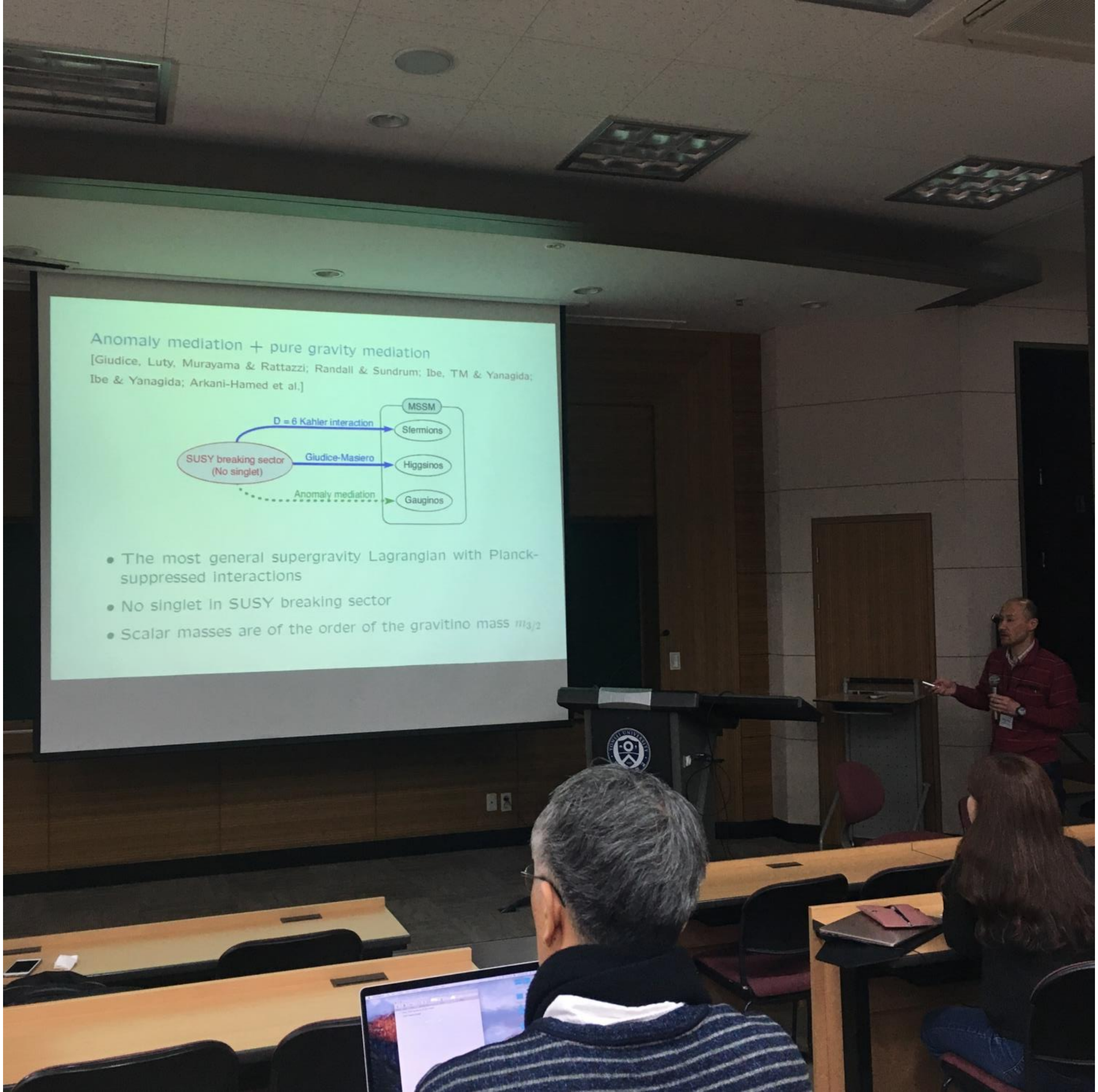
Yonsei university Cosmology and High Energy physics workshop (YuCHE 2019)

