What happen in GEM module ?

What happen based on fact

In order to keep away from the same problem

What we did

Module in the test box standalone HV test
3 modules are OK

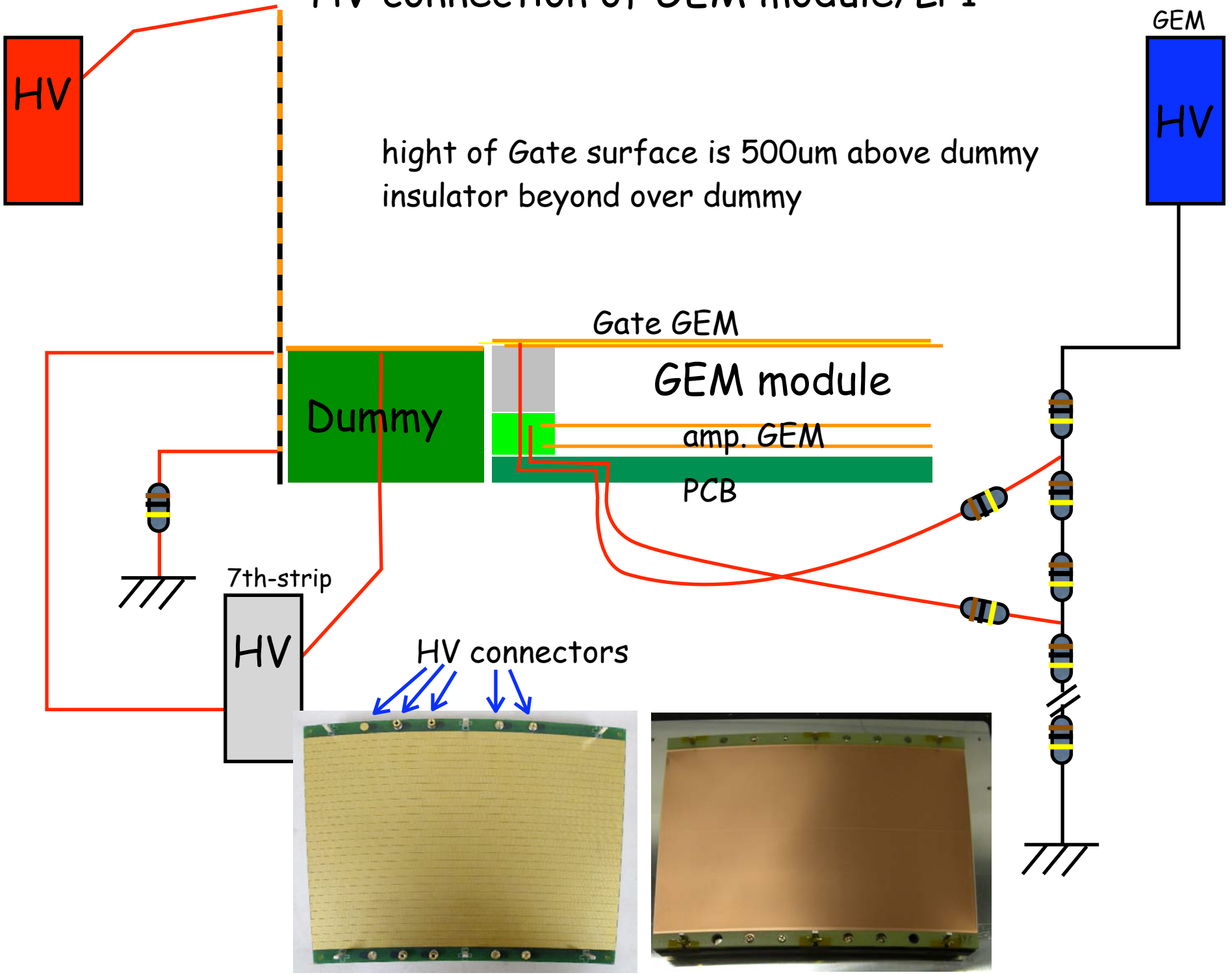
3 modules into LP1 HV test
all OK
but a few trips after ?? hours

