






Plan for jet charge measurement and LGAD sensor radiation test

Hyunchul Kim
(Chonnam National University)



Manpower of KCMS-HI group (not sure latest..)

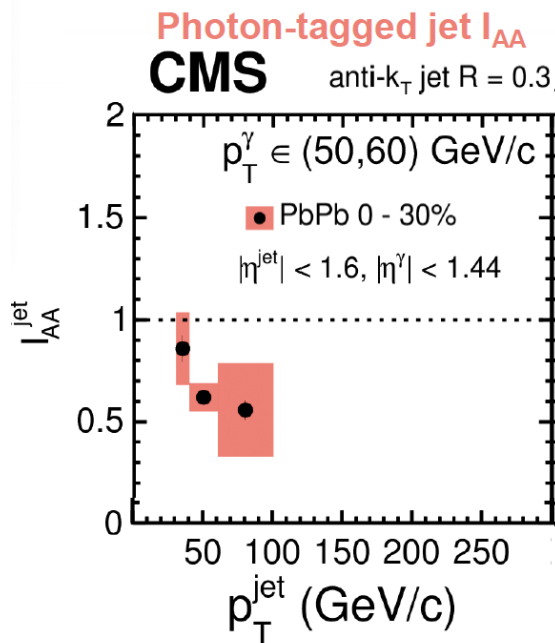
University	Professor	Postdoc.	Graduate student
	Byungsik Hong	Seyoung Han	Kisoo Lee Soohwan Lee Junseok Lee Bayu Adi Nugraha Putra
	Dong Ho Moon	Hyunchul Kim	Gyoenghwan Bak Piljun Gwak Junhu Seo Seonghak Lee Hanseul Lee
	Yongsun Kim		Jeongho Kim
	3	2	10



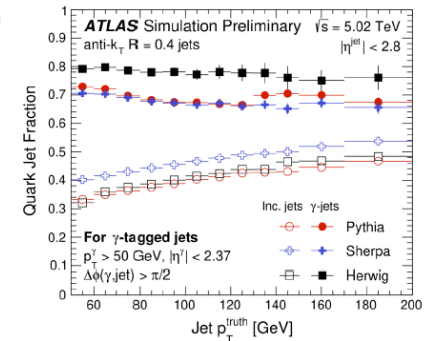
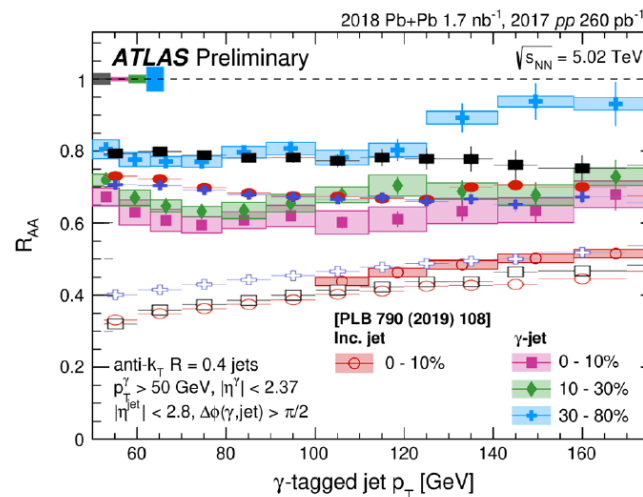
Motivation of the jet charge measurement

- Gluon jet is more suppressed than quark jet in PbPb collision (shown in data and expected in the model)

Photon-tagged Jet R_{AA} vs inclusive jet



Photon-tagged jet (Quark fraction $\sim 70-80\%$)
inclusive jet (Quark fraction $\sim 30-40\%$)



Inclusive jet PLB 790 (2019) 018

- Photon-Jet: CMS $I_{AA} \sim$ ATLAS $R_{AA} \sim 0.6$
- Photon-tagged jet $R_{AA} >$ inclusive jet R_{AA}
- Photon-tagged and inclusive jet $R_{AA} \sim$ Quark fraction in ATLAS Sherpa simulation



Yen-Jie Lee (MIT)