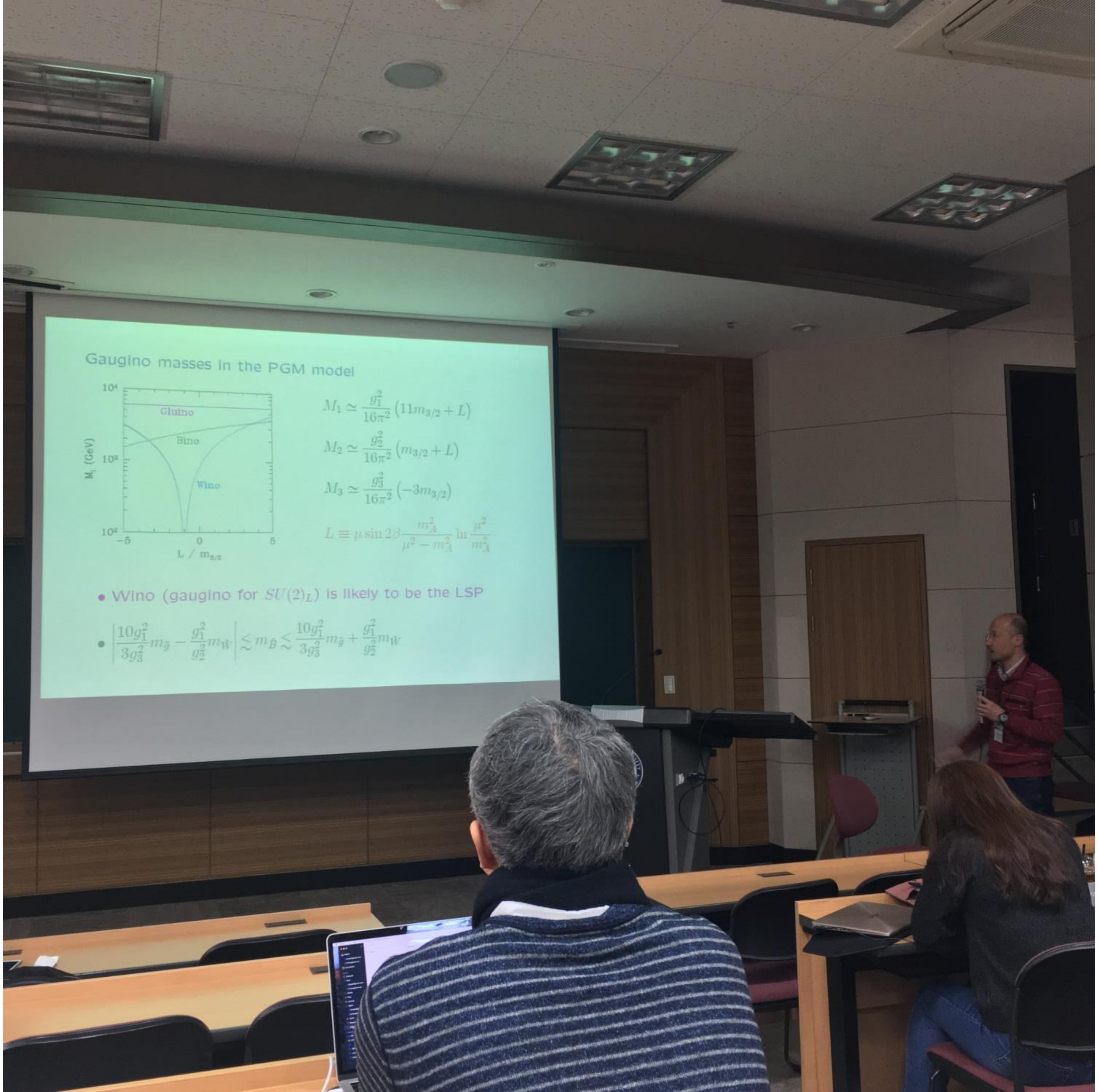
Pictures Day2

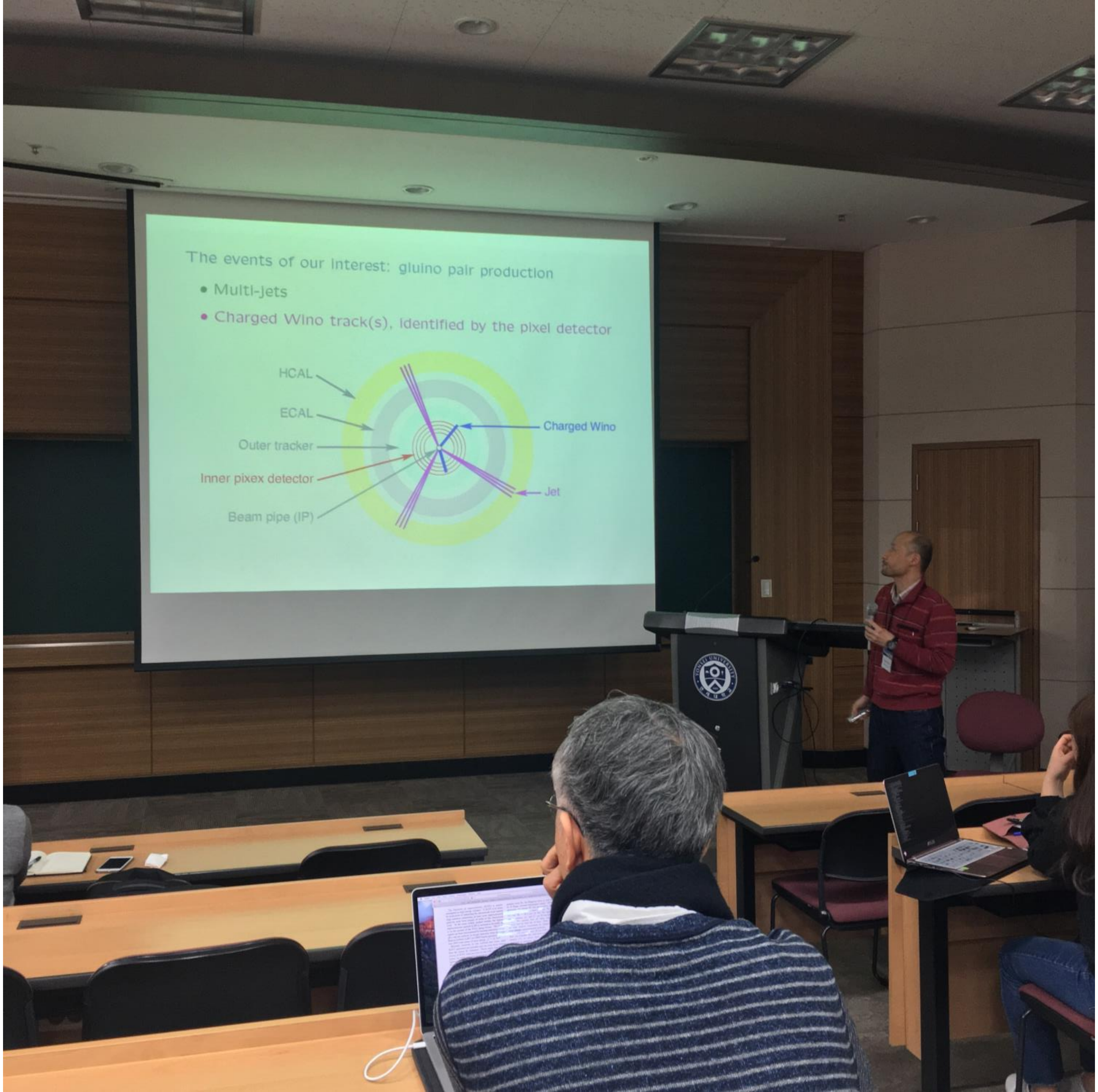
Photo by K.Y.Ban (ban94gy@yonsei.ac.kr)

