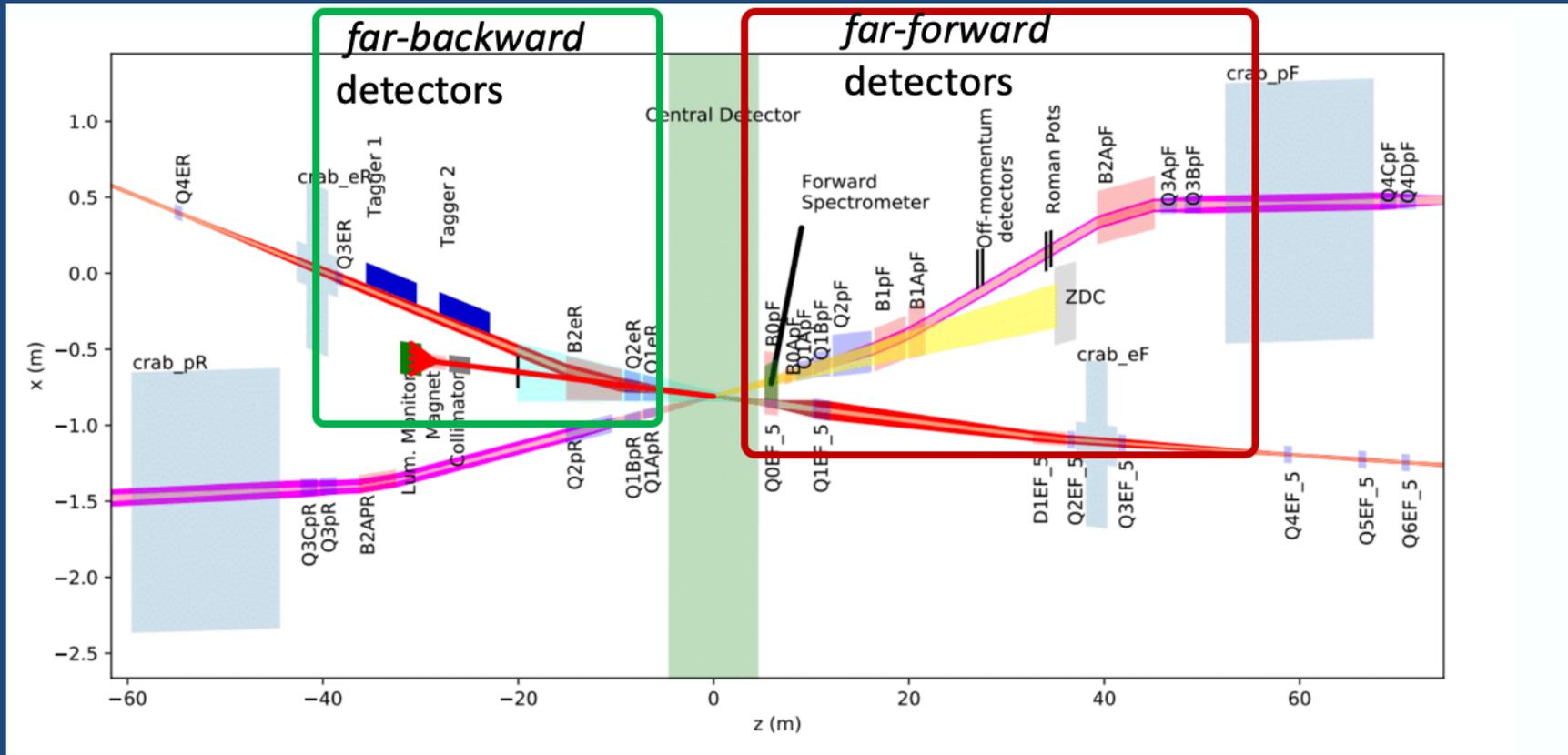


eRD27: ZDCs for new physics @ EIC

How do we design a forward detector system within an evolving accelerator matrix in 2 years?



