International Development Team

IDT WG2 Activities

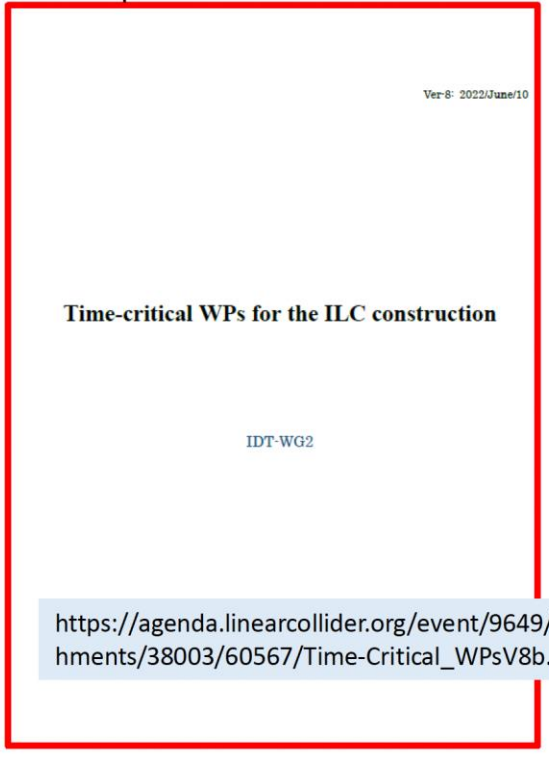
Benno List

ILC Europe Meeting

4.10.2023

ITN document

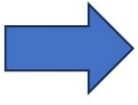
The CERN-KEK Memorandum of Understanding regarding the ILC Technology Network was signed.
Currently, the WPs for the ITN are available on Indico. This is before the term ILC Technology Network was released, so it should be changed to something that refers to the ILC Technology Network.
Here is the public Ver8b with some minimal changes (Ver8c).


Ver-8: 2022/June/10

Time-critical WPs for the ILC construction

IDT-WG2

https://agenda.linearcollider.org/event/9649/attachments/38003/60567/Time-Critical_WPsV8b.pdf




Ver-8: 2023/July/10

Work packages at the ILC Technology Network (ITN)

IDT-WG2

To be uploaded to IDT or ITN web site.

-> available from
https://agenda.linearcollider.org/event/10075/

S. Michizono 11.7.23
https://agenda.linearcollider.org/event/10075/

ITN: Work Packages

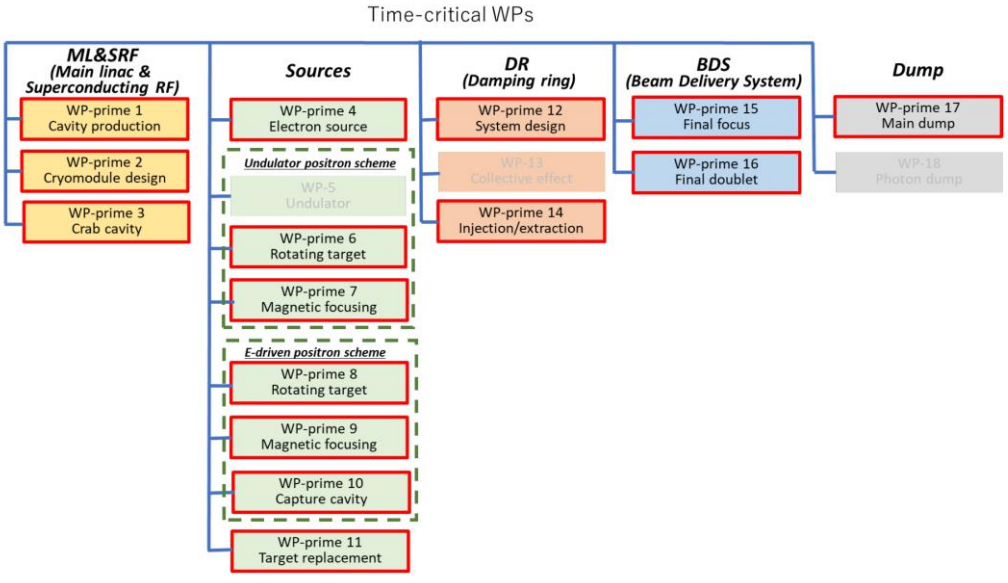


Figure 3: Time-critical WPs at the ILC Technology Network (ITN)

