

Joonsuk Bae

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*ALICE PWG-JE Run 3 charged-particle jets – end-to-end pipeline for the first inclusive cross-section measurement at $\sqrt{s} = 13.6$ TeV (preliminary; paper in preparation; EPS-HEP 2025 PWG-JE merge talk on behalf of ALICE).
Pb/scintillating-fiber calorimetry R&D for the ePIC Barrel Imaging Calorimeter.*

Education

Ph.D. Candidate, Physics – Sungkyunkwan University 2022.03 – expected 2027.02

Advisor: Beomkyu Kim. Thesis: *R-dependent charged-particle jet production in pp collisions at $\sqrt{s} = 13.6$ TeV with ALICE*. Defense expected 2026.11–12; degree conferral 2027.02.

B.S., Physics – Sungkyunkwan University 2021.02

Appointments and Collaboration Membership

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|--|-------------------|
| ALICE Collaboration, CERN, Geneva | 2022.10 – present |
| ePIC Collaboration, Brookhaven National Laboratory | 2024.02 – present |
| LAMPS Collaboration, RAON, Korea | 2022.03 – 2024.04 |

Awards and Fellowships

- **BK21 FOUR Graduate Scholarship** – Sungkyunkwan University Physics BK21 sponsored unit (Korean Ministry of Education), 2022 – present.
- **Conference travel support** – KoALICE, NRF Korea–CERN programme, and SKKU Graduate School; HP 2024 (Nagasaki), QM 2025 (Frankfurt), EPS-HEP 2025 (Marseille).

Research Experience

Main analyzer, ALICE Run 3 charged-particle jets (PWG-JE) – CERN 2023.04 – present

- End-to-end ownership of the first ALICE Run 3 inclusive charged-particle jet cross-section measurement at $\sqrt{s} = 13.6$ TeV – O²Physics task development, QA, Bayesian/SVD unfolding, full systematic-uncertainty programme, and PWG-JE-approved preliminary results. Paper in preparation; presented on behalf of ALICE at EPS-HEP 2025.
- **Tracking-efficiency systematics for Hard Probes 2026 (PWG-JE)** – contributed the pp $\sqrt{s} = 13.6$ TeV charged-particle tracking-efficiency systematic (p_T -binned, $\sim 1.5\%$ across the dominant range) for the 2022, 2023, and 2024 periods; the ITS-TPC matching code was reused by a PWG-JE colleague as a starting point for PbPb tracking studies.
- **Trigger-level inefficiency in the new readout** – quantified bunch-crossing and track-matching inefficiencies introduced by the continuous-readout TPC and asynchronous reconstruction (each with its own time-frame); derived signal-loss corrections used in subsequent PWG-JE Run 3 charged-jet analyses.
- **Track p_T resolution** – studied data–MC resolution mismatch via covariance-matrix propagation, MC residuals, and V0 mass-resolution methods; tuned the central TrackTuner with a p_T -dependent smearing used in Run 3 charged-jet systematic studies.
- **Cross-section normalization** – established the Run 3 charged-jet normalization based on the TVX visible cross section under continuous readout; author of `jetCrossSectionEfficiency.cxx` (PR #14057, merged), the PWG-JE task used for cross-section normalization at particle level by the SKKU Run 3 charged-jet analyses (pp 13.6 TeV and O–O). Provided the normalization factor and QA for the ALICE Run 3 O–O charged-jet measurement led by two MSc co-analyzers in the SKKU group.
- Presented preliminary results at **EPS-HEP 2025** (on behalf of the ALICE Collaboration; PWG-JE merge talk), **Quark Matter 2025**, and **Hard Probes 2024**; regular PWG-JE working-group speaker since 2023.
- Extending the programme to semi-inclusive h+jet recoil (PWG-JE Run 3), *R*-dependent cross-section ratios as a hadronization-vs-perturbative-radiation probe, and groomed substructure (Soft Drop z_g ; primary

Lund-plane density) in high-multiplicity pp and forthcoming O–O / Ne–Ne running, motivated as a small-system baseline for energy-loss searches.

Detector physicist, ePIC Barrel Imaging Calorimeter (BIC) – Korea-BIC consortium 2024.02 – present

- Led PMT-module QA prior to test beams – cosmic-ray and source signal characterization, timing-coincidence checks, optical-coupling stability; applied per-module acceptance criteria.
- On-site DAQ shifter at **KEK AF–AR** (2025.03; equalization, prompt analysis; co-author on the corresponding paper in preparation) and lead offline analyst for the **CERN PS T10** (2025.07) campaign of the Pb/scintillating-fiber prototype – energy response, resolution, and linearity (in preparation, 2026).
- Contributed energy- and η -dependent sampling-fraction studies in JANA2 / EIC-recon for the Korea-BIC simulation effort; Geant4 prototype modeling.
- Module assembly and integration – Pb/scintillating-fiber bundle alignment, polishing, PMT/SiPM coupling.