Yuji Goto, Michael Murray for eRD27
Generic R&D meeting 25 March 2021

People who made plots

Quan Wang



Yuya Ohsumi



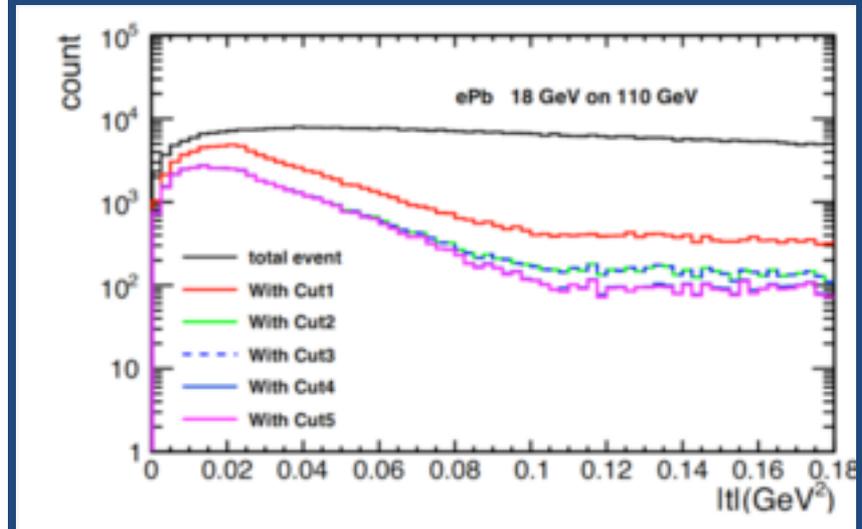
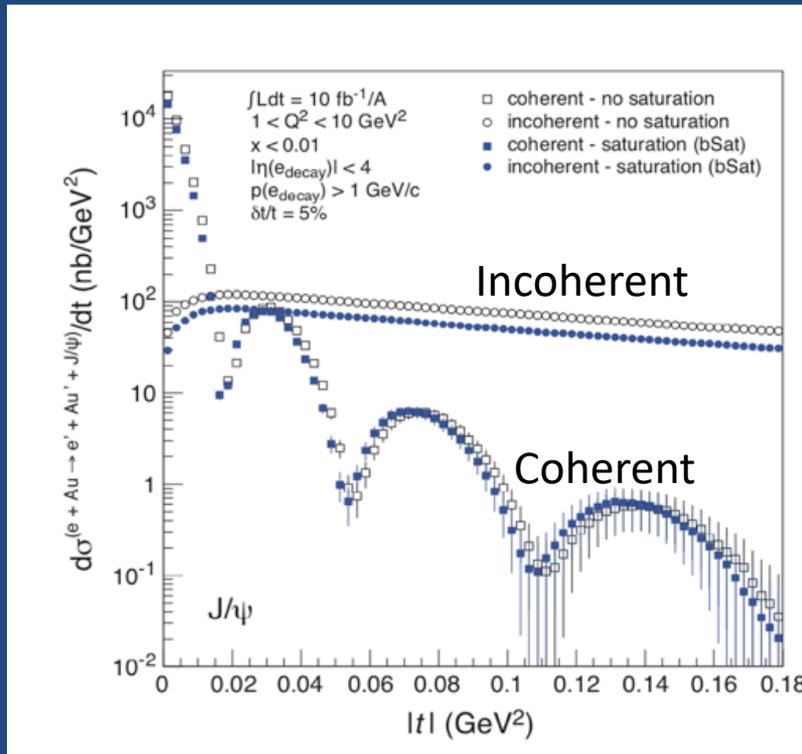
Alex Jentsch



Vitaly Baturin

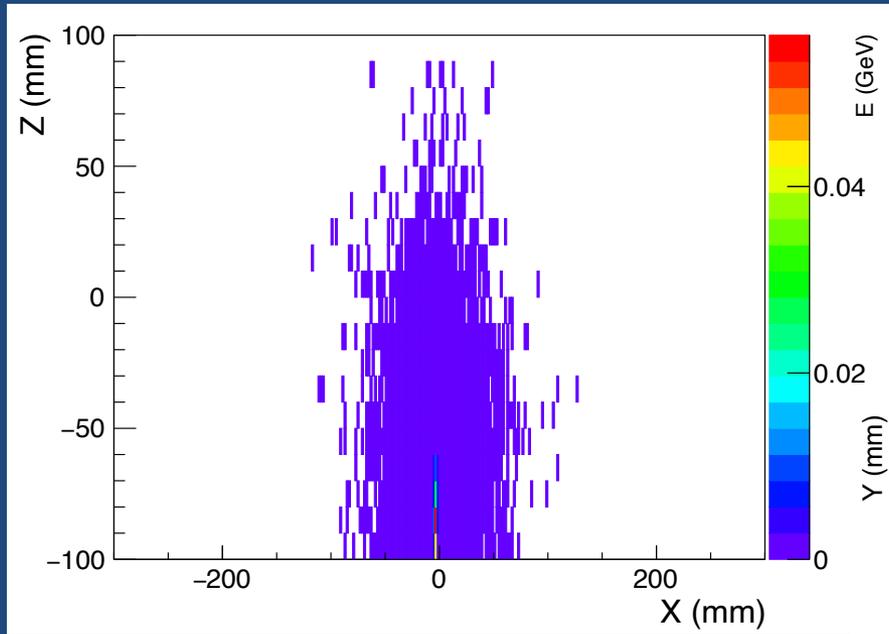
Mandate from committee, veto low energy photons

