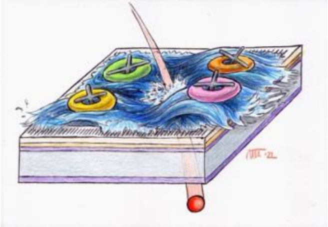
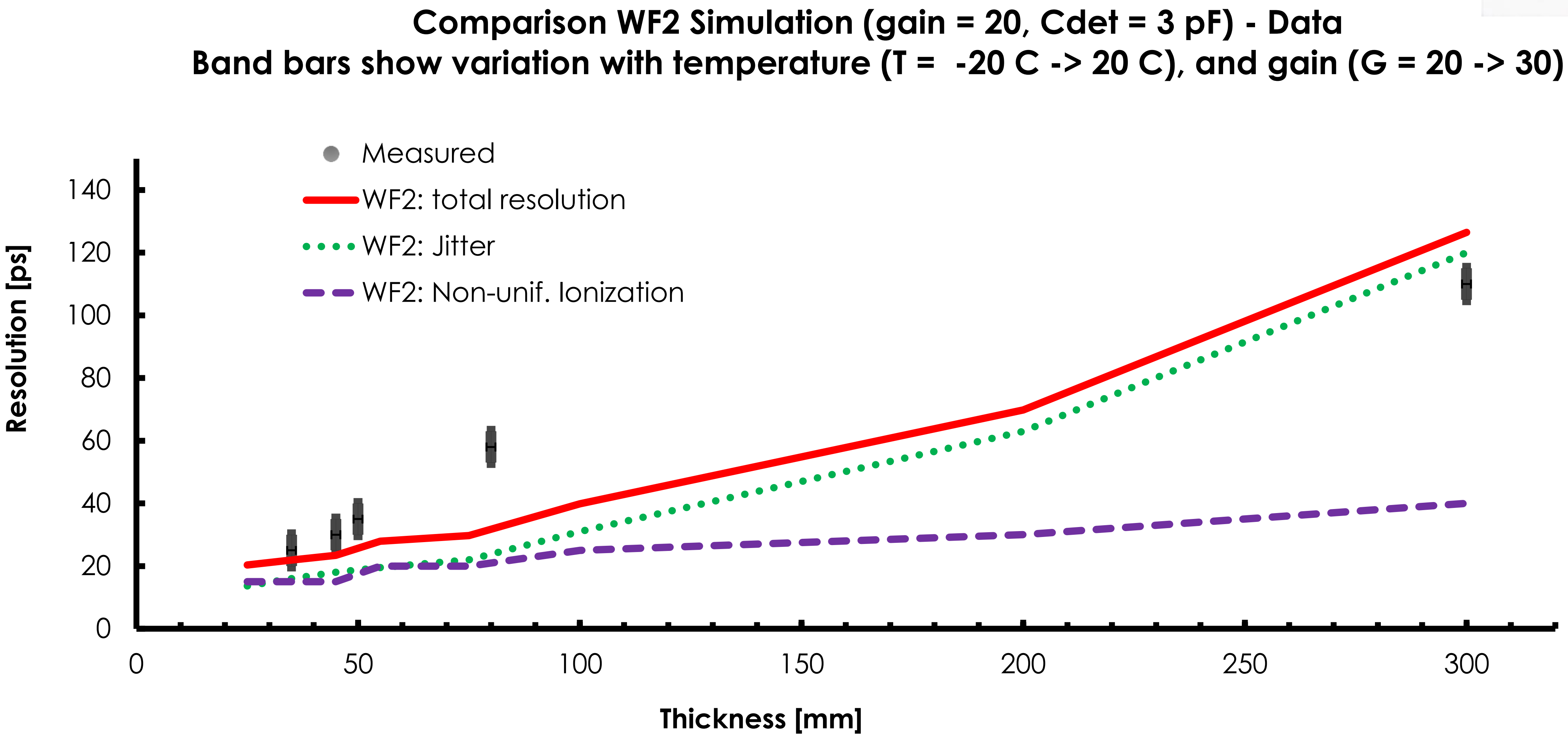
What is the intrinsic limit of LGAD timing?

