

Belle II @ Roma 3

E. Graziani

Consiglio di Sezione 5-7-2022

Status

- SuperKEKB è in shutdown da luglio 2022 (430 fb⁻¹ acquisiti)
- Molte attività di manutenzione e completamento sono programmate e in corso sia per la macchina che per il detector
- Con l'arrivo del nuovo PXD a Belle II i programmi sono ora più definiti
- La ripartenza è fissata a dicembre
- Nel 2024 (anno solare) sono previsti 8.5 mesi di run

Some highlights in LSI works

PXD2 arrival at KEK (March 16)



PXD2 mounting



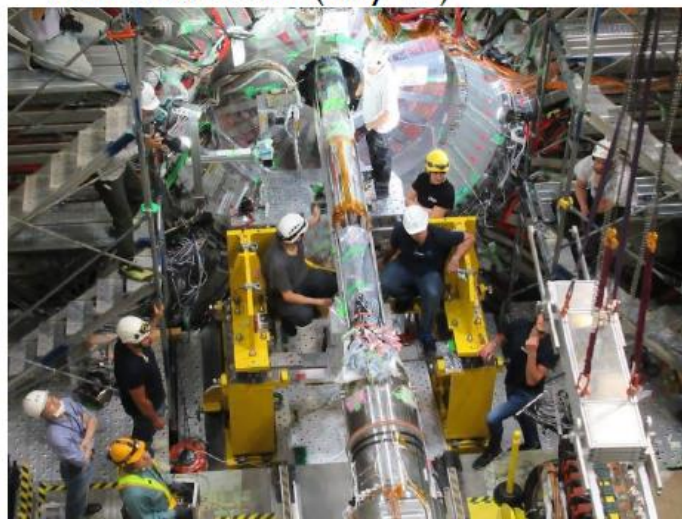
PXD2 tests at B4



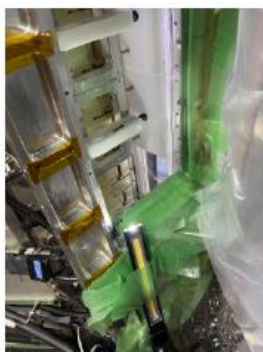
Replacement of TOP MCP-PMT and boardstack (Feb. → Apr.)



VXD extraction (May 10)



SVD detachment (May 16, 17)



More works:

- CDC
- KLM
- ARICH
- ECL
- DAQ upgrade

→ *discussions at TB*

Replacement works in SuperKEKB
→ *Talks by M. Yoshida, T. Kobayashi*

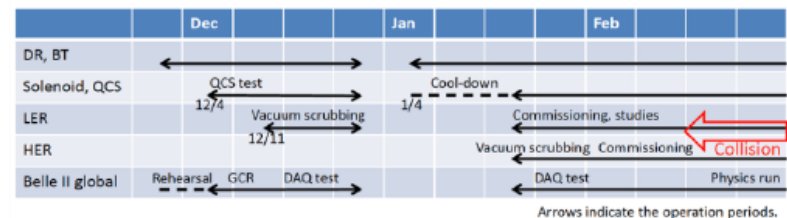
Schedule

- We plan to resume run on Dec.11 (schedule critically examined by TB)
 - Vacuum scrubbing, tests of newly installed components (NLC, new collimators, ...)
- When can we resume after the new year break?
- Constraints in FY2024 running?
 - Power restriction fir to renewal of the central electric power substation.
 - Reinforcement work for the roof of Tsukuba hall

We will do our best to minimize impact on our data taking

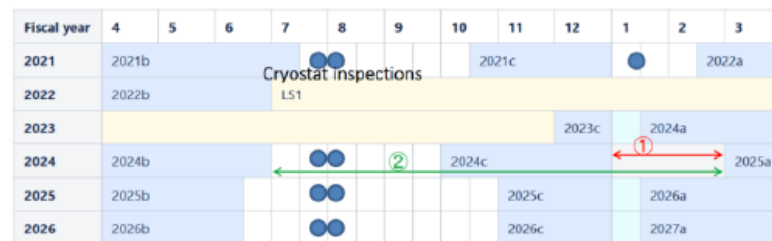
→ *Discussions at EB*

Tentative rough schedule



- Every Belle II subsystem should be ready by Nov 26.
- Operation rehearsal with subsystem experts from Nov 27
- Global operation with CR shifters from Dec 4
 - One week of global cosmic runs at 1.5 T
 - Enough time for DAQ test during MR single-beam operation
- Some tests with HV can be done in the first half of Jan (at 0 T)

Rough idea of the near-term run periods <https://confluence.desy.de/display/BI/Run+Plan>



Assumption: 7 months operation per fiscal year with sufficient budget

- ✓ Continuous 7-8 months operation with a short break on the new year holidays.
 - Stop at the year end and about 2 weeks to restart the cryostats after the holidays.
 - Became possible because the regular cryostat inspections could be rearranged.

① Power restriction due to renewal of the central electric power substation (already decided)

② Renovation work of the roof of Tsukuba Hall in parallel to the operation (under discussion → We are asked to give the green light by Jun 9.)

Operation schedule and constraints for JFY2024 (Kodai Matsuoka)

Rough idea of the near-term run periods

<https://confluence.desy.de/display/BI/Run+Plan>

Fiscal year	4	5	6	7	8	9	10	11	12	1	2	3
2021	2021b							2021c				2022a
2022	2022b			LS1								
2023									2023c	①	2024a	
2024	2024b			③			2024c			②		2025a
2025	2025b							2025c	①	2026a		
2026	2026b							2026c	①	2027a		

Assumption: 7 months operation per fiscal year with sufficient budget

- ① Pause of operation for new year holidays instead of a usual winter shutdown (decided to try it first in FY2023; to be discussed for FY2025 and beyond)
- ② Power restriction due to renewal of the central electric power substation (already decided)
- ③ Renovation work of the roof of Tsukuba Hall in parallel to the operation (under discussion → We are asked to give the green light by Jun 9.)