Experimental Perspective on Jet Quenching

39



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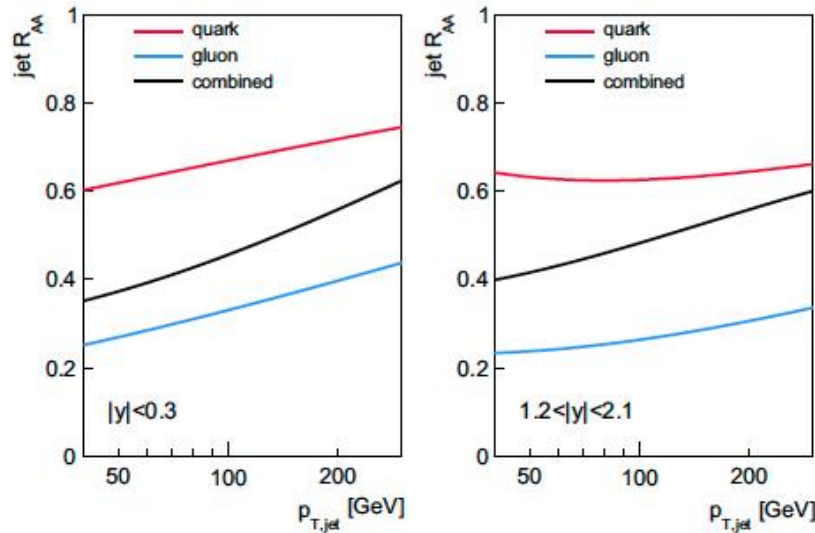
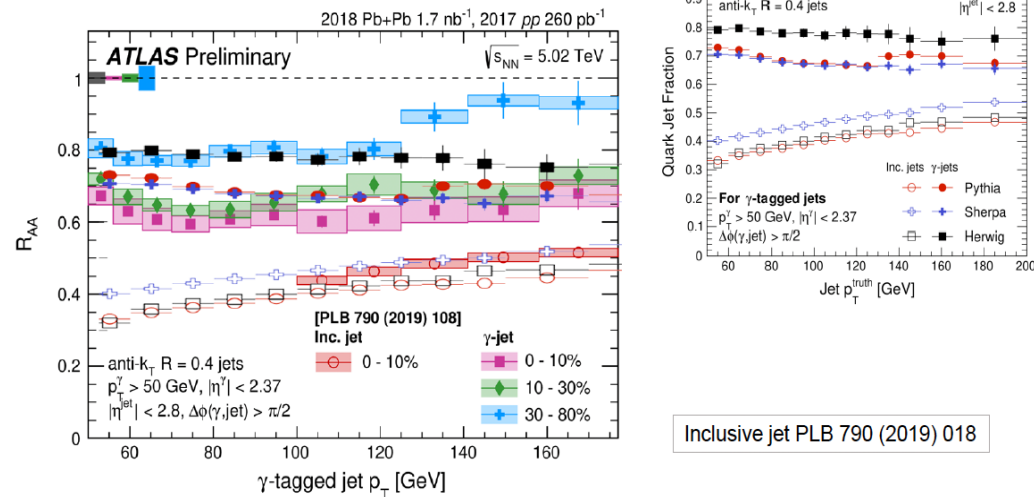


Fig. 8 Quark, gluon, and combined R_{AA} vs p_T^{jet} for the $|y| < 0.3$ (left) and $1.2 < |y| < 2.12$ (right) rapidity bins

