

# dRICH throughput update

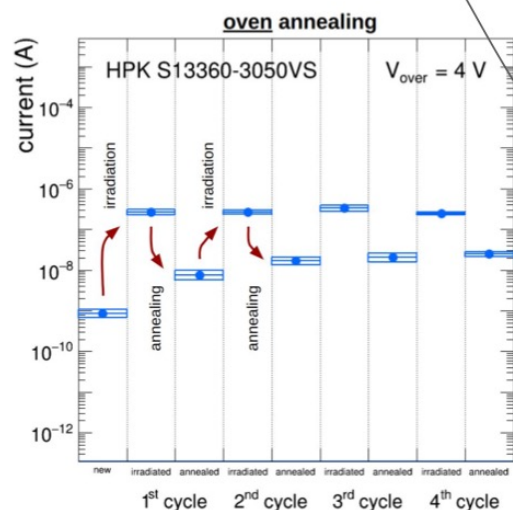
P. Antonioli on behalf of dRICH Collaboration

- Following PID review and other work several numbers further optimized (at PID review we said optimization was on-going)
- On-going communication between Marco → Beni/David/Fernando to converge on numbers
- Here focus on predicted **throughput** (following some discussion in Streaming RDO group)

R. Preghenella [ slide shown in several presentation including HEP-EPS ]

## Ageing model

max acceptable DCR for  
Physics performance  
~ 10 noise hits / sector within 500 ps



