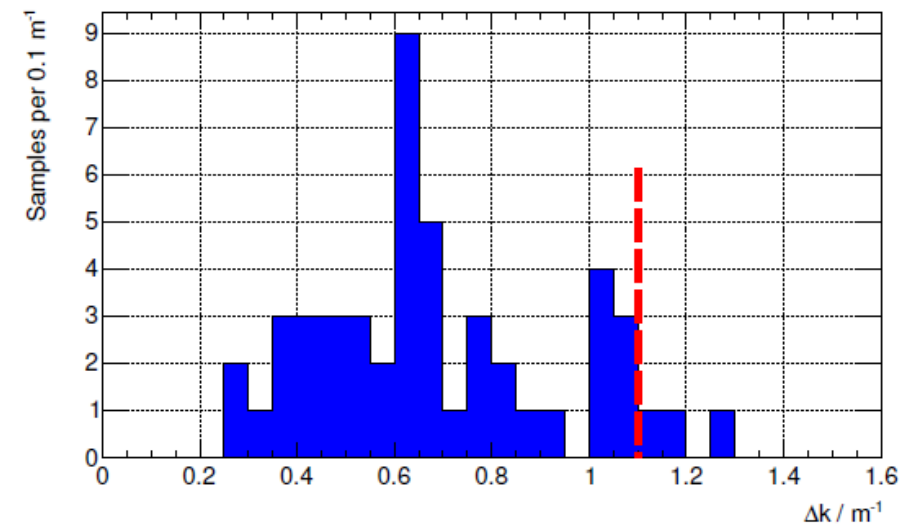
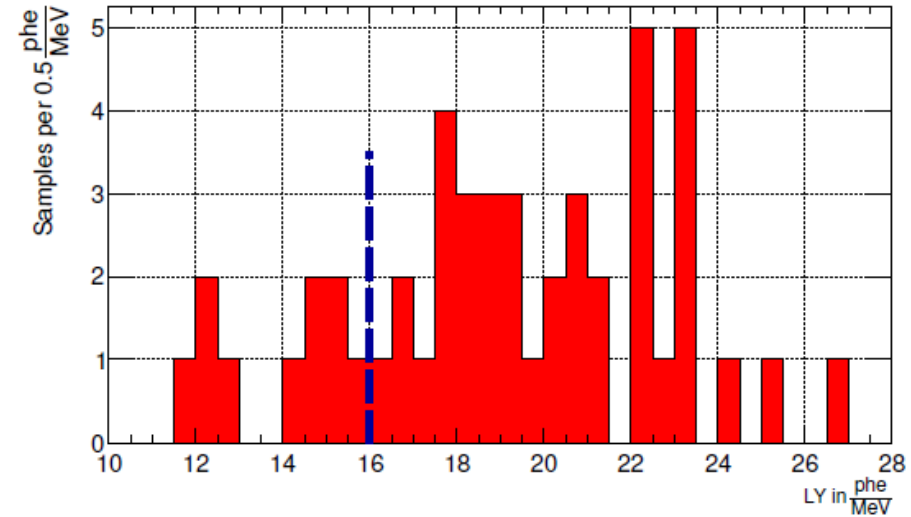
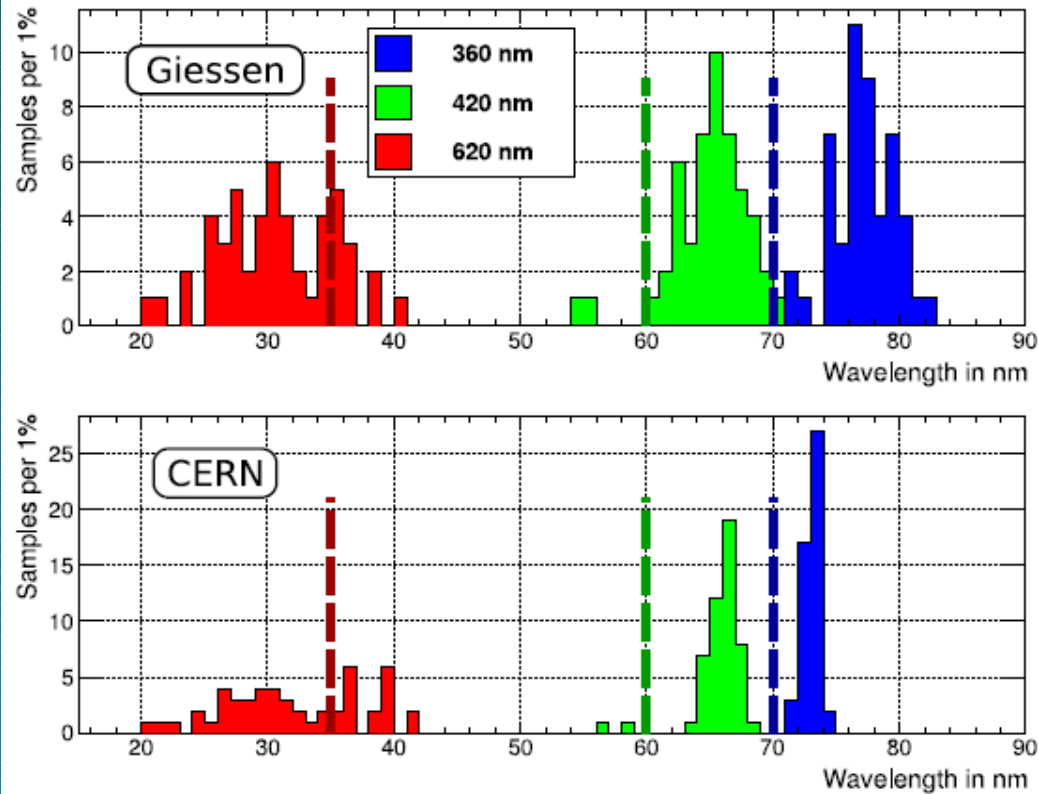