To measure coherent J/ψ production need to veto, neutrons, photons and protons

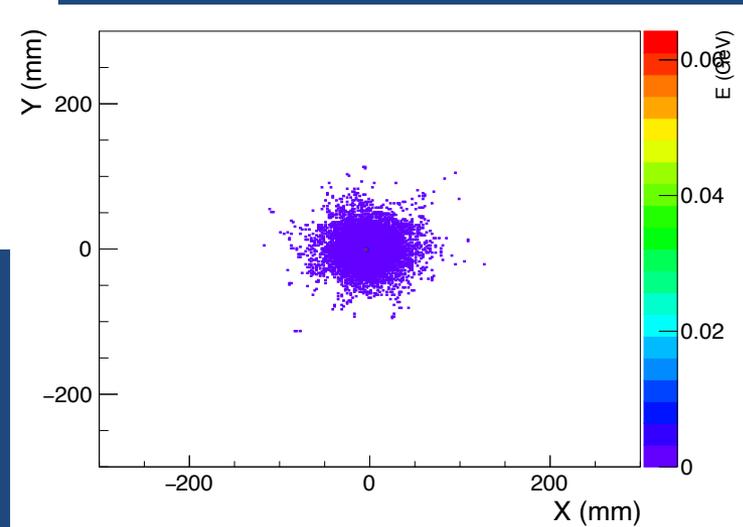


Since Pb produces 400 MeV photons we took this as our target. This led us to move to an electromagnetic section of PbWO_4 .

Transverse and depth profiles of 400 MeV photons

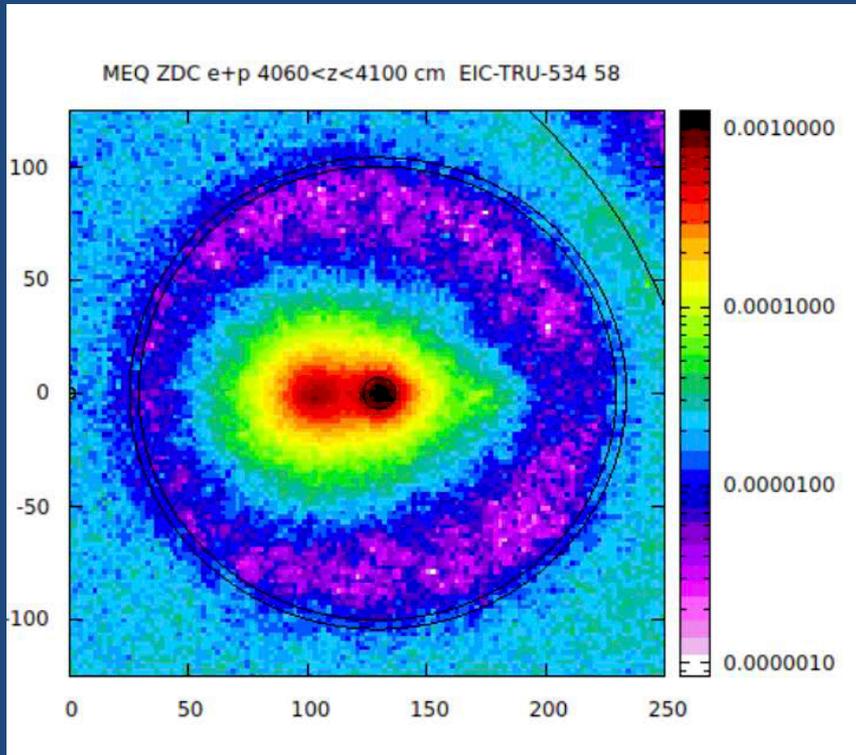


5 or 6 cm of PbWO_4 should be enough to catch 400 MeV photons



Quan Wang

Background at the ZDC from ep collisions



- Neutron dose centered on line-of-sight from IP.
- Central dose = $6 \cdot 10^{11}$ n/cm²/year
- Background tolerable for PbWO₄

