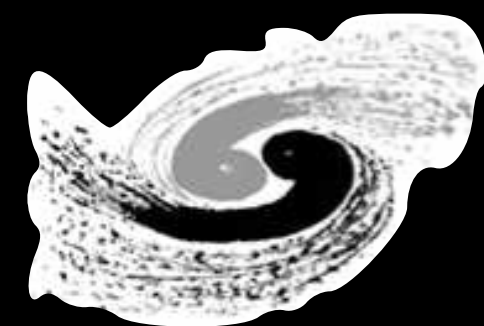


EF04: EW Precision Physics and constraining new physics

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EF04: status and meeting

- Conveners: Alberto Belloni, Ayres Freitas, Junping Tian
- Meeting every two weeks, Friday 10:00am US/Eastern time
- CEPC contact: Zhijun Liang
- First CEPC talk in EF04: June 19th

➤ <https://indico.fnal.gov/category/1138/>

EF04 Topical Group Community Meeting
Friday Jun 19, 2020, 10:00 AM → 11:20 AM US/Eastern

Description Connect through Zoom: <https://cern.zoom.us/j/95541369778>
Meeting ID: 955 4136 9778
Password: 120464

There are minutes attached to this event. [Show them.](#)

10:00 AM → 10:05 AM News
Speakers: Alberto Belloni, Ayres Freitas (University of Pittsburgh), Junping Tian (University of Tokyo)
intro

10:05 AM → 10:25 AM EWPOs at CEPC
Speaker: Zhijun Liang (The Institute of High Energy Physics, Chinese Academy of Sciences)
Zhijun-snowmass-j...

10:25 AM → 10:45 AM EWPOs at ILC
Speaker: Graham Wilson (University of Kansas)
ILCPrecisionEW-Sn...

11:00 AM → 11:20 AM EWPOs at FCC-ee
Speaker: Alain Blondel (DPNC Université de Genève)
Snowmass-EF04-2...

EF04: EW Precision Physics and constraining new physics

July 2020

- 30 Jul [EF04 Topical Group Community Meeting](#)
- 17 Jul [EF04 Topical Group Community Meeting](#)
- 02 Jul [EF04 Topical Group Community Meeting](#)

June 2020

- 19 Jun [EF04 Topical Group Community Meeting](#)
- 04 Jun [EF04 Topical Group Community Meeting](#)

May 2020

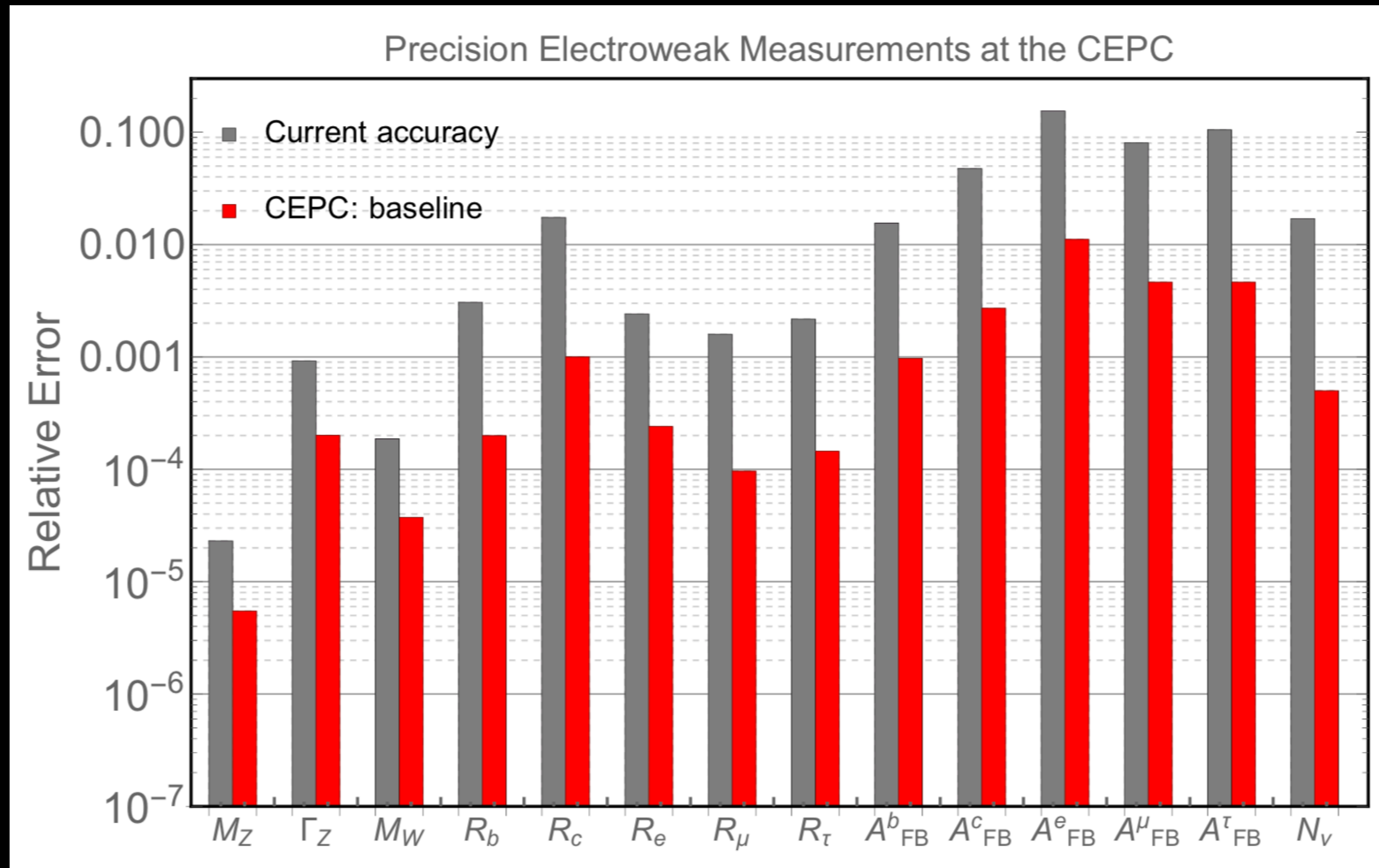
- 15 May [EF04 Topical Group Community Meeting](#)