# prototype performance PROTO 60 15 GeV positrons





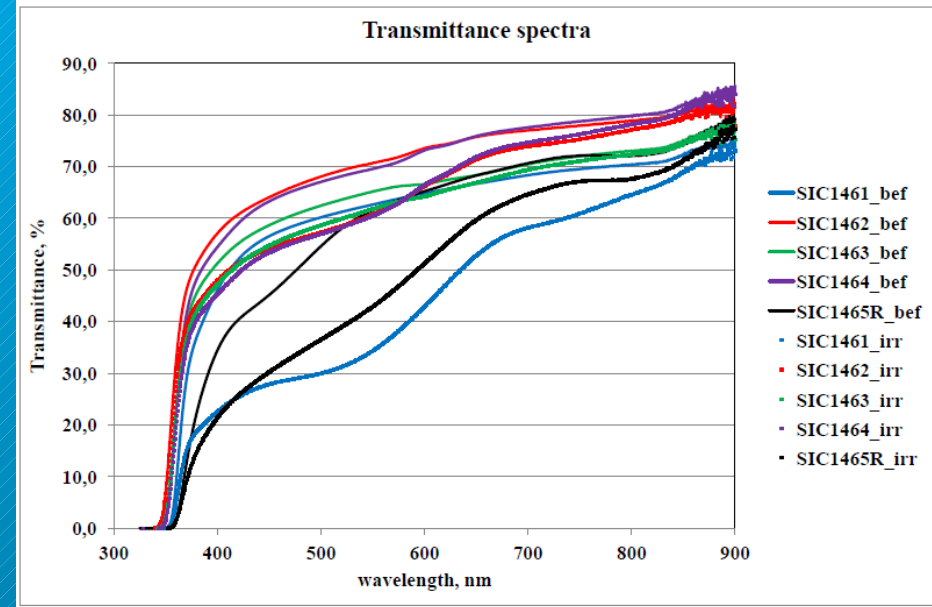
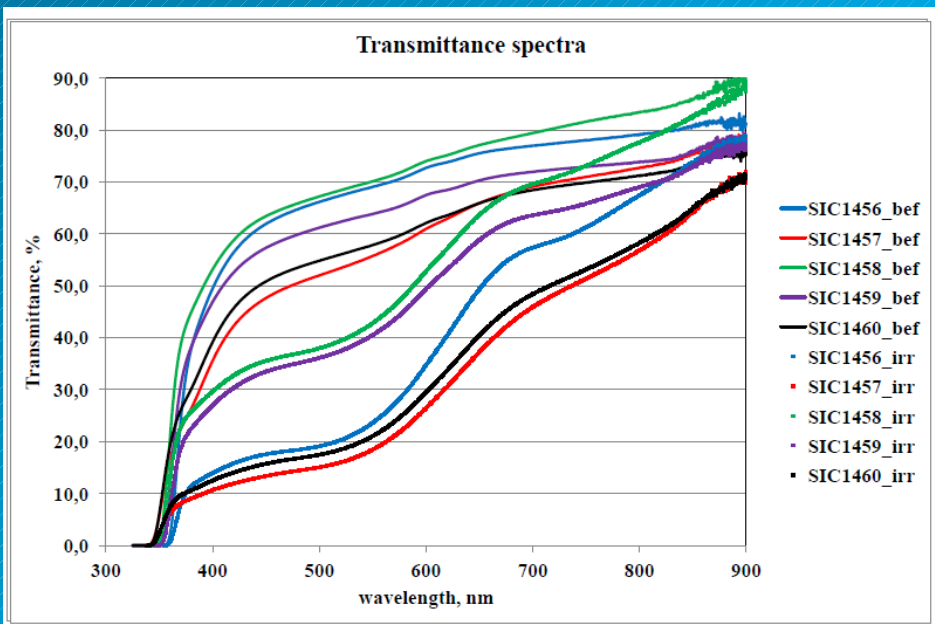