LUND team mount cables/FECs on LP1

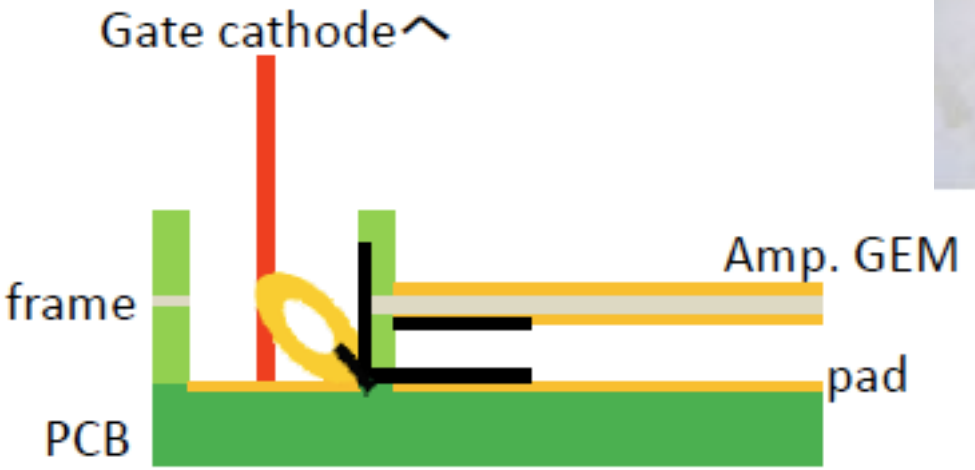
HV test -> cannot raise full HV due to drawing current
@ over 1.kV

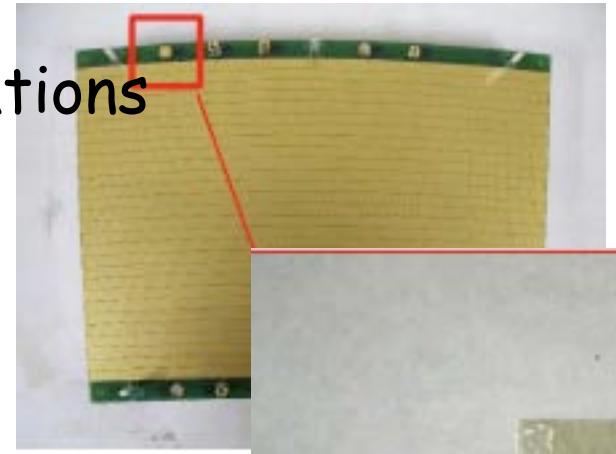
Investigation
Gate is terminated to GND through MΩ reg.
w/o HV connection