April 2020

- 30 Apr [EF04 kick-off meeting with community \(joint with EF01\)](#)

Overview of CEPC electroweak physics

- expected precision of electroweak measurements in CEPC CDR
- Estimated by extrapolation from LEP experiments



observables
m_Z
Γ_Z
σ_{had}
R_e
R_μ
R_τ
R_b
R_c
$A_{FB}^{0,e}$
$A_{FB}^{0,\mu}$
$A_{FB}^{0,\tau}$
$A_{FB}^{0,b}$
$A_{FB}^{0,c}$
$A_e(\tau \text{ pol})$
$A_\tau(\tau \text{ pol})$
BR($Z \rightarrow inv$)
m_W
m_W
Γ_W
$\sigma_{240GeV}^{tot}(WW)$
BR($W \rightarrow e\nu$)
BR($W \rightarrow \mu\nu$)
BR($W \rightarrow \tau\nu$)
BR($W \rightarrow jj$)★
derived quantities
$\sin^2 \theta_W^{eff}$
N_ν
N_ν

Example 1: Branching ratio (R^b)

$$\frac{\Gamma(Z \rightarrow b\bar{b})}{\Gamma(Z \rightarrow \text{had})}$$

- At LEP measurement 0.21594 ± 0.00066
- CEPC aim to improve the precision by a factor ~ 20
- R^b measurement is sensitive to New physics models (SUSY)
 - SUSY predicts corrections to $Z \rightarrow b\bar{b}$ vertex
 - Through gluino and chargino loop ...