LS1 (many upgrade works at SuperKEKB)

LINAC

M. Yoshida

- e- beam
 - Laser system has worked fine without any significant trouble.
 - DOE was installed also at 2nd laser line in the last summer maintenance, and it has worked fine.
 - In the run 2022a/b, bunch charge of 2 nC can be kept with bunch charge feedback.
 - 5 nC from gun was demonstrated. Further beam study is on-going during LS1.
 - New DOE with large area improve energy spread and emittance until HER injection.
 - BTe-ECS is planned to install at FY2024
- e+ beam
 - The new FC is working fine.
 - Reached bunch charge of 3.5 nC at BT end (final design 4 nC).
- Upgrade work during LS1
 - Pulsed Quads (x8) at J-ARC for the simultaneous dedicated matching of HER/LER injection beam
 - Pulsed Quads (x4) at Sector1, 2 for low beta optics of HER injection beam
 - New accelerating structure
 - Replacement of air conditioners at SectorA, B (in the accelerator tunnel)
 - Fast kicker for 2nd bunch orbit correction
- Issues
 - Emittance growth at end of BT2 for both of e- and e+ beam (BT report, Injection report)
 - Low e- injection efficiency of 2nd bunch
 - Increase the e- bunch charge while keeping small emittance

MR

T. Kobayashi

- **Many upgrade & maintenance works are progressed during LS1.**
 - LS1 started in July 2022 and will end in November 2023.
 - Next beam operation is scheduled to restart in December 2023.
- **Progress of “IR works” & “NLC construction” were reported.**
 - And also, damaged collimator heads were replaced with new ones.
 - Most planed works will be completed by October 2023.
 - Beam operation will resumed from December 2023.
- **Sudden Beam Loss (SBL) is one of the concerned issues to be solved.**
 - Frequently, the beam suddenly disappears within few turns just before the abort.
 - The cause of SBL is still unknown. (Several candidates for the cause are considered.)
 - Continuation of investigation or study of SBL is needed to avoid it.

What are our goals for 2024 ?

(please a clear and sound message)



Run stably at $10^{35}/\text{cm}^2/\text{s}$

reach 150 fb^{-1} per month

exceed 1 ab^{-1}

Karim

(setting the pace for run 2)
(while doing good physics and working for the upgrade)

... 'This was their finest hour.'

Authorship policy

Authorship

Authorship is the most important element in the academic records. It acknowledges every author's contribution to the scientific result and establishes their academic responsibility for it. Excluding some authors for non-scientific reasons damages the scientific credibility of the work.

Constraints

Belle II members in some countries cannot at this time be listed as authors on papers together with Russian institutes or funding agencies. In particular, this is the case for scientists from Ukraine. Ensuring the unity of the Belle II Collaboration necessitates respecting this constraint.

Summary – Belle II Measures

Considering the above points, the Belle II Collaboration adopts the following measures:

- Belle II members from Russian institutes continue to contribute to the experiment as collaboration members.

As for publications,

- We list all the names who signed the authorship confirmation
- Affiliations and country names are not shown
- ORCID number for each author is provided
- Funding-agency acknowledgments are listed, including those from Russia
- A disclaimer «This work, based on data collected using the Belle II detector, which was built and commissioned prior to March 2019, was supported by ...»

Analisi in corso @ Roma 3

Dark Higgstrahlung $e^+e^- \rightarrow A'h'$ $\mu\mu$ + invisibile

Moriond, ICHEP, submitted to PRL EG,GDP

Z' to invisible: update @ $\approx 80 \text{ fb}^{-1}$

ICHEP, to be submitted to PRL EG,GDP

$Z', S, \text{ALP} \rightarrow \tau\tau$

ICHEP, to be submitted to PRL EG, GDP

Muonic dark force $Z' \rightarrow \mu\mu$ $\mu\mu\mu\mu$

Tesi di M.Laurenza, ML, EG, GDP

$B \rightarrow J/\psi K_L$

A.Passeri, C.Martellini

Dark sector

2022 slide

Analisi in corso @ Roma 3

Dark Higgstrahlung $e^+e^- \rightarrow A'h'$ $\mu\mu$ + invisible

published on PRL and arXiv

Z' to invisible: update @ $\approx 80 \text{ fb}^{-1}$

published on PRL and arXiv

$Z', S, \text{ALP} \rightarrow \tau\tau$

published on arxiv, submitted to PRL

Muonic dark force $Z' \rightarrow \mu\mu$ $\mu\mu\mu\mu$

unblinded this week, to be submitted to PRD

All the studies to update these papers to the full pre-shutdown luminosity (430 fb^{-1}) started \Rightarrow 3-4 more papers in 2024

$B \rightarrow J/\psi K_L$

A.Passeri, C.Martellini

Belle II detector

Electromagnetic calorimeter (ECL):

CsI(Tl) crystals, waveform sampling to measure time and energy (possible upgrade: pulse-shape)
Non-projective gaps between crystals

K_L and muon detector (KLM):

Resistive Plate Counters (RPC) (outer barrel)
Scintillator + WLSF + MPPC (endcaps, inner barrel)

Magnet:

1.5 T superconducting

Trigger:

L1: < 30 kHz
HLT: < 10 kHz

Vertex detectors (VXD):

2 layer DEPFET pixel detectors (PXD)
4 layer double-sided silicon strip detectors (SVD)

Central drift chamber (CDC):

He(50%):C₂H₆ (50%), small cells,
fast electronics

Particle Identification (PID):

Time-Of-Propagation counter (TOP) (barrel)
Aerogel Ring-Imaging Cerenkov Counter (ARICH)

electrons (7GeV)

positrons (4GeV)

KLM UPGRADE PROPOSAL

Sostituzione degli RPC nel barrel con scintillatori

Realizzazione di un setup a SIPM

da utilizzare per:

- a) Fare dei test di timing utilizzando un diodo laser
- b) Fare dei test della parte di pre-amp per la lettura con adc anche essa sviluppata a RM3.