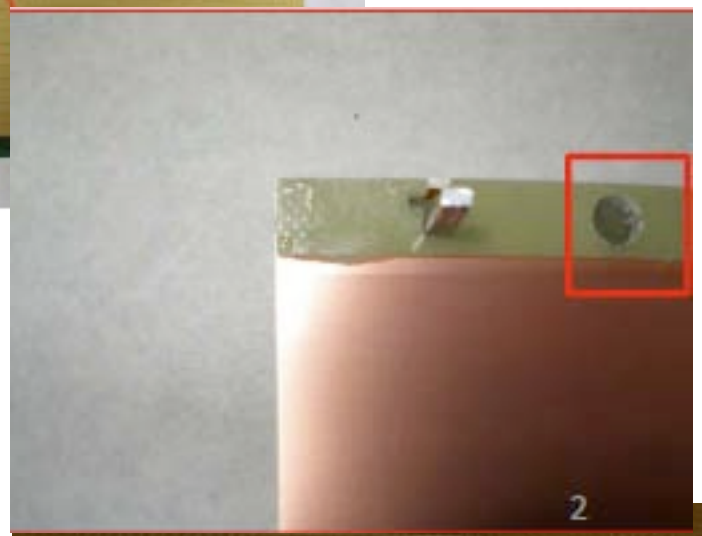
HV connection of GEM module/LP1



What we found through investigations

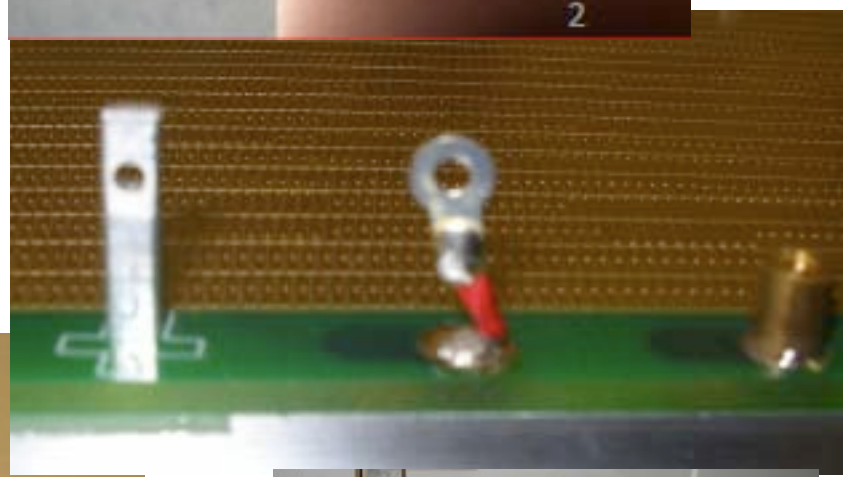




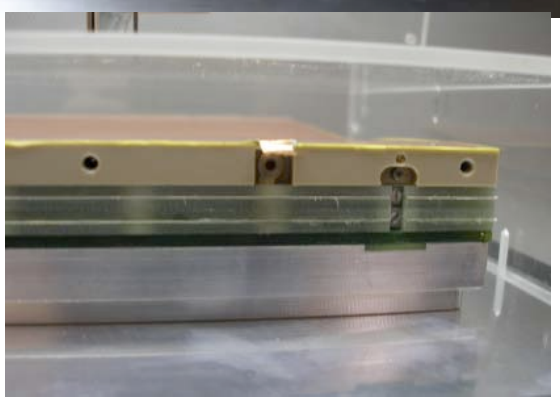


HV connection problem happen last time

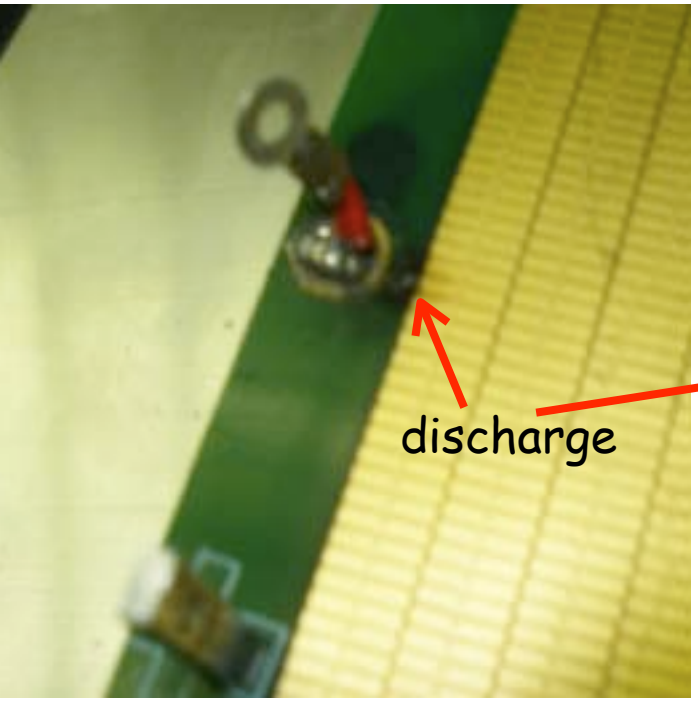
solution => put Cu washer at HV - GEM connection

