R&D proposal for new target system including positron capture device in ILC positron source

Present members :

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What is new target system.

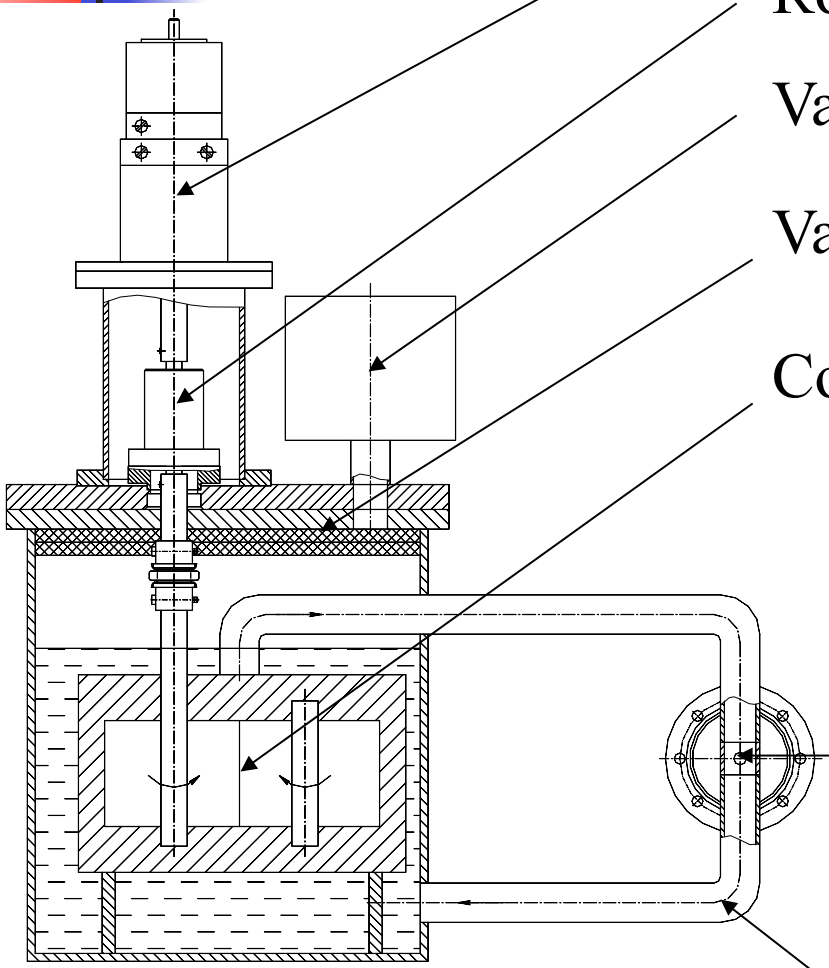
1. Liquid Lead Target System

(90% Pb, 10% (mass)Sn alloy, 300°C)

2. Hybrid Target System

proposed by R.Chehab

Scheme of the prototype of liquid lead positron production target.