La proposta di upgrade è in fase di revisione. Per il momento ripresentiamo la stessa richiesta dell'anno scorso, ma stiamo valutando altre soluzioni

Belle II VR @ Roma Tre

- Masterclass
 - Corso di rivelatori di R. Di Nardo
 - Scuola di Fisica
-
- Festival delle Scienze di Genova

Da quest'anno è iniziata la somministrazione di questionari pre/post attività e relativa analisi. Antonio è in questo momento alla conferenza EDULEARN per presentare questo lavoro.

A. Budano

F. Budano

I. De Angelis

C. Martellini

D. Tagnani

R. Antonietti

Responsabilità

A. Passeri Responsabile Nazionale + Jennifer

ANAGRAFICA

Personale ricercatore

H. Boubalat	100
P. Branchini	90
S. Bussino	50
A Cemmi	25
M. Ciuchini	20
E. Colantoni	100
S. Cormenier	100
I. Di Sarcina	25
E. Graziani	100
C. Martellini	60
A. Passeri	50+20
L. Salutari	100
J. Scifo	25
A. Verna	25
D. Vincenzi	100
L. Zani	100
Tot. fte	10.7+0.2

← ENEA
← new

Personale tecnologico

A. Budano	50
I. De Angelis	30
D. Tagnani	30
Tot. fte	1.1

Tot fte: 12 (include 0.2 di A. Passeri in Jennifer2)

Personale tecnico

F. Budano

Richieste sui servizi

Elettronica	6 mu
Meccanica	3 mu

RICHIESTE ECONOMICHE

Missioni

k€

Responsabile Nazionale (A.Passeri)

5

Metabolismo

90

Mantenimento & debug elettronica KLM

12 sj

Turni di presa dati (tutta Belle II) 8.5 mesi 2024

59.5

154.5 + 12 sj

Consumo

Metabolismo

18

Upgrade KLM

14 sj

SPSERVIZI

pagamento M&O 2024

200 sj

Totale

172.5 + 226 sj

KLOE: RICHIESTE ECONOMICHE

ANAGRAFICA

F. Ceradini	0
A. Passeri	20
L. Tortora	0
tot fte	0.2

Missioni	k€
Metabolismo	0.5
Analysis board	1
Policy board	1
Consumo	
Metabolismo	0.5

Stato del run

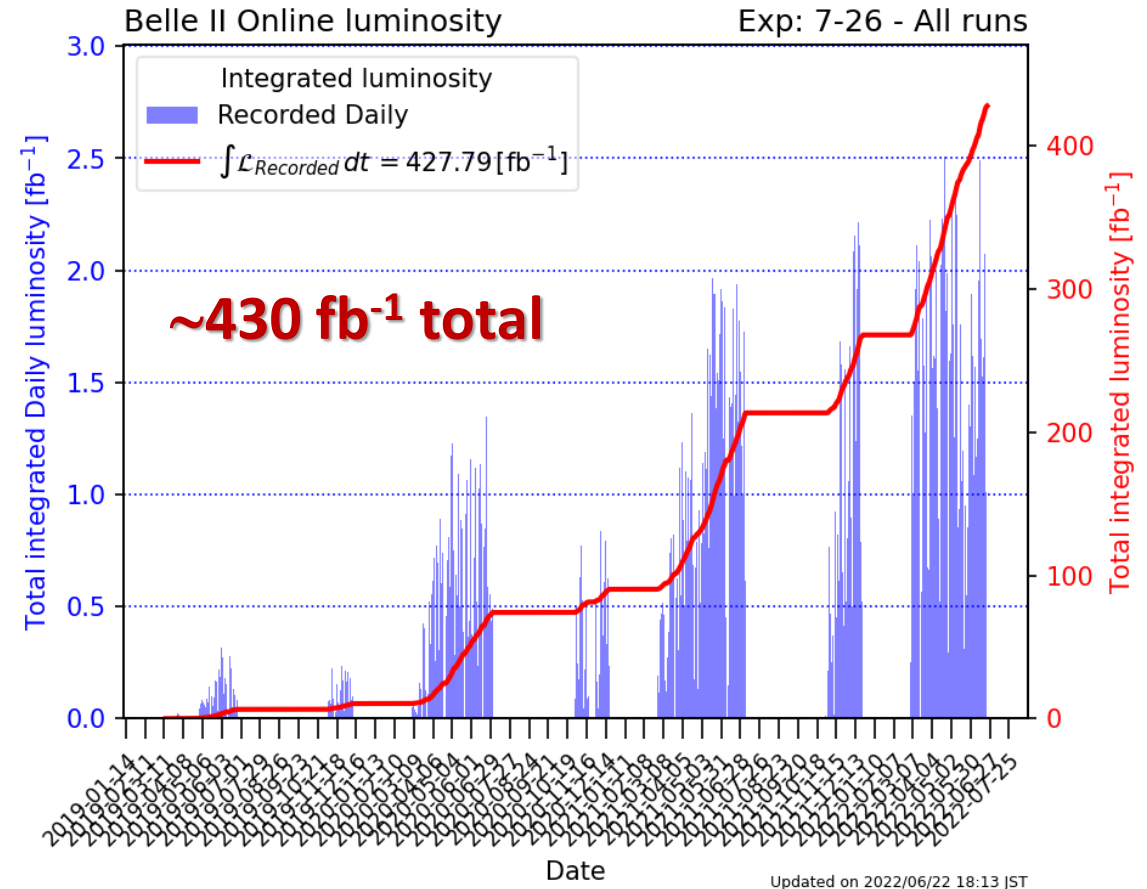
Collected luminosity up to now: 2019-2022