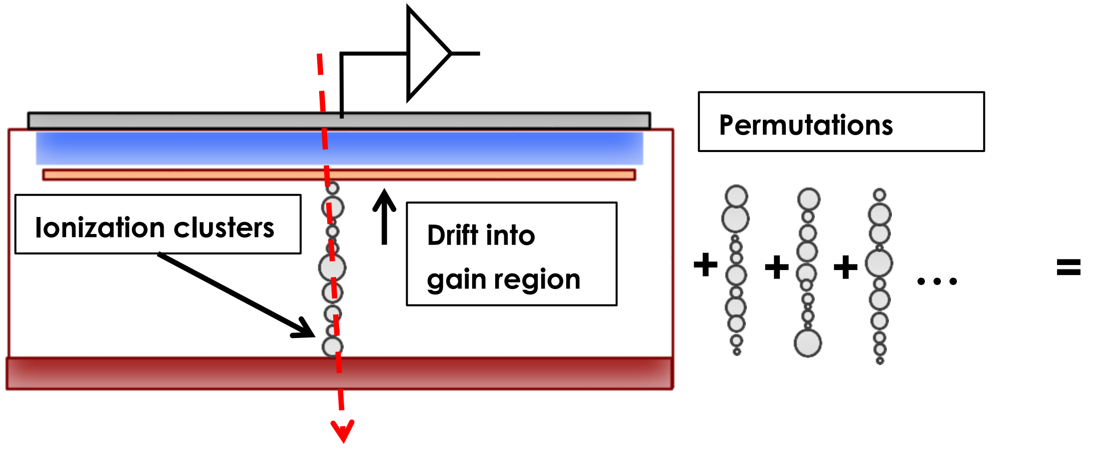


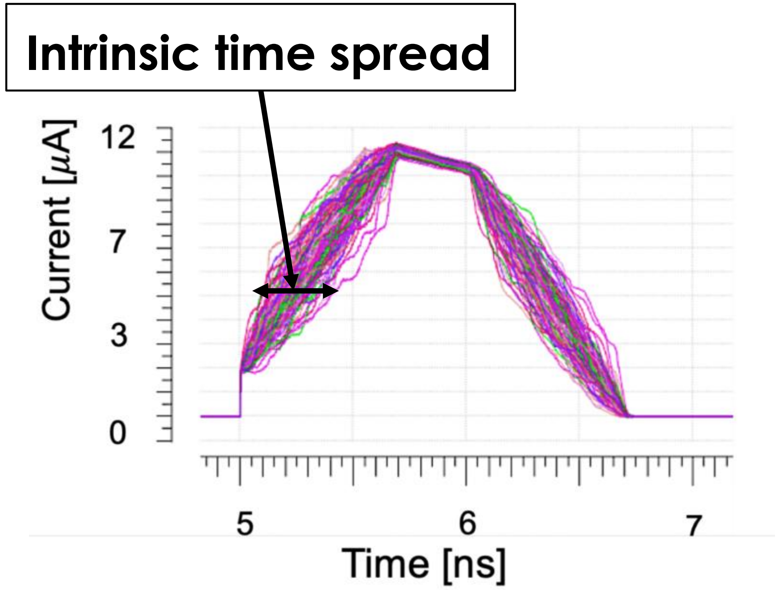


Why intrinsic time resolution is a function of thickness?

Why LGAD have an "intrinsic" time resolution?

It is a combinatorial problem: how many different ways are there to produce a given amplitude summing up individual ionization clusters (imagine there is 1 cluster every 1 micron) ?





50 micron thick ==> 50! Permutations…

10 micron thick ==> 10! Permutation

1 micron thick ==> 1 permutation, no temporal spread!

