ECL FWD Upgrade status and what's next?

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- Introduction
-CsI(Tl) rad hard status
-Study of the ECL performances
- Software what we have
- Software + lab measurements, what is missing?

ECL FWD upgrade

1. Some physics studies were presented by the groups from Canada about performances for the ECL FWD
2. And some extrapolations from dose accumulated by crystals during BELLE experiment

→ Upgrade of the ECL FWD:

- → not significant improvement seem to be obtained from the change of the technology (from point 1 above)
- → CsI(Tl) calorimeter is good enough also at the dose rate of BelleII (from point 2 above)

Physics studies summary

Using pdf from BaBar + background expected in BelleII (with safety factor 3 applied to Bkg and CsI timing resolution)→

Significance improvement of 4.5% in B→K nu nu

3.0% in B →Tau nu

Repeat the study with the new simulation of the background

Dose rate from BELLE

- Paper from Kuzmin et al. on CsI(Tl) irradiation studies: between 10 and 30% LY loss at 3.7Krad negligible impact on resolution
- From BELLE dose extrapolation and from Bckgnd sim:

450 rad/year expected in the fwd (steady state operation, injection could be the same)

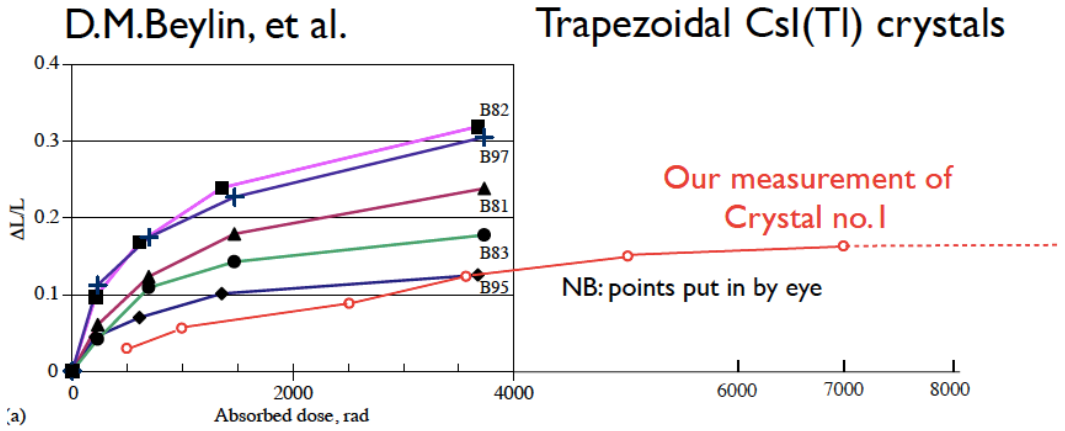
Lifetime dose quotation is 10krad (dose expected in 10 years of BelleII, changed to 3krad with the background simulation presented at the last B2GM) → we do not expect any effect