Driving motor

Rotating vacuum feedthrough

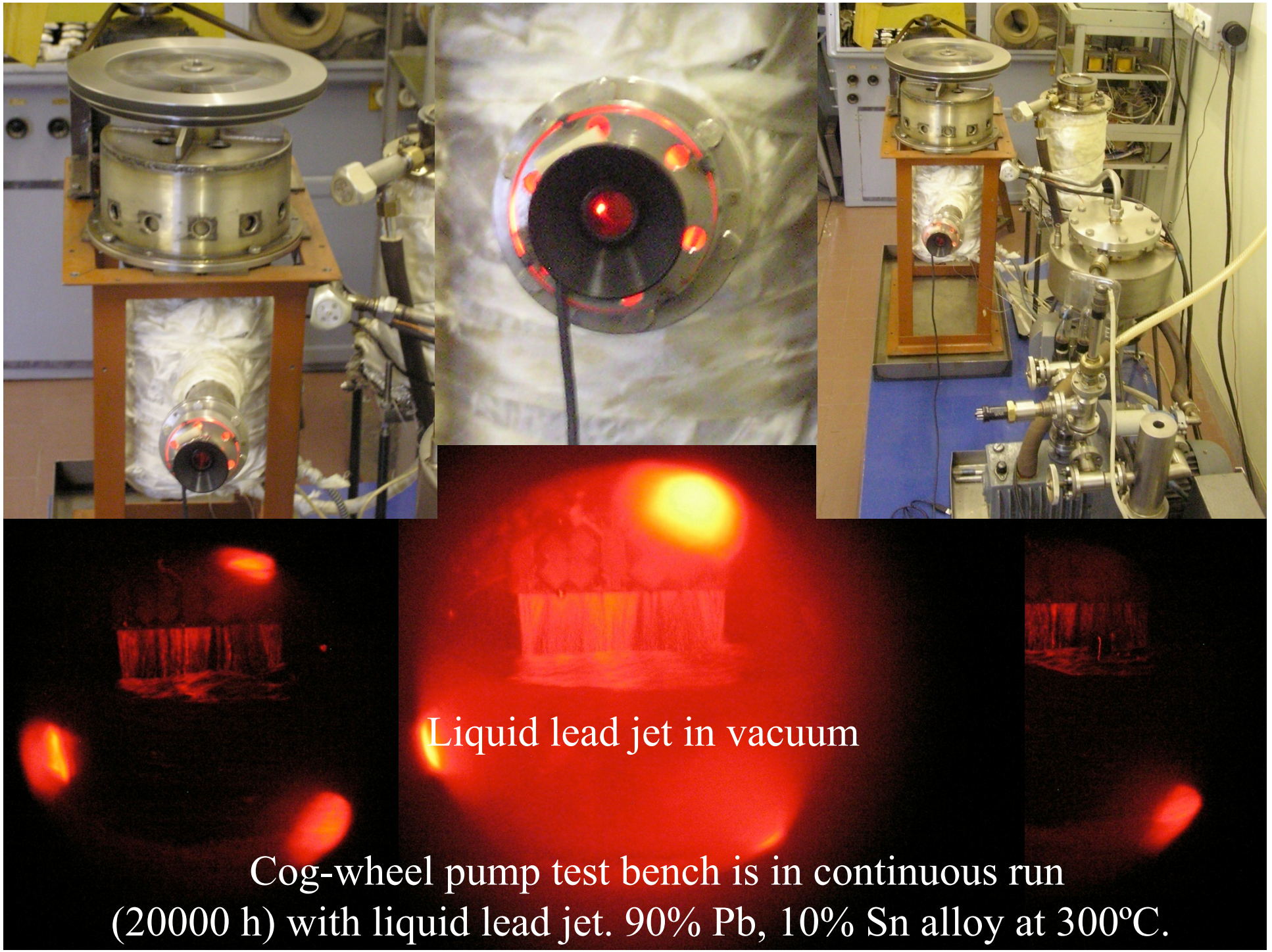
Vacuum pump

Vacuum tank of the system

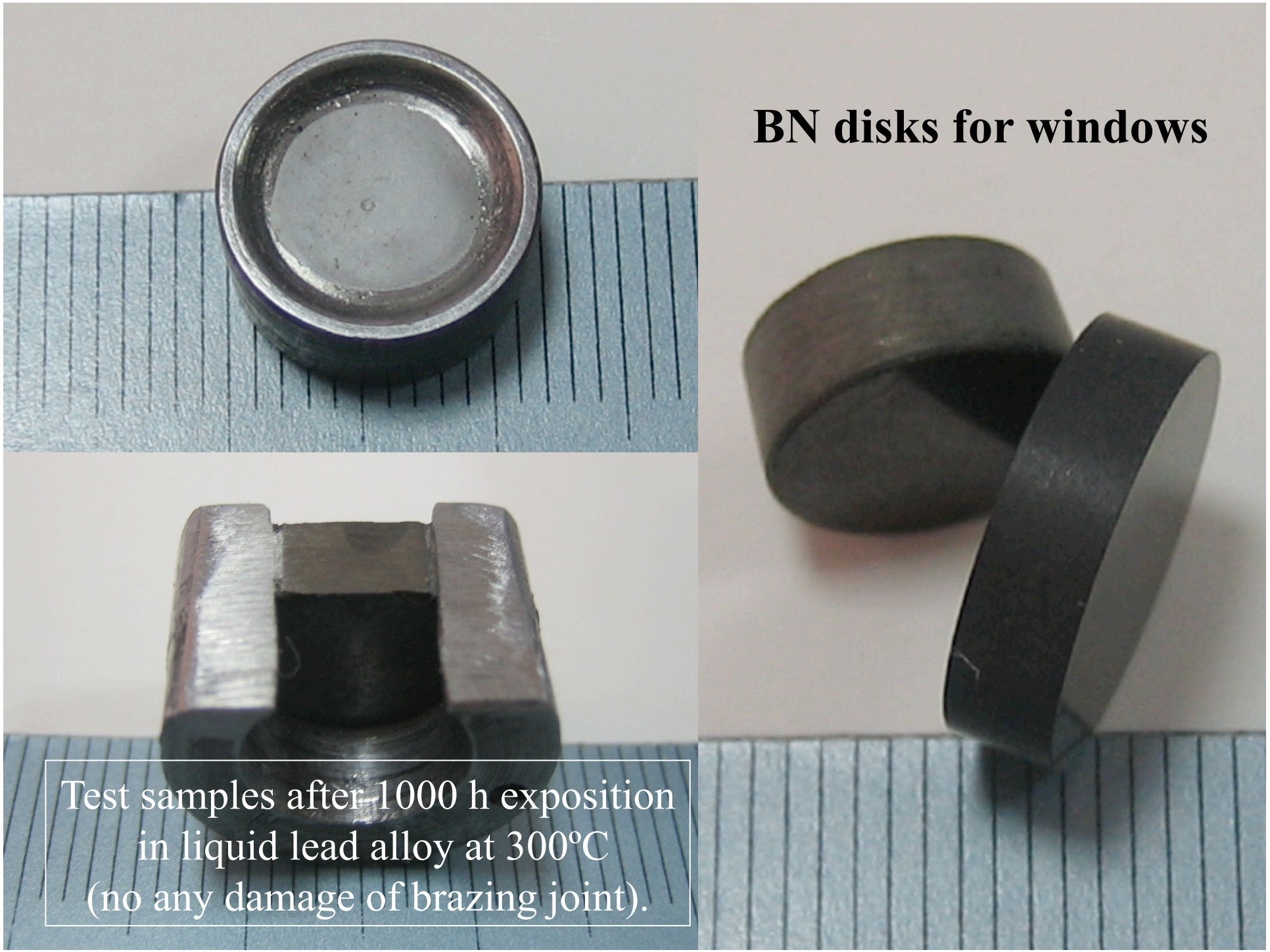