Vitaly Baturin

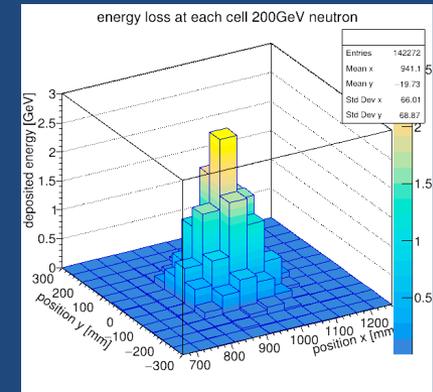
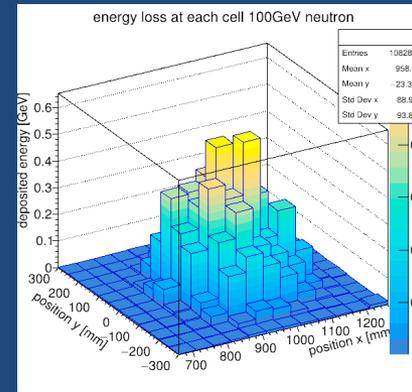
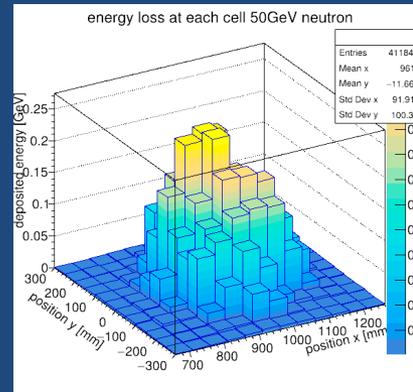
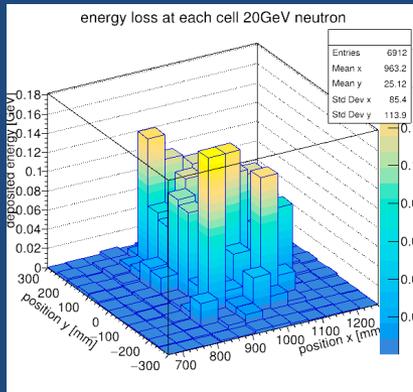
Transverse & depth profiles for neutrons