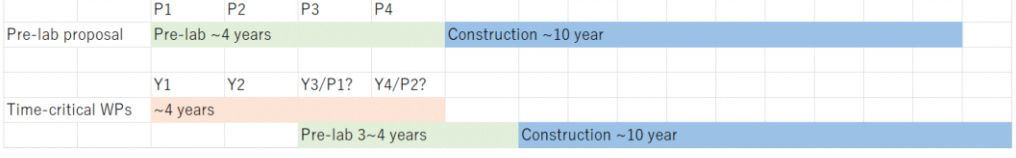


Figure 2: Assumed schedule of the time-critical WPs

https://agenda.linearcollider.org/event/10075/contributions/52733/attachments/38998/61522/Time-Critical_WPsV8e.pdf

Korea visit by KEK/IDT delegation

KEK/IDT delegation visited Korea University and Pohang Accelerator Laboratory (PAL) and explained ILC Technology Network.

Korea Univ. and PAL will attend the ITN Information Meeting.

https://sejong.korea.ac.kr/user/boardList.do?boardId=1464&siteId=kr&id=kr_060200000000&boardSeq=188465&command=view

S. Michizono 3.10.23
https://agenda.linearcollider.org/event/10183/

Recent progress of SRF 5-year plan

- Japan (KEK)
  - License agreement with DESY is under progress
    - KEK discussed with H. Weise which institutes are included in ITN
  - Leaders for each sub-group were assigned at KEK
  - MG material procurement
    - A vendor cannot produce any MG material for cavity production from this FY
    - KEK should consider to change the strategy, KEK and FNAL will negotiate strongly with a vendor
  - Procurement for dust-free gate valve and shortest connecting bellows beampipe
  - Negotiation on HPGS with KHK and local government is continuing
  - KEK started the discussion with oversea vendors for cavity production
  - Discussion with some vendors related to power coupler started
  - Discussion with some vendors related to SCQ started
- Overseas
  - Americas
    - JLAB sent the proposal for ITN to KEK
  - Europe
    - Enrico went back to CEA
      - We discussed cavity production, radiation simulation, magnetic shield, etc.
    - DESY is preparing for new license agreement with KEK

04.10.2023

Y. Yamamoto 5.9.23
https://agenda.linearcollider.org/event/10105/

Medium Grain Material

Summary of MG disk material (updated!)

Billet	length [mm]	# of disks	necessary disk	Purpose
1st batch (slicing done)		21	4	Korea 1-cell
			4	CFF MG 1-cell
			6	DESY (they are interested in inspecton on this MG disks)
			4	EU 1-cell (one cavity)
			1	KEK-9 for welding test related to HPGS (iris)
			1	KEK-9 for welding test related to HPGS (CET)
			1	KEK-9 for welding test related to HPGS (equator) 1.7mm as mill ends
270L (currently stored in KEK, slicing will be done in FY2023) Eddy current scan @DESY as free of charge	270	86	25	CFF 9-cell 2024 (HPGS)
			22	EU 9-cell 2024 (HPGS)
			8	EU-training disks(RI=4, ZANON=4)
			4	US 1-cell (unknown number)
			9	Supporting back data related HPGS documentation for safety check
			6	for delivery inspection
			10	US 9-cell 2024 (HPGS)
			2	reserve
200L (currently stored in KEK)	200	65	25	CFF 9-cell 2025 (HPGS)
			25	CFF 9-cell 2025 (HPGS)
			12	US 9-cell 2024 (HPGS)
			3	reserve
270L (currently stored in KEK)	270	86	25	Oversea vendor from Japan 9-cell 2025 (HPGS)
			22	Oversea vendor from Japan 9-cell 2025 (HPGS)
			22	EU 9-cell 2025 (HPGS)
			6	for delivery inspection
			11	reserve
1200L (delivery deadline will be the end of CY2024)	200	1 (not sliced)	1	Crab
	200	65	25	CFF 9-cell 2026 (HPGS)
			25	CFF 9-cell 2026 (HPGS)
			15	US 9-cell 2026 (HPGS)
	200	65	65	reserve
			25	EU 9-cell 2026 (HPGS)
	200	65	25	EU 9-cell 2026 (HPGS)
			6	for delivery inspection
			9	reserve
			25	EU 9-cell 2026 (HPGS)
	200	65	25	US 9-cell 2026 (HPGS)
			15	reserve
			25	US 9-cell 2026 (HPGS)
	200	65	25	US 9-cell 2026 (HPGS)
			15	reserve

united to one 9-cell cavity

A vendor stops this production! KEK and FNAL will negotiate with a vendor before TTC meeting in Dec.