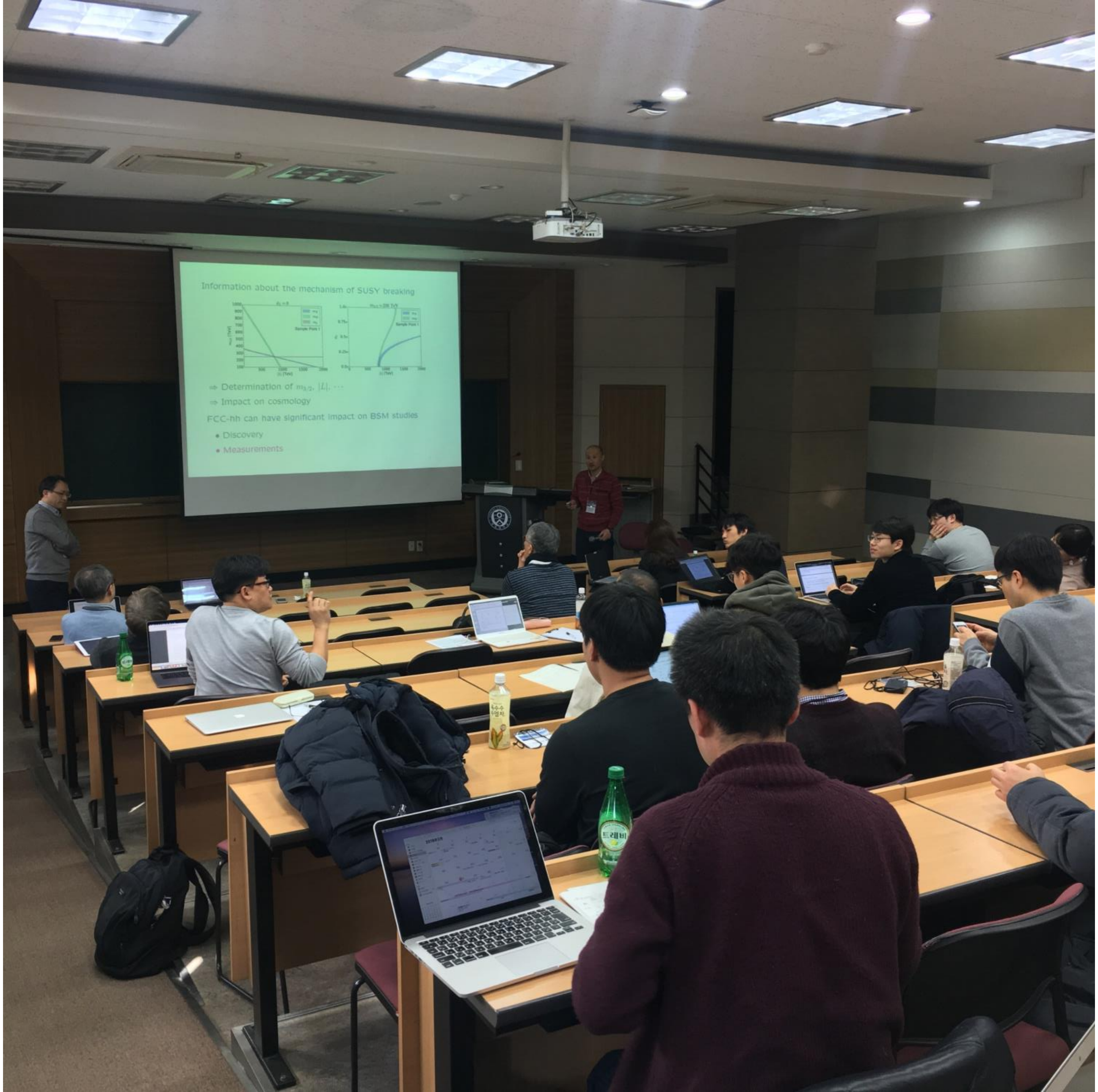
Lab. for Dark Universe
3 papers
(평균인용수 37)
5 papers
(평균인용수 10.6)
2 papers
(평균인용수 228)
9 papers
(평균인용수 40.6)
35
YONSEI UNIVERSITY



Anomaly mediation + pure gravity mediation
[Giudice, Luty, Murayama & Rattazzi; Randall & Sundrum; Ibe, TM & Yanagida; Ibe & Yanagida; Arkani-Hamed et al.]
MSSM
D = 6 Kahler interaction
Sfermions
SUSY breaking sector
(No singlet)
Giudice-Masiero
Higgsinos
Anomaly mediation
Gauginos
• The most general supergravity Lagrangian with Planck-suppressed interactions
• No singlet in SUSY breaking sector
• Scalar masses are of the order of the gravitino mass $m_{3/2}$


Gaugino masses in the PGM model
10^4
10^3
10^2
M_i (GeV)
Gluino
Bino
Wino
−5
0
5
L / $m_{3/2}$
$M_1 \simeq \frac{g_1^2}{16\pi^2}(11m_{3/2}+L)$
$M_2 \simeq \frac{g_2^2}{16\pi^2}(m_{3/2}+L)$
$M_3 \simeq \frac{g_3^2}{16\pi^2}(-3m_{3/2})$
$L \equiv \mu \sin 2\beta \frac{m_A^2}{\mu^2 - m_A^2} \ln \frac{\mu^2}{m_A^2}$
• Wino (gaugino for $SU(2)_L$) is likely to be the LSP
• $\left|\frac{10g_1^2}{3g_3^2}m_{\tilde{g}} - \frac{g_1^2}{g_2^2}m_{\tilde{W}}\right| \lesssim m_{\tilde{B}} \lesssim \frac{10g_1^2}{3g_3^2}m_{\tilde{g}} + \frac{g_1^2}{g_2^2}m_{\tilde{W}}$


The events of our interest: gluino pair production
• Multi-jets
• Charged Wino track(s), identified by the pixel detector
HCAL
ECAL
Outer tracker
Inner pixex detector
Beam pipe (IP)
Charged Wino
Jet


Information about the mechanism of SUSY breaking
⇒ Determination of $m_{3/2}$, $|L|$, $\cdots$
⇒ Impact on cosmology
FCC-hh can have significant impact on BSM studies
• Discovery
• Measurements
트레비

