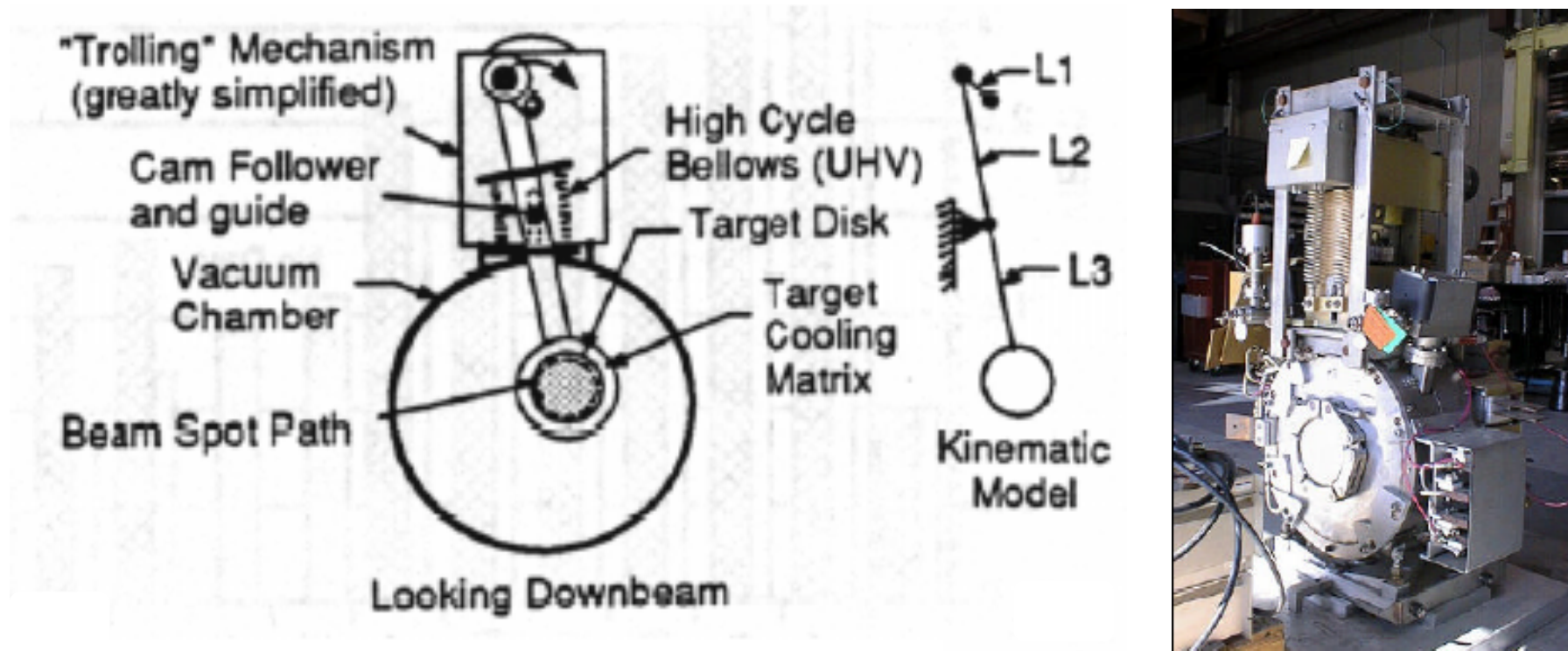# Rotating Vacuum Seal
Learning from Experiences of SLC and NLC

T. Omori (KEK), with many thanks to Marc-san
28 March 2010,   ILC10&LCWS10 at Beijing
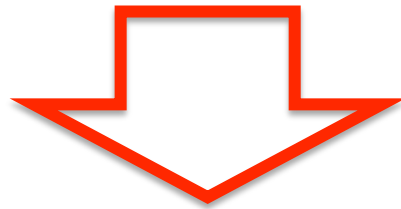
SLC and NLC targets

SLC e+ target(s):

    The only e+ target(s) for a LC in which we have real operation experience.

NLC e+ target design study:

    Very seriously studied (many drawings remains) by SLAC people (they have SLC experience).

Learning from SLC and NLC experiences may help ILC target design.

SLC targets

In the SLC project, three types of targets were made. They were, in chronological order,
(a) Rotation Target (seal: ferromagnetic fluid),
(b) Stationary Target,
(c) Trolling Target (seal: bellows).