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EPJC 76 (2016) 50

PLB 785 (2018) 14

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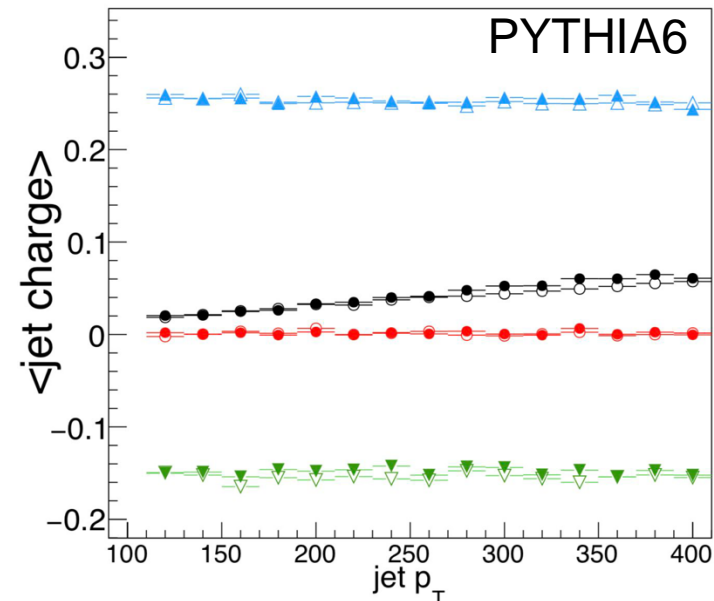
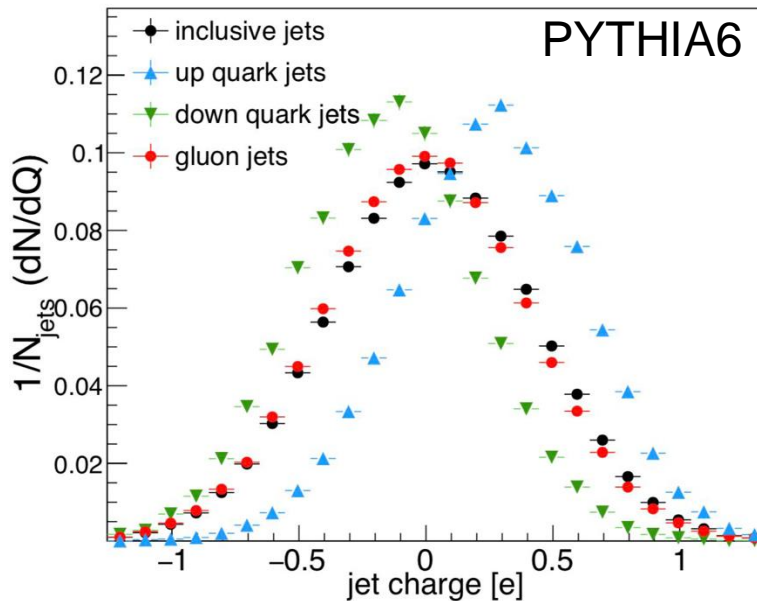
Motivation of the jet charge measurement

- Jet charge : momentum-weighted sum of the electric charges of the particles in a jet