Detector R&D, LAMPS Forward Tracker – RAON, Korea 2022.03 – 2024.04

- Early-stage design and Geant4 simulation of an MPPC–scintillator-plane forward tracking detector; sensor surveys, specifications, and tracking-concept feasibility studies.

Selected Publications

Full publication list: inspirehep.net/authors/2117232. ALICE Collaboration co-author since 2022.10.

First/lead-analyst works in preparation

- **FLAGSHIP** ALICE Collaboration, *R-dependent charged-particle jet production in pp collisions at $\sqrt{s} = 13.6$ TeV with ALICE* (in preparation, target 2026). *First ALICE Run 3 inclusive charged-jet publication; thesis paper.* [main analyzer; full responsibility for analysis, systematics, unfolding, and paper draft]
- Korea-BIC Collaboration, *Beam-test characterization of a Pb/scintillating-fiber imaging calorimeter prototype – CERN PS T10 (2025.07) campaign* (in preparation, 2026). [lead offline analyst; on-site prompt analysis and follow-up offline reconstruction]

Submitted (detector)

- Y. Hong, J. Bok, G. An, **J. Bae et al.**, “Test-beam performance of the AstroPix silicon sensor for imaging calorimetry,” submitted to *Nucl. Instrum. Meth. A* (NIMA-D-26-00572). Corresponding: Prof. Sanghoon Lim. [co-author; ePIC BIC silicon-layer test-beam analysis]
- H. Lee, C. Lee, J. Ryu, G. An, **J. Bae et al.**, “Beam test of a Pb/SciFi prototype for the Barrel Imaging Calorimeter at the Electron-Ion Collider” – first beam-test campaign; submitted to *Nucl. Instrum. Meth. A* (NIMA-D-26-00482; also submitted to JKPS); arXiv preprint posted. Corresponding: H. Lee. [co-author; module-construction support and PMT/module performance characterization (KPS Spring 2025 poster)]

In preparation (detector – co-author roles)

- Korea-BIC Collaboration, *Beam-test characterization of a Pb/scintillating-fiber imaging calorimeter prototype – KEK AF–AR (2025.03) campaign* (in preparation, 2026). [co-author; DAQ shifter and on-site prompt-analysis at KEK test beam]

ePIC/EIC and related calorimeter R&D (peer-reviewed)

- J. K. Adkins et al. (ECCE Collaboration), “Design of the ECCE detector for the Electron-Ion Collider,” *Nucl. Instrum. Meth. A* **1073** (2025) 170240. [co-author; ECCE consortium member]
- S. Y. Jang, G. An, **J. Bae et al.**, “Performance of dual-readout calorimeters for various absorbers,” *Nucl. Instrum. Meth. A* (2026), DOI 10.1016/j.nima.2026.171598. [co-author; dual-readout R&D for e^+e^- colliders]

- G. Cho, S. Kim, **J. Bae** *et al.*, “Beam tests of the copper-based dual-readout calorimeter to measure electromagnetic performance for future e^+e^- colliders,” *J. Subatom. Part. Cosmol.* **3** (2025) 100021. [*co-author; module construction and beam-test data taking*]
- ECCE Consortium, “AI-assisted optimization of the ECCE tracking system at the Electron-Ion Collider,” *Nucl. Instrum. Meth. A* (2023), DOI 10.1016/j.nima.2022.167748. [*co-author; ECCE consortium member*]
- ECCE Consortium, “Open heavy-flavor studies for the ECCE detector at the Electron-Ion Collider,” arXiv:2207.10632 (2022). [*co-author; preprint*]

Earlier detector R&D (LAMPS, RAON; peer-reviewed)