SLC Rotation Target

Specification (SLAC-PUB-4437)

- **Diameter** : 0.15 m
- **Rotation Speed** : no data
- **Tangential Speed**: no data
- **Vacuum Seal** : ferromagnetic fluid

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- **Vacuum Seal** : ferromagnetic fluid

What happened (SLAC-PUB-4704)
- Capture section **failed to achieve high gradient**.
- This target was suspect (especially the **ferromagnetic rotating seal**) as a possible **cause of contamination in the RF section**.
- This target had never been operated in actual SLC operations.

SLC Trolling Target

Specification
- Tangential Speed: 0.1 m/s
- Vacuum Seal   : bellows

The target was used in SLC running in several years.
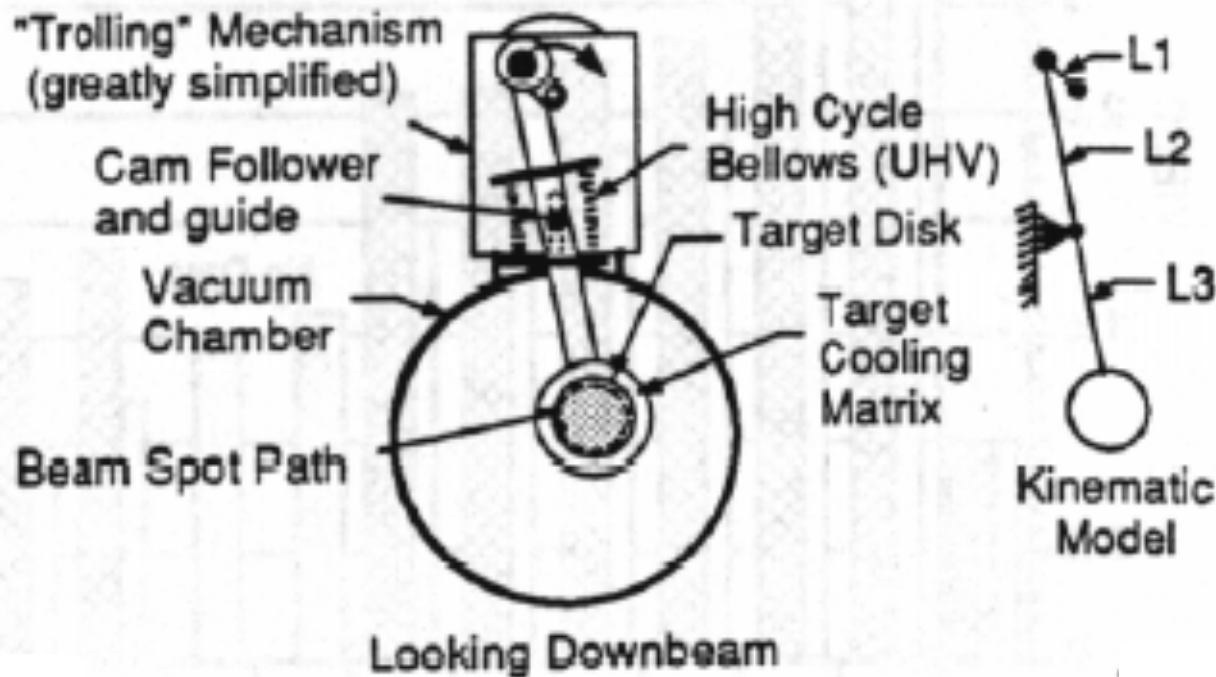
Mechanism similar to a piston and a crank of a reciprocating engine (piston engine)
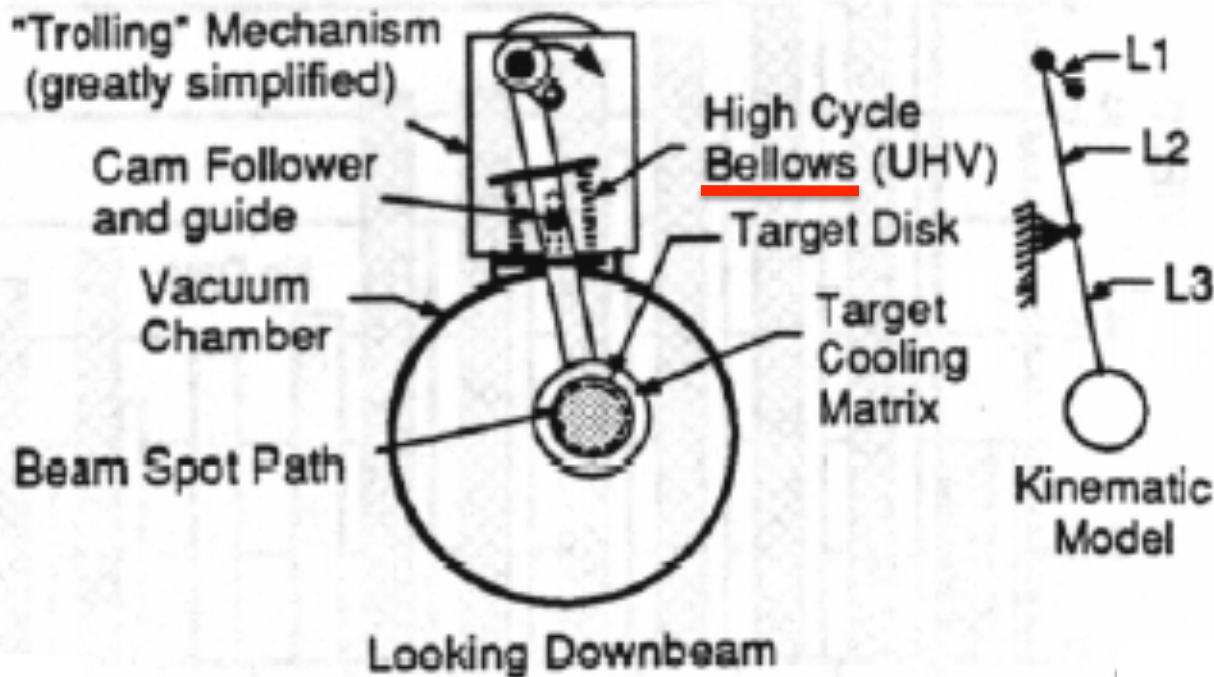
Target head swings