Physics run (2022 a+b) ended on Jun25
Some days before expected, due to increased electricity costs

Entering Long Shutdown now (LS1)

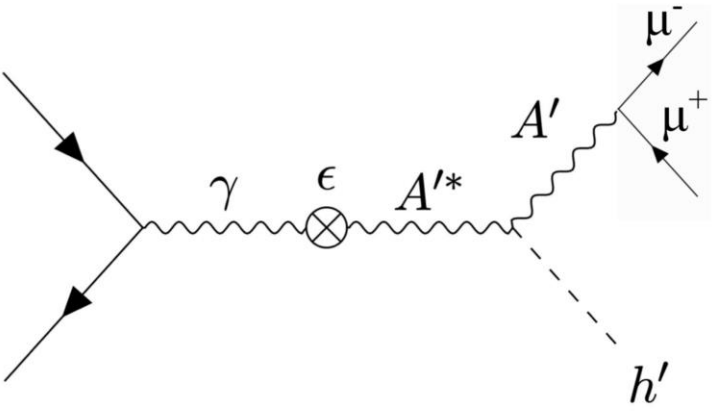
- Replace PXD
- Replace TOP PMs
- Replace beam pipe

Resume physics run in fall 2023



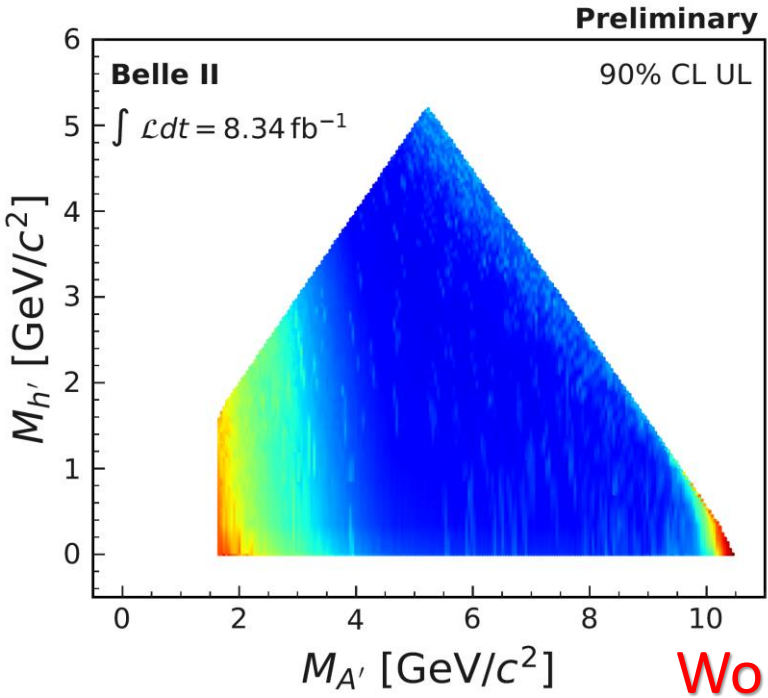
Peak luminosity world record: **$4.7 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$**

Dark Higgsstrahlung: $e^+e^- \rightarrow A'h'$

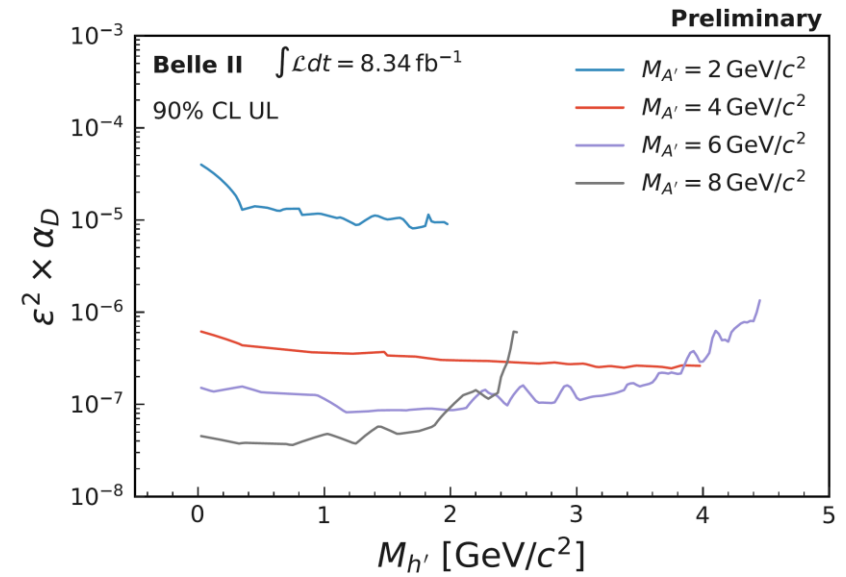
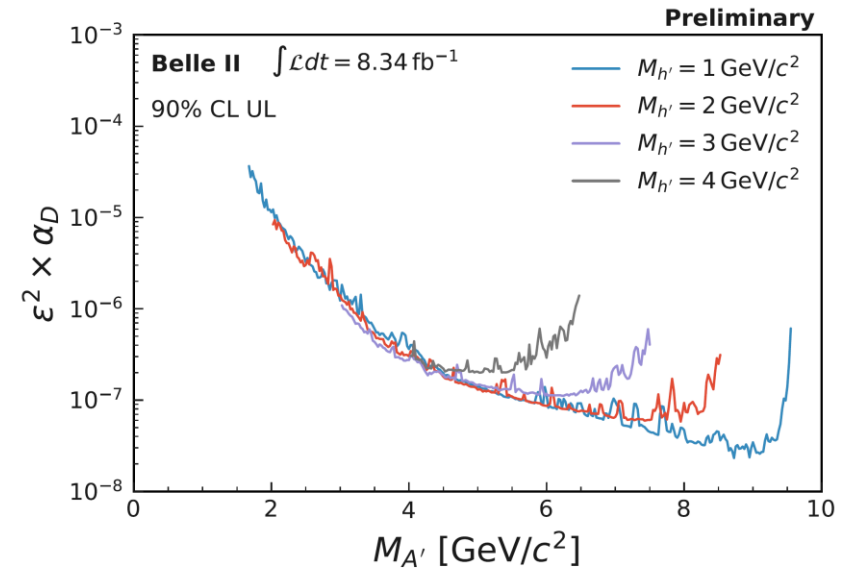


