Summary of 2025/26 operations and plans for future operations

2026/11/11

20th ATF ICB/TB meeting

KEK, Japan

Toshiyuki OKUGI

Main mission of the nano-beam technology for ATF3 goal

- to keep 37nm beam stable for a few days.

Three topics in ATF3 project

- *Development of highly quality beam tuning techniques*
- *Beam stabilization for long-term stabilization*
- *Development of highly quality beam diagnostic devices*

International cooperation thought ATF international collaboration

5-year program for nano-beam technology of MEXT-ATD program

- ***compatible to ATF3 program***

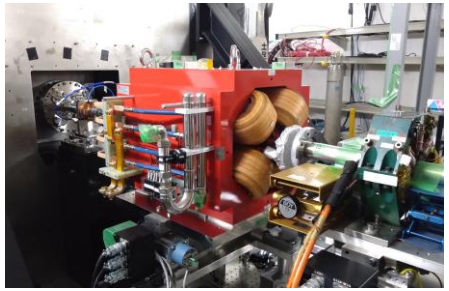
2023	2024	2025	2026	2027
● *Procurement of correction magnets* ● *Beam operation and equipment upgrade*	● *Reduction of high-order aberrations and wakefield* ● *Beam operation and equipment upgrade*	● *Precision improvement of nano-beam measurement* ● *Beam operation and equipment upgrade*	● *Advanced beam tuning technology* ● *Beam size <37nm*	● *Advanced beam tuning technology* ● *long-term stability (keep for a couple day)*

- ***JFY2023-2025 Focus on updating the ATF equipment necessary for advancing the nanobeam.***
- ***JFY2026-2027 Focus on beam test with prepared hardware by MEXT-ATD.***
  - ✓ ***Main target is to achieve the 37 nm beam size for JFY2026.***

Hardware preparation for ATF3 project in JFY2023-2025

2023	2024	2025	2026	2027
● *Procurement of correction magnets* ● *Beam operation and equipment upgrade*	● *Reduction of high-order aberrations and wakefield* ● *Beam operation and equipment upgrade*	● *Precision improvement of nano-beam measurement* ● *Beam operation and equipment upgrade*	● *Advanced beam tuning technology* ● *Beam size <37nm*	● *Advanced beam tuning technology* ● *long-term stability (keep for a couple day)*

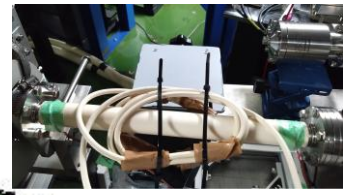
Final Focus Magnet
- JFY2024 Procurement
- JFY2025 Installation