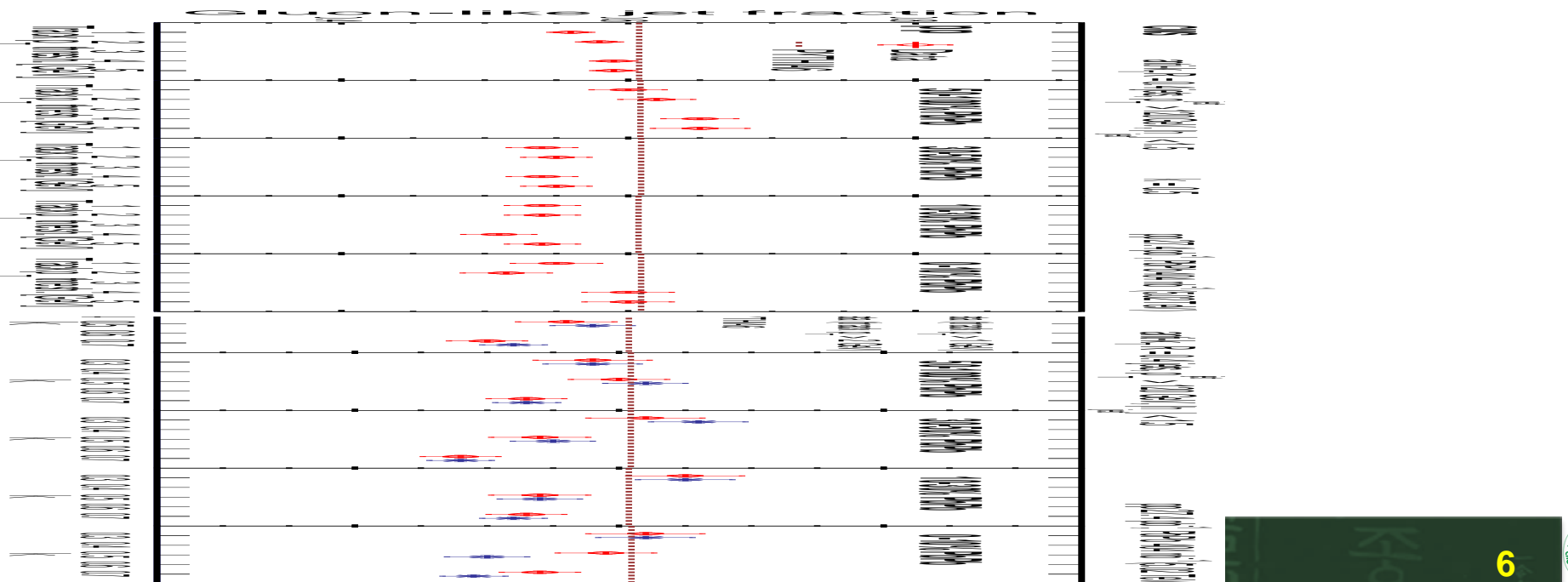
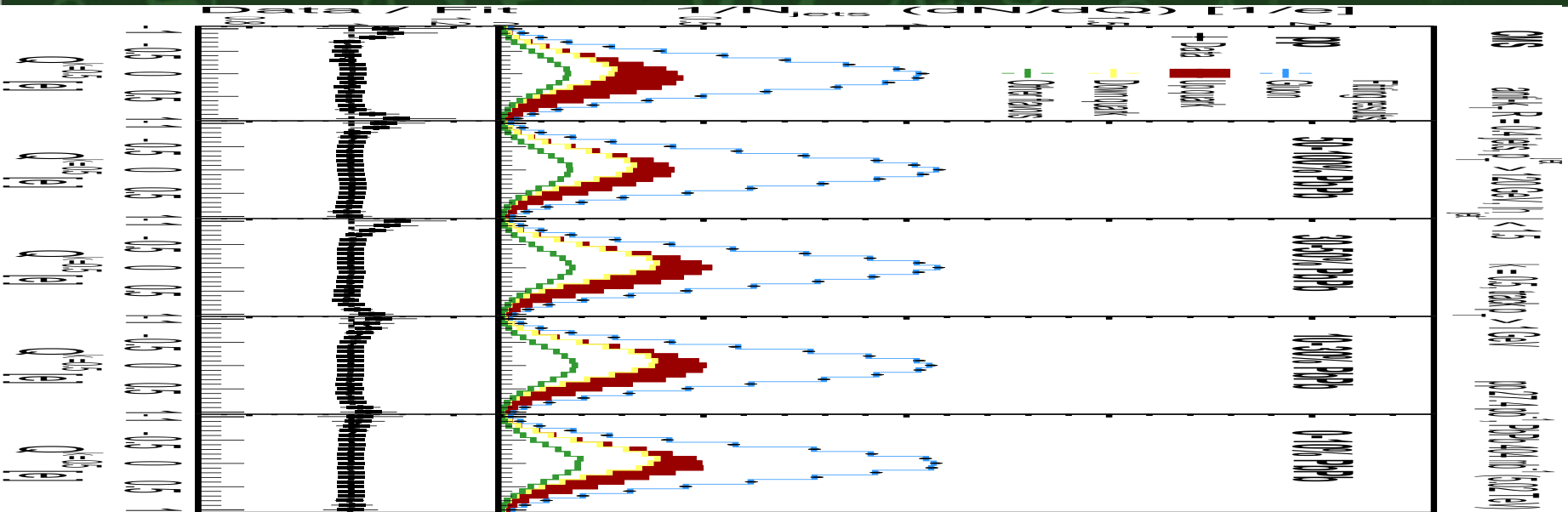
$$Q^\kappa = \frac{1}{(p_T^{\text{jet}})^\kappa} \sum_{i \in \text{jet}} q_i (p_T^i)^\kappa$$

Charge of the particle

controls the sensitivity to the soft particles within the jet



Motivation of the jet charge measurement



Motivation of the jet charge measurement

- Jet charge measurement result conflicts with previous other jet measurement and theory, showing the more suppression of gluon jet than quark jet in AA collision with centrality dependence
- But previous measurement was done with 2015 PbPb data
- Need to confirm with larger statistics and check the other dependency