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⇒ Determination of $m_{3/2}$, $|L|$, ⋯
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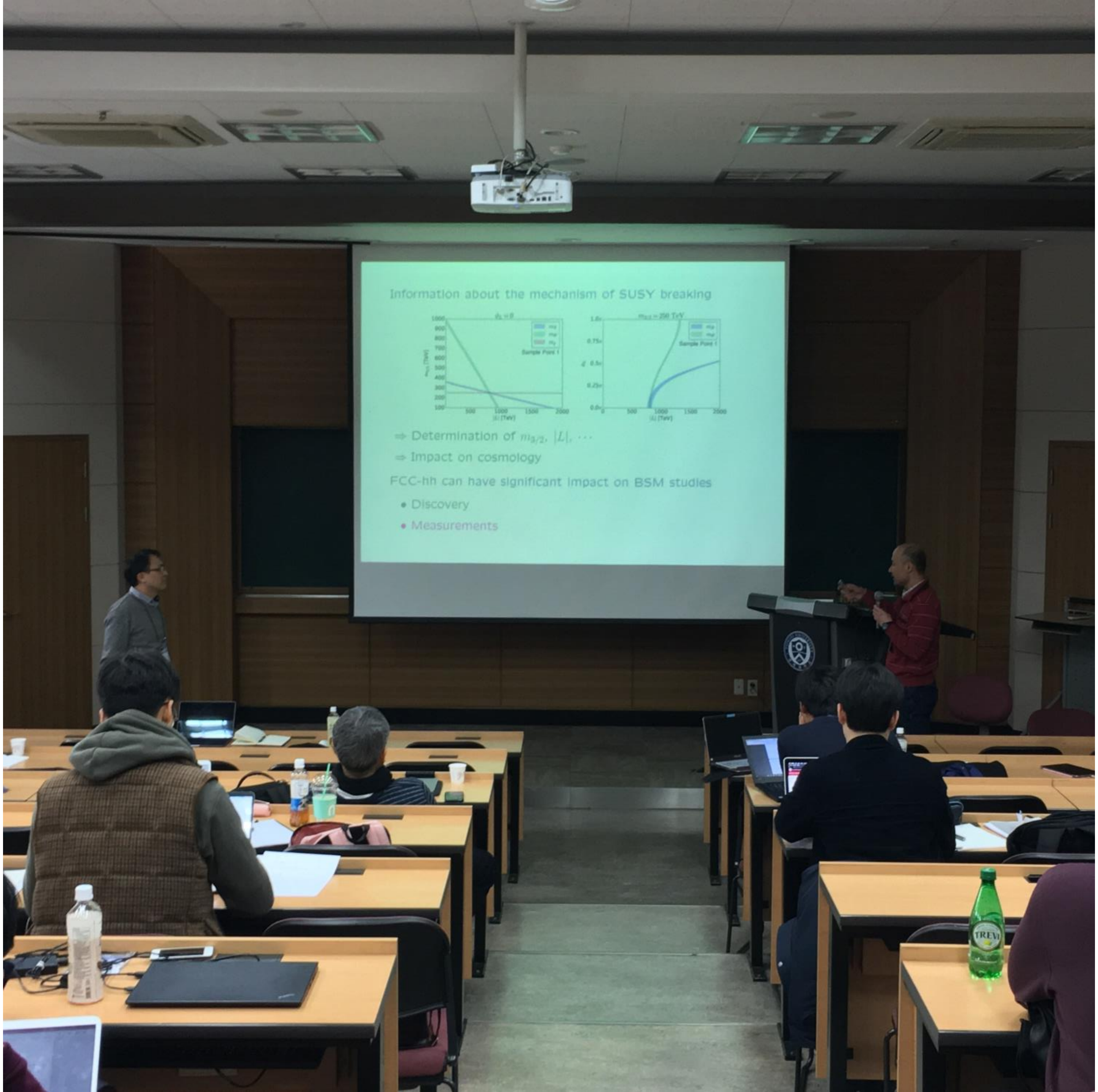
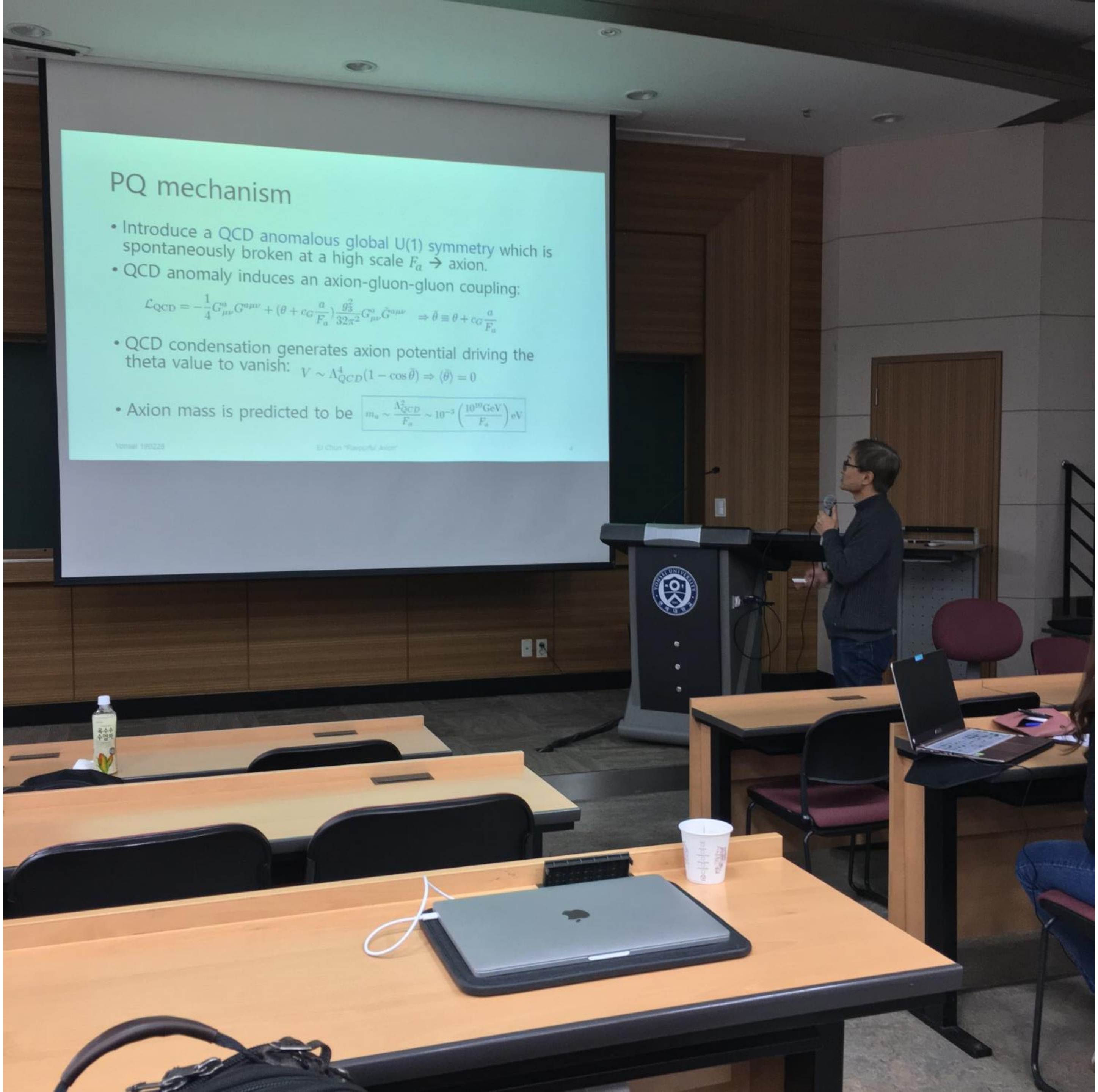
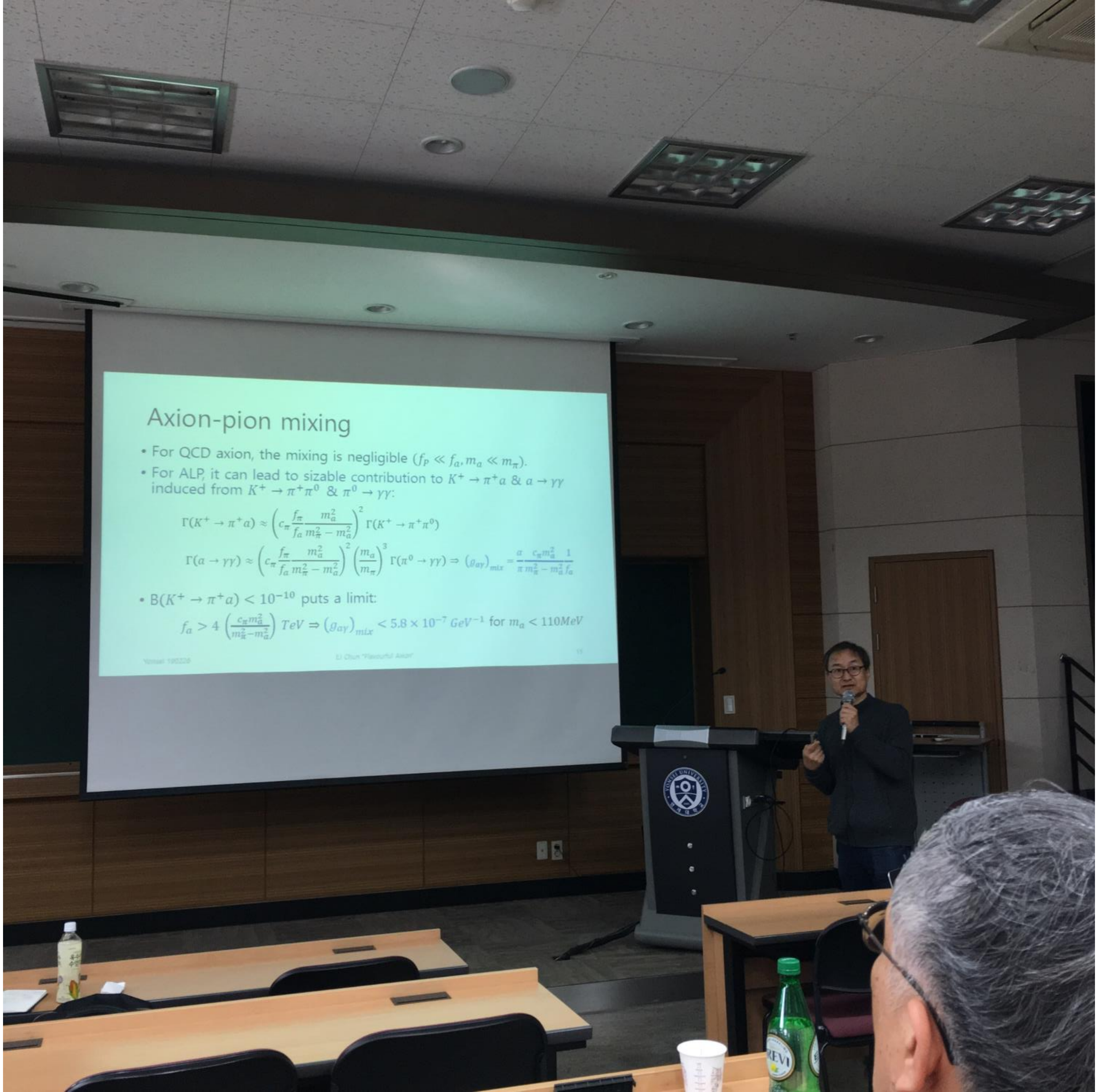