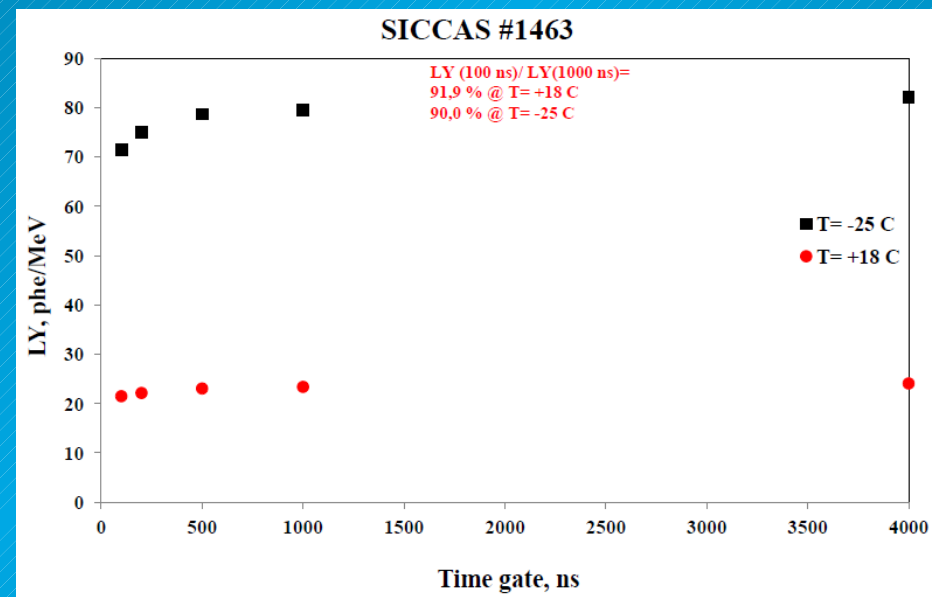
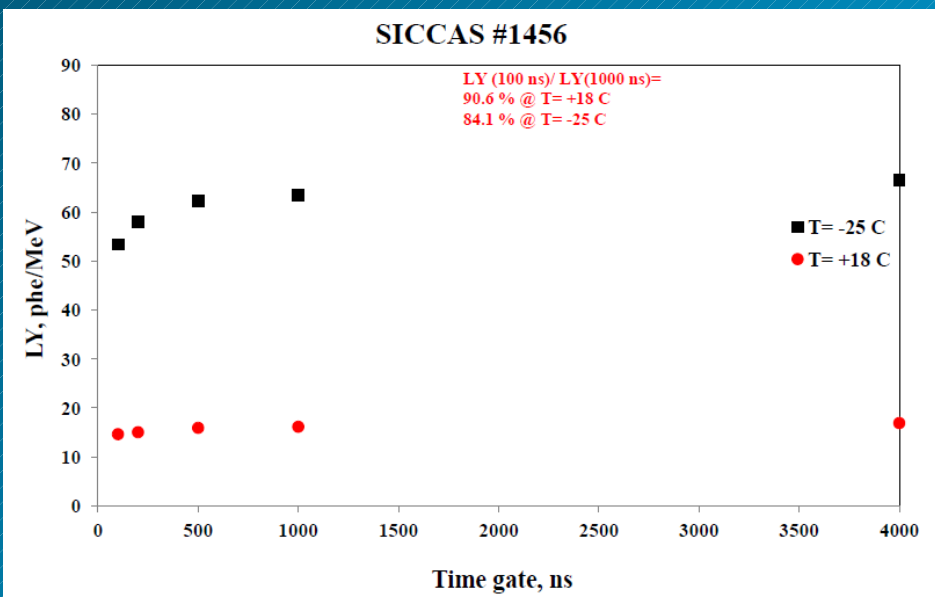
# former production @ SICCAS