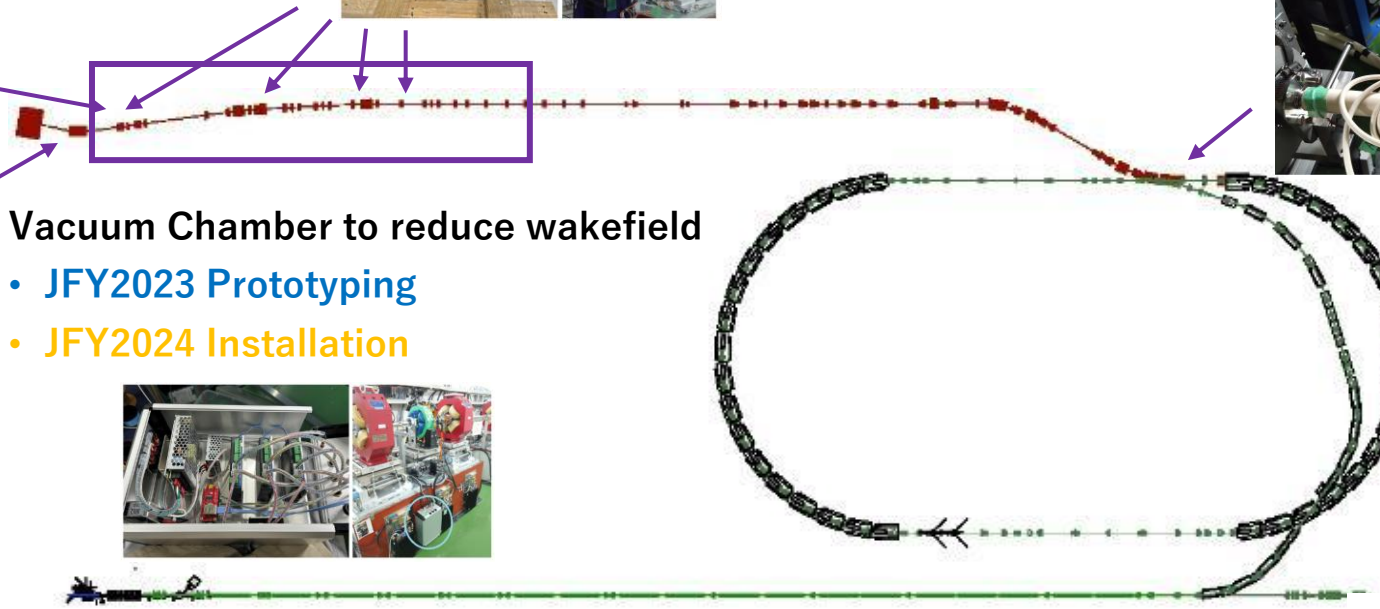


Skew Sextupole Magnets
- JFY2023 Procurement
- JFY2024 Installation



Extraction kicker
- JFY2023 Procurement of ceramic chamber
- JFY2024 Installation of ceramic chamber
- JFY2025 Kicker test will be started.

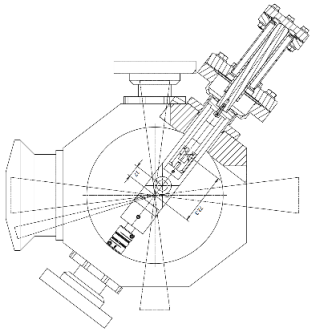




Vacuum Chamber to reduce wakefield
- JFY2023 Prototyping
- JFY2024 Installation

IP Beam size monitor
- JFY2024 Renewal of IP target
- JFY2025 Renewal of IP-BSM laser





Magnet mover system
- JFY2023 Prototyping
- JFY2024 Installation for sextupole
- JFY2025 Installation for quadrupole



Timing System
- JFY2023 Partially installation
- JFY2024 Fully installation

Human resources in KEK (from last ATF ICB/TB meeting)

JFY2025

- *One fulltime staff left at January 2026.*
- *One new engineer joined from February 2026.*

JFY2026

- *Two new domestic graduate students joined from domestic university.*
- *One Sekendai student may join (visit to KEK from April 2027).*
- *One full-time staff joined from November 2026.*

Full-time staff (9)

Nobuhiro Terunuma
Toshiyuki Okugi
Alex Aryshev
Eiji Nakamura
~~***Konstantin Popov***~~
Yuki Abe
Motoki Sato
Sakae Araki
Toshihiro Okada
Miho Shimada

Part-time staff (2 ; 2 days a week)

Kiyoshi Kubo
Shigeru Kuroda

Staff with concurrent work (3)

Masafumi Fukuda (Positron)
Yu Morikawa (Positron)
Masakazu Kurata (cERL)

Students (3)

Takumi Senno (U. of Tokyo)
Haato Sasaki (U. of Tokyo)
Nandana Haridas (SOKENDAI)

ATF project meeting (2025/11/27-28)

Report ; https://agenda.linearcollider.org/event/10859/attachments/40878/65154/Summary_ATF_project_meeting.pdf