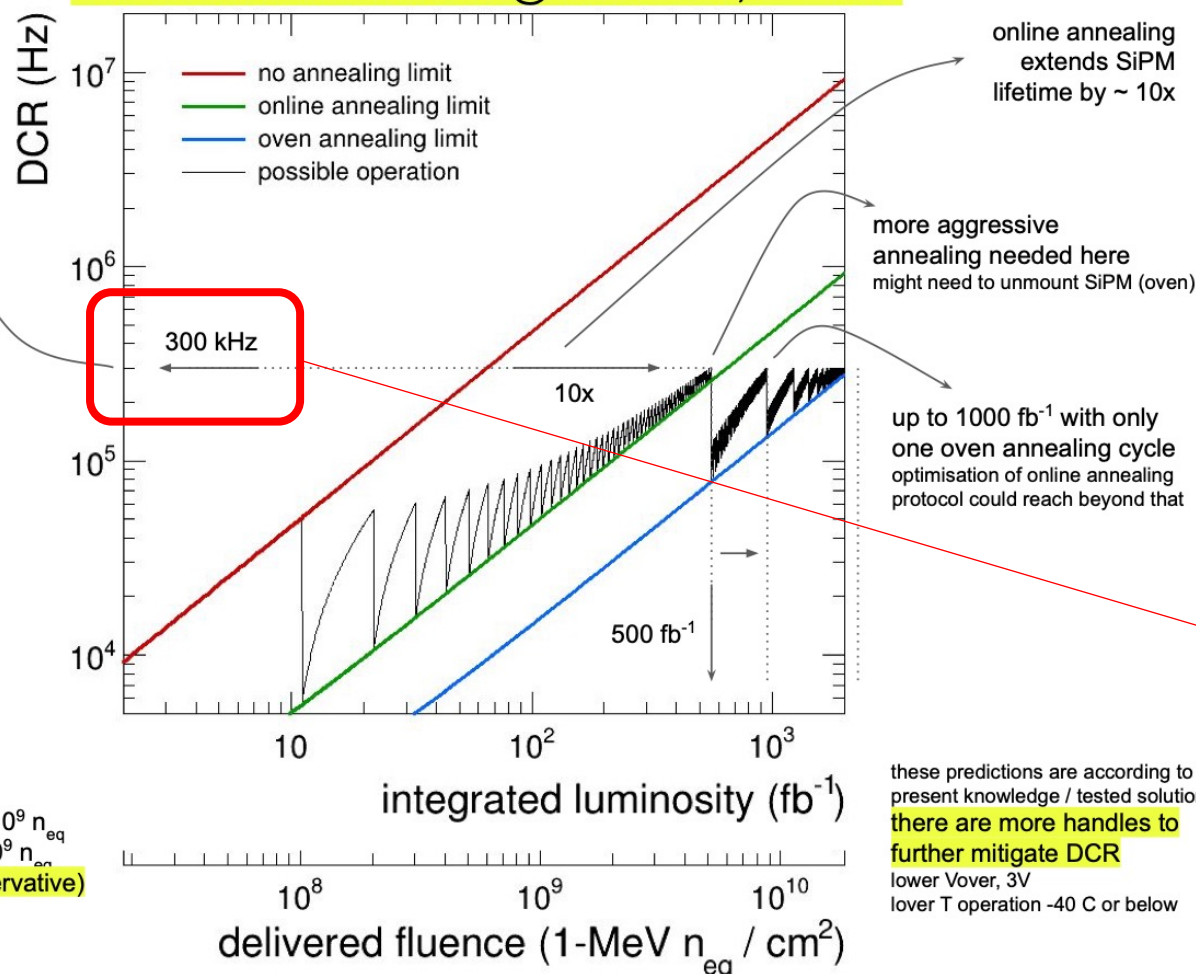
### model input from R&D measurements

- DCR increase:  $500 \text{ kHz}/10^9 n_{eq}$
- residual DCR (online annealing):  $50 \text{ kHz}/10^9 n_{eq}$
- residual DCR (oven annealing):  $15 \text{ kHz}/10^9 n_{eq}$

### 1-MeV neq fluence from background group (conservative)

- $9 \cdot 10^6 n_{eq} / \text{fb}^{-1}$
- includes 10x safety factor

Hamamatsu S131360-3050 @  $V_{over} = 4 \text{ V}$ ,  $T = -30 \text{ C}$

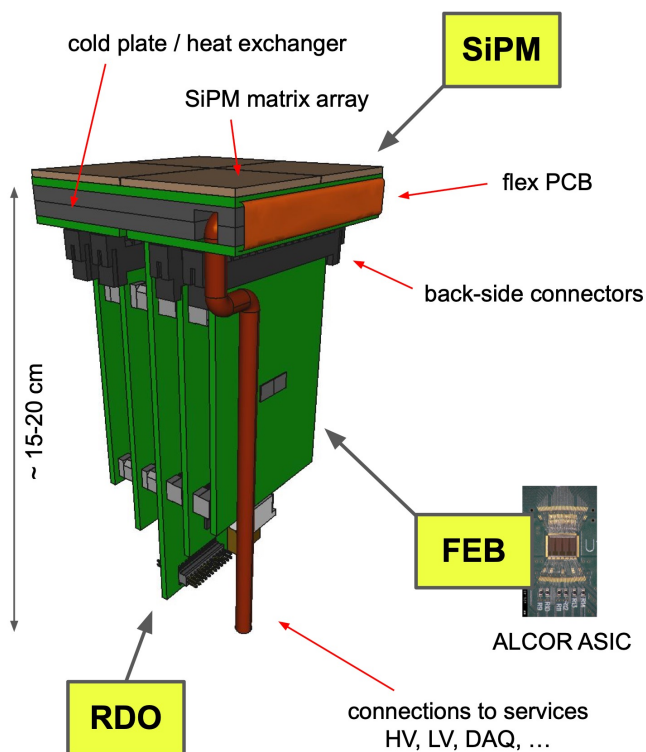


these predictions are according to  
present knowledge / tested solutions  
**there are more handles to  
further mitigate DCR**  
lower  $V_{over}$ , 3V  
lower  $T$  operation -40 C or below