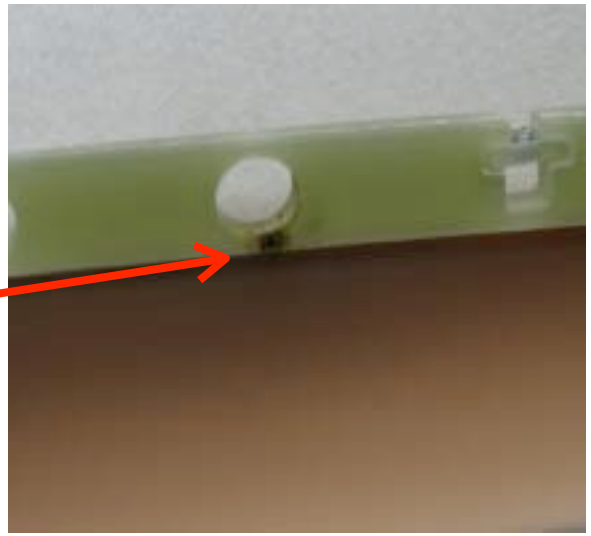


washer was found at Gate HV hole



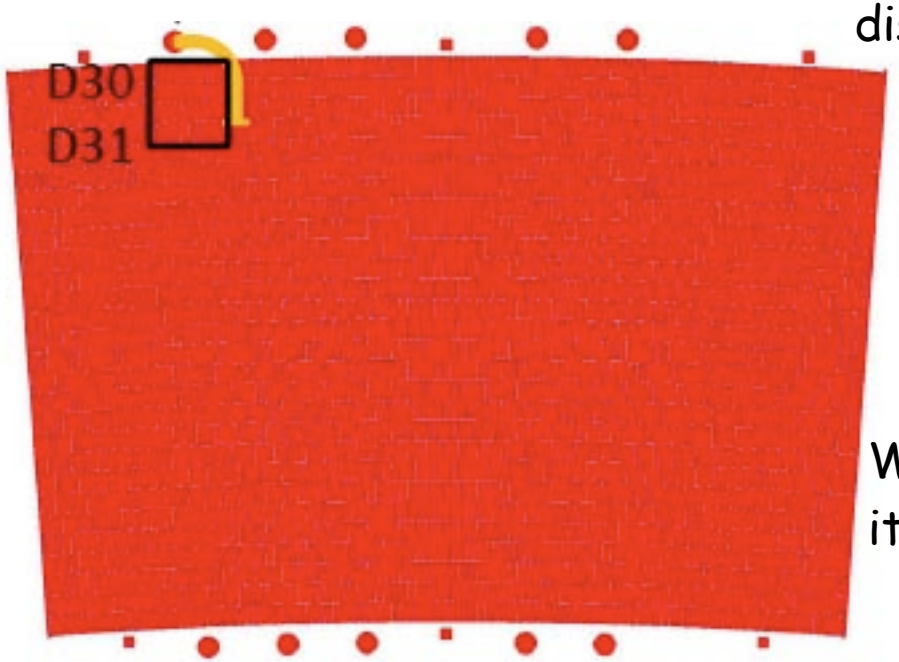
Discharge trace is seen on corresponding PCB and GEM frame





At the initial HV test washer might be at the opposite position of pad plane.
After rotation of TPC,
washer came to unlucky position and initiate discharge

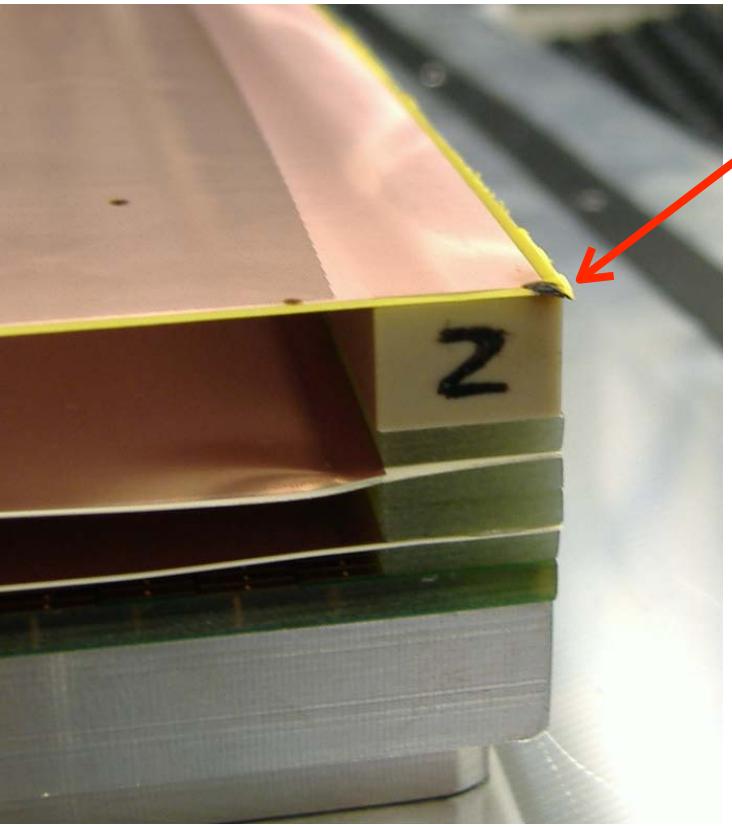
Corresponding Pad connector is D30
discharge seen on connector side between pad-GND