20 GeV

50 GeV

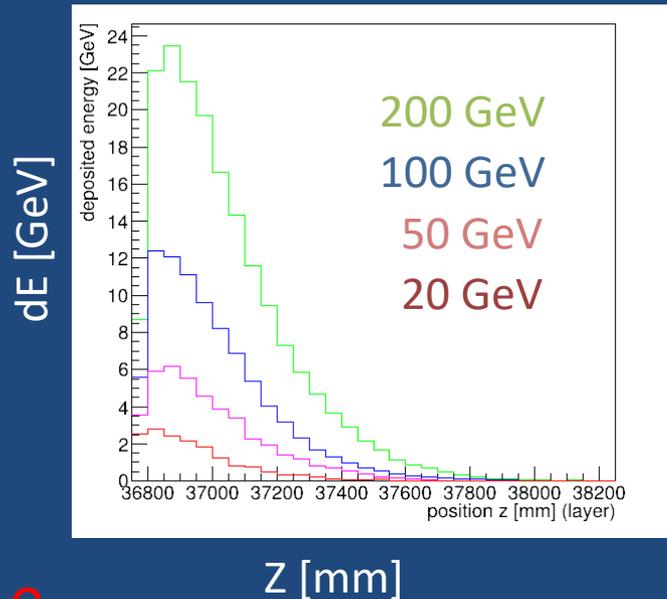
100 GeV

200 GeV



Note neutrons have a mean pT of 300 MeV

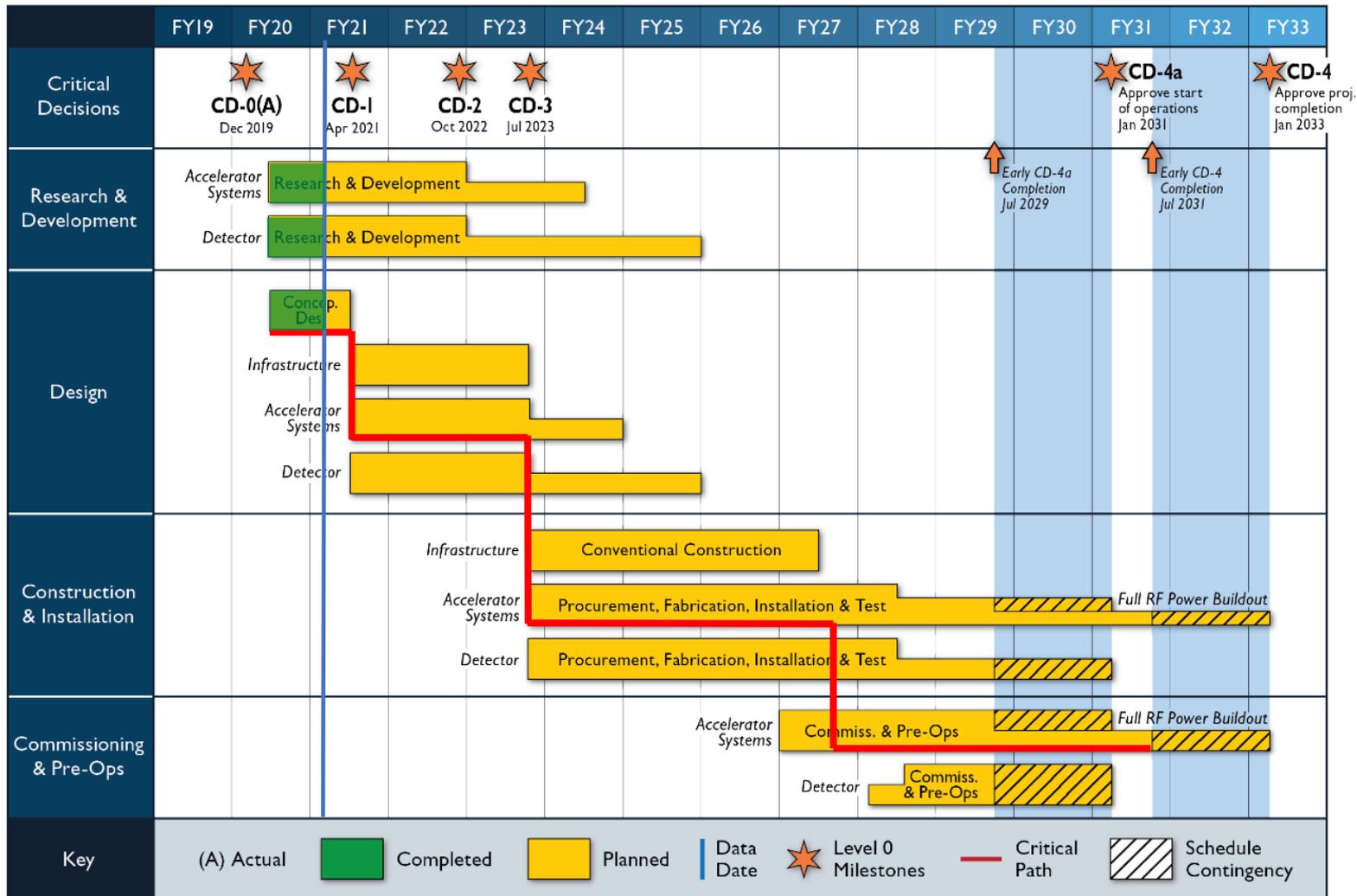
Yuya Ohsumi



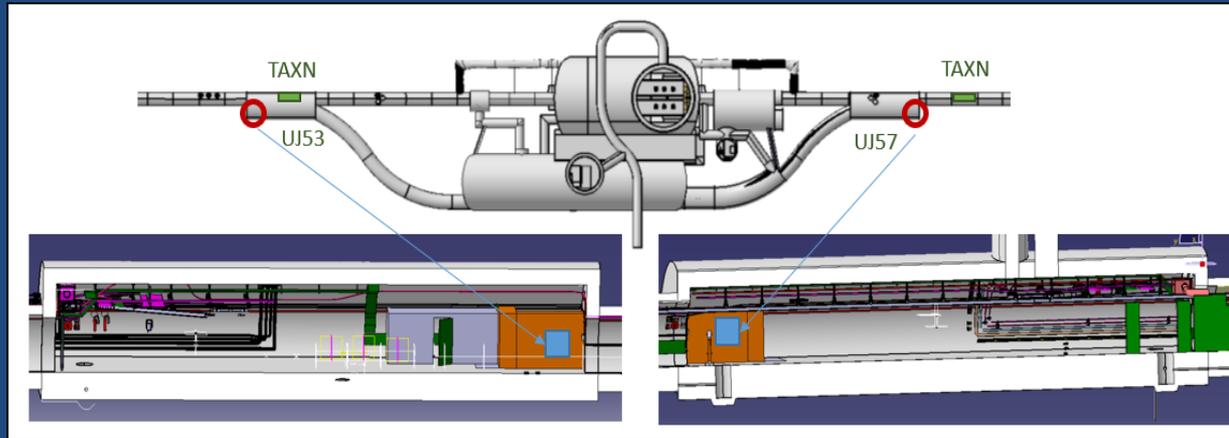
neutron energy	20 GeV	50 GeV	100 GeV	200 GeV
deposited energy $\times 10^{-10}$ [J]	0.3	0.4	1.0	2.7
Radiation dose $\times 10^{-11}$ [Gy/event]	1.1	1.7	4.0	18.2