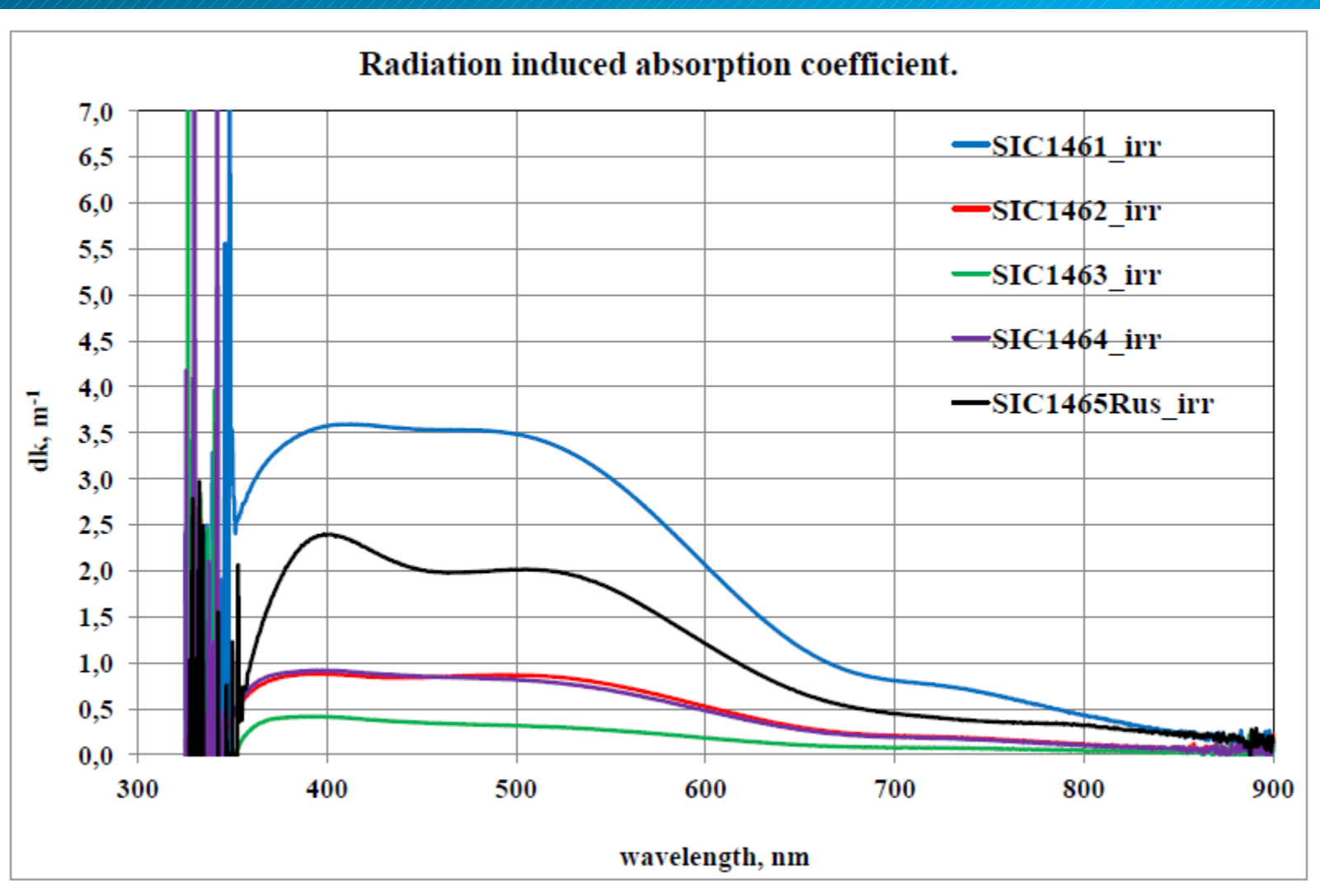
# recent delivery from SICCAS (1)