Information about the mechanism of SUSY breaking
Sample Point 1
Sample Point 1
⇒ Determination of $m_{3/2}$, $|L|$, $\cdots$
⇒ Impact on cosmology
FCC-hh can have significant impact on BSM studies
• Discovery
• Measurements
TREVI

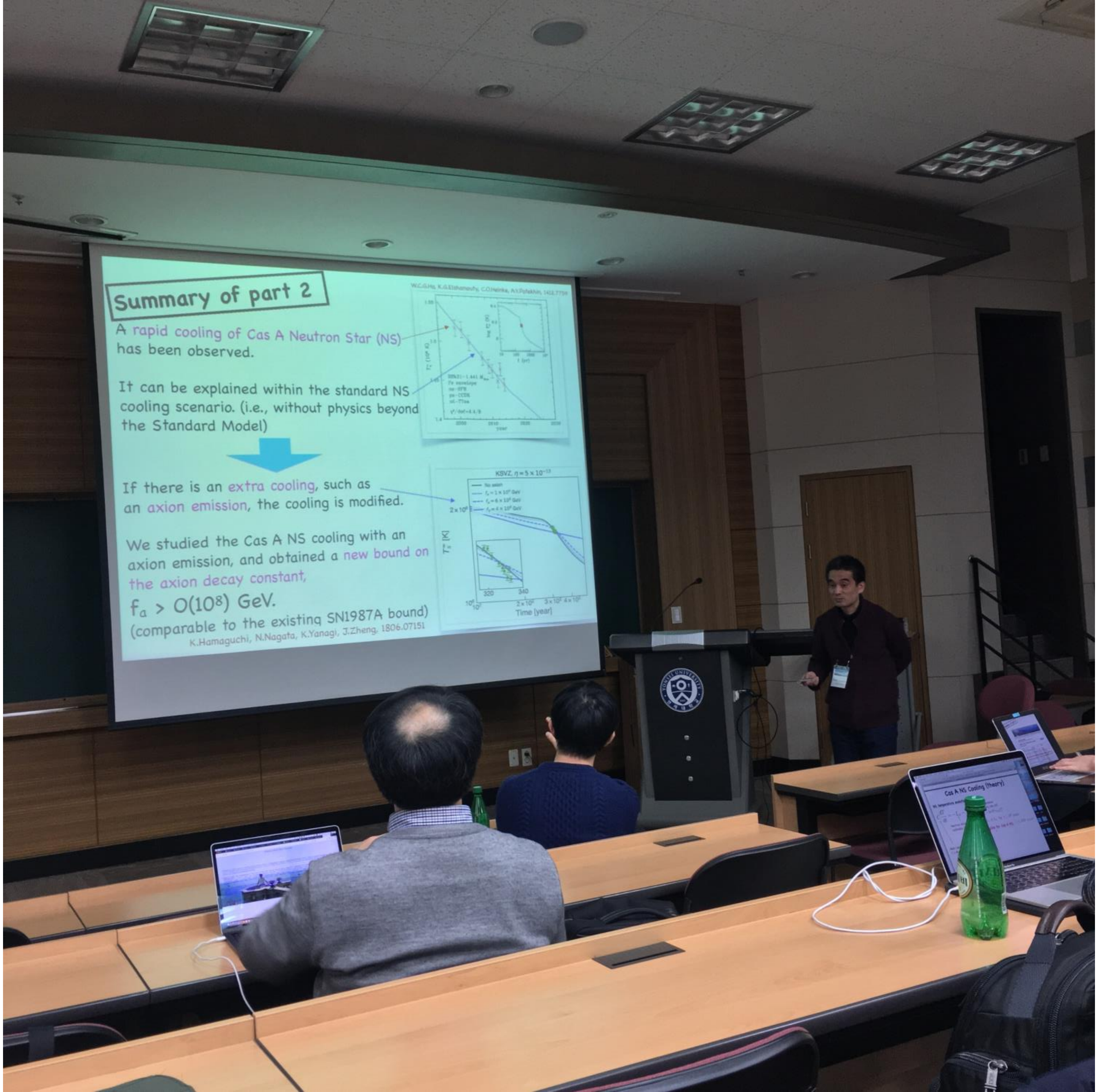


PQ mechanism
• Introduce a QCD anomalous global U(1) symmetry which is spontaneously broken at a high scale F_a → axion.
• QCD anomaly induces an axion-gluon-gluon coupling:
$\mathcal{L}_{\rm QCD} = -\frac{1}{4}G^a_{\mu\nu}G^{a\mu\nu} + (\theta + c_G\frac{a}{F_a})\frac{g_3^2}{32\pi^2}G^a_{\mu\nu}\tilde{G}^{a\mu\nu} \Rightarrow \bar{\theta} \equiv \theta + c_G\frac{a}{F_a}$
• QCD condensation generates axion potential driving the theta value to vanish: $V \sim \Lambda^4_{QCD}(1-\cos\bar{\theta}) \Rightarrow \langle\bar{\theta}\rangle = 0$
• Axion mass is predicted to be $m_a \sim \frac{\Lambda^2_{QCD}}{F_a} \sim 10^{-3}\left(\frac{10^{10}{\rm GeV}}{F_a}\right){\rm eV}$



Axion-pion mixing
• For QCD axion, the mixing is negligible ($f_P \ll f_a, m_a \ll m_\pi$).
• For ALP, it can lead to sizable contribution to $K^+ \to \pi^+ a$ & $a \to \gamma\gamma$ induced from $K^+ \to \pi^+\pi^0$ & $\pi^0 \to \gamma\gamma$:
$\Gamma(K^+ \to \pi^+ a) \approx \left(c_\pi \frac{f_\pi}{f_a} \frac{m_a^2}{m_\pi^2 - m_a^2}\right)^2 \Gamma(K^+ \to \pi^+\pi^0)$
$\Gamma(a \to \gamma\gamma) \approx \left(c_\pi \frac{f_\pi}{f_a} \frac{m_a^2}{m_\pi^2 - m_a^2}\right)^2 \left(\frac{m_a}{m_\pi}\right)^3 \Gamma(\pi^0 \to \gamma\gamma) \Rightarrow (g_{a\gamma})_{mix} = \frac{\alpha}{\pi} \frac{c_\pi m_a^2}{m_\pi^2 - m_a^2} \frac{1}{f_a}$
• $B(K^+ \to \pi^+ a) < 10^{-10}$ puts a limit:
$f_a > 4 \left(\frac{c_\pi m_a^2}{m_\pi^2 - m_a^2}\right) TeV \Rightarrow (g_{a\gamma})_{mix} < 5.8 \times 10^{-7}\, GeV^{-1}$ for $m_a < 110MeV$