large discharge current may draw into D30,D31

W/o termination connector, pad is not GNDed
it makes situation complicated during investigation

discharge at Gate surface



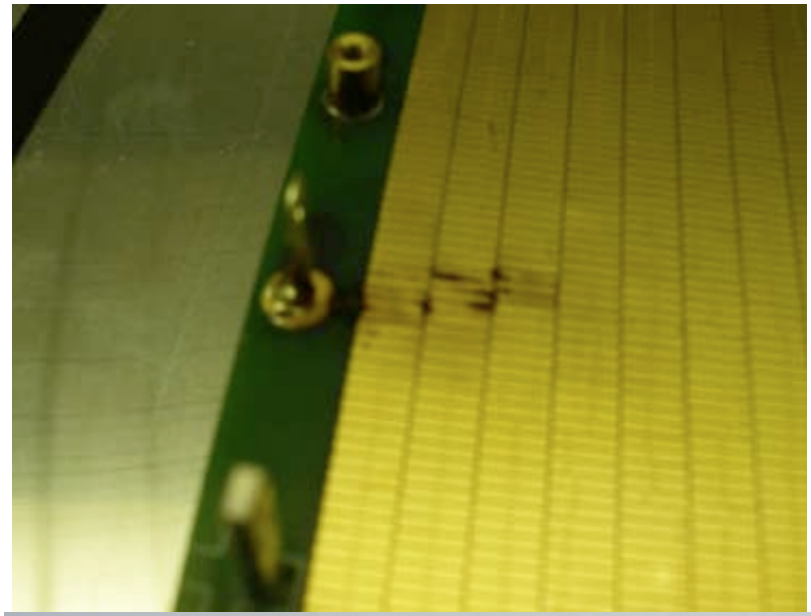
When HV trip, discharge may happen
because Gate electrode is too close to Dummy surface
over placed insulator help discharge

Chronological order is not proved

washer initiate discharge -> HV trip (Gate - GND term.)
HV trip -> discharge at Gate (Gate - Dummy)
more current from Dummy -> Gate -> PCB ?

If this happen only at the module 0 (washer prob.), we feel better
But similar problem also happen at the module 3

discharge at module 3



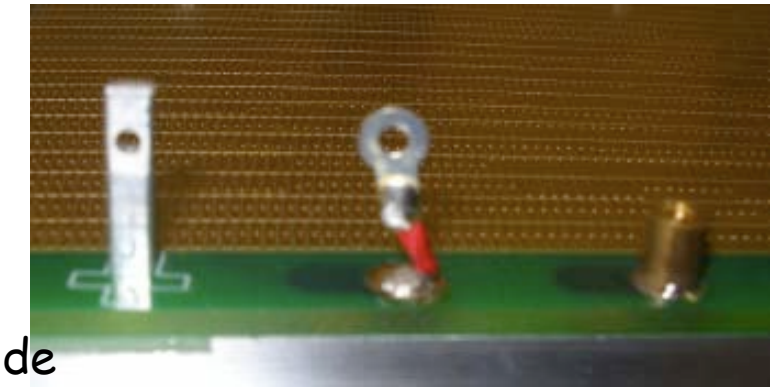
for module 0,
trace of discharge is concentrated at local

for module 3
trace is spread over wide area

we are not sure
why this happen on module 3
without initiator(like washer)