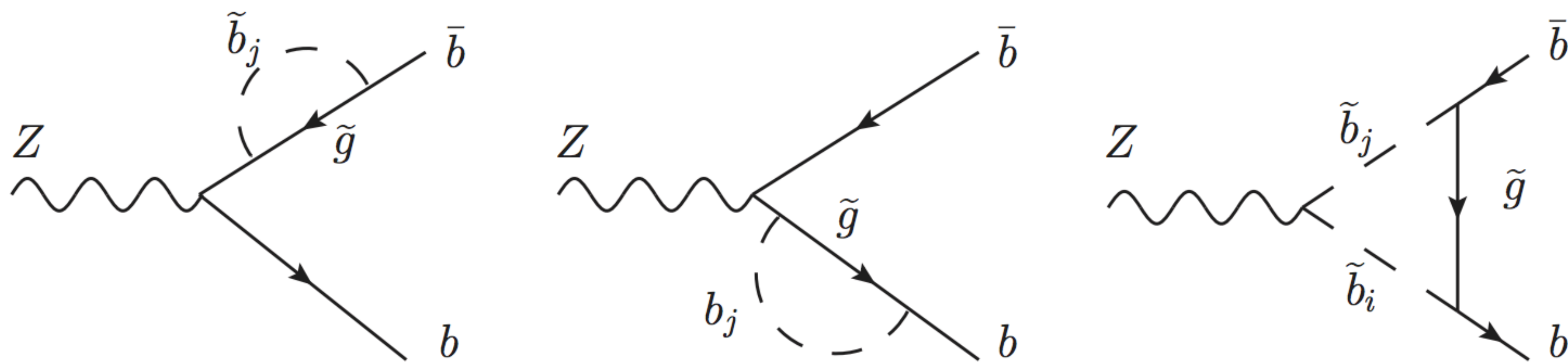


FIG. 1: One-loop Feynman diagrams of gluino correction to $Z \rightarrow \bar{b}b$

R^b : b tagging hemisphere correlations

- Hemisphere is taken to be tagged
 - if it is tagged by either one or both of the secondary vertex and lepton tags.
- Major systematics: **hemisphere correlations**
 - The tagging efficiency correlation between the two hemispheres in one event:
 - Angular effects : due to inefficient regions of detector
 - QCD effects ($g \rightarrow bb$)
 - Vertex effects : due to vertex fitting

$$C_b = \frac{\epsilon_{2jet-tagged}}{(\epsilon_{1jet-tagged})^2}$$

Single (N_t) and double tagged events (N_{tt})