29/Aug/2023

4

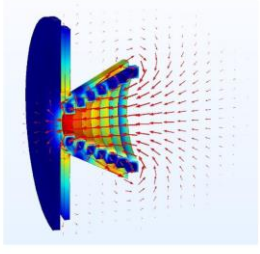
Y. Yamamoto 5.9.23
https://agenda.linearcollider.org/event/10105/

Positron Source R&D: Flux Concentrator

New developments on the pulsed solenoid and the optic matching (Carmen)

➢Design parameters

- ✓~50 kA peak
- ✓4 ms half-sine pulse + 1ms flat-top
- ✓7 turns, linear taper (⌀ 20mm ・ 80mm)
- ✓Peak field ~5 T
- ✓Average heat load on target: 73 W + 711 W
- ✓Peak force on wheel 612 N
- ✓ Mechanical prototype design pending



2023/05/02 WG2
K.Yokoya
5

Engineering design to be done at DESY
Financed by ITN

Plan for Pulsed Solenoid

- ✓Funding available for prototype design
- ✓Mechanical design department at DESY signaled available manpower for design
- ✓Goal of development is a prototype solenoid to demonstrate ---- field strength & distribution, field stability, mechanical stability, thermal stability.
- ✓No vacuum vessel in the first prototype
- ✓Start of mechanical design in ~autumn

→ Overall goal is to resolve open questions on mechanical feasibility of design

2023/05/02 WG2
K.Yokoya
6

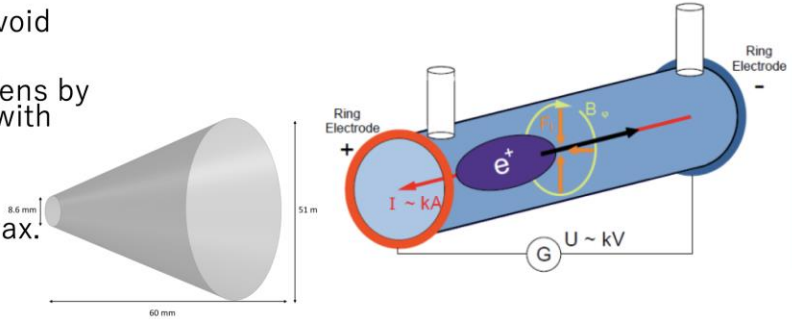
K. Yokoya 11.7.23
https://agenda.linearcollider.org/event/10075/

Positron Source R&D: Plasma Lens as OMD

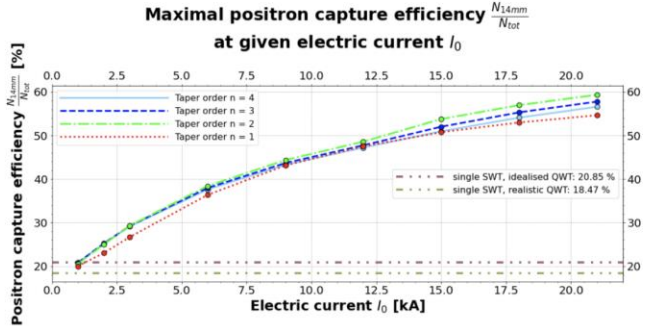
Current status of the prototype plasma lens as an optical matching device for the ILC e+ source

N. Hamann, M. Formela (U.Hamburg), G. Loisch, K. Ludwig, J. Osterhoff (DESY), G. Moortgat-Pick

- Current limited to ~9kA to avoid electrode erosion
- Optimized the shape of the lens by particle tracking simulation with ASTRA
- Yield 43% at 9kA
- Down scale for prototype (max. current ~350 A)

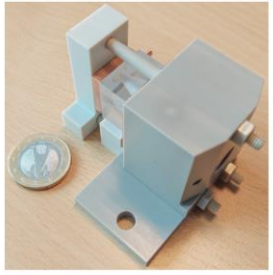


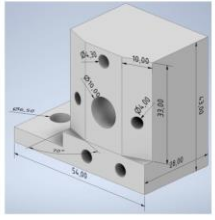
	ILC	prototype
Total electric current	9 kA	350 A
Plasma lens length	60 mm	11.8 mm
Opening radius	4.3 mm	0.85 mm
Ending radius	25.5 mm	5.03 mm

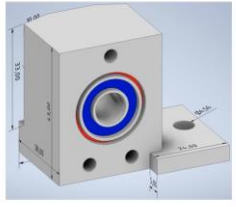


Prototype fabricated

- Electrodes : copper
- Plasma lens: sapphire block (20 x 20 x 12 mm)