- *Share the MEXT-ATD goal with all collaborators (beam stability over several days).*
- *Confirm the present status and achievements to the MEXT-ATD goal.*
- *Clarify how each group's research relates to the MEXT-ATD goal.*
- *Confirm the schedule for the next two years to achieve the goal.*



Participants: all collaboration (17 in person, 10 remote)

We confirmed in this meeting that

- *Most of the ATF beam time for FY2026 and FY2027 will be dedicated to achieving the MEXT-ATD goal.*
- *Cooperation toward the common objectives (MEXT-ATD goal) of each group was reconfirmed.*

Timetable of ATF project meeting

Thursday 27 November

Report for hardware update for ATF2-3 program
Session | Location: KEK 2-go-kan , Large Meeting Room (1F)

- 14:00–14:30 **Hardware upgrade for ATF2-3 project**
  Speaker: Alexander Aryshev
- 14:30–15:00 **Low level RF and timing system upgrads**
  Speaker: KONSTANTIN POPOV
- 15:00–15:30 **New kicker system test**
  Speaker: Eiji Nakamura

15:30 **Coffee break**
Break | Location: KEK 2-go-kan, Large Meeting Room (1F)

16:00 **ATF2-3 project and goals**
Session | Location: KEK 2-go-kan, Large Meeting Room (1F)

- 16:00–16:10 **Opening address**
  Speaker: Tadashi Koseki
- 16:10–16:30 **ATF contribution to ITN**
  Speaker: Hiroshi Sakai
- 16:30–17:00 **ATF2-3 project and goals**
  Speaker: Toshiyuki Okugi
- 17:00–17:30 **Vacuum system upgrade for wakefield study**
  Speaker: Yuki Abe
- 17:30–18:00 **Discussion about the goal for ATF2-3**

Friday 28 November

Report from study groups 1
Session | Location: KEK 2-go-kan, Large Meeting Room (1F)

- 09:00–09:30 **Timing system study**
  Speaker: KONSTANTIN POPOV
- 09:30–10:00 **FONT**
  Speaker: Douglas Bett
- 10:00–10:30 **Cherenkov DR**
  Speaker: Orson Vermare

Coffee break
Break | Location: KEK 2-go-kan, Large Meeting Room (1F)

Report from study group 2
Session | Location: KEK 2-go-kan, Large Meeting Room (1F)

- 11:00–11:30 **ML BPM (Korea University)**
  Speaker: Soohyung Lee
- 11:30–12:00 **ML BPM (IFIC)**
  Speaker: Juan Carlo
- 12:00–12:30 **Flight Simulator - mOTR (IJCLab)**
  Speaker: Anna Korsun

Lunch
Break | Location: KEK 2-go-kan, Large Meeting Room (1F)

Report from study groups 3
Session | Location: KEK 2-go-kan, Large Meeting Room (1F)

- 14:00–14:30 **Flight Simulator (CERN)**
  Speaker: Andrea Latina
- 14:30–15:00 **Flight Simulator (KEK)**
  Speaker: Motoki Sato
- 15:00–15:30 **Ultra-low beta study**
  Speakers: Conrad Caliari, Lewis Kennedy

Coffee break
Break | Location: KEK 2-go-kan, Large Meeting Room (1F)

Discussion for the future collaboration and closing
Session | Location: KEK 2-go-kan, Large Meeting Room (1F)

- 16:00–17:30 **Discussion of the schedule for the next two years to achieve the goals.**
- 17:30–17:50 **closing**

- ***Share the MEXT-ATD goal in collaboration***
- ***Hardware status and upgrade plan***

Presentation from each study group about the present status and how to contribute to the MEXT-ATD goal.