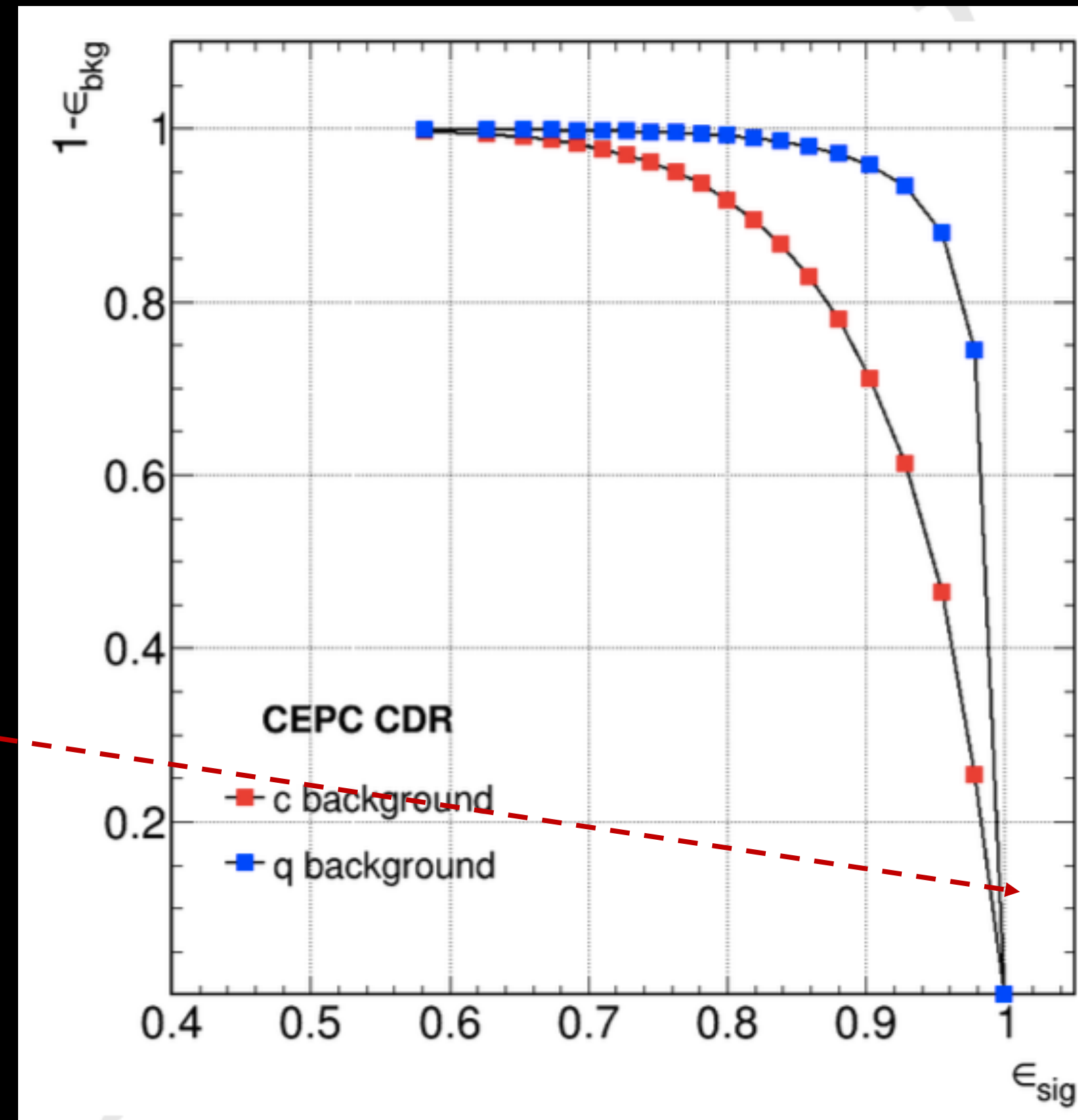
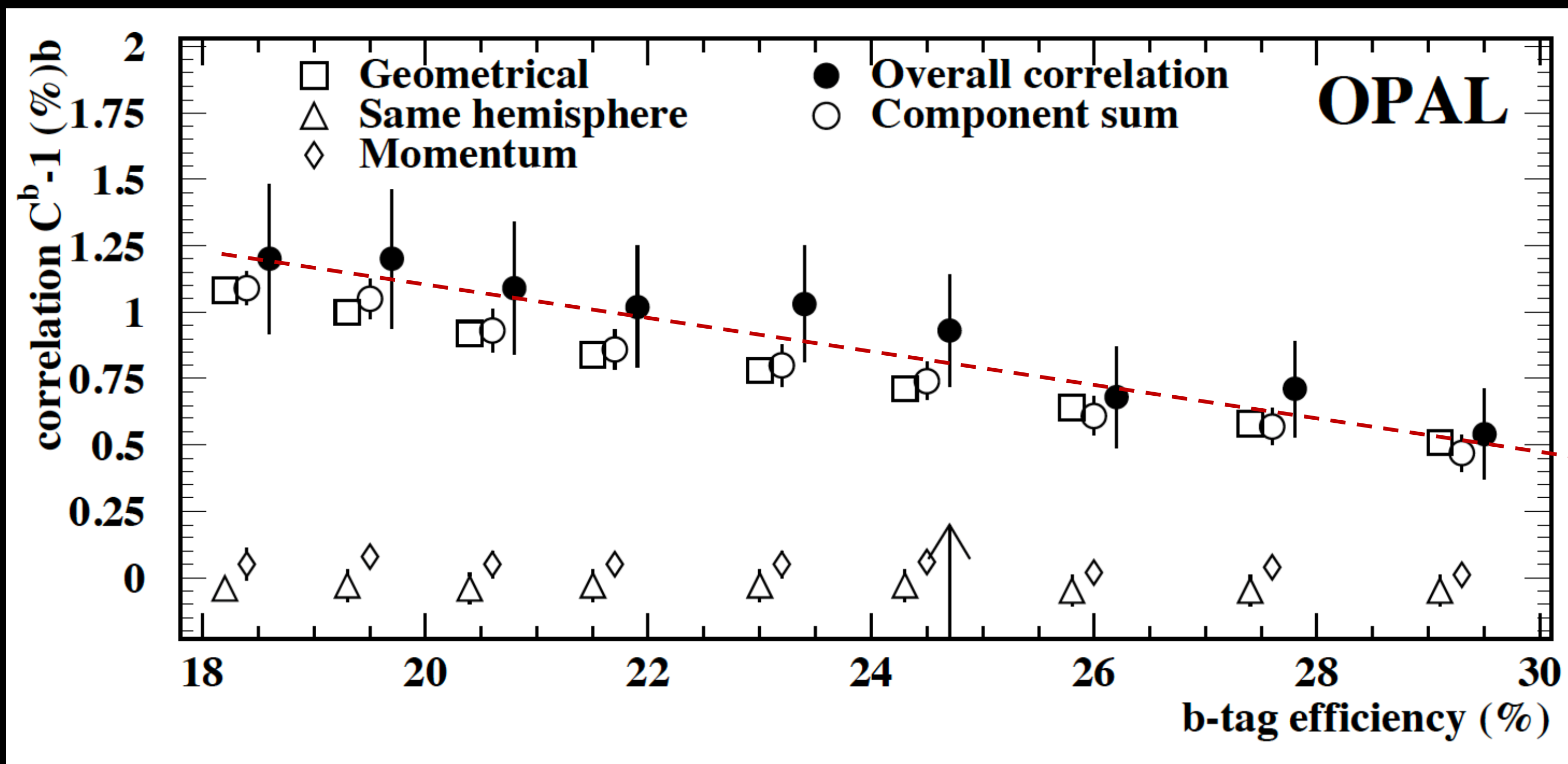
$$N_t = 2N_{had} \{ \epsilon^b R_b + \epsilon^c R_c + \epsilon^{uds} (1 - R_b - R_c) \},$$
$$N_{tt} = N_{had} \{ C^b (\epsilon^b)^2 R_b + C^c (\epsilon^c)^2 R_c + C^{uds} (\epsilon^{uds})^2 (1 - R_b - R_c) \},$$