Constraining neutrino-DM interaction with IceCube180922A
[work on progress with Carsten Rott and Jongkuk Kim]
Ki -Young Choi
성균관대학교
SUNG KYUN KWAN UNIVERSITY
26 February, 2019 at Yonsei University
Ki-Young Choi, Sungkyunkwan University, Korea


Summary of part 2
A rapid cooling of Cas A Neutron Star (NS) has been observed.
It can be explained within the standard NS cooling scenario. (i.e., without physics beyond the Standard Model)
If there is an extra cooling, such as an axion emission, the cooling is modified.
We studied the Cas A NS cooling with an axion emission, and obtained a new bound on the axion decay constant,
$f_a > O(10^8)$ GeV.
(comparable to the existing SN1987A bound)
K.Hamaguchi, N.Nagata, K.Yanagi, J.Zheng, 1806.07151
KSVZ, $\eta = 5 \times 10^{-13}$
Time [year]
Cas A NS Cooling (theory)


Cas A NS Cooling with axion
$C\frac{dT}{dt} = -L_\nu - L_a$
axion emission
What we did:
• followed NS cooling with axion emission (Brems. and PBF). by modifying a public code NSCool.
• APR EoS.
• NS mass M = 1.4 Msun.
• gap models:
n-$^1S_0$ gap: SFB (doesn't matter)
p-$^1S_0$ gap: CCDK (doesn't matter as far as large enough)
n-$^3P_2$ gap: gap height $\Delta \propto T_c$ and width: free parameter.


ENERGETIC ALPS FROM DECAYING DARK MATTER
Kyu Jung Bae
Center for Theoretical Physics of the Universe,
기초과학연구원
Institute for Basic Science
based on
arXiv: 1806.08569
with A. Kamada (IBS-CTPU), H. J. Kim (KAIST)
YuCHE 2019 @Yonsei U.
Feb. 26, 2019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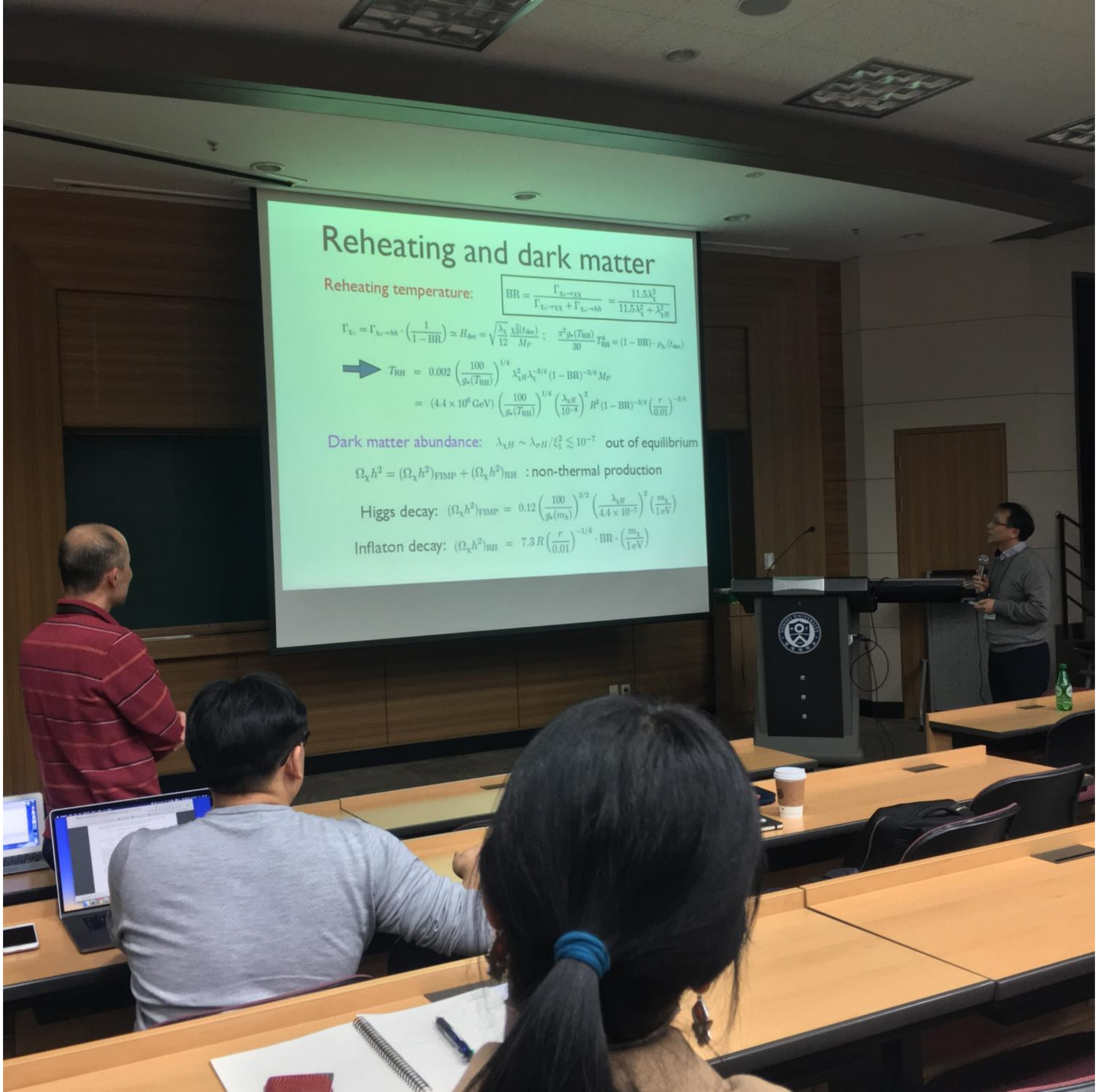
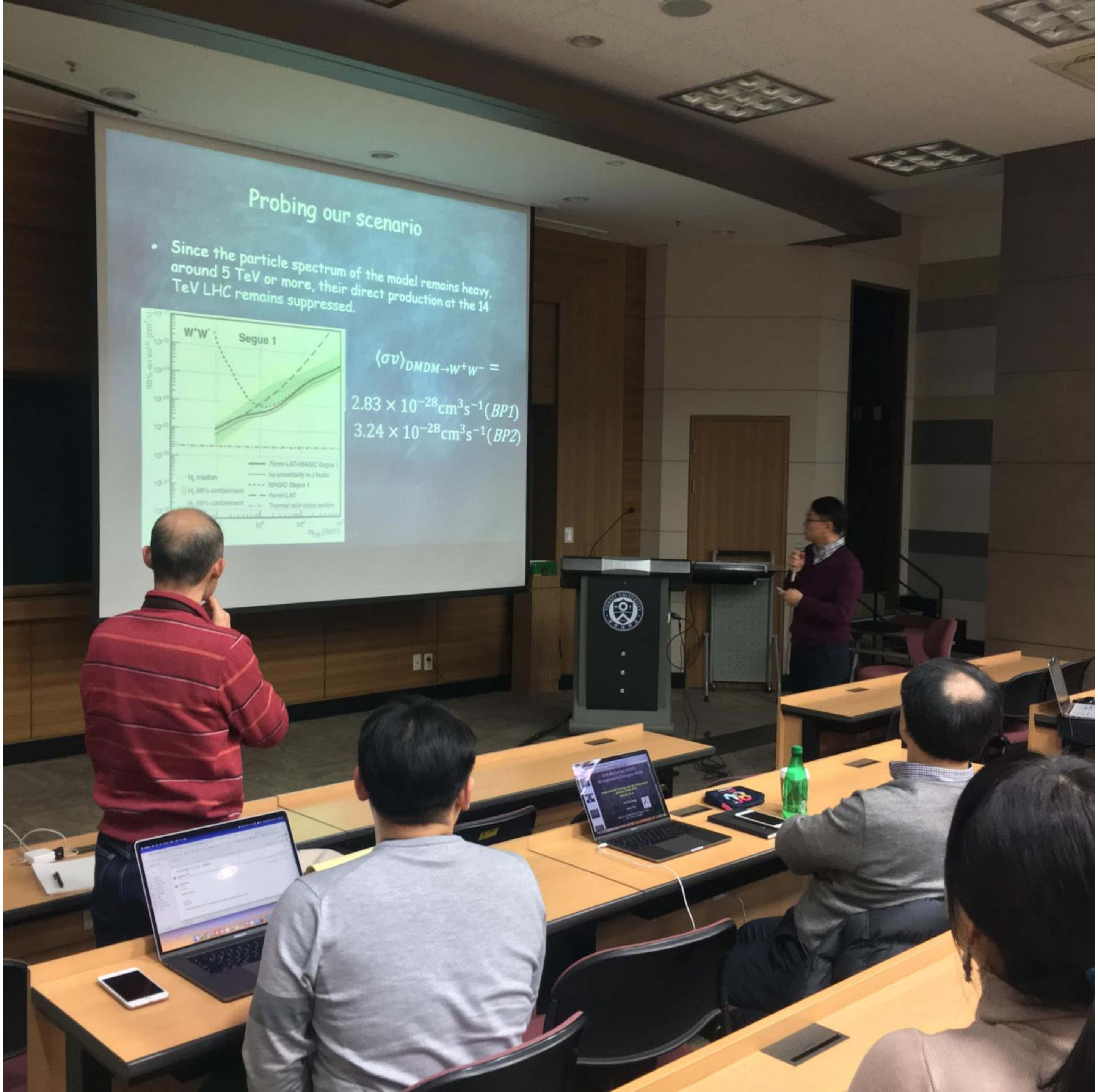
1885
연세대학교