Cog-wheel pump

Target head

Liquid lead transport tubes



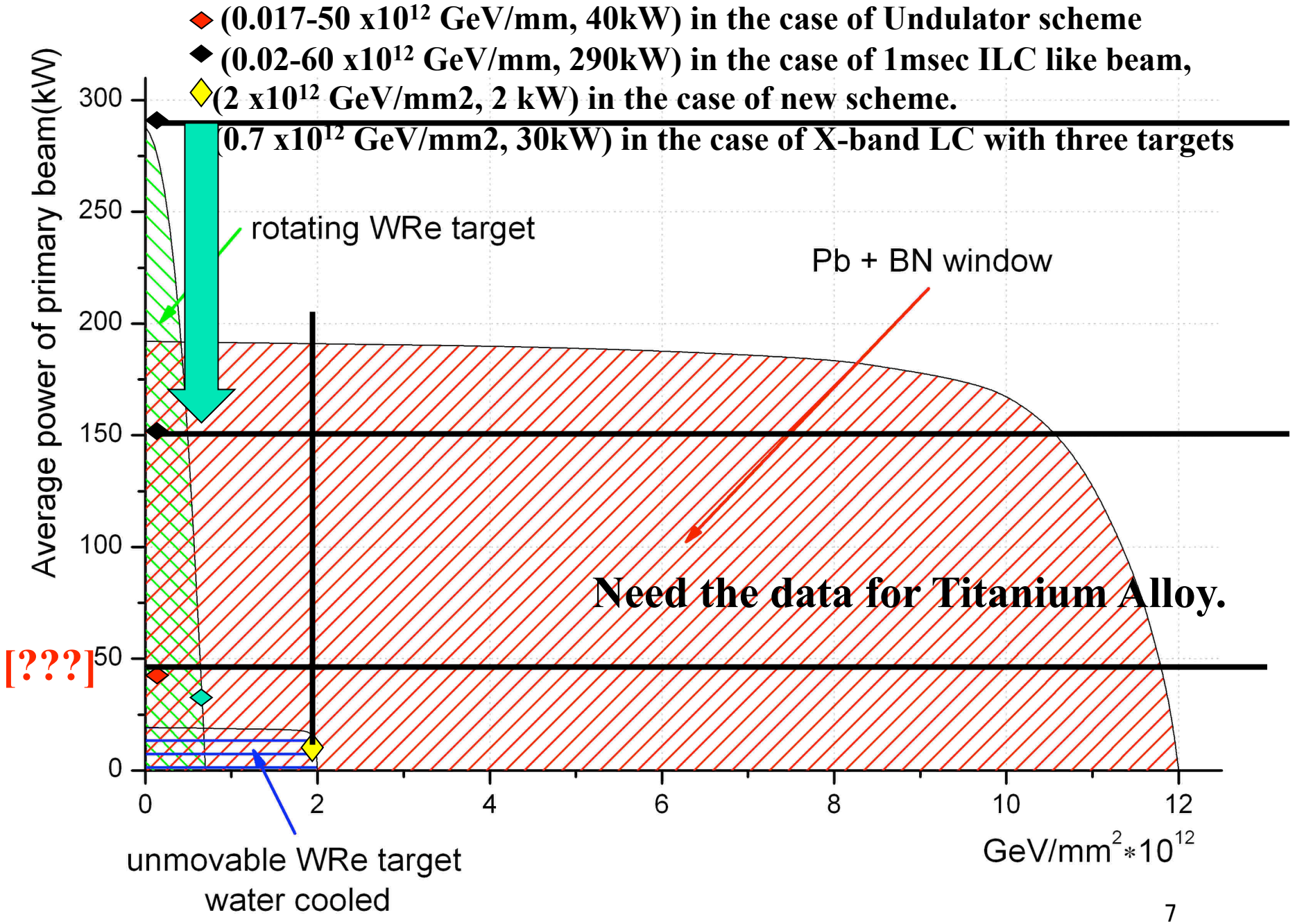
Cog-wheel pump test bench is in continuous run
(20000 h) with liquid lead jet. 90% Pb, 10% Sn alloy at 300ºC.


BN disks for windows
Test samples after 1000 h exposition
in liquid lead alloy at 300ºC
(no any damage of brazing joint).