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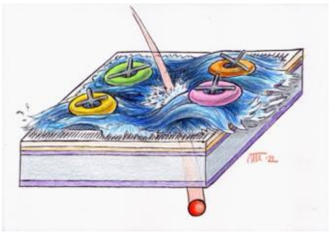
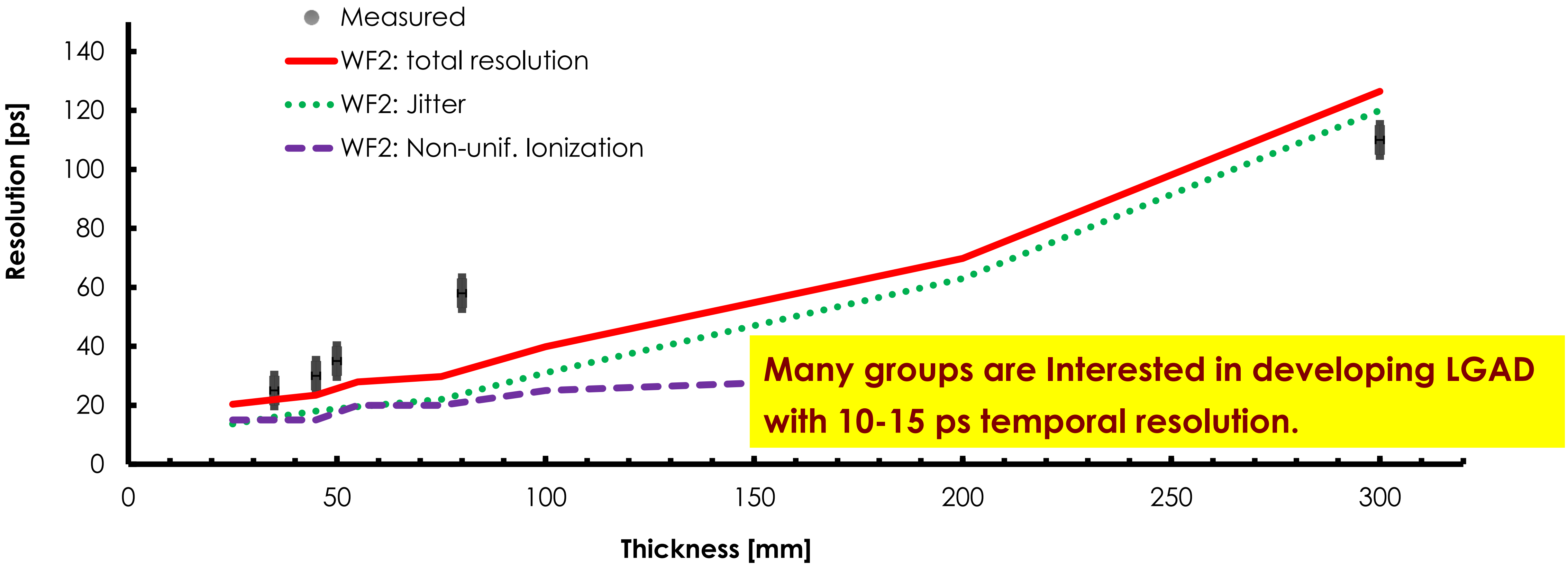


Comparison WF2 Simulation (gain = 20, Cdet = 3 pF) - Data
Band bars show variation with temperature (T = -20 C -> 20 C), and gain (G = 20 -> 30)



Many groups are Interested in developing LGAD with 10-15 ps temporal resolution.

Results

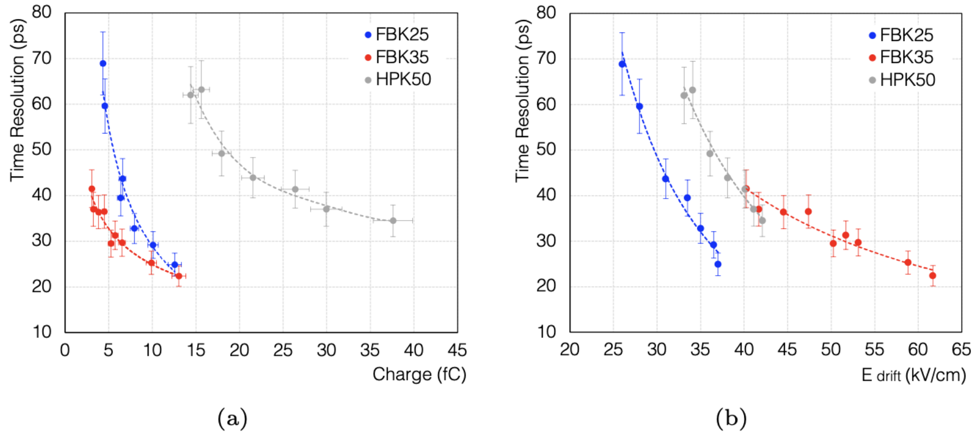
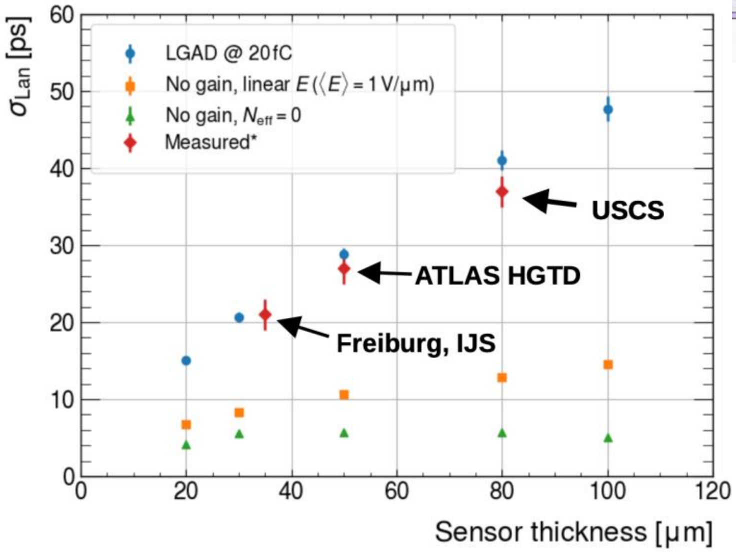