Status of analysis

- **Cowork with UoS (University of Seoul) group**
 - Prof. Inkyu Park and Youngkwon Jo
- **Reproduce the result with 2023 PbPb data**
 - HIN-18-018 : 5.02 TeV, 404 μb^{-1} (in 2015) + (pp : 27.4 pb^{-1})
 - New in 2023 : 5.36 TeV, 1.7 nb^{-1} (> x4), not yet pp
 - With 2023 data, try to analyze more precisely
 - MC with PYTHIA8 (PYTHIA6 in 2015)
- **Reference analysis**
 - HIN-18-018 (Dhanush Anil Hangal (left CMS)) : [JHEP 07 \(2020\) 115](#)
 - previous jet charge analysis, baseline
 - HIN-21-002 (Jussi Vinikainen (CHICAGO)) : [JHEP 07 \(2023\) 139](#)
 - Jet v2 and v3 from dijet events in PbPb collisions at 5.02 TeV
 - Get the technique for dijet analysis
 - HIN-24-010 (Raghunath Pradhan (CHICAGO)) : PAS-PUB
 - Measurements of jet axis decorrelation in inclusive jets in PbPb collisions at 5.02 TeV and exploration of potential color-charge effects of energy loss
 - Discuss with Raghunath to get the help
- **Look into the correlation between jet charge and other jet substructure observables (idea by Yen-Jie)**
 - Jet charge vs. jet width
 - Jet charge vs. jet constituent multiplicity
 - With pp, could vary the gluon jet fraction by comparing pp and HI results
- **Not yet planned conference (if possible, QM 2025 or others in 2025?)**
 - Try to go forward step by step

Bottleneck nowadays

- **Make the analysis framework**
 - Previous analyzer left, need to remake the framework
- **Using HiForest (2018 PbPb, pp data)**
 - Need to access jet and track tree
 - At present tree, not exist the connection between jet and track tree (ex. track 1 in jet 2)
 - Could get the connection in the present HiForest framework?
 - If not, easiest way is running FastJet with present tracktree in offline?
 - If possible, try to use Run 3 data stacked in 2023-2024?

Current Korea CMS Activities and Future plan

▶ **KCMS responsible for the delivery of one layer of ETL sensors!**

- ▶ 25% of the total endcap coverage

▶ **Significant contributions to prototyping towards production:**

▶ **LGADs prototyping and validation:**

- ▶ Detailed testing of prototype LGADs informed vendor qualification
- ▶ Probe station measurements to verify quality and uniformity of full-size wafers

▶ **ETROC2 testing**

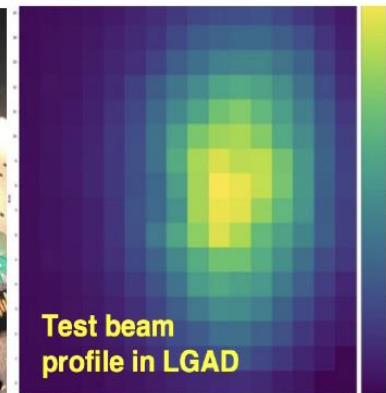
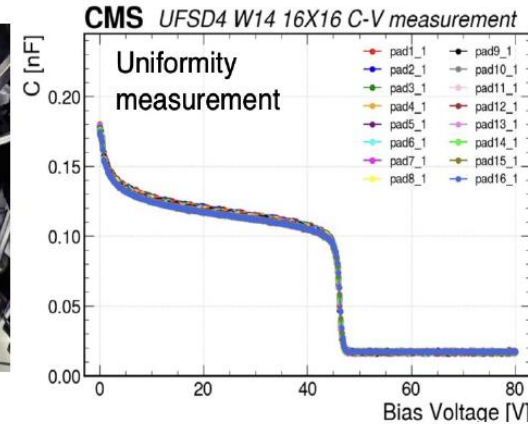
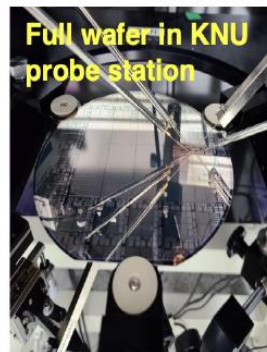
- ▶ Active in ETROC testing, including test beam campaigns for validation of the performance of the LGADs + ETROC chain

▶ **Wafer processing:**

- ▶ Exploring wafer processing with one of the qualified LGADs vendors for wafer thinning, dicing, and surface preparation at Korean companies for the production phase