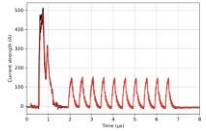


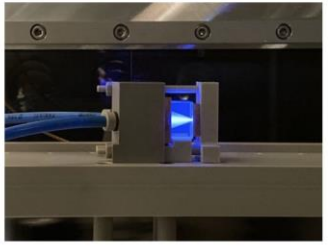




First test

- First test successful
  - ✓ Plasma created
  - ✓ But pinching and unstable, yet





- Next step: High temporal resolution imaging of gas discharge at ADVANCE LAB at DESY
  - ✓ Investigation of the exact time and circumstances of the pinching
  - ✓ Put more constraints on plasma lens geometry to stabilize the plasma

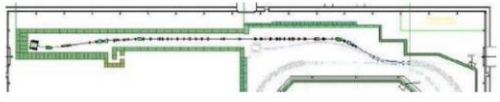
WP-prime 15: System design of ILC FFS

WP-prime-15 related items conducted by KEK on ITN

- The research will be conducted with the following 3 main topics
  - ✓ Improvement of beam tuning techniques for nano-beam
  - ✓ Long-term stabilization of nano-beam
  - ✓ Upgrading of beam diagnostic devices
- The first 2-3 years will be mainly devoted to procurement of the necessary equipment to implement the research items listed in the time-critical WP, and performance tests using the latest accelerator technologies, such as machine learning, will be carried out at the ATF accelerator as needed.

- ATF2 beamline is the only existing test accelerator in the world to test the final focus system (FFS) of linear colliders.
- The following 3 research topics are important topics to be pursued at the ATF.
  - wakefield mitigation
  - correction of higher-order aberration
  - training for ILC beam tuning

ATF2 beamline



Timeline described in the time-critical work package document

Priority	*Items*	Y1	Y2	Y3	Y4
A	wakefield mitigation				
	mitigation and correction of higher-order aberration				
	training for ILC beam tuning (machine-learning etc.)				

The research topics will be conducted consistent with the content and timeline of WPP-15.

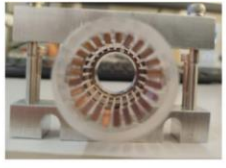
2

T. Okugi 5.9.23
https://agenda.linearcollider.org/event/10105/

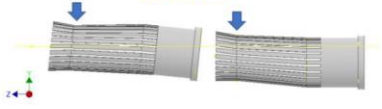
Wakefield mitigation

Wakefield modeling for shielded bellows

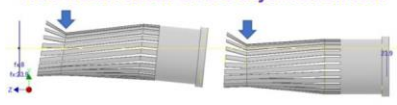
The effect of wakefield was simulated using a model that assumes deformation with reference to the deformation of a bellows shield component attached to a plastic pipe.



Old model



New model based on the deformation test

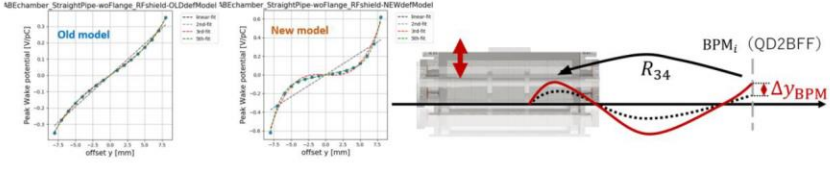


Assumed distance from the pipe wall at the neck of the shield component to be 1 ±(mover displacement)/10.

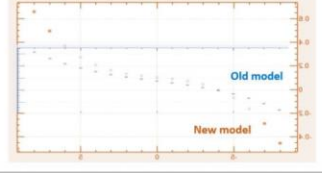
The model is not perfect yet, but it is closer to the actual deformation than the old model.

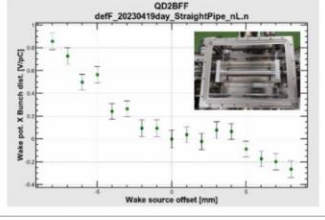
Wakefield kick test for the straight pipe with shielded bellows

Wakefield simulation with GdfidL



Result of the tracking simulation for the wakefield kick

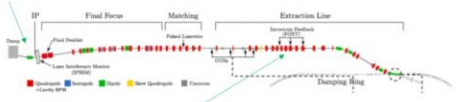




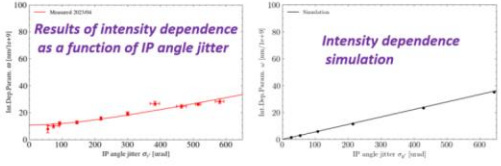
Wakefield confirmation for the entire ATF2 beamline

The effect of wakefield on the entire ATF2 beamline is investigated by measuring the dynamic beam intensity dependence of the IP beam size.