R^b : b tagging hemisphere correlations

- hemisphere correlations depends on b tagging efficiency
 - with 95% purity working points efficiency > 70%
 - This systematics will not be dominated

$$C_b = \frac{\varepsilon_{2jet-tagged}}{(\varepsilon_{1jet-tagged})^2}$$

CEPC b tagging ROC curve



OPAL collaboration, Eur.Phys.J.C8:217-239,1999

Plan for Snowmass EF04 LOIs contribution

- More detailed study of 2~3 benchmark electroweak observables
 - Eg: weak mixing angle from $Z \rightarrow b\bar{b}$ backward-forward asymmetry
 - More study with more realistic simulations
 - More detailed study on experimental and theory systematics
- High order EWK calculation (NNLO EWK corrections)
 - Already setup connection between Zhao Li and EF04 conveners
- EFT fit from EWPOs
- aTGCs/QGCs in WW events
- Please consider to join us and write down your topics in QQ docs

<https://docs.qq.com/sheet/DR1NXTXp6V2JkR1NH?tab=m0d77k>

EF04	EW Precision Physics and constraining new physics	
EF04.1	WW process	Junmou Chen
EF04.2	TGC (remark: Jet can be measured to energy resolution of 4%, direction resolution of 1%)	
EF04.3	Afb(b) – $\sin^2(\theta_W)$ (remark: Jet Charge Measurement)	
EF04.4	NNLO EW correction to HZ production	Zhao Li

Feedback from Snowmass EF04

- R^b measurement is sensitive to New physics models (SUSY)

- Very interesting about physics implication from $Z \rightarrow bb$ measurements

- Ayres Freitas would like to follow up on that

- Systematics: b tagging efficiency hemisphere correlations high

- Feedback: Need input from QCD experts

- Feedback: better to avoid extrapolation from LEP, try standalone estimation from CEPC simulation.

- Feedback about the our plan:

- Conveners would like to talk with Zhao Li to coordinate NNLO EWK correction calculation

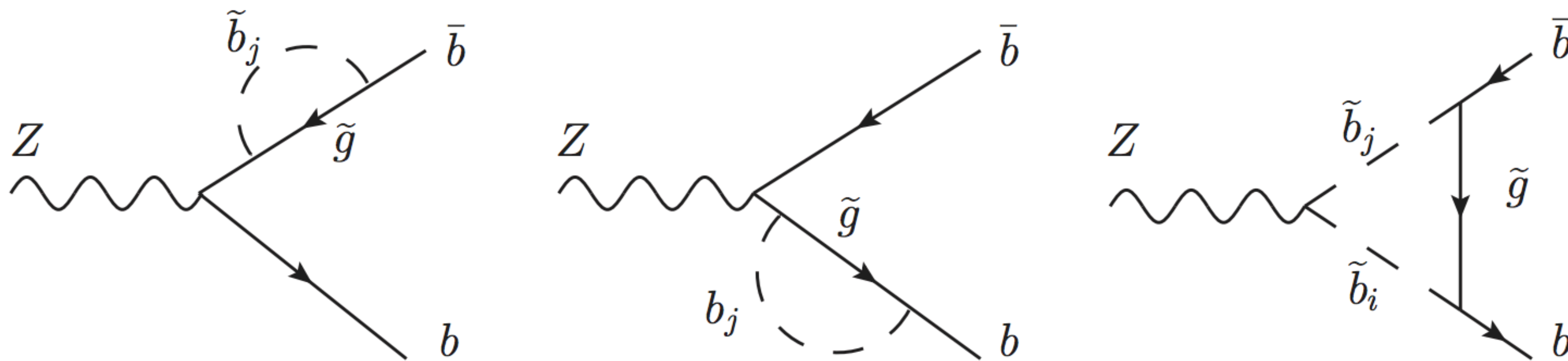


FIG. 1: One-loop Feynman diagrams of gluino correction to $Z \rightarrow b\bar{b}$

EF04: News EU strategy (from Alain Blondel)

- Alain Blondel presented the news of Fcc-ee and news in EU strategy
- He mentioned to prepare Fcc-ee TDR and financial documents by ~2025



HOT NEWS

Preamble

The particle physics community is ready to take the next step towards even higher energies and smaller scales. The vision is to prepare a Higgs factory, followed by a future hadron collider with sensitivity to energy scales an order of magnitude higher than those of the LHC, while addressing the associated technical and environmental challenges.