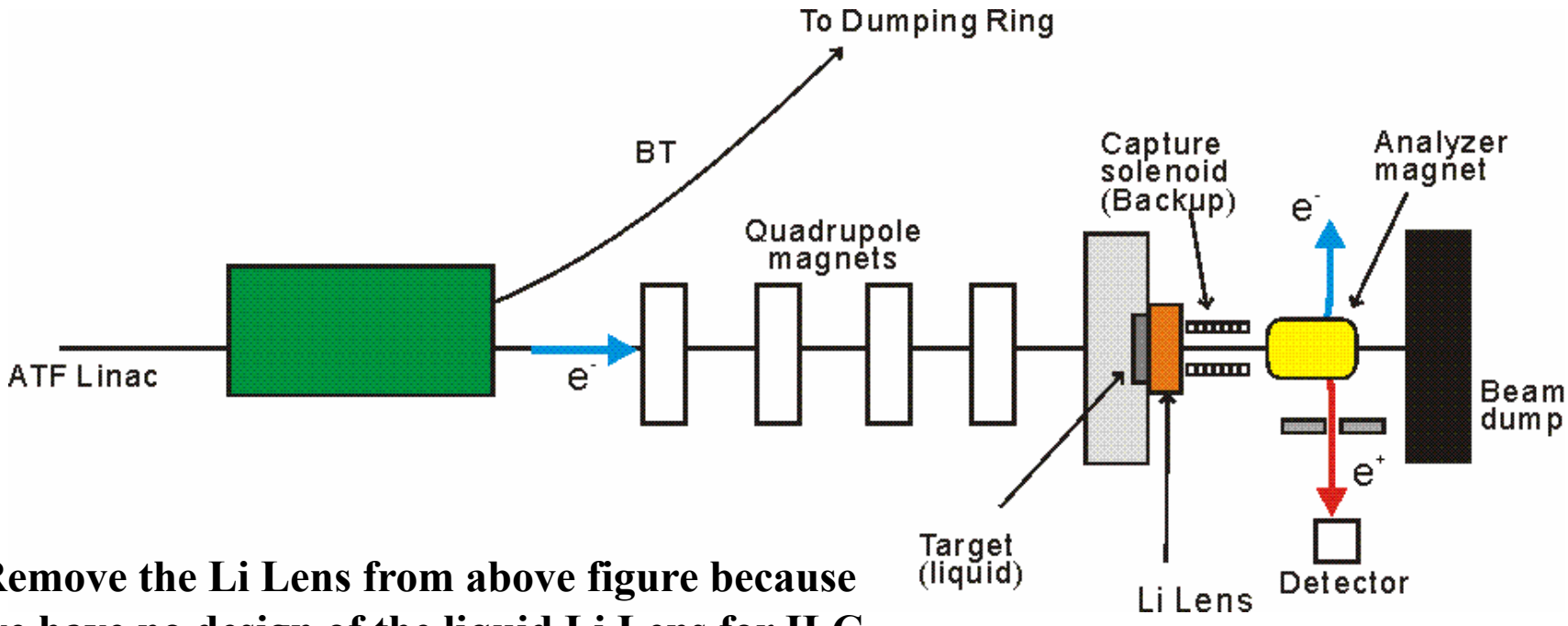
Summary of the studies

Name	e- (GeV)	Spot (mm)	Pb flow (m/s)	Yield e+/e-	Ne- (nC)	NB limit
MK1	0.7	2.5	-	0.27	11.85	-
MK2	1.4	2.5	-	0.48	6.67	-
MK3	2.2	2.5	-	0.71	4.51	-
ANL1	0.7	1.0	10	0.45	7.11	182
ANL2	0.7	3.0	10	0.27	11.85	1200
ANL3	0.7	3.0	30	0.27	11.85	Saturated at 1973K
ANL4	0.7	4.0	30	0.27	11.85	Saturated at 1600K

- MK proposed 2.2 GeV drive beam.
- Boiling of Liquid Pb (2200K) is a serious problem according to ANL's study.
- High speed flow (20-30m/s) and larger spot size (2-3mm) help to avoid the boiling.