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Mechanism similar to a piston and a crank of a reciprocating engine (piston engine)

Target head swings

SLC --> NLC

- **Bellows is very reliable way to seal vacuum.**
  - No Oil, No liquid of any kind --> No cause of contamination
  - Very tight seal --> Good Vacuum

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- **NLC target needs much faster tangential speed than SLC.**

- **NLC design: rotation seal other than ferromagnetic fluid.**

NLC Rotation Target Design

**Specification** (SLAC-PUB-6852, SLAC-PUB-7270, ZEROTH-ORDER DESIGN REPORT)

- **Diameter** : **0.2 m**
- **Rotation Speed** : **120 rpm** (depends on paper/document)
- **Tangential Speed** : **1.2 m/s**
- **Vacuum Seal** : **labyrinth seals + diff. pumping + face seal with carbon contacting**
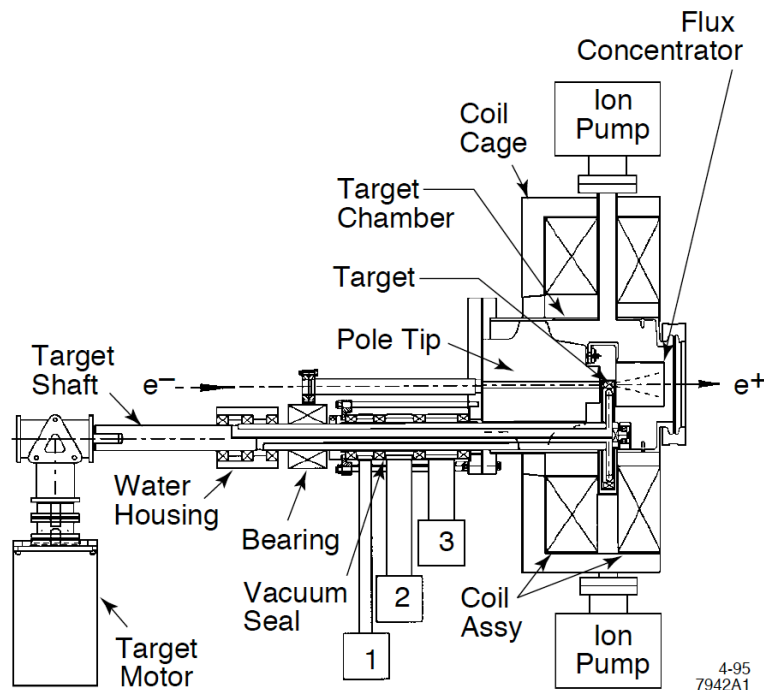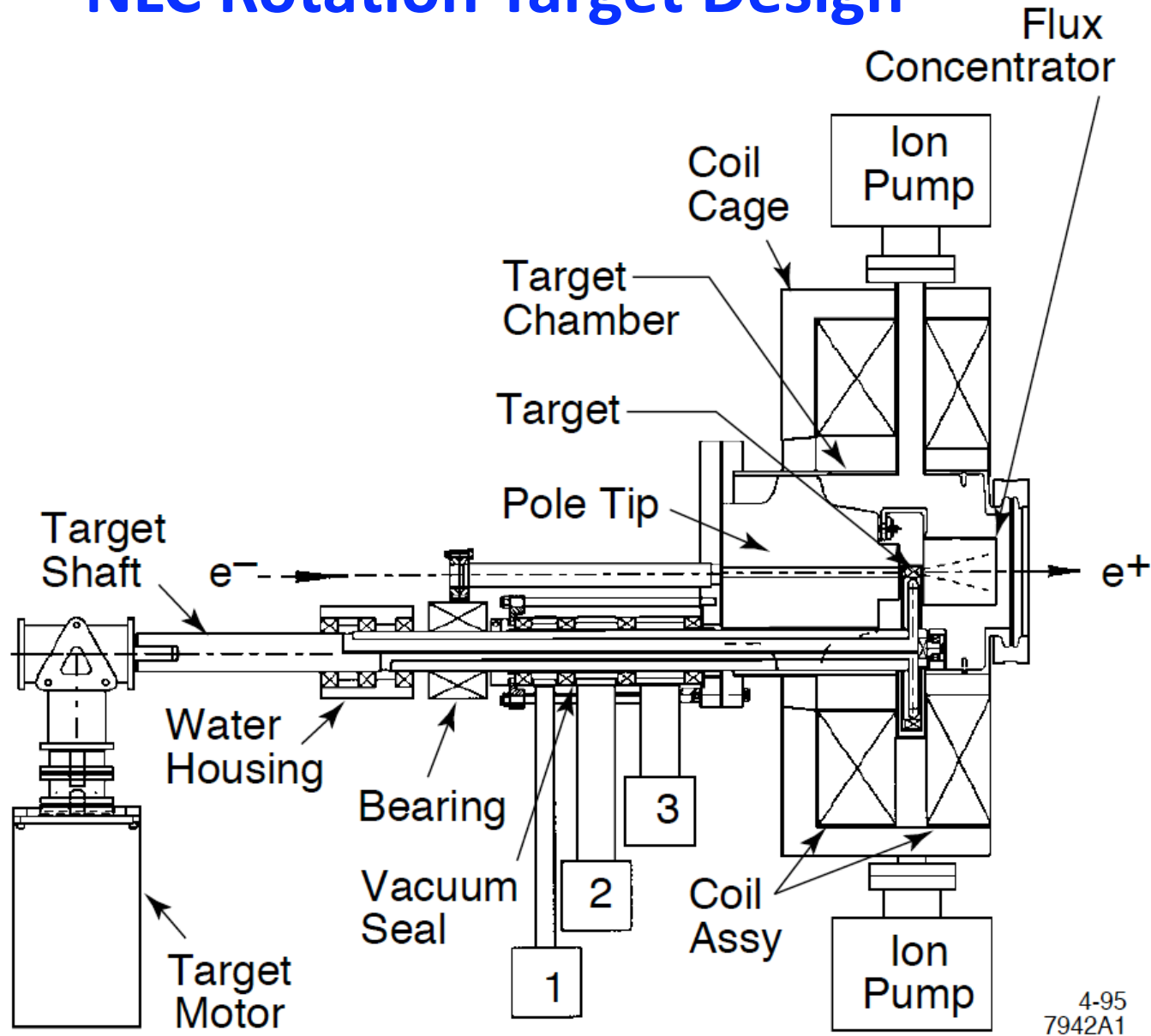