High-priority future initiatives

An electron-positron Higgs factory is the highest-priority next collider. For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy. Accomplishing these compelling goals will require innovation and cutting-edge technology:

the particle physics community should ramp up its R&D effort focused

- on advanced accelerator technologies, in particular that for high-field superconducting magnets, including high-temperature superconductors;

- Europe, together with its international partners, should investigate the technical and financial feasibility of a future hadron collider at CERN with a centre-of-mass energy of at least 100 TeV and with an electron-positron Higgs and electroweak factory as a possible first stage. Such a feasibility study of the colliders and related infrastructure should be established as a global endeavour and be completed on the timescale of the next Strategy update.

The timely realisation of the electron-positron International Linear Collider (ILC) in Japan would be compatible with this strategy and, in that case, the European particle physics community would wish to collaborate.

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EF04 news: beam polarization (from Alain Blondel)

- Fcc-ee seems to conclude that longitudinal polarization is not preferred
- Only keep transverse polarization for beam energy measurement.

Beam Polarization can provide two main ingredients to Physics Measurements

2. Longitudinal beam polarization provides chiral e+e- system

- High level of polarization is required (>40%)
- Must compare with natural e+e- polarization due to chiral couplings of electrons (15%) or with final state polarization analysis for CC weak decays (100% polarized) and top)
- **Physics case for Z peak is very well studied and motivated:**
 $A_{LR} = A_e, A_{FB}^{Pol}(f)$ etc... (CERN Y.R. 88-06)
figure of merit is $L \cdot P^2$ --> must not lose more than a factor 2
- self calibrating polarization measurement requires both e+ and e- polarization
at high statistics $A_{FB}^{Pol} = A_e$ plays the role of A_{FB}
- enhance Higgs cross section (by up to ~30%)
top quark couplings? final state polarizations as well (Janot arXiv:1503.01325)
enhance signal, subtract backgrounds, for $ee \rightarrow WW$, $ee \rightarrow H$
- requires High polarization in both e- and e+ polarization
→ not interesting if luminosity is too high
- Obtaining high polarization in high luminosity collisions is delicate in top-up mode
DECIDED TO KEEP ONLY TRANSVERSE POLARIZATION FOR ENERGY CALIBRATION

As far as we could check, there is no physics that can be done with longitudinal polarization that cannot be done without, given enough luminosity

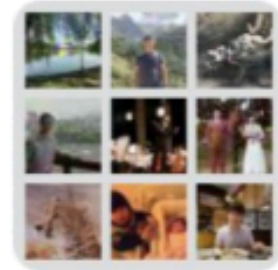
EF04: New: EF MC task force (from conveners)

- We should fill in the survey prepared by the EF MC Task Force members
- Make our CEPC MC sample as official sample for snowmass study
 - <https://docs.google.com/forms/d/e/1FAIpQLSfBDI8fy08uli35gLPFYAL2vGRF9YtkApm5i27Z6MCS9FDNXg/viewform?pli=1>
 - Discuss your plans / interests with conveners
- The input will be used to determine if centralized effort to produce additional MC samples is needed
 - Details in email sent to EF mailing list by J. Stupak (EF MC Task Force) on June 1
- All the information provided to the EF MC Task Force is collected here:
 - <https://docs.google.com/document/d/1evkV0F7RA2GS8kFjr4A6YsryxY6D9KVIqTEbVADeIRe/>
 - https://docs.google.com/spreadsheets/d/19KWScsrEgmHRBtqq3tKxHiREEbT0e_IC3DIPcTdEixc/

EF04: plan

- Internal CEPC discussion every two weeks.
- Prepare for LOIs in this summers
- Next snowmass EF04 meeting in July 2nd
 - Next topic: Input from Diboson measurements.
- Snowmass joint EF workshop July 22nd (time to be confirmed)

Backup: EF04 wechat group



SnowMass EF04: EWK precision



该二维码7天内(7月5日前)有效, 重新进入将更新