SICCAS ID	T(360	T(420	T(620	LY(T= +18 C, t=100	LY(100	dk(420 nm)	comment SICCAS	LY
	%	%	%	phe/MeV	at T=18C, %	m <sup>-1</sup>		SICCAS
limits	≥ 35	≥ 60	≥ 70	≥ 16	> 90	< 1.1		
1451	19,0	58,8	73,8	22,3	94,1	1,92		
1452	25,2	62,9	74,2	22,3	94,1	0,72		
1453	23,2	57,8	75,3	11,1	90,4	3,94		
1454	35,0	67,2	77,8	26,9	93,7	0,69		
1455 rus	10,1	52,5	73,5	15,4	93,9	2,68		
1456	2,0	56,5	73,8	15,6	90,6	6,36	doping	17,1
1457	16,4	42,3	62,9	13,1 at -25 C	87,8	6,32	doping	13,4
1458	20,4	58,8	75,2	17,8	91,3	2,93	doping	22,0
1459	11,3	52,6	68,5	19,2	92,1	2,74	doping	21,1
1460	19,1	45,7	63,6	?	?	5,89	doping and raw materia	15,4
1461	8,8	52,0	65,6	19,7	91,7	3,59	doping and raw materia	20,5
1462	32,5	60,7	74,3	21,9	91,5	0,85	doping and raw materia	17,7
1463	22,9	55,1	67,3	21,5	91,9	0,38	doping and raw materia	19,7
1464	22,7	59,0	74,1	20,5	91,6	0,89	doping and raw materia	23,9
1465 rus	1,8	40,3	66,5	12,9	90,8	2,26		9,3