Radiation load from physics tolerable for PbWO₄

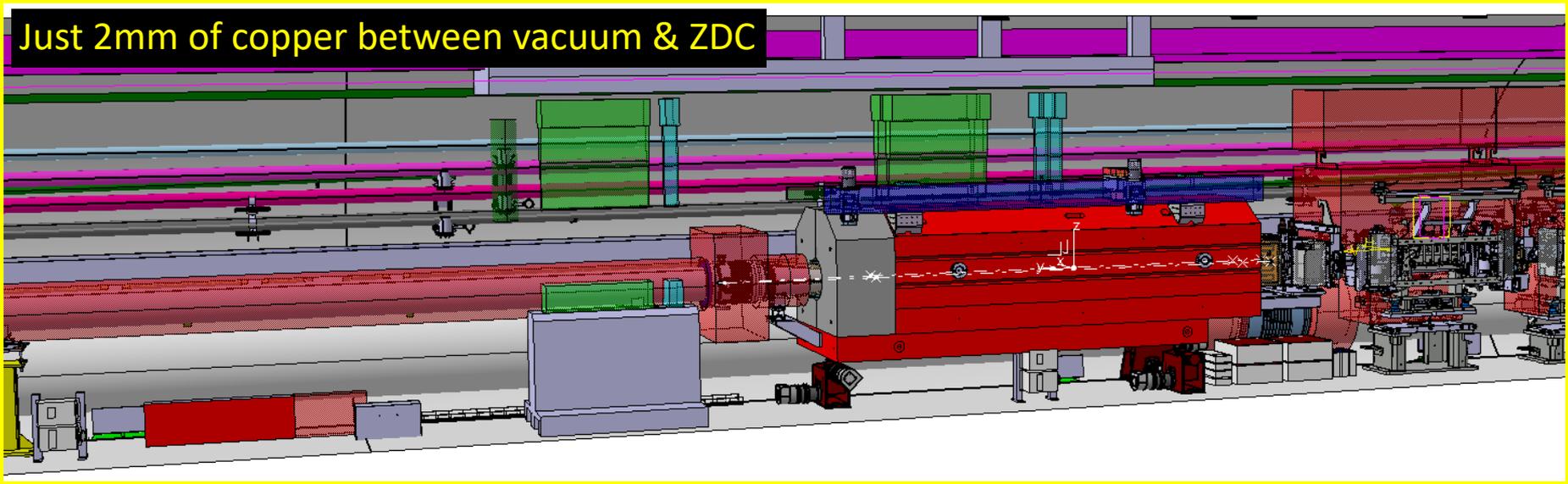
ZDC has small window to influence accelerator