But..large spread in LY loss for

Different producers

Different theta

Phi dependence of absorbed dose has been observed



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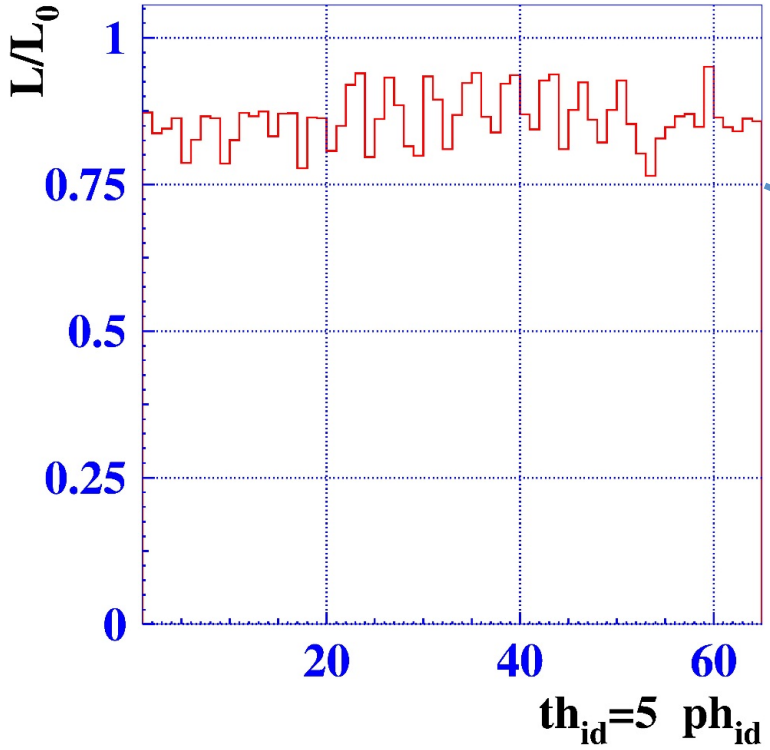
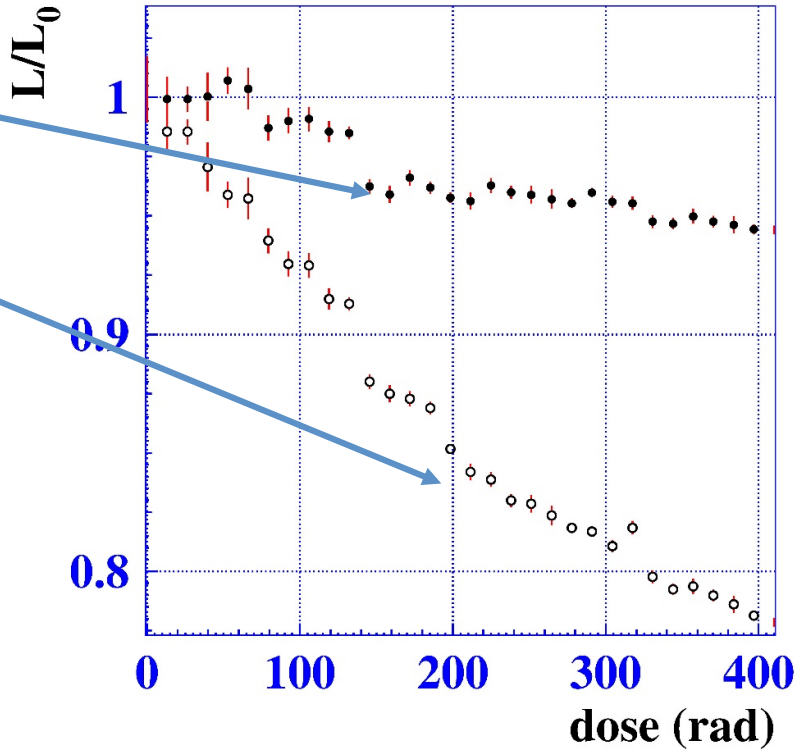
After 1 ab^-1 at BELLE