- ***Discussion about each group contribution to MEXT-ATD.***

Beam Operation statistics of JFY2025

Beam operation

- *14 operating weeks in JFY2025.*

2025

April						
Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

May						
Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

June						
Su	Mo	Tu	We	Th	Fr	Sa
1	IPAC2025					7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

July						
Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

August						
Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September						
Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

October						
Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	LCWS					
26	27	28	29	30	31	

November						
Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

December						
Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

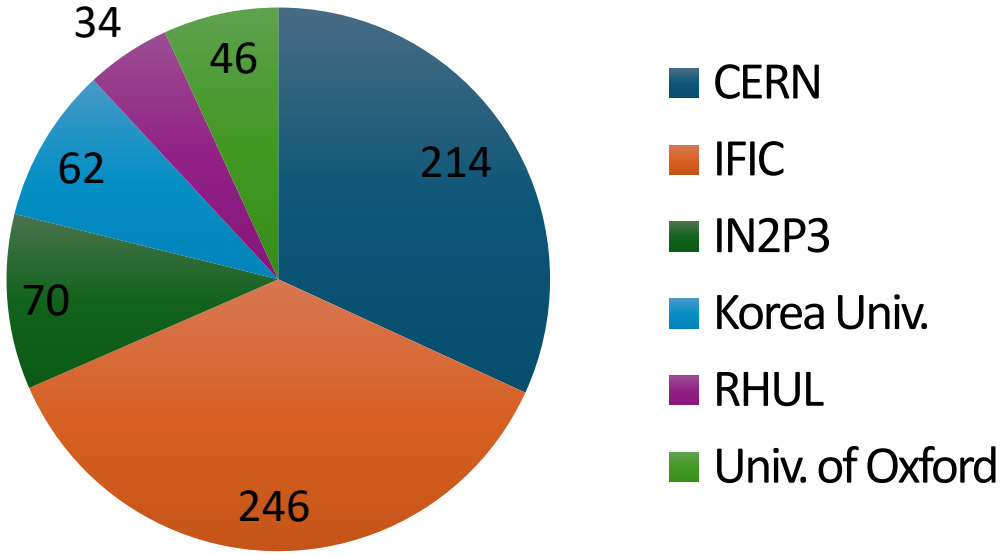
2026

January						
Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February						
Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

March						
Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

JFY2025 Statistics of oversea collaboration



	JFY2023	JFY2024	JFY2025
Operation week	14	20	14
Countries	7	5	5
institutions	11	7	6
person days	387	358	672

Beam Operation program of JFY2026

Main purpose of beam operation of JFY2026

Beam size minimization

- **37 nm beam size**

14+alpha operation weeks per year

- *8 operation weeks already finished.*
- *6+alpha operation week remains*
- *Two ATF3 goal weeks in April-June 2026*
- *One ATF3 goal weeks plan in December 2026*

Human resources

- *9 full-time staffs*
- *2 part-time staffs (Kuroda, Kubo)*
- *3 staffs with concurrent work*
- *3 new graduate students*

ATF3 progress meeting (a half day; hybrid)

- *Plan at the week of 2027/01/12-01/15*
- *Summary report of 2026 April to 2026 December*
- *Discuss the strategy to ATF3 goal*

ATF beam schedule plan of JFY2026

2026

April						
Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May						
Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
IPAC 2026						23
24	25	26	27	28	29	30
31						

June						
Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

July						
Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

August						
Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September						
Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

October						
Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

November						
Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	LCWS2026					14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