11

## Photodetector unit

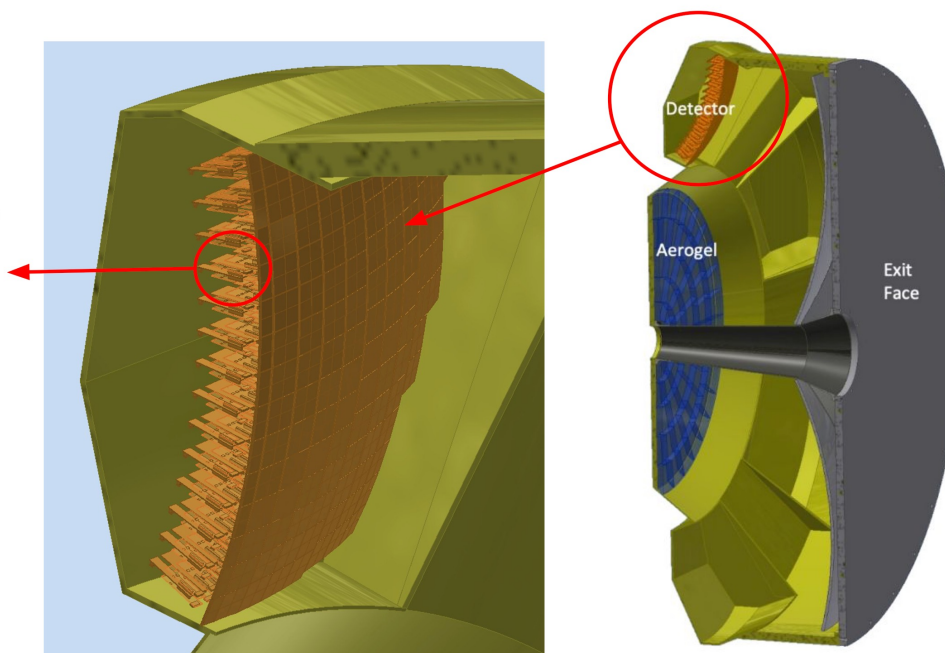
## conceptual design of final layout



R. Preghenella [at last TIC meeting]

## compact solution to minimise space

- cold plate and flex-PCB circuit
- uniform sensor cooling with no loss of active area
- all electronics and services on the back side



## Main points for us:

- 1) 1 RDO per PDU → 1242 RDO
- 2) X DAM-L1
- 3) Y DAM-L2

→ an interaction tagger giving reduction factor 200 is key and part of the model  
 → we use DAM as intermediate cards waiting for interaction tagger

dRICH DAQ parameters		ALCOR parameters		Notes
RDO boards	1242	Front end limit [kHz]	4000	
ALCOR64 x RDO	4	ALCOR Clock [ MHz]	394,08 ▼	It will be 394.08 MHz or 295.55 MHz
dRICH channels (total)	317952	Channels/serializer	8	
Number of DAM L1	27	Bits per hit	64	2 32-bit words per hit (also TOT)
Input link in DAM L1	46	Bits per hit encoding 8/10	80	
Output links in DAM L1	1	Serializer band limit [Mb/s]	788,16	
Number of DAM L2	1	Theoretical Serializer limit/ channel [kHz]	1231,5	this would be with 0 control words
Input link to DAM L2	27	Serializer limit single ch [kHz]	800	this is expected to improve with ALCOR v3
Link bandwidth [ Gb/s] (assumes PolarFire)	12,7	Number of serializer per chip	8	
Interaction tagger reduction factor	200	Channel/chip	64	
Interaction tagger latency [s]	2,00E-06	Shutter width (ns)	2	
EIC parameters				
EIC Clock [MHz]	98,522			
Orbit efficiency (takes into account gap)	0,92			

Note 1: we realized that the number of 1240 RDO recently circulated is not divisible by 6... so → 1242

Note 2: DAM-L1+DAM-L2 optimization “27+1” (but some further studies needed here... consider configuration etc.). 30+6 could be “luxury” configuration

Note 3: ALCOR shutter part of the model

Note 4: interaction tagger part of the model

INPUT	Bandwidth analysis		Limit	Comments
	Sensor rate per channel [kHz]	300,00 ▾	4.000,00	
	Rate post-shutter [kHz]	55,20	800,00	
	Throughput to serializer [ Mb/s]	34,50	788,16	
	Throughput from ALCOR64 [Mb/s]	276,00		limit FPGA dependent: with RDO prototype we will have something
	Throughput from RDO [ Gb/s]	1,08	12,70	based on Microchip
	Input at each DAM I [Gbps]	49,59	584,20	
	Buffering capacity at DAM I [MB]	0,01		to be checked but seems manageable
	Throughput from DAM I to DAM II [Gbps]	0,25	12,70	this might be higher (from FELIX to FELIX)
	Output to each DAM II [Gbps]	6,70	342,90	

ALCOR

RDO

This is the aggregated number we could sell

Aggregated dRICH data		Comments
Total input at DAM I [ Gb/s ]	1.339,03	This is only "inside" DAM, not to be transferred on PCI
Total input at DAM II [ Gb/s ]	6,70	This is based on aggregation above + reduction factor of the interaction tagger
Total output from DAM II [ Gb/s ]	6,70	Further reduction possible to be investigated (FPGA level?)