fixed theta, modules along phi

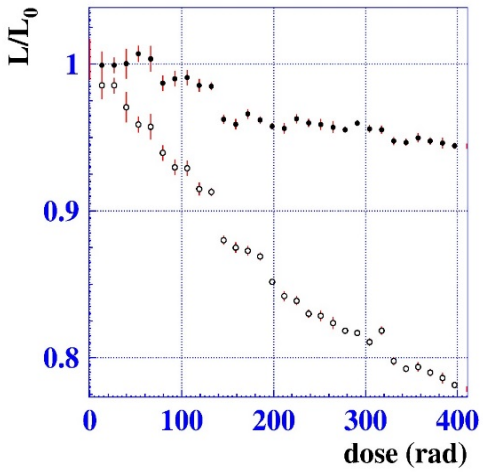


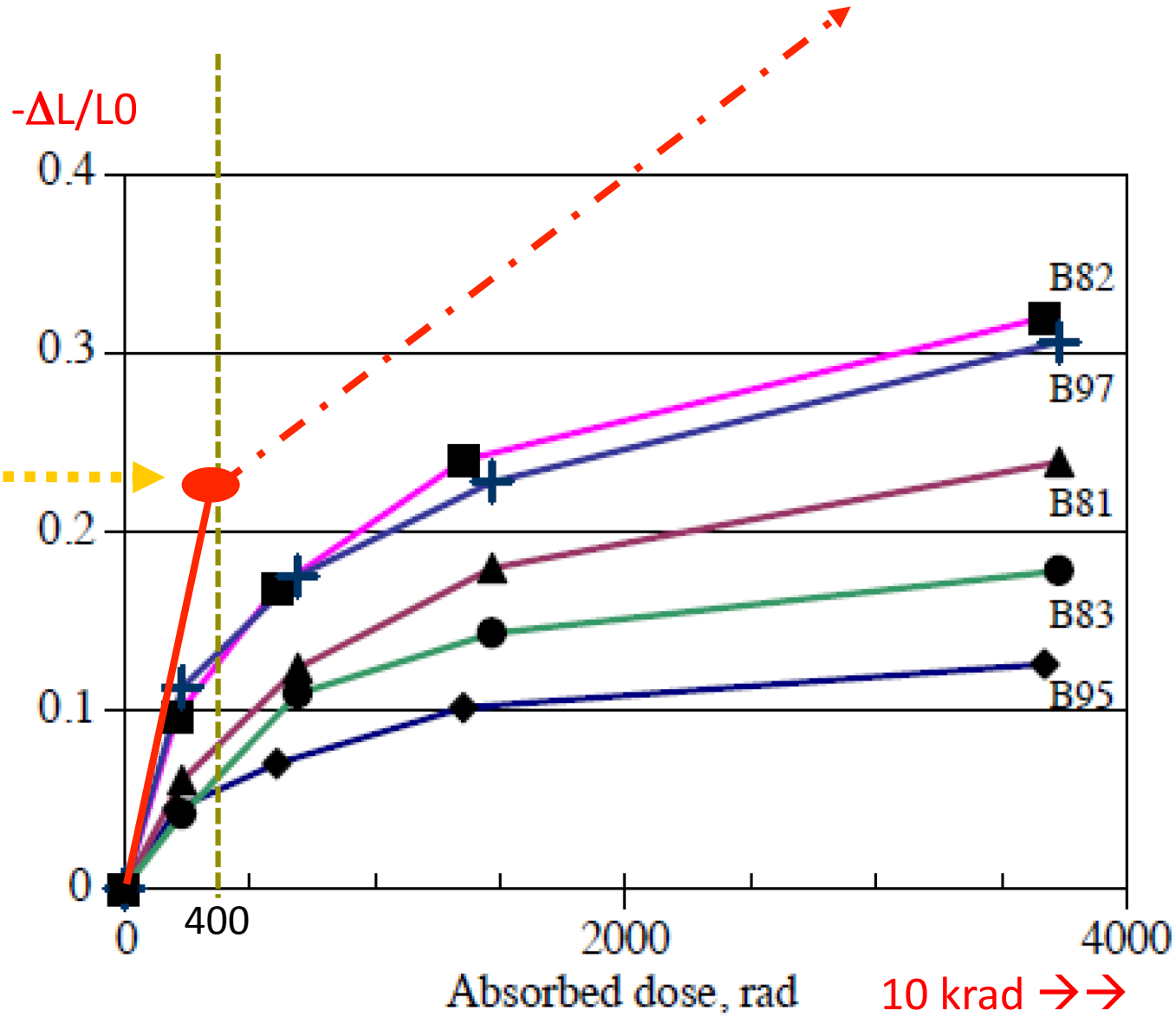
fixed theta, best and worst modules



What happens when 400 rad → up to 10 krad?