December						
Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

2027

January						
Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

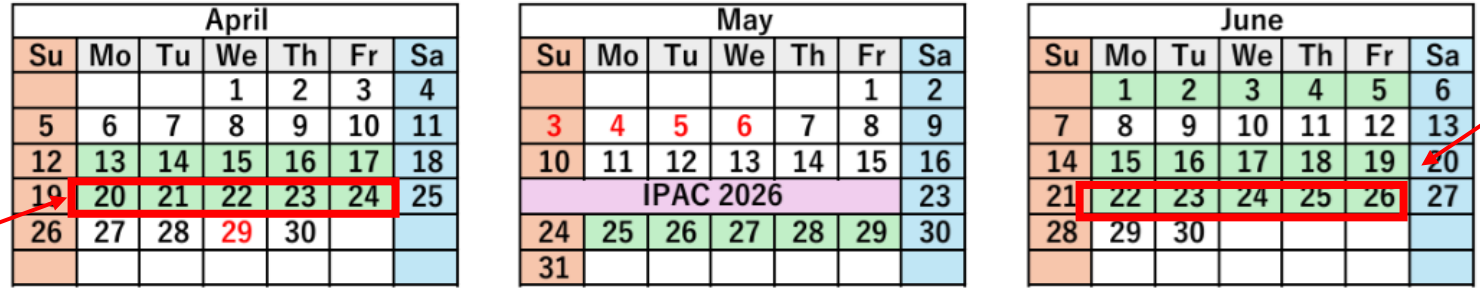
February						
Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

March						
Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

candidate　　backup

Beamtime schedule for April-June 2026

2026



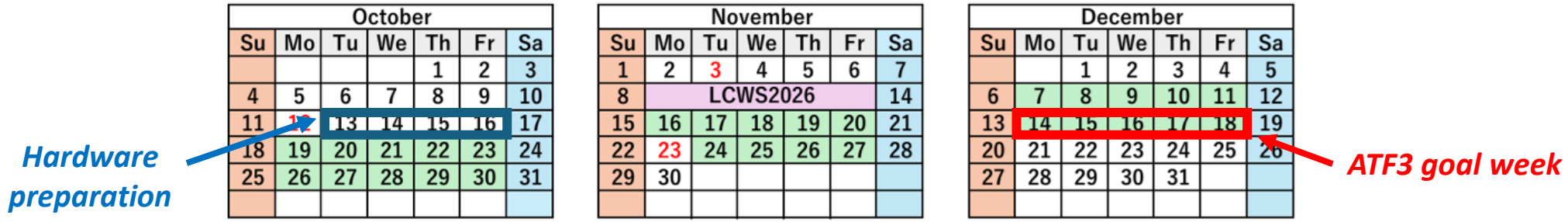
ATF3 goal study week

ATF3 goal study week

- **Cherenkov DR study (CERN)**
- **IP beam size tuning (CERN)**
  - 1-2 dedicated shifts in the week of 6/22
- **FONT (Oxford Univ.)**
  - During the weeks of 25 May, 1 June and 15 June.
  - minimum of 1 shift per week, but 2 would be nice.
- **ML BPM study (IFIC)**
  - Electronics set-up and new BPM installation May 7th-22nd.
  - At least one shift per week (5/25, 6/01, 6/15,6/22).
- **ML BPM study (Korea univ.)**
- **Flight simulator study (CERN and IJClab)**
- **Timing system (IJClab)**

	Cherenkov DR	Ultra-low beta	FONT	ML BPM (IFIC)	ML BPM (K.U.)	Flight Sim.	Timing
04/13							
04/20							
05/25			**1-2**	1 + α (2 sep.)			
06/01			**1-2**	1 + α (1)			
06/15		Join to FS	1-2	1 + α (2 sep.)		3+1	
06/22		1-2		1 + α (1)		3	

Beamtime schedule for October-December 2026



- ***Cherenkov DR study (CERN)***
  - *10/23; late afternoon 8h shift*
  - *10/27; two consecutive shifts (2x8h)*
  - *10/29; two consecutive shifts (2x8h)*
- ***EXT emittance (IJClab)***
  - *Angeles will stay at 10/28-11/14*
  - *December; shift request.*
- ***FONT (Oxford Univ.)***
  - *just the second week of the October beam time*
  - *both weeks of the November beam time*
  - *both weeks of the December beam time*
- ***ML BPM study (IFIC)***
- ***Timing (IJClab)***
  - *November 1+1*
- ***Flight simulator (CERN)***
  - *(remote in 1st week of December)*
- ***Kicker test (KEK)***
  - *1-2 shift (end of the week)*
- ***Ultra-low (CERN)***
  - ***Join to mOTR study***
  - ***Join to ATF3 goal week***