- Y. J. Kim, D. S. Ahn, J. K. Ahn *et al.* (LAMPS), “Large Acceptance Multi-Purpose Spectrometer (LAMPS) at the RAON,” *J. Korean Phys. Soc.* **87** (2025) 670–682. [*co-author; Time-of-Flight detector maintenance and on-site checks*]
- Y. Bae *et al.* (LAMPS), “Performance test of prototype LAMPS Start Counter using proton beams at 100 MeV,” *Nucl. Instrum. Meth. A* (2025), DOI 10.1016/j.nima.2025.170827. [*co-author; Start-Counter prototype testing*]
- Y. Cheon *et al.* (LAMPS), “Characteristics of the prototype LAMPS TPC for low-energy nuclear collisions at RAON,” *Nucl. Instrum. Meth. A* **1066** (2024) 169610. [*co-author; TPC prototype characterization*]
- H. Kim *et al.* (LAMPS), “Performance of the prototype beam drift chamber for LAMPS at RAON with proton and ^{12}C beams,” *JINST* **19** (2024) P12008; arXiv:2412.08662. [*co-author; forward-tracking R&D and prototype performance studies*]
- LAMPS Collaboration, “Status of large acceptance multi-purpose spectrometer (LAMPS) at RAON,” *AIP Conf. Proc.* **2319** (2021) 080002. [*co-author; SiPM and scintillator-based detector R&D*]

Software and Computing

ALICE O²Physics – AliceO2Group/O2Physics

- **Central-framework patch** in `Common/Tools` (PR #15174, merged) – fixed stale Q/p_T values in the graph-based TrackTuner momentum-smearing path.
- **Author of `jetCrossSectionEfficiency.cxx`** (PR #14057, merged) – the PWG-JE task used for cross-section normalization at particle level by Run 3 charged-jet analyses in the SKKU group (pp 13.6 TeV and O–O).
- 37 pull requests, 18 merged (2023 – present), covering jet finding, response matrices, systematic-uncertainty pipelines, hadronic-rate fixes, and central reconstruction; code review on community PRs across PWG-JE and Common.

Invited and Contributed Talks

Summary since 2022: 3 invited workshops [*external*] · 5 invited collaboration-meeting talks [*internal*] · 6 international conference contributions (one on behalf of the ALICE Collaboration at EPS-HEP 2025) · 8 domestic (KPS) · regular PWG-JE working-group speaker since 2023.

Invited Talks (external workshops, seminars)

- **France–Korea Particle Physics Network (FKPPN) Workshop**, Inha University – *Cross-section normalization in Run 3; charged-jet studies in ALICE Run 3* – 2025.12
- **1st Heavy-Ion Meeting (HIM 2025)**, APCTP – *From precision to structure: jet measurements in ALICE Run 3 and ongoing substructure studies* – 2025.05
- **FKPPN Workshop**, Inha University – *Charged-jet studies in ALICE Run 3* – 2023.11

Invited Collaboration-Meeting Talks (internal)

- **Korea-BIC 2025 Summer Workshop** – *Data analysis of the recent beam test at CERN* – 2025.09

- **KoALICE National Workshop 2024** – *Jet analysis status: first look at the charged-particle jet spectrum in Run 3 pp collisions* – 2025.01
- **ALICE Physics Week 2024** – *Charged-particle jet production in Run 3* – 2024.12
- **KoALICE National Workshop 2023** – *Charged-jet O^2 MC and data QA* – 2024.01
- **KoALICE National Workshop 2022** – *Dijet studies with ALICE at the LHC* – 2023.01

Contributed Talks and Posters

- **EPS-HEP 2025**, Marseille – *Inclusive and semi-inclusive jet cross-section measurements in pp collisions at $\sqrt{s} = 13.6$ TeV with ALICE [on behalf of the ALICE Collaboration; PWG-JE merge talk]* – 2025.07
- **INPC 2025**, Daejeon – *Charged-particle jet and jet quenching measurement in pp collisions at $\sqrt{s} = 13.6$ TeV during LHC Run 3 with ALICE [international, talk]* – 2025.05
- **Quark Matter 2025**, Frankfurt – *Inclusive charged-particle jet spectrum in pp collisions in Run 3 at $\sqrt{s} = 13.6$ TeV with ALICE [international, poster]* – 2025.04
- **Hard Probes 2024**, Nagasaki – *First measurements of charged-particle jet production in pp collisions at $\sqrt{s} = 13.6$ TeV with ALICE [international, poster]* – 2024.09
- **Quark Matter 2023**, Houston – *Charged-particle multiplicity distribution in pp collisions at $\sqrt{s} = 13.6$ TeV with ALICE [international, poster]* – 2023.09
- **ATHIC 2023** (9th Asian Triangle Heavy-Ion Conf.), Incheon – *Dijet studies at the LHC [international, poster]* – 2023.04
- **KPS Fall 2025**, Daejeon [domestic, talk] – *Inclusive and semi-inclusive jet cross-section measurements in pp collisions at $\sqrt{s} = 13.6$ TeV with ALICE* – 2025.10
- **KPS Spring 2025** [domestic, talk] – *Inclusive charged-particle jet spectrum in pp collisions in Run 3 at $\sqrt{s} = 13.6$ TeV with ALICE* – 2025.04
- **KPS Spring 2025** [domestic, poster] – *Prototype calorimeter QC for the Barrel Imaging Calorimeter at the EIC* – 2025.04
- **KPS Fall 2024** [domestic, talk] – *First jet measurement in ALICE Run 3: charged-particle jet production* – 2024.10
- **KPS Spring 2024** [domestic, talk] – *Charged-particle jet production in pp collisions at $\sqrt{s} = 13.6$ TeV* – 2024.04
- **KPS Fall 2023** [domestic, talk] – *First look at charged-particle jet production in pp collisions at $\sqrt{s} = 13.6$ TeV with ALICE Run 3 data* – 2023.10
- **KPS Spring 2023** [domestic, poster] – *Dijet studies at the LHC* – 2023.04
- **KPS Fall 2022** [domestic, poster] – *Dijet studies with ALICE at the LHC* – 2022.10