Submitted to PRL

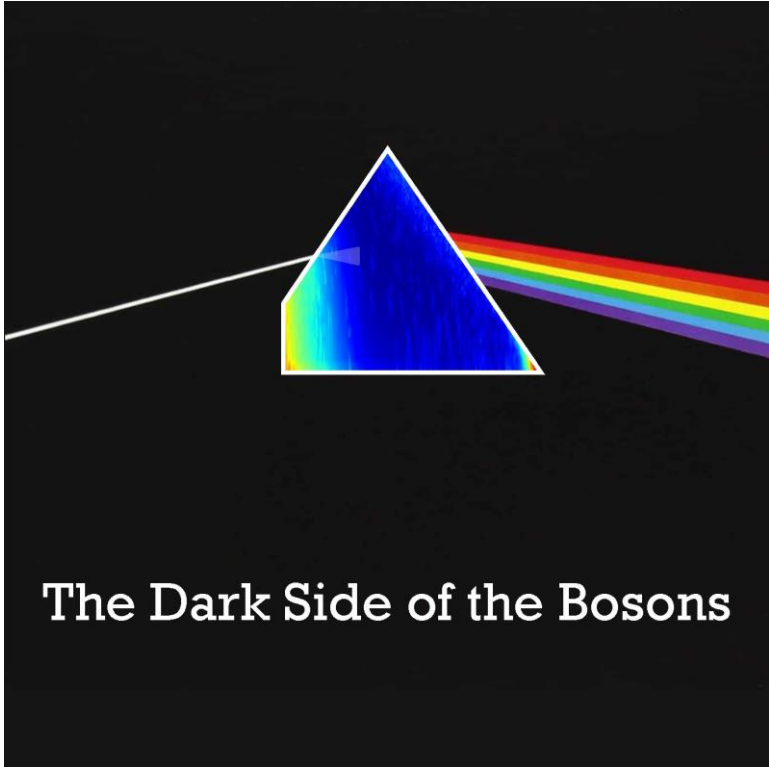
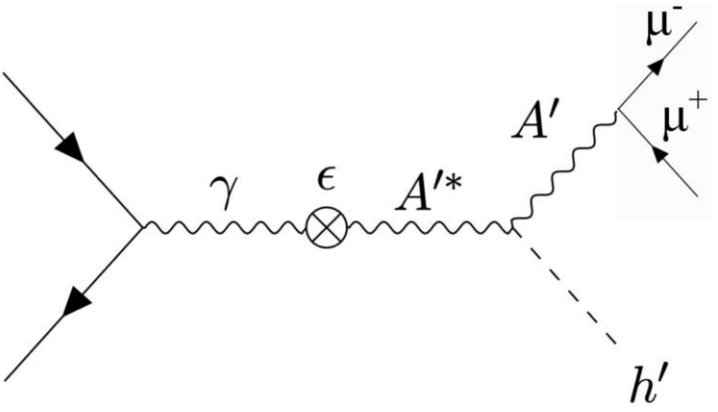
Moriond, ICHEP