Fig. 7 Measured time resolution results from the beam test as a function of the (a) charge and (b) drift electric field (E_{drift}) for all the UFSDs: FBK25, FBK35 and HPK50 for a CFD of 60%, 20% and 50%, respectively. The errors for the measured time resolution have been estimated as 10% of the value. The lines are included to guide the eye.

"Beam test results of 25 um and 35 um thick UFSD", F. Carnesecchi, S. Strazzi et al, https://arxiv.org/abs/2208.05717

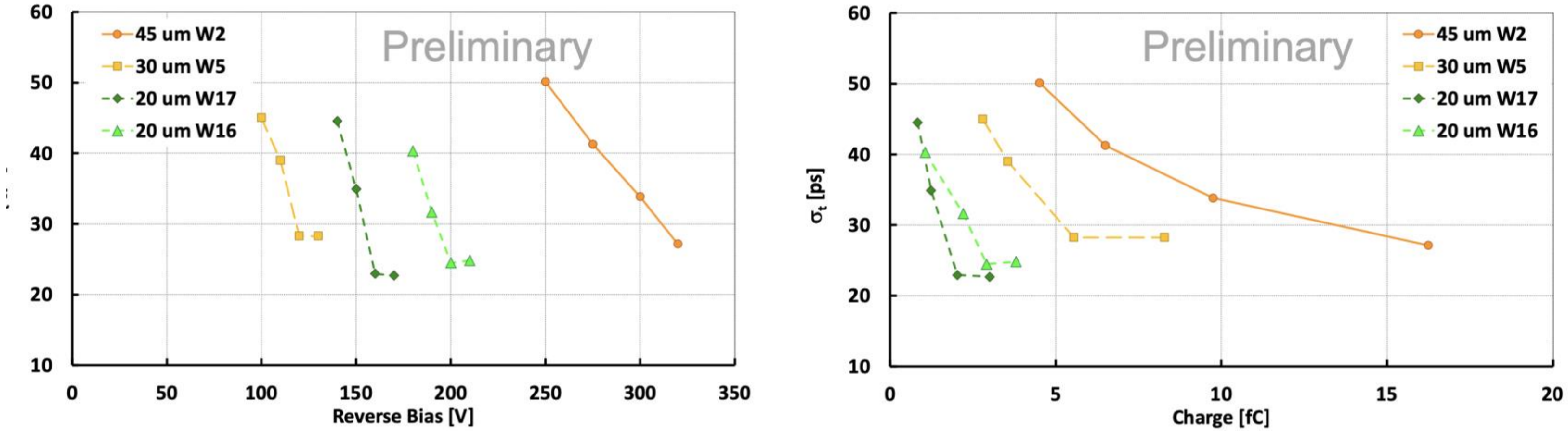


Presented today by Jernej

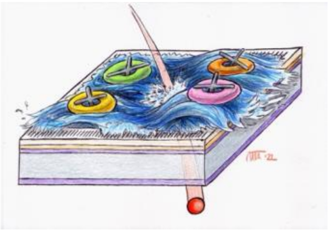
EXFLU1 single pads 1.3 × 1.3 mm² read out by SC board + 20 dB BB Cividec an

Can we do 10 ps?

Presented yesterday by Valentina



What can we do?



Is it true that the intrinsic time resolution keeps decreasing with thickness?

How do we measure it?

Better electronics?

Note: there a
"Beam test results of 25 um and 35 um thick UFSD", F. Carnesecchi, S. Strazzi et al, https://arxiv.org/abs/2208.05717