Note: first hard limit (RDO-DAM link) hit only at 3 MHz input..

But we should think how to present things...  
(see next slide)

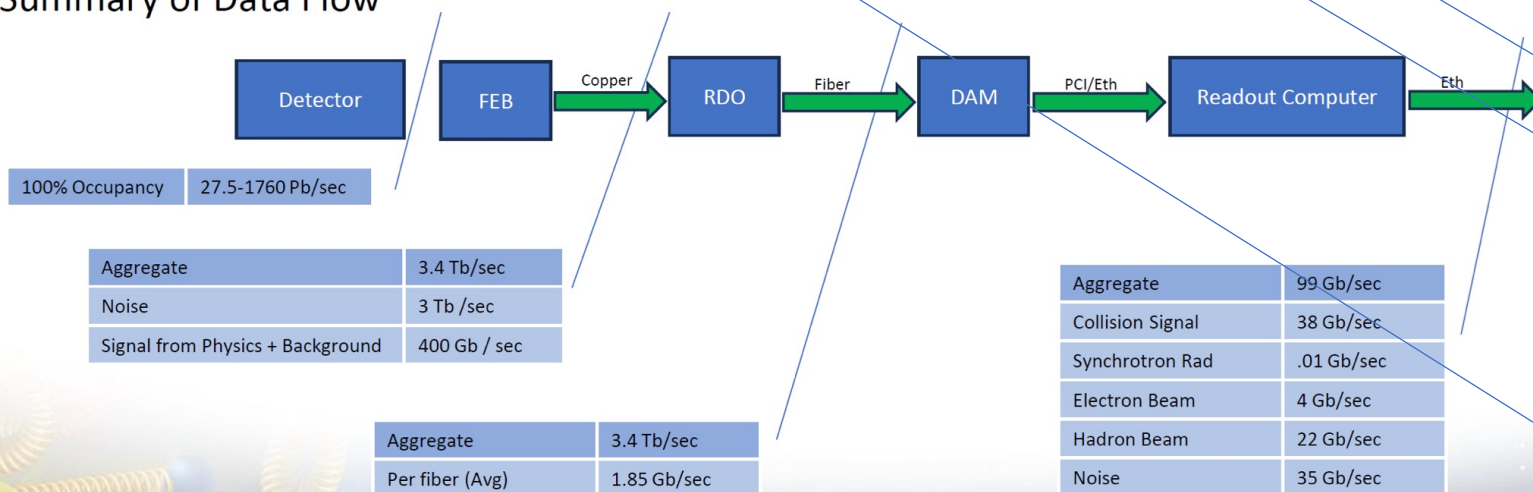


## Summary of Channel Counts

By Jeff Landgraf, presented on Aug 22 WG meeting [\[link\]](#)

Detector Group	Channels					RDO	Fiber	DAM	Data Volume (RDO) (Gb/s)	Data Volume (To Tape) (Gb/s)
	MAPS	AC-LGAD	SiPM/PMT	MPGD	HRPPD					
Tracking	36B			202k		872	1744	24	27	26
Calorimeters	88M		123k			258	556	10	502	27
Far Forward	300M	2.3M	170k			178	492	5	15	8
Far Backward	146M		2k			50	100	6	150	1
PID		7.8M	320k		140k	241	523	39	2628	36
TOTAL	36.5B	10.1M	615k	202k	140k	1599	3415	84	3,322	98

## Summary of Data Flow



How much of this is dRICH?

dRICH only is more than this....

dRICH is ok

We don't have here DAM-L2/DAM-L1, should we represent it somehow?