Extrapolation after 50 ab^-1





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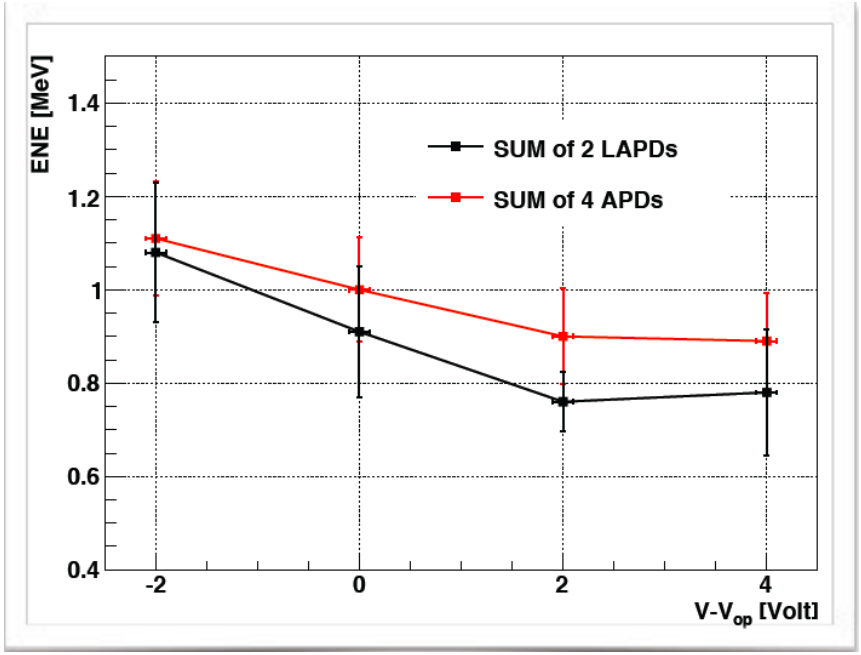
What we have done since then…

- Continued and almost finish R&D on APD's readout of pure CsI crystals
- Irradiation campaign on CsI(Tl)

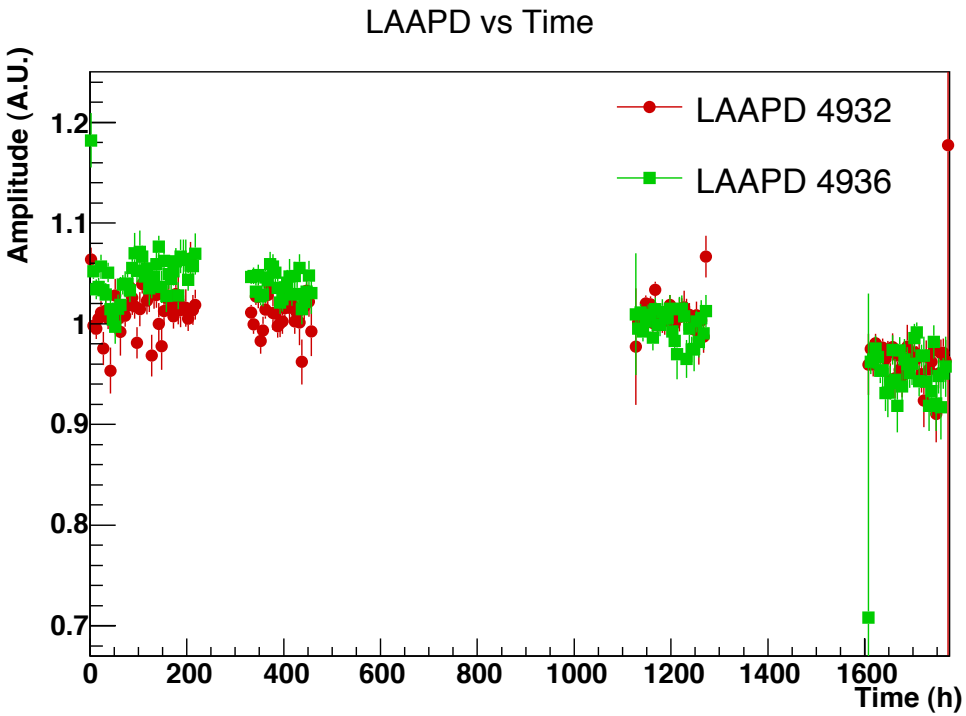
- Software study and development to create essential tools for physics performance studies

R&D on APD's

Extenisve R&D has been carried out to verify the possibility of using APD's as photodetectors for pure CsI crystals.