Test-beam and Detector Activities

ALICE ITS2 alignment monitoring at CTF level (Run 3)

- Analyzed compressed-time-frame (CTF) data – below the standard AO2D analyzer interface – to provide period-by-period tracking-performance diagnostics.

ePIC Barrel Imaging Calorimeter test beams

- **CERN PS T10** (2025.07) – on-site analysis lead; energy response and resolution.
- **KEK AF-AR** (2025.03) – DAQ, equalization, prompt analysis.
- **Korea-BIC module production** (2024 – 2025) – Pb/scintillating-fiber bundle assembly, polishing, and PMT/SiPM integration; PMT-level QA on the prototype modules used in the 2025 beam-test campaigns.

Service and Professional Activities

- **PWG-JE tracking-efficiency contribution for Hard Probes 2026** – pp 13.6 TeV studies; ITS-TPC matching code reused by a PWG-JE colleague as a starting point for PbPb tracking studies.
- **ALICE Run 3 O-O charged-jet measurement** (PWG-JE) – co-author on the Analysis Note; service contribution: cross-section normalization factor derivation and QA; co-mentor of the two MSc analyzers.

- **ALICE ITS2 alignment monitoring** – service work at CTF level for tracking-performance diagnostics.
- **O²Physics community** – code review on community pull requests across PWG-JE and Common.
- **ePIC Korea-BIC analysis coordination** – analysis liaison between the SKKU group and the Korea-BIC consortium for beam-test data products.
- **KoALICE national activities** – regular participation since 2022, including invited collaboration-meeting talks.

Teaching and Mentoring

Student mentoring (non-supervisory) – Sungkyunkwan University

2024 – present

- *Wooseok Ham* (M.Sc., co-analyzer on the ALICE Run 3 O–O charged-jet measurement) and *one further MSc co-mentee* (co-analyzer on the same O–O analysis) – mentored on Run 3 jet reconstruction methodology, correction procedures, and systematic-uncertainty estimation; co-author with W. Ham on the corresponding PWG-JE Analysis Note.
- *Harim Seong* (undergraduate) – ePIC BIC detector-performance studies using JANA2-based reconstruction; energy response and sampling-fraction extraction.

KoALICE O² Tutorial – student co-organizer and instructor – Sungkyunkwan University, Suwon2024.01.22 – 23

- Co-organized (with Hyungjun Lee) the two-day Run 3 analysis-framework tutorial for the Korean ALICE community – ~22 participants from SKKU, Inha University, and other Korean institutes; listed as the official Indico contact for the workshop. indico.cern.ch/event/1361235
- Instructor on *Running O²Physics with Hyperloop* (solo) and co-instructor on *Practical PWG-JE tasks* (with H. Lee).

Teaching Assistant, SKKU Physics (2022 – 2024) – *Nuclear Reactions* (graduate), *Quantum Mechanics II*, *General Physics I and Laboratory I*.

Technical Skills

Languages. English (professional working proficiency), Korean (native).

Programming. C++, Python, ROOT, L^AT_EX, Bash, Git.

HEP frameworks. ALICE O²Physics, Geant4, JANA2 / EIC-recon, PYTHIA, FastJet.

Analysis methods. jet reconstruction and unfolding (Bayesian, SVD), efficiency and systematic-uncertainty evaluation, data/MC validation, test-beam calibration and energy-response fitting.

Detector hardware. PMT and SiPM readout characterization, cosmic-ray and source calibration, optical-coupling QA, calorimeter module assembly.

References

Available on request.