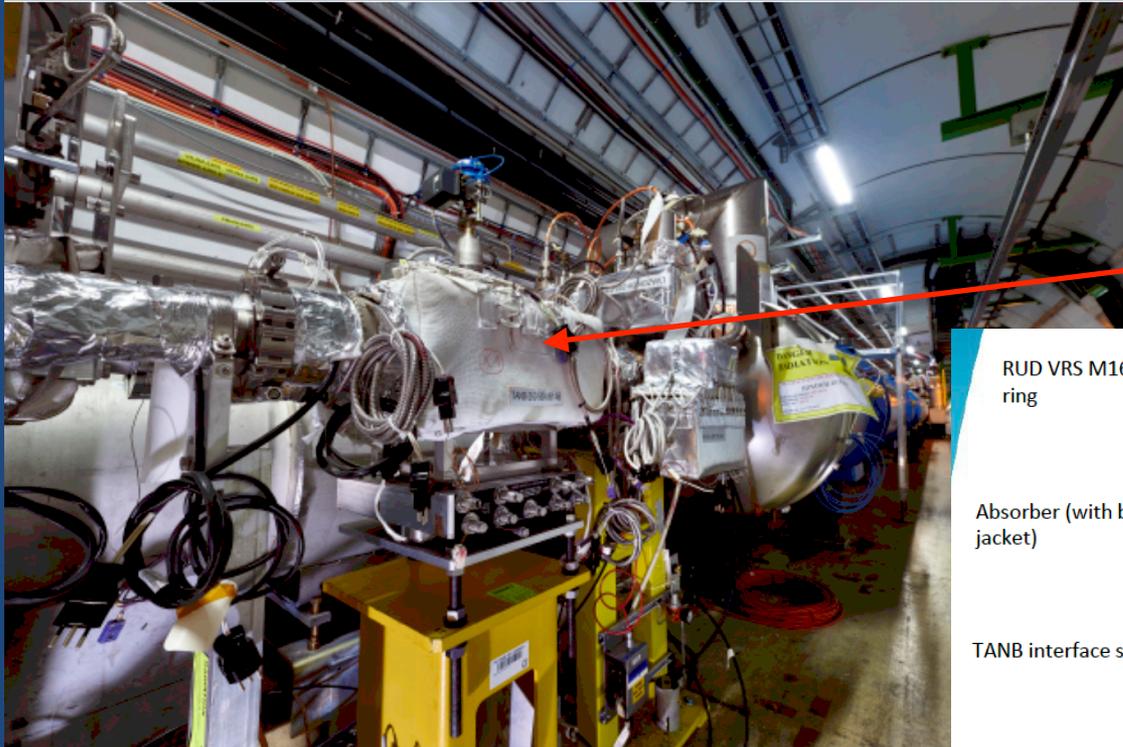
For HL-LHC spent 2 years intensively working with machine groups to integrate ZDCs in ATLAS/CMS