World first for $1.65 < M_{A'} < 10.51 \text{ GeV}/c^2$



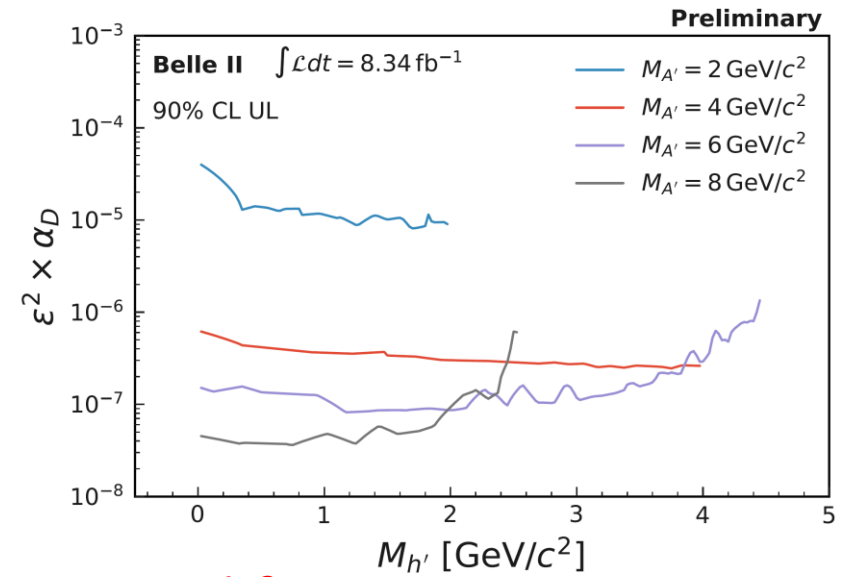
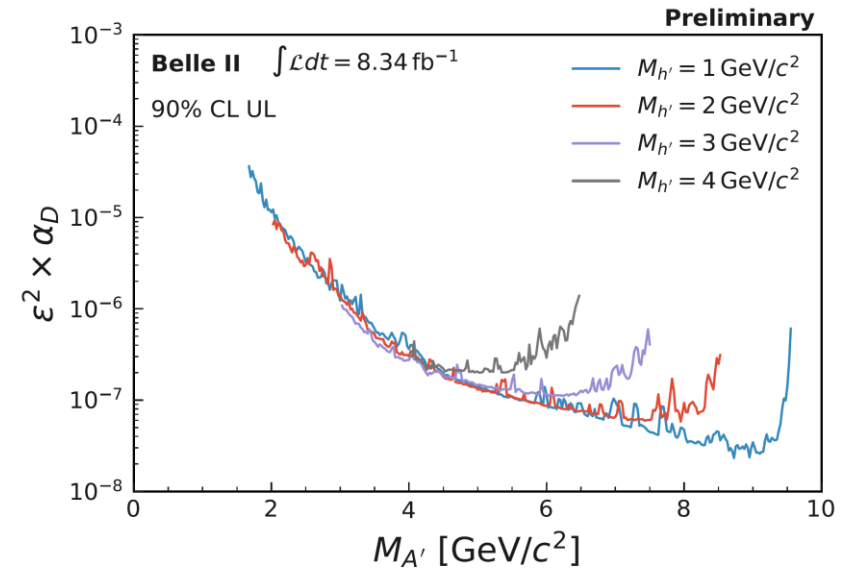
Dark Higgsstrahlung: $e^+e^- \rightarrow A'h'$