Has to be < 1 MeV



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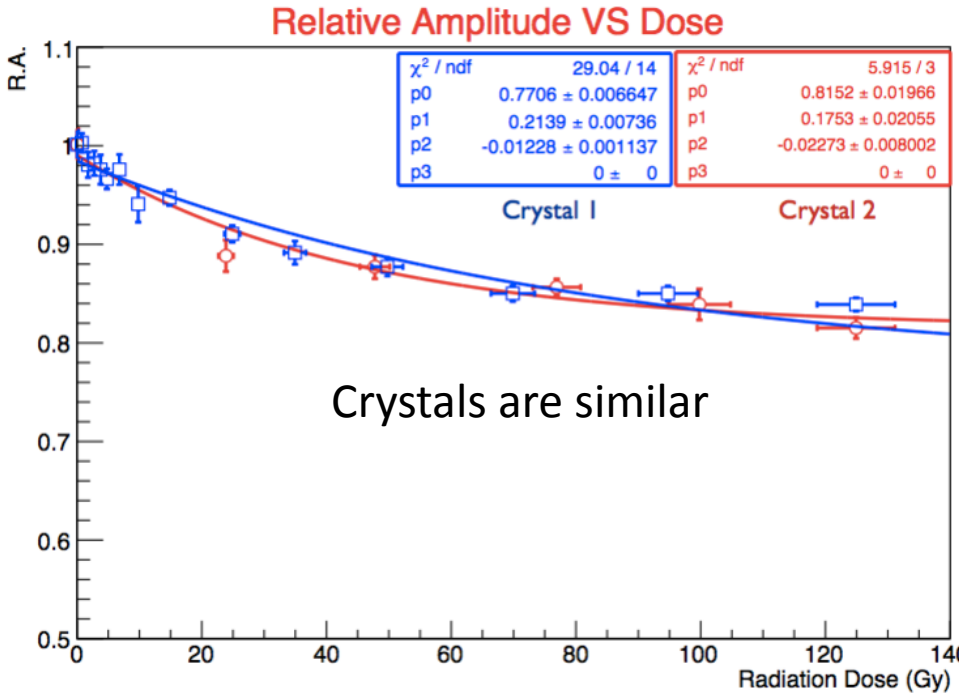
Test Beam preliminary results