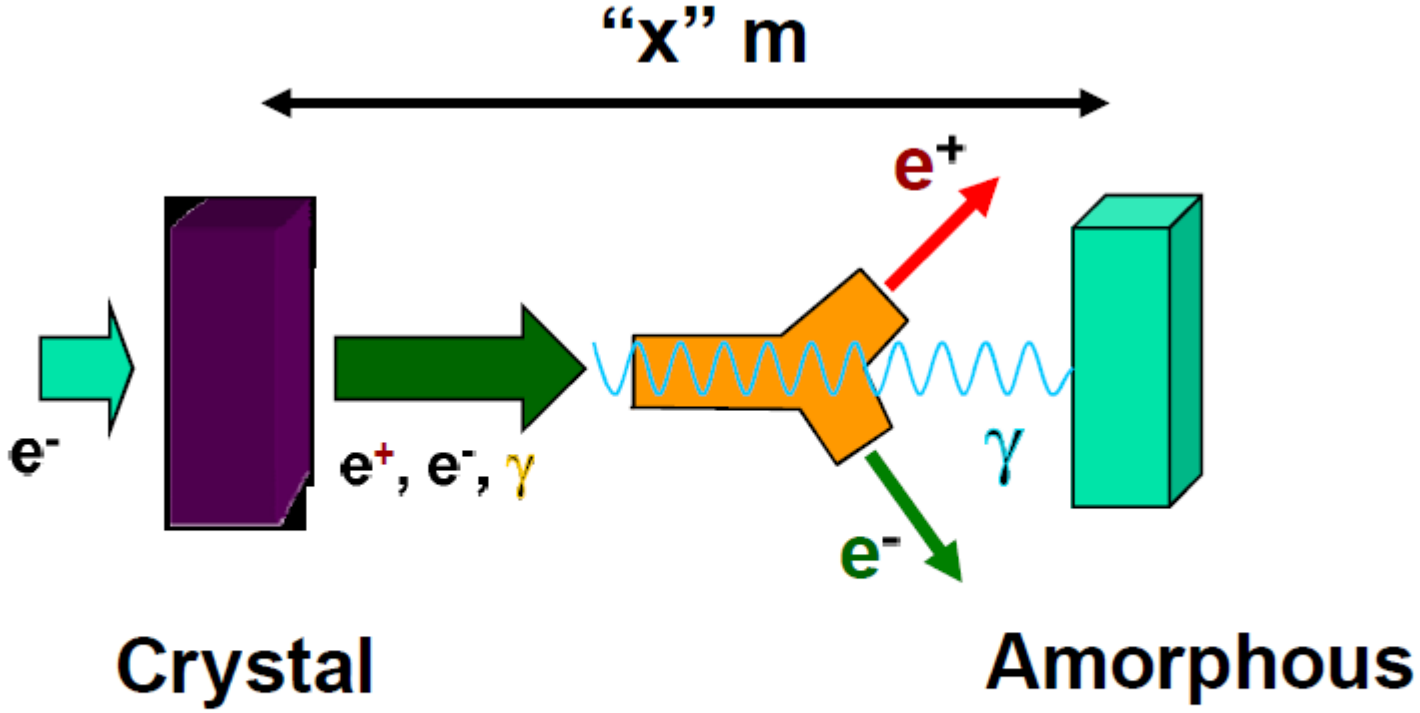

(0.017-50 x10^12 GeV/mm, 40kW) in the case of Undulator scheme
(0.02-60 x10^12 GeV/mm, 290kW) in the case of 1msec ILC like beam,
(2 x10^12 GeV/mm2, 2 kW) in the case of new scheme.
(0.7 x10^12 GeV/mm2, 30kW) in the case of X-band LC with three targets
rotating WRe target
Pb + BN window
Need the data for Titanium Alloy.
[???]
Average power of primary beam(kW)
300
250
200
150
100
50
0
0
2
4
6
8
10
12
GeV/mm2*10^12
unmovable WRe target
water cooled

Systematic Experimental Study on Pavel's Map



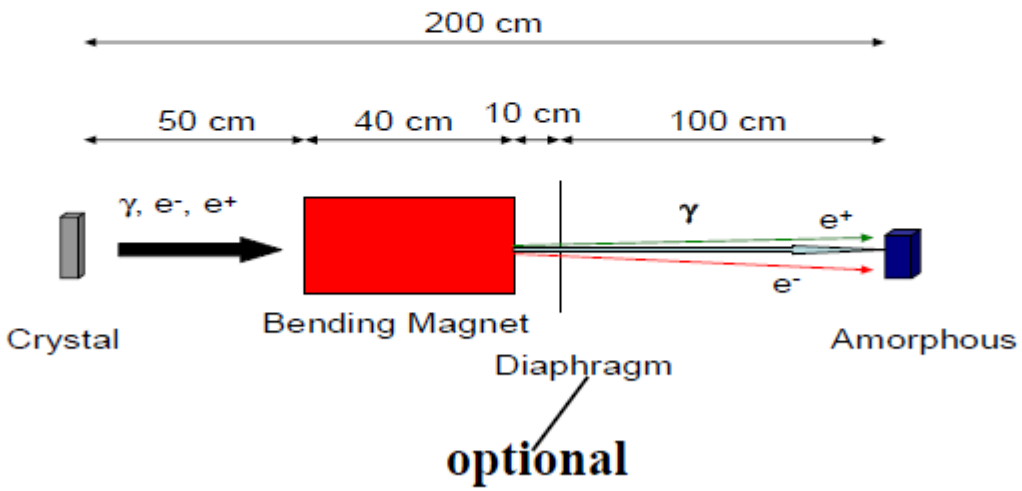
Remove the Li Lens from above figure because we have no design of the liquid Li Lens for ILC.

- **THE HYBRID TARGET**



Part or all the charged particles can be swept after the crystal; all the γ are impinging on the amorphous target.

- **PHOTONS, ELECTRONS AND POSITRONS ON THE AMORPHOUS TARGET : THE LAY OUT**



～2009 年８月 実験装置設計

KEK における関係者打ち合あわせ

海外研究者を交えた打ち合わせ

～2009 年 12 月　実験装置作成

結晶、結晶用真空容器、真空仕様ゴニオメータ、ステージ、

電磁石（スイープ、解析）、非結晶標的、真空ポンプ、検出器を購入・製作する。

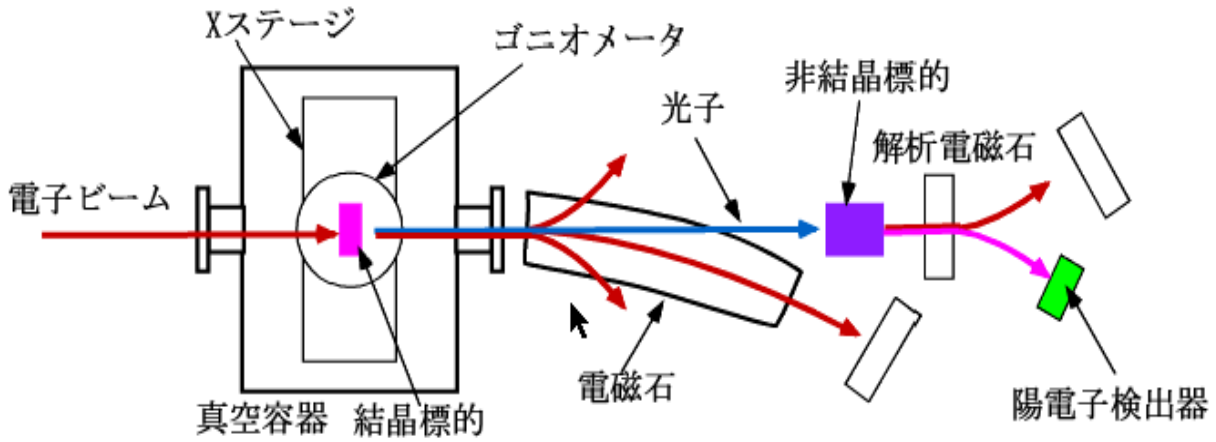


図　実験装置概要：

高エネルギー電子ビームを薄膜結晶に入射。結晶中で生成された低エネルギー電子・陽電子および、入射電子ビームは電磁石によって除去され、非結晶標的にはチャネリング光子のみ入射される。