Submitted to PRL

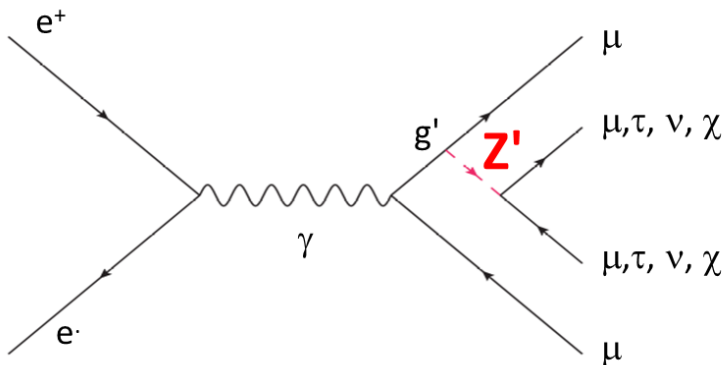
Moriond, ICHEP

Presto su Facebook



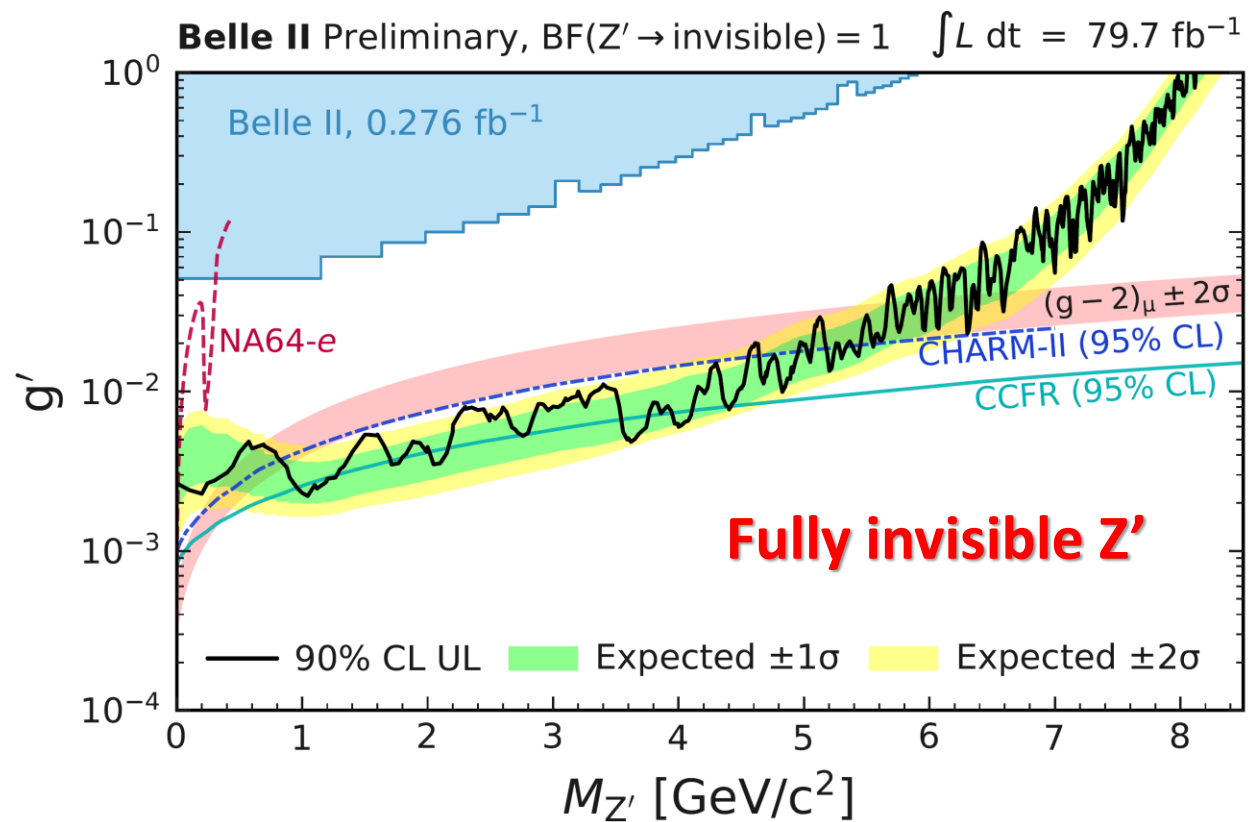
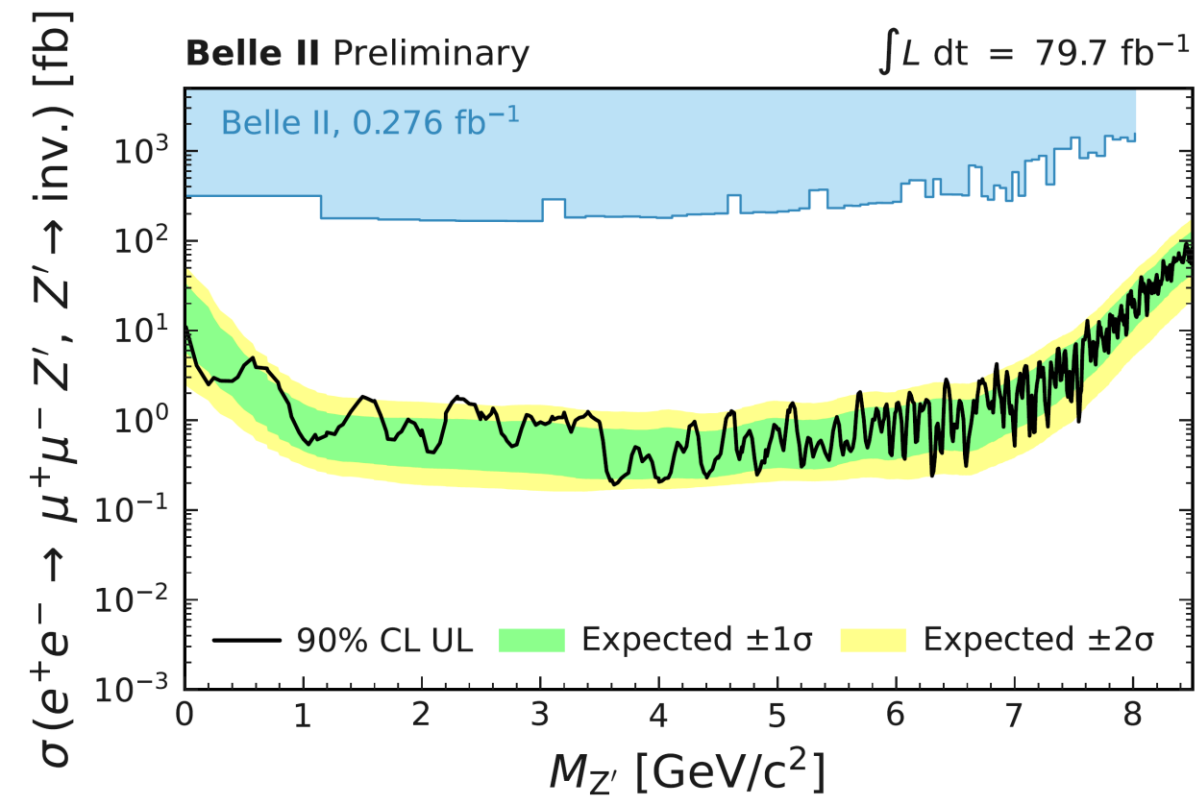
World first for $1.65 < M_{A'} < 10.51 \text{ GeV}/c^2$