	Cherenkov DR	EXT emittance	FONT	Timing (IJClab)	Flight Sim.	Kicker	Ultra-low
10/19	1 (end)						
10/26	2+2		1-2				
11/16			1-2	1			
11/24			1-2	1		1-2 (end)	
12/07		2	2		(remote)		(Join to mOTR)
12/14							(Join ATF3GW)

Recent Progress for nanobeam development

JFY2023 JFY2024 JFY2025 JFY2026 JFY2027

Multipole field — Magnet → Higher order aberration reduction
Orbit jitter reduction with FONT feedback

Wakefield — Vacuum chamber → Wakefield effect reduction

Beam tuning — Magnet mover, IP-BSM laser, Beam diagnostics → Beam tuning with latest tuning technologies

Beam stabilization for long-term stabilization — Timing system, Kicker, RF system → Beam control with latest tuning technologies

JFY2026 main target

Beam size minimization

37 nm beam size

Beam Stabilization

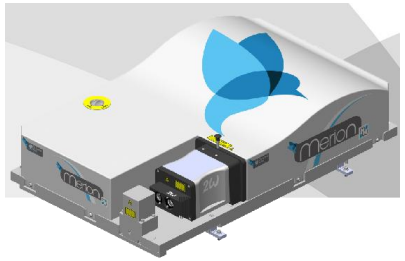
few days

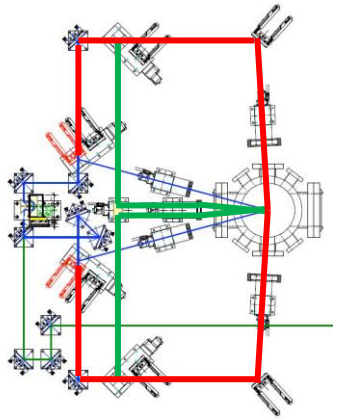
Updating the beam instrument device

ATF IP beam size monitor

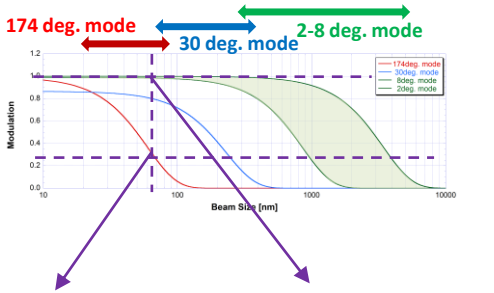
By comparing the beam with the laser interference pattern, the beam size can be evaluated.

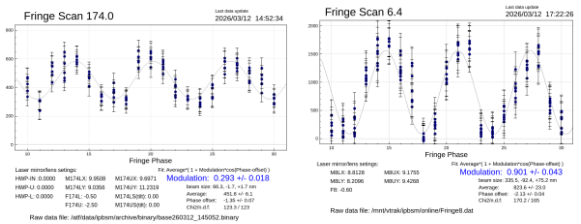
New IP-BSM laser





Dynamic range of ATF IP-BSM





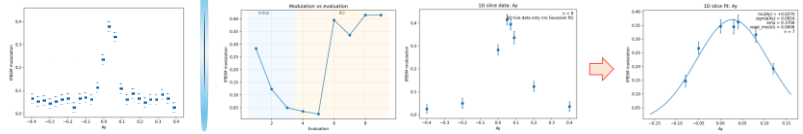
Updating the machine tuning strategy

- *The introduction of parameter optimization using machine learning has improved the accuracy of beam tuning.*
- *Many operators used the tuning software.*