# recent delivery from SICCAS (1)

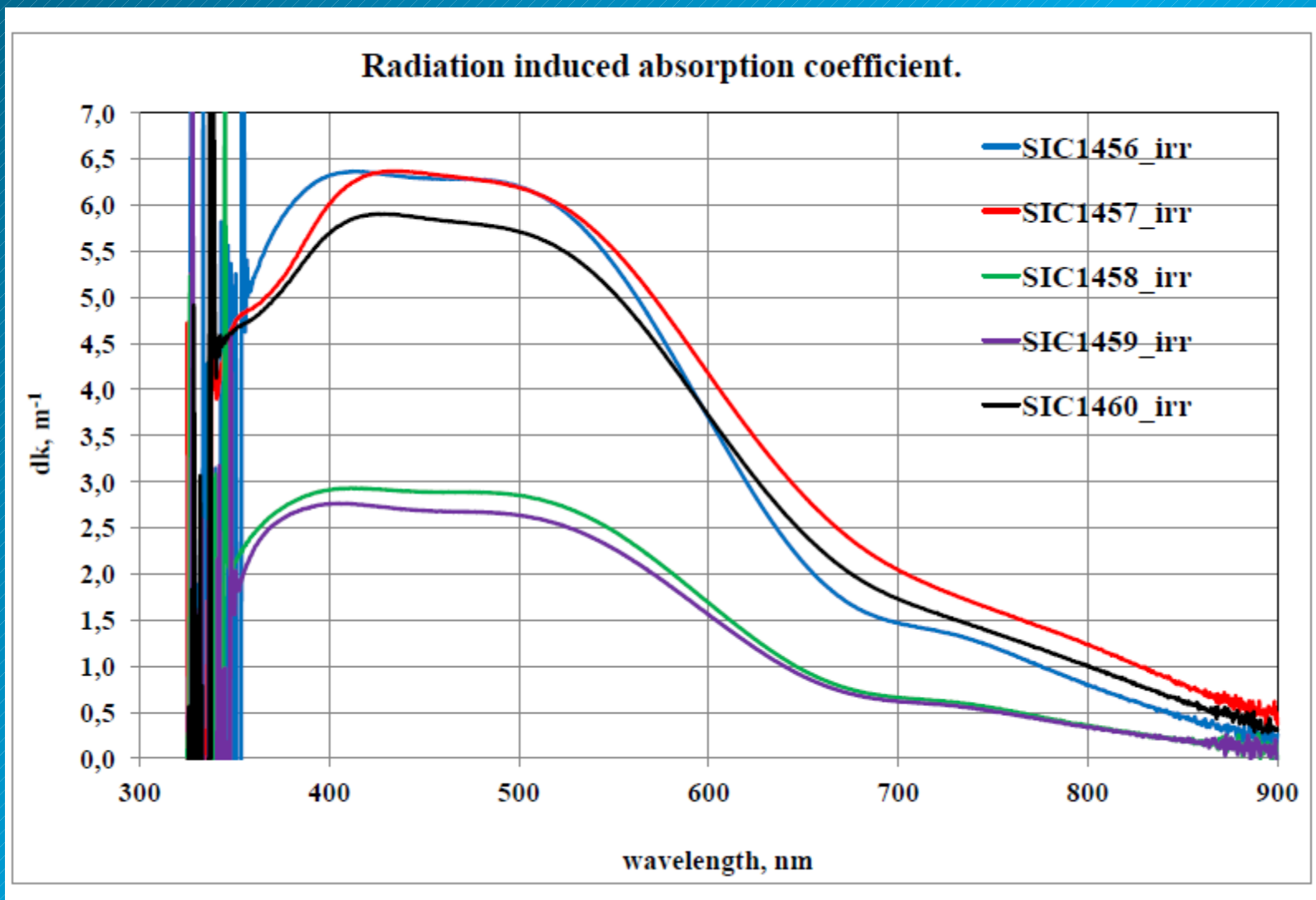


# recent delivery from SICCAS (1)





# recent delivery from SICCAS (1)

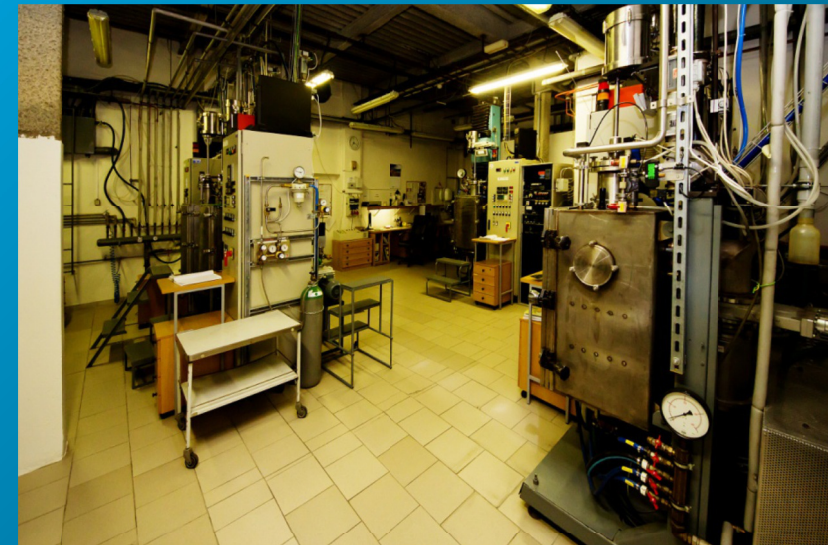


# additional new PWO manufacturer

CRYTUR – Turnov, Czech Republic



- R&D phase just started (June 2014)
- Czochralsky technology (identical to BTCP)
- know-how and raw material still available



- alternatives ?