▶ **Bump-bonding:**

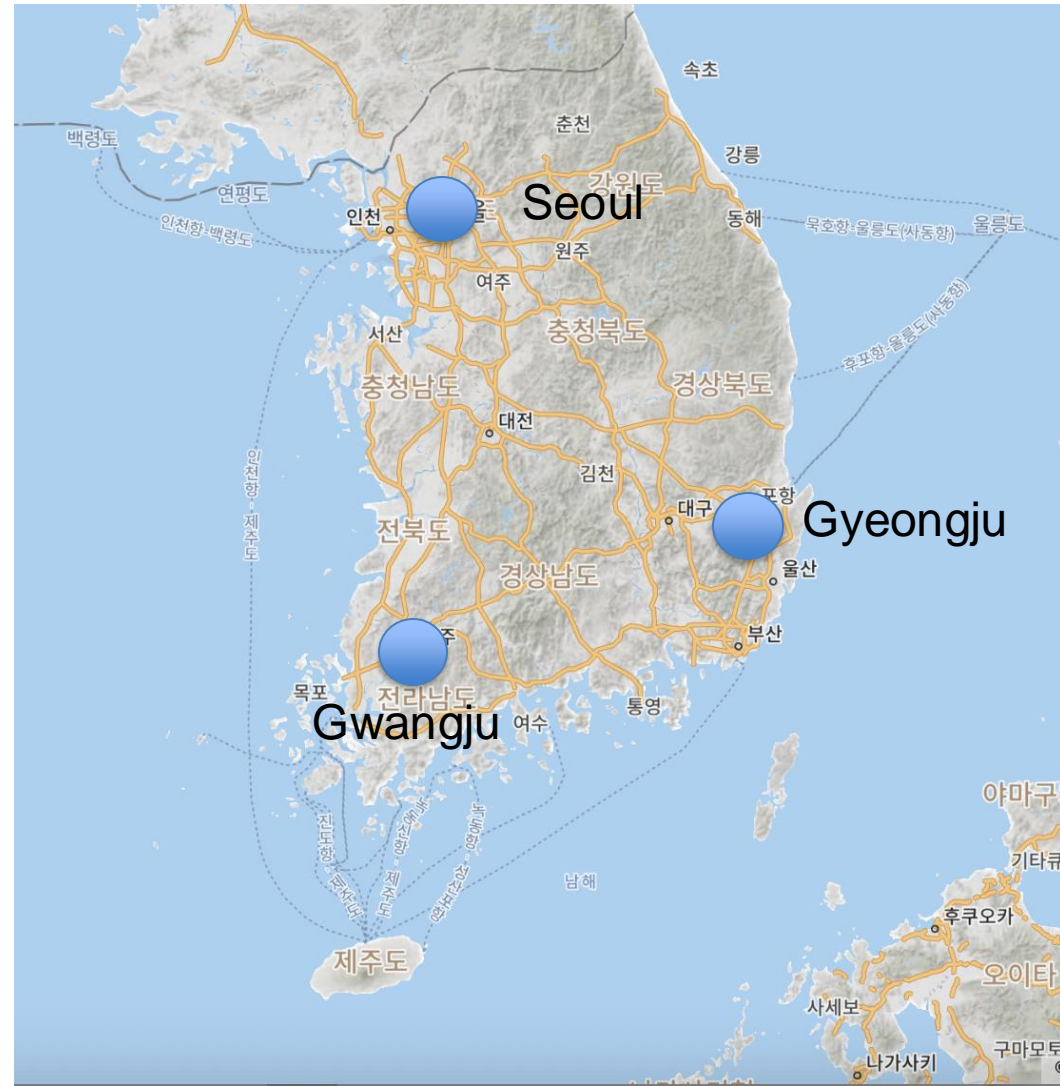
- ▶ Exploring options with Korean companies for LGAD-to-ETROC bump-bonding during production



- In Korea, several university are working for the ETL LGAD sensor related work, including CNU

MTD Activity in CNU group

- Contribution of the work at FNAL (Piljun, Seonghak)
- Try to setup LGAD sensor testing machine
- Radiation tolerance test of the LGAD sensor
 - With 20 MeV proton beam at KOMAC in Gyeongju
 - Plan to irradiate 50% or 100% equivalent estimated dose



Summary

- **Reproduction of jet charge measurement with 2018 PbPb data might provide more clear information**
 - Propose new model?
- **CNU HI group joined MTD group and will increase the contribution for group**
- **KCMS CNU group expect the more collaboration with LLR group, based on the previous collaboration**
 - Charmonium polarization
 - LLR : Bottomonium polarization
 - Could share the technique in the group
 - Electroweak probes (such as W boson in PbPb?)
 - Plan after charmonium analysis

If we can make the opportunity...

- Let's visit at Gwangju
 - Famous for delicious food at first 😊
 - Near Jeju (< 1 hr)