Beam size measurement with IP-BSM



Kickers to create IP angle jitter



Wakefield model of entire ATF2 beamline

- **Considered Wakefield sources**
  - septum chamber
  - OTR
  - Bellows (masked/unmasked)
  - ICF70 Flange (masked/unmasked)
  - CBPM
  - Wake chamber
  - Collimator (half gap: 3mm)
  - Gate valve
- **Not considered**
  - wakefield sources mislignment
  - magnet alignment error
  - magnet strength error

Wakefield test for single component

=> tested by beam orbit kick with cavity-BPMs.

Wakefield test for the entire ATF2 beamline

=> tested by beam size growth for the IP angle jitter.

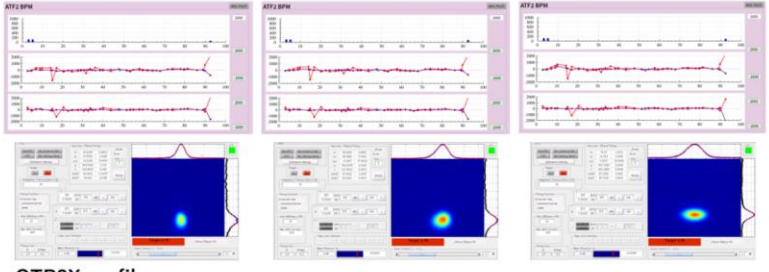
T. Okugi 5.9.23
https://agenda.linearcollider.org/event/10105/

Correction of higher-order aberration

Beam orbit difference at extraction septum (2023 June)

- We changed the kicker strength to investigate the downstream effects of the different trajectories of the beam through the septum chamber.
- Beam orbit after the septum magnet was tuned.

(EXT Kicker)=36400 (EXT Kicker)=37600 (EXT Kicker)=38400

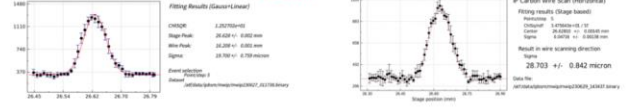


OTR2X profile

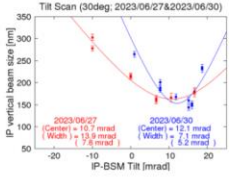
IP horizontal profile

(EXT Kicker)=37600 19.8um

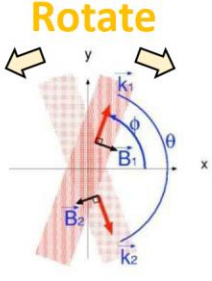
(EXT Kicker)=38400 28.7um



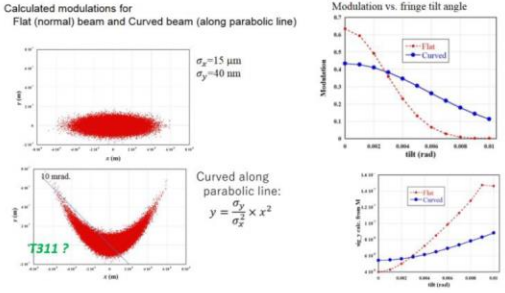
Tilt scan@IP-BSM 30degree mode



- *When the kicker strength was changed, the beam size in OTR and IP changed.*
- *The IP beam tilt angle and tilt measurement width also changed when the kicker strength was changed.*



by K.Kubo (2023/03/06)



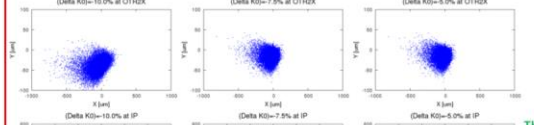
When the shape of the beam at the IP is deformed, the width of the IP-BSM tilt scan could be wider.

Anyway, since it is difficult to discuss any more detail with only these data as the accuracy of the data is too poor, we need more detail investigation.

Simulation

Skew sextupole field error at septum magnets

- Strength of (Bend K2) is assumed to be 200 times stronger than BH1X.
- Rotation of (Bend K2) is assumed to be 50mrad (with sextupole field).



The beam tilt at IP is generated, by normal and skew sextupole field error.

The bend of the beam profile is also generated.

	-10.0%	-7.5%	-5.0%
OTR2X	92.4um (H) / 15.4um (V)	61.7um (H) / 12.0um (V)	53.0um (H) / 10.0um (V)
IP	11.8um (H) / 97.6nm (V)	15.0um (H) / 78.8nm (V)	18.4um (H) / 60.5nm (V)