- 4x4 matrix at the BTF beam line
- Electrons between 100 - 450 MeV

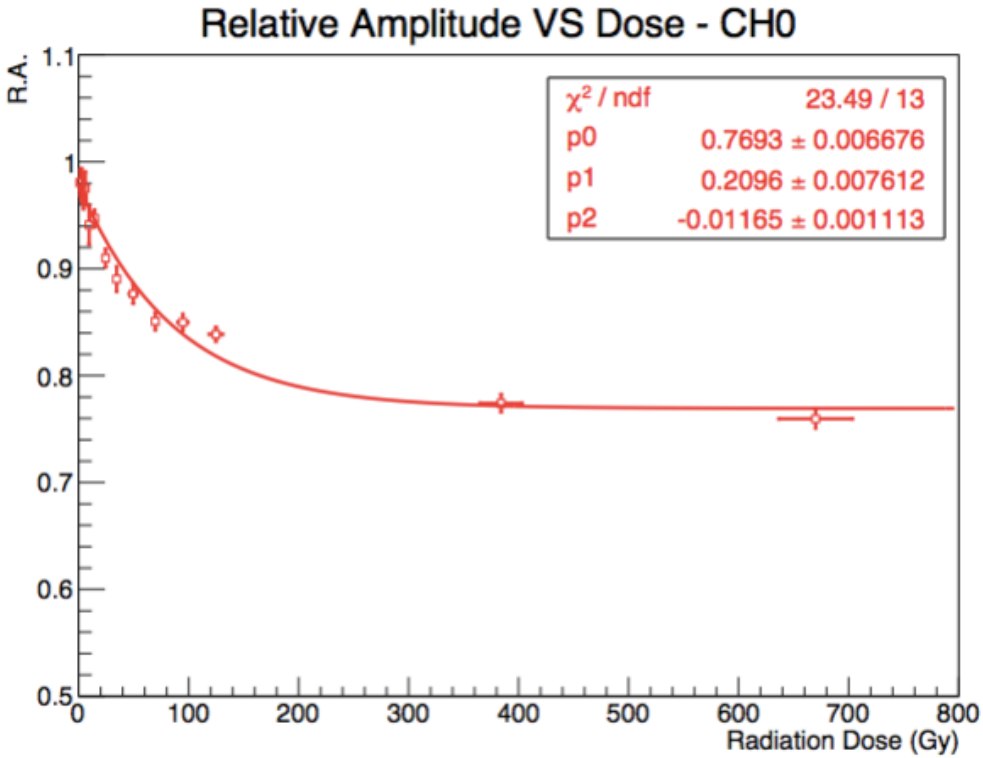
TO BE UPDATED AFTER DISCUSSION SUNDAY

CsI(Tl) Rad Hard



Crystals are similar

LY decrease of about 20%
We do not have a simulation to see the effect on resolution but we do not expect this to be enough to have the upgrade.



Campaign will continue with other irradiations:
- irradiation from the front
-new CsI(Tl) crystals

See Riccardo De Sangro talk

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Studies of ECL performance

- Possible configurations
  1. CsI(Tl) + PiN (actual ECL= BELLE)
  2. CsI(Tl) + APD (never studied in lab)
  3. Pure CsI + APD
  4. Pure CsI + photopentode

Study of the resolution at different energies

- Photons-electrons in ECL sigma(E)/E vs E
- Π^0, reconstruction + Δm
- Physics benchmark channels

What we could do….

Study the change of the resolution vs S/N (ENE) → to be implemented in the Digitizer

- Allow the study of the response of the different photodetectors and their corresponding shaping times
- An example: could be useful to replace PiN with ADP even not replacing CsI(Tl)?
- → this is a very important question if CsI(Tl) is good w.r.t. rad hard but PiN is not

What we could do……

Study of the timing window to distinguish S e B

As of today:

$|t_0 - t_{TRIG}| < 5000$ ns/E(MeV)

(In this cut heritage of BELLE? Has it been studied for BelleII?)

TDR ref: reduction of the background for a factor of 7 with an efficiency of 93% (E> 20 MeV)

How it changes for the different configurations? In case of APD+CsI(Tl) or APD/photopentodes + pure CsI S/N is expected to change→ how it changes the rejections factor?

Strictly related to the clustering algorithm (should we study it in detail for BelleII?)

Details of the configurations

CsI(Tl) + PiN → 500ns shaping - 700 KeV ENE

CsI(Tl) + APD → ??? We are setting up in lab

Pure CsI + photopentode → 30ns shaping – 100 KeV ENE

Pure CsI + APD → 50ns-100ns shaping – 1 MeV ENE

What is missing?

- Irradiation of the BELLE PiN (we have 2 pcs) second half of February
- Study S/N for CsI(Tl) + APD in lab

1 CsI(Tl) setup is ongoing

(The two studies are partially correlated)

- Study of the clustering

What is missing?

Digitizer:

- implement the different configurations

The information on the signal shape is implemented trough matrices in the Digitizer Module; is it possible to reproduce the same for all the options

We are working on how we can put the information in the Digitizer

Things are moving to have all tools available→ goal is to be ready to start performance and physics studies

See Elisa Manoni talk

Conclusions

- Many steps before to have the good instruments for the studies of the performances (detector and physics)
- But the effort is proceeding
- Irradiation campaign is also very important due to the uncertainties that we have on the behavior of some crystals and on background simulation
- Irradiation of PiN diodes with neutrons important and scheduled together with APD's