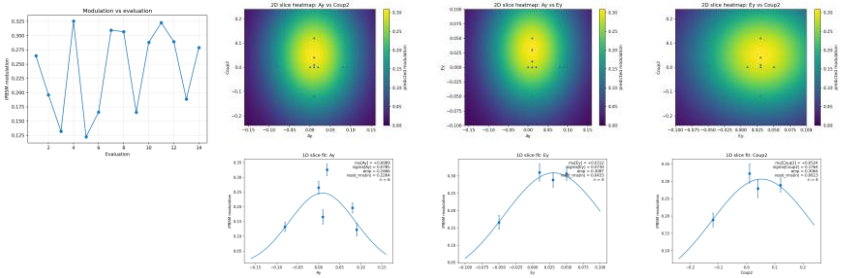
Previous scan

1) Bayesian optimization for wide range scan

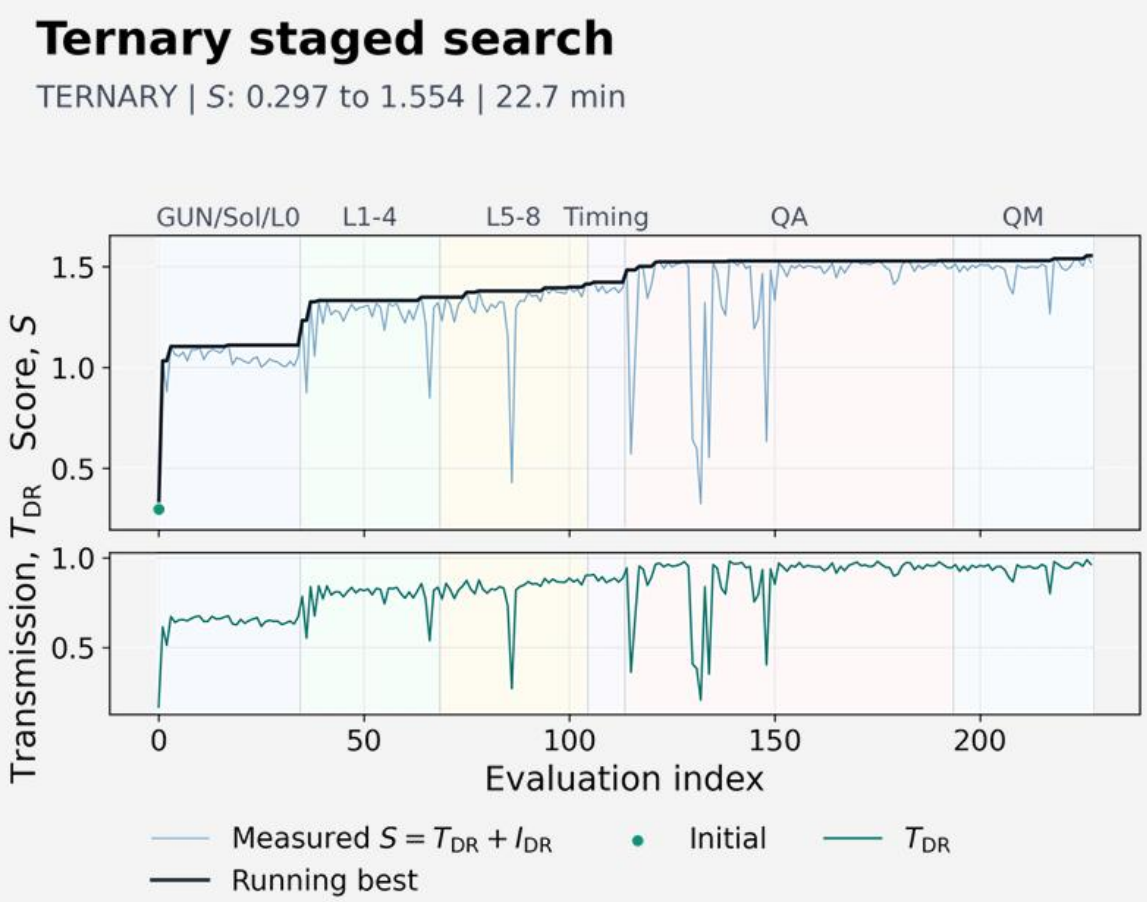
2) Gaussian fit for fine optimization