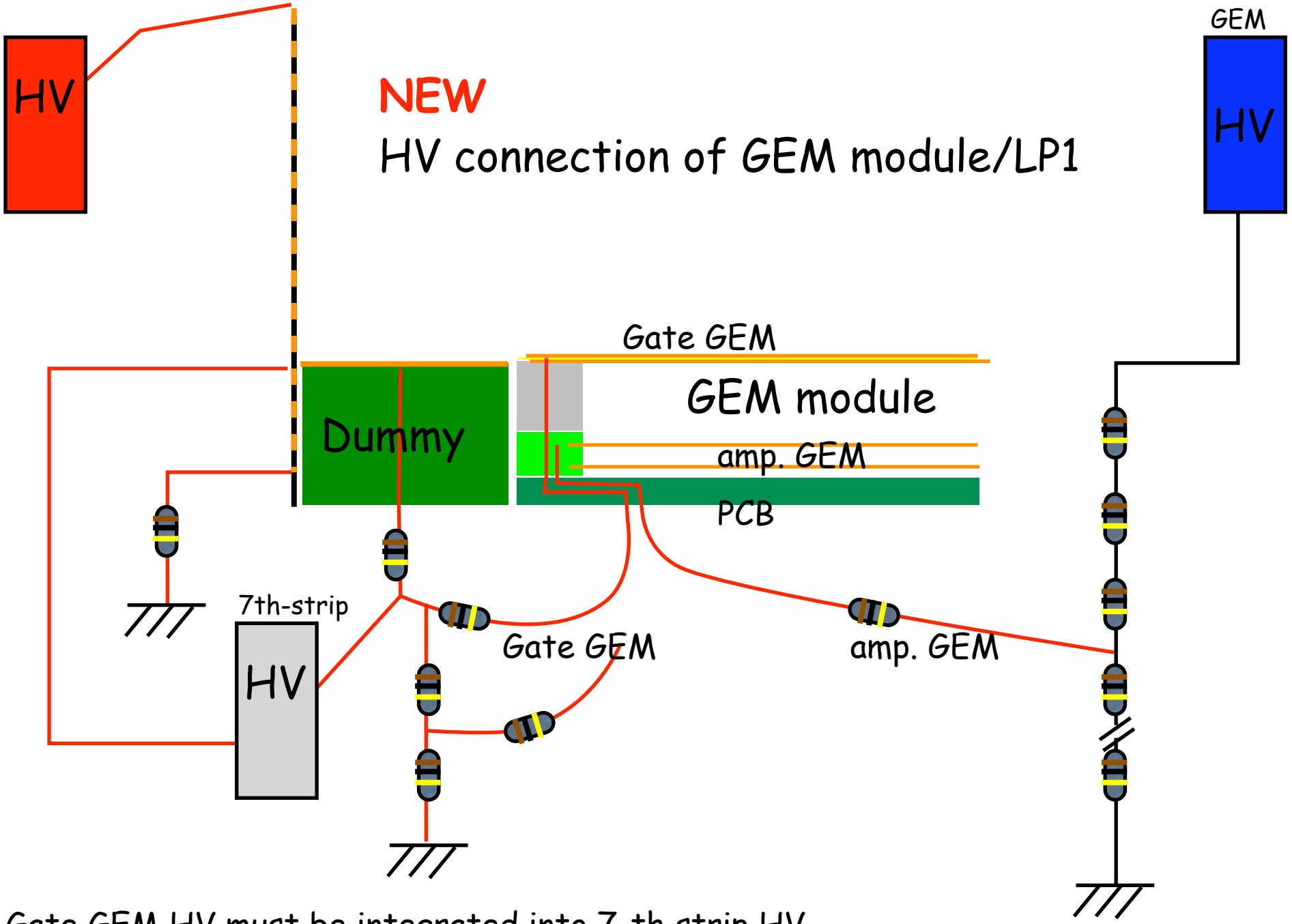
We don't understand this but
we are believing
this problem would not happen
without the initial problem.

What we can do for next



1. do not leave washer !
   more protection on PCB ?
   fence around HV electrode
2. prevent discharge between Gate and dummy
   renew Gate module (reduce size)
   renew HV system (incl. dummy)
   put protection register for any electrode

Gate GEM use new material
Now we accumulate exp.
are able to make them having just size



Gate GEM HV must be integrated into 7-th strip HV

OR CAEN multi channel HV

When can we do the next ?

upto how much modification/reproduction we do

Gate renewal ~3 months
Field shaping frame ~2-3 months
wire gate for a while

August ~September
is possible period

if Lund group can accept.

I'm busy in August(MC exam...

We don't have to fix schedule so quickly
but we want to know rough one