Unitary inflaton as dark matter and radiation
Hyun Min Lee
Chung-Ang University, Korea
Based on: HML, Phys. Rev. D78, 015020 (2018);
S. Choi, Y. Kang, HML, K. Yamashita, arXiv: 1902.03781[hep-ph].
Cosmology and High Energy Physics Workshop
Yonsei University, Feb 26, 2019.


Reheating and dark matter
Reheating temperature:
Dark matter abundance:
out of equilibrium
: non-thermal production
Higgs decay:
Inflaton decay:


Dark Matter and WIMPy
Baryogenesis in Scotogenic Model
Yonsei university Cosmology and High Energy physics
workshop (YuCHE 2019)
2019.02.26-27
Sin Kyu Kang
Seoul-Tech
Based on arXiv:1806.04689 (to appear in JHEP)
with D Borah, A Dasgupta


Probing our scenario
Since the particle spectrum of the model remains heavy, around 5 TeV or more, their direct production at the 14 TeV LHC remains suppressed.
W⁺W⁻
Segue 1
Fermi-LAT+MAGIC Segue 1
no uncertainty in J-factor
MAGIC Segue 1
Fermi-LAT
Thermal relic cross section
$\langle\sigma v\rangle_{DMDM\to W^+W^-}=$
$2.83\times10^{-28}\mathrm{cm}^3\mathrm{s}^{-1}(BP1)$
$3.24\times10^{-28}\mathrm{cm}^3\mathrm{s}^{-1}(BP2)$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$3.24 \times 10^{-28}\mathrm{cm}^3\mathrm{s}^{-1}(BP2)$


Yonsei university Cosmology and High Energy physics
workshop (YuCHE 2019)
Murdering the 4th
generation 2HDM
Jeonghyeon Song
(Konkuk University, Korea)
w/ S.K.Kang, Z. Qian, Y.W. Yoon
Yonsei Univ, 2019.2.26


초가을
우엉차


Introduction
A model for light DM
Direct detection of light dark baryons
WIMP miracle for correct thermal relics
Weakly interacting massive particles (Lee+Weinberg, 1977)
DM
DM
SM
SM
annihilation
$\langle \sigma v \rangle = \frac{\alpha^2}{m_{\rm DM}^2}$
$m_{\rm DM} \sim 100$ GeV
5/35


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