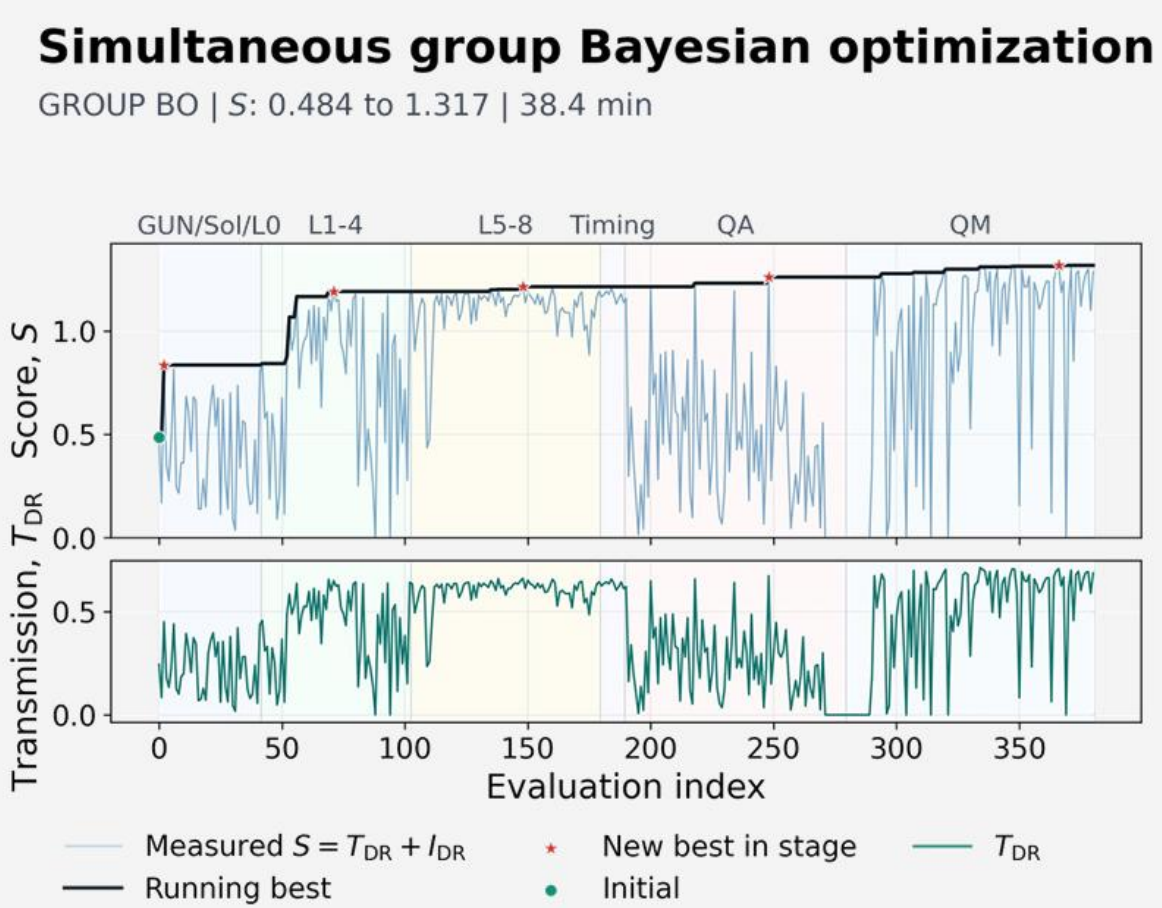


Multiple parameter scan with Bayesian optimization



DR injection tuning by Machine Learing





M. Sato