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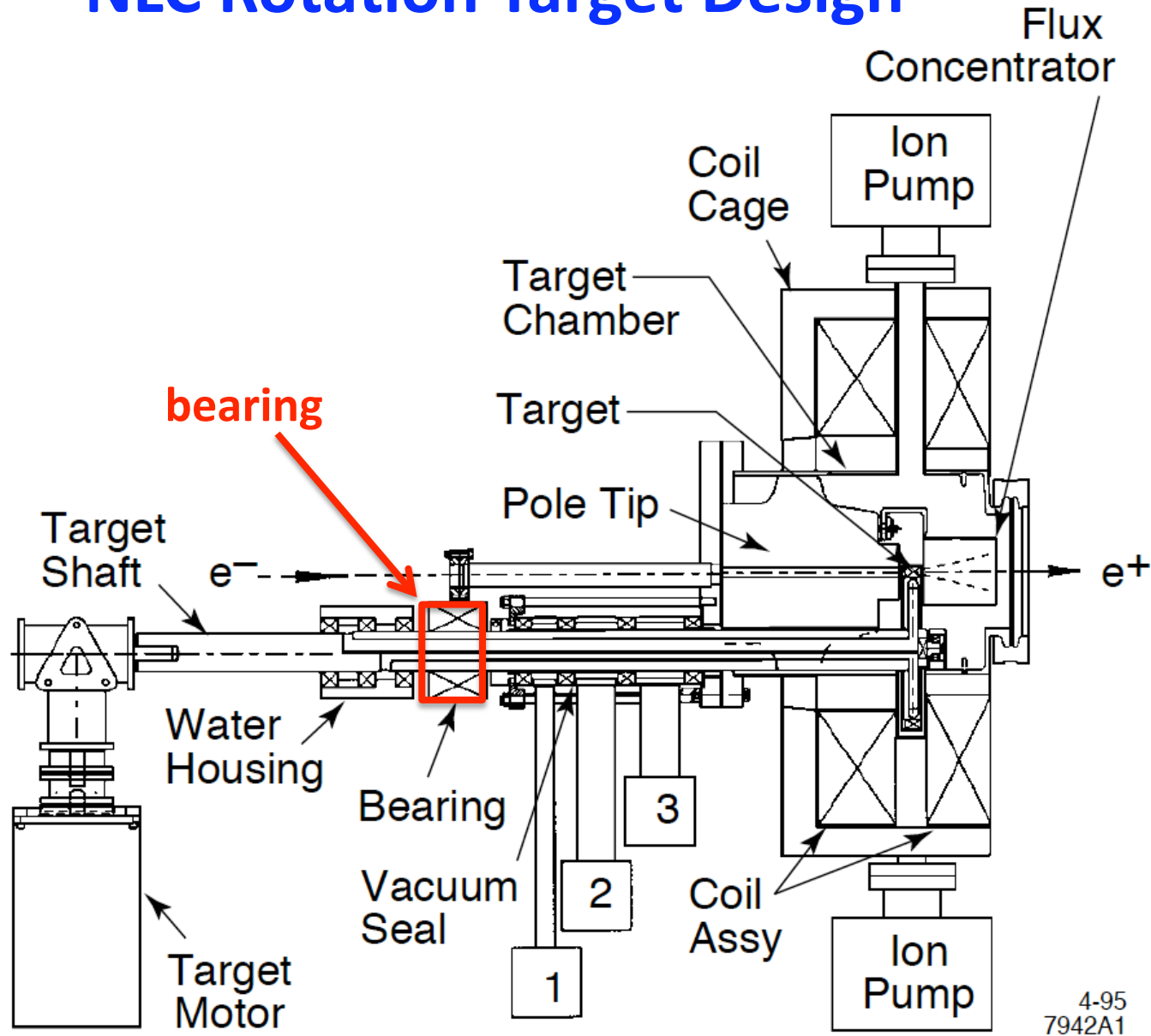- **Vacuum Seal** : **labyrinth seals + diff. pumping + face seal with carbon contacting**
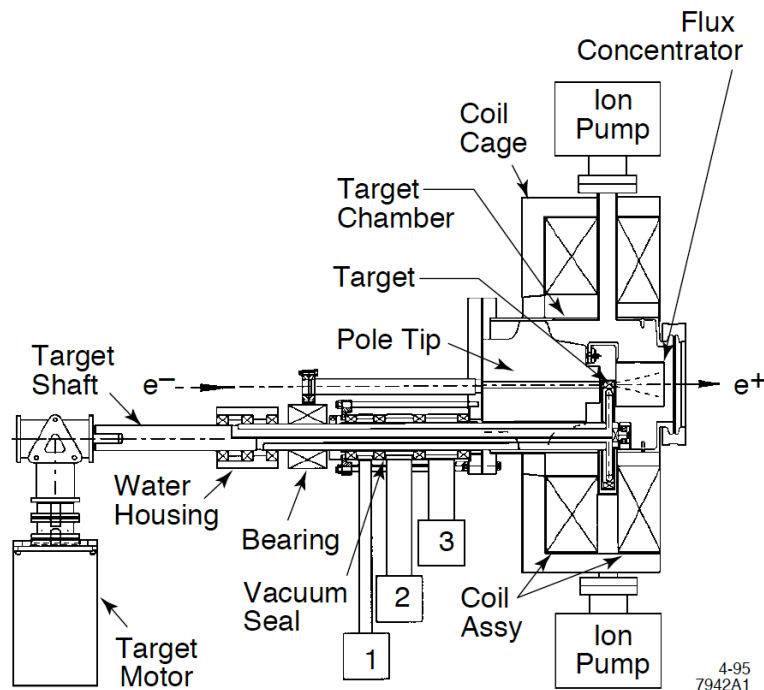
**Drawing Exits,
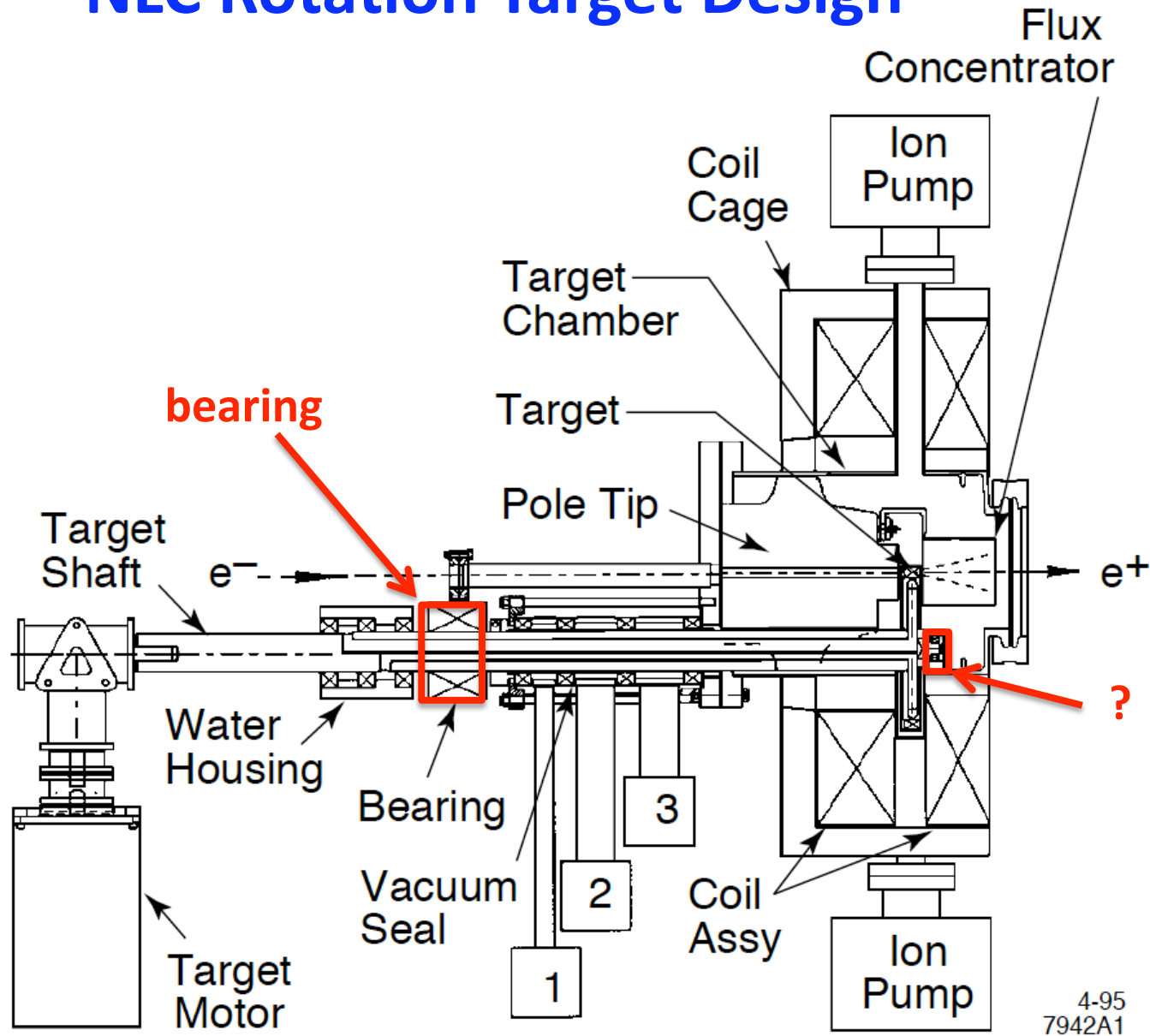