非結晶標的下流に電子・陽電子分離のための電磁石と陽電子検出器を置く。

～2010 年 3 月　陽電子生成実験を行う。

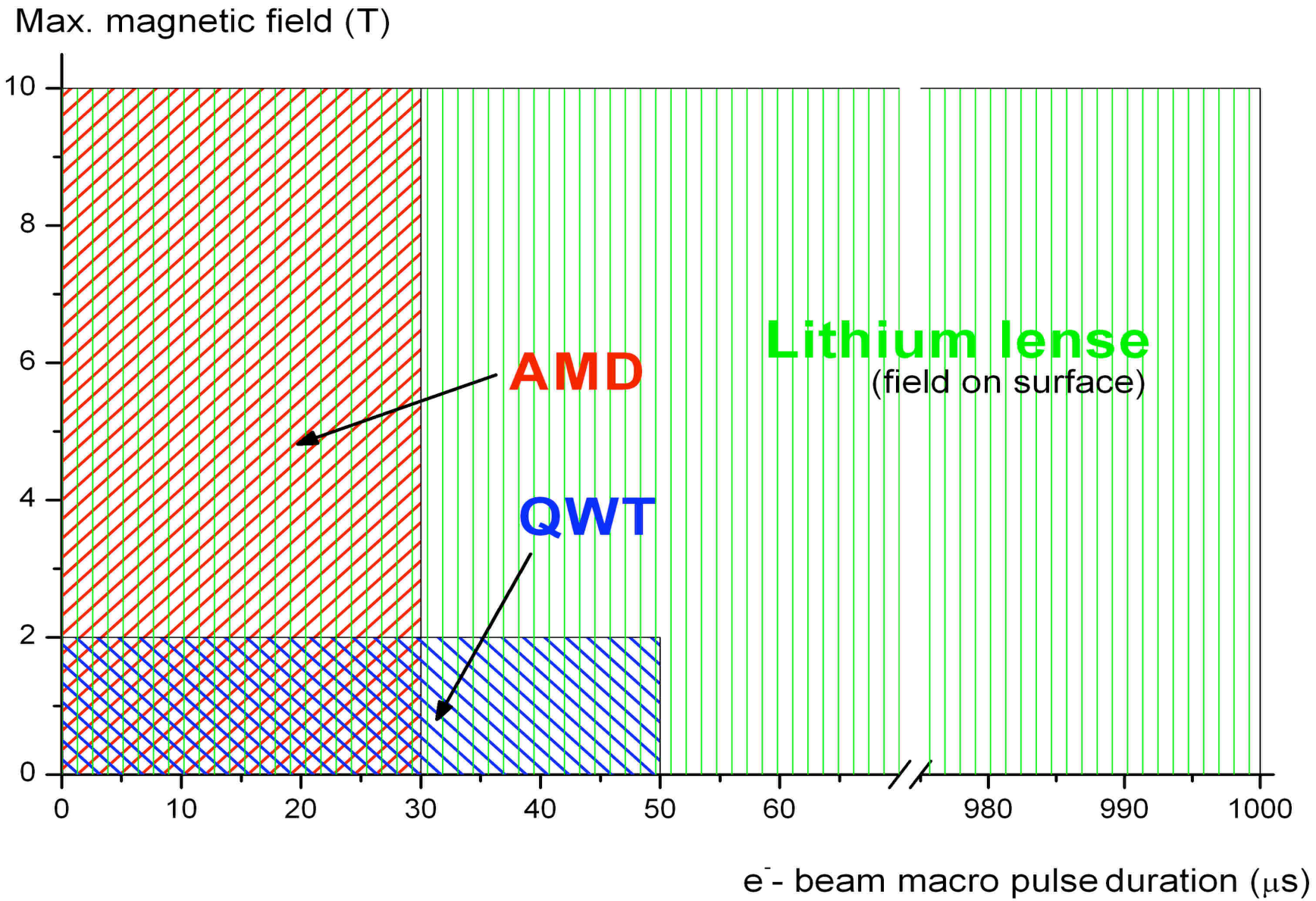
Present status of our R&D proposal

Two R&D plans to KEK were proposed by Osaka University and Hiroshima University, which are liquid Pb target with liquid Li lens and hybrid target R&D's.
KEK can support advanced accelerator R&D's which were proposed by Japanese Universities. Since total budget of this program is limited by about 2M$/year, KEK has to select good proposals for this program soon.
Our request budget is about 400k$/year for three years.
If KEK select our proposals, we can start our R&D with University students and staffs.

Advanced positron capture device

1. BINP Flux Concentrator magnet (FC)
This is ongoing with the collaboration of KEKB and BINP.

2. BINP Liquid Lithium Lens
Need a design work for ILC positron beam by BINP.


Max. magnetic field (T)
10
8
6
4
2
0
AMD
QWT
Lithium lense
(field on surface)
0
10
20
30
40
50
60
980
990
1000
e⁻- beam macro pulse duration (μs)

R&D Schedule

1. BINP starts the manufacturing of windows (BN, BC and Be) for test at KEKB ring in 2009. (If I confirm the budget support, BINP can send them until April.)

2. Until early 2010, systematic experimental studies on Liquid 90%Pb+10%Sn target system with BN window and the hybrid target system.

3. ---