Z' to invisible



To be submitted to PRL

ICHEP



Z', S, ALP $\rightarrow \tau\tau$

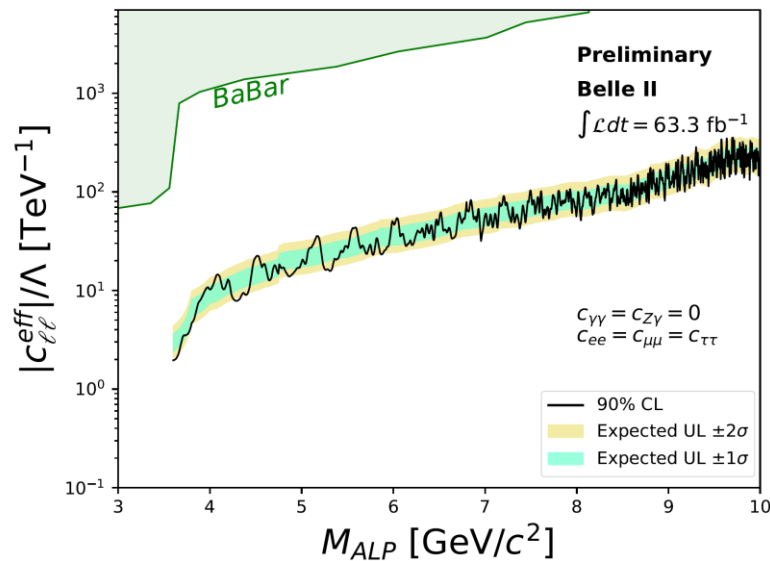
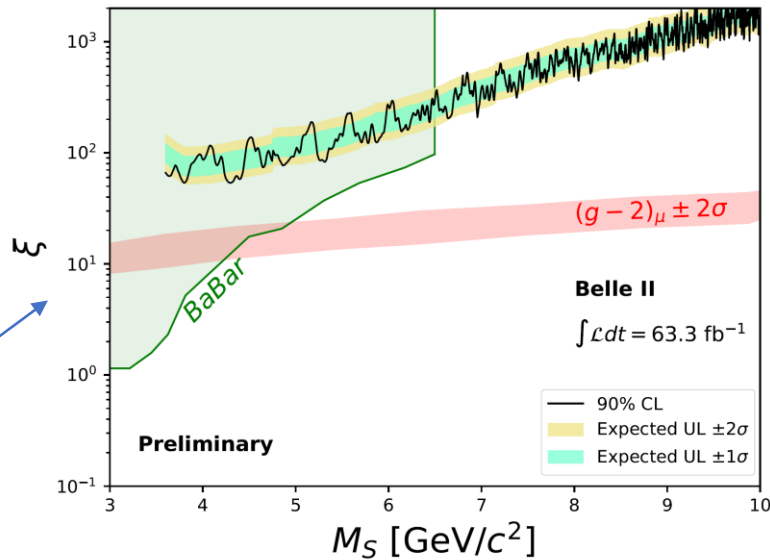
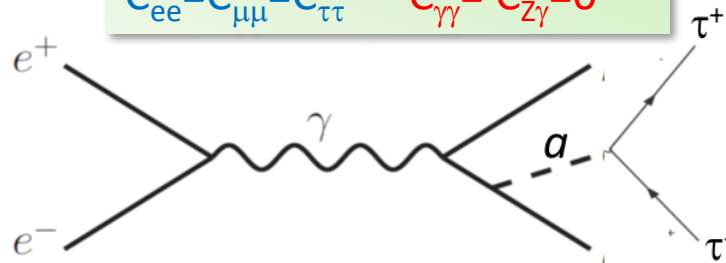
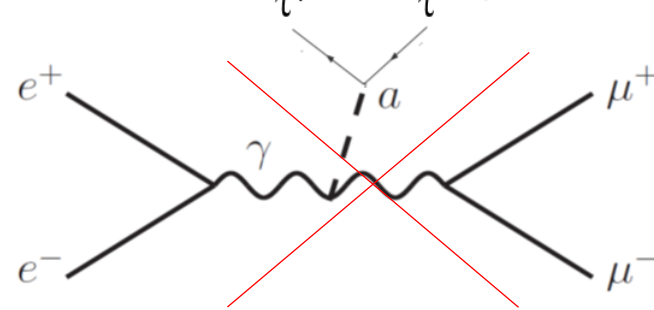
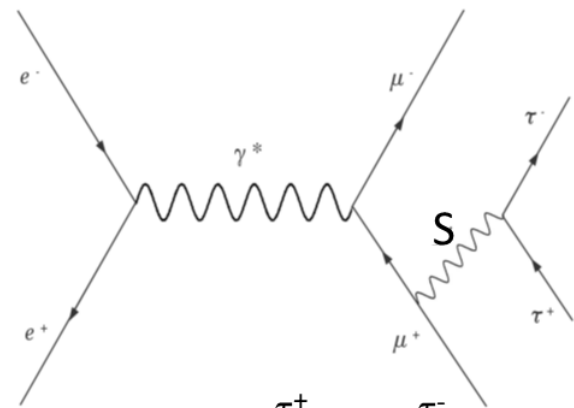
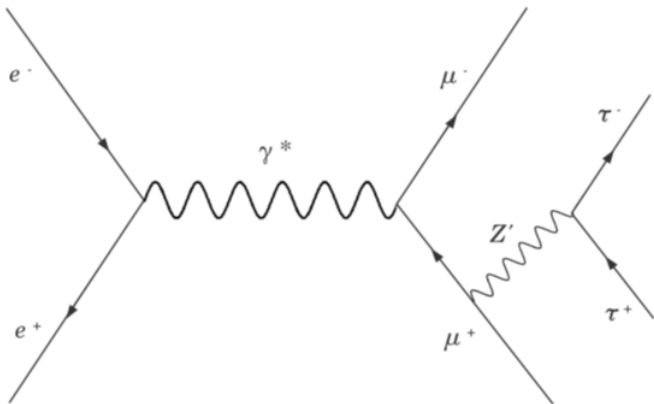
To be submitted to PRL

ICHEP

Leptophilic scalar S model

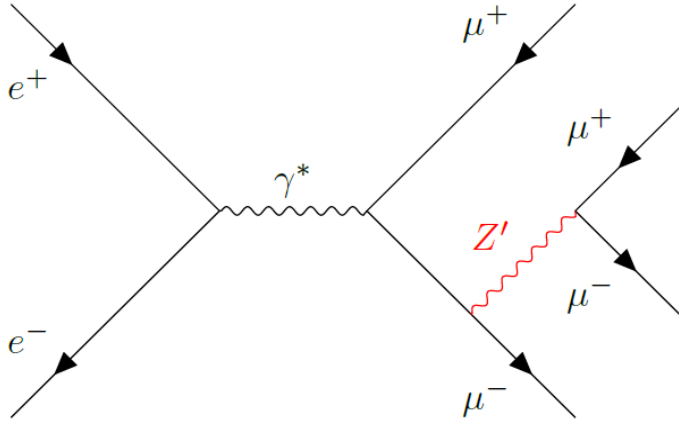
ALP $\rightarrow \tau\tau$

$$C_{ee} = C_{\mu\mu} = C_{\tau\tau} \quad C_{\gamma\gamma} = C_{Z\gamma} = 0$$



- First constraints on S for $M_S > 6.5 \text{ GeV}/c^2$
- First direct constraints for ALP $\rightarrow \tau\tau$

$Z' \rightarrow \mu\mu$



Lavoro di tesi di Martina

Sensitivity \sim BaBar, 1/3 luminosity

In review, da finalizzare entro agosto