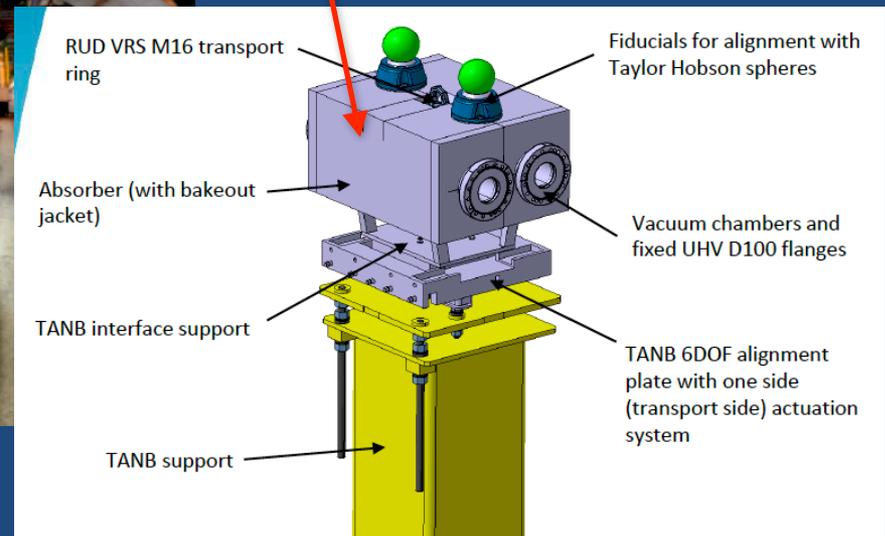
Just 2mm of copper between vacuum & ZDC



A cautionary tale from LHCb

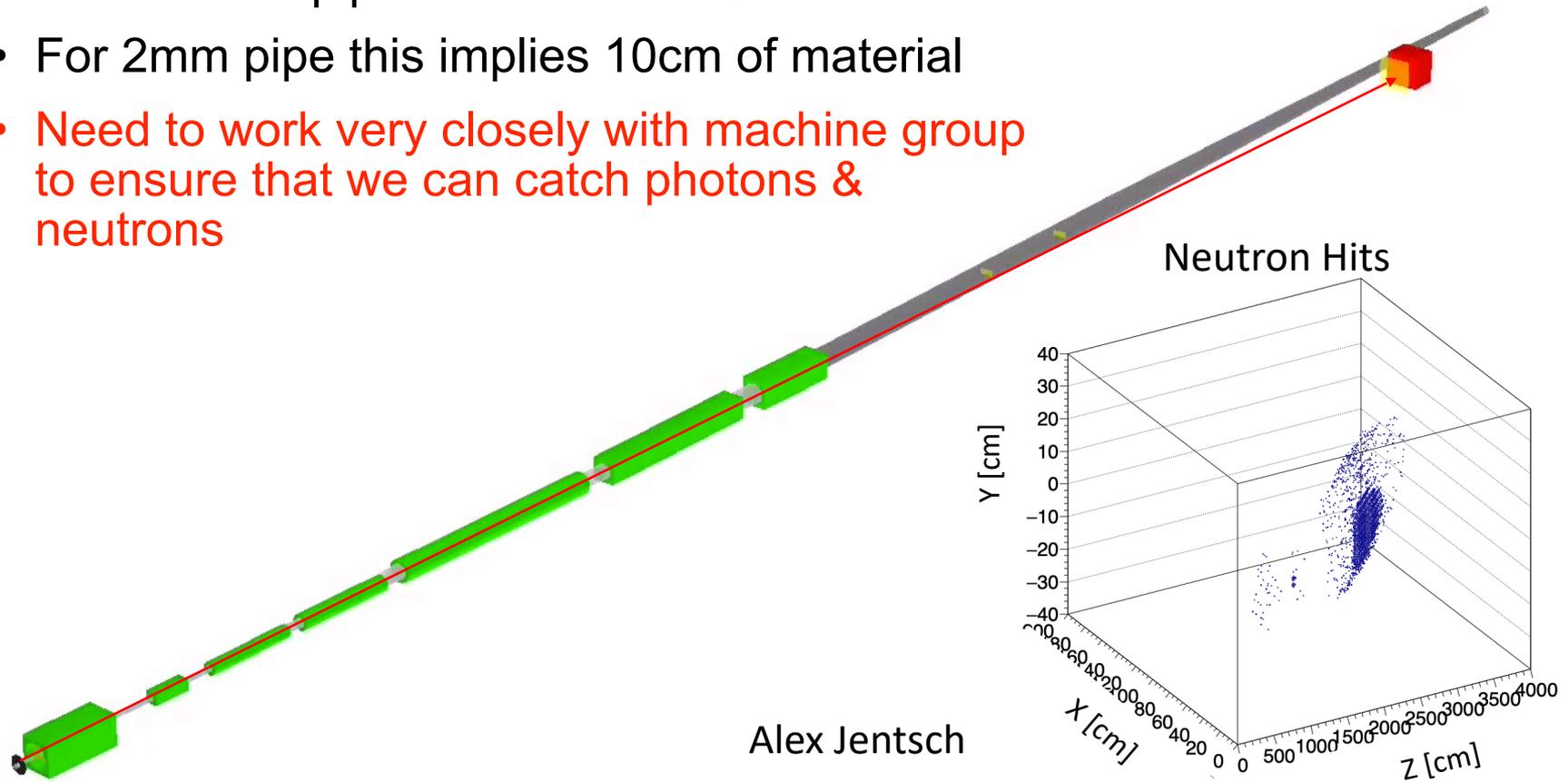


LHCb did not have an active ZDC group until mid 2020. This was too late to stop the installation of a new absorber with no slot for ZDC.



Design of the beam pipe is crucial

- Neutrons hit pipe at $\Theta \sim 20\text{mrad}$.
- For 2mm pipe this implies 10cm of material
- Need to work very closely with machine group to ensure that we can catch photons & neutrons



Alex Jentsch

Summary & Outlook

- A short PbWO_4 EM section catches 400 MeV photons and seems rad hard enough.
- Still wB0 detector could increase acceptance
- Urgent to work with accelerator group on beam pipe
- Need to work with others on an integrated forward system
- TDR requires ~ 1.5 FTE postdocs for 2 years
 - Will need test beam + students
- ZDC group looking at all funding sources, eg EPSCoR, fast timing and machining learning initiatives and will continue to benefit from LHC developments.

Back up

ZDCs at LHC: magnetic moment of tau

$$\gamma\gamma \Rightarrow \tau^+ \tau^-$$


 CMS Experiment at the LHC, CERN
 Data recorded: 2018-Nov-25 02:25:02.462080 GMT
 Run / Event / LS: 327219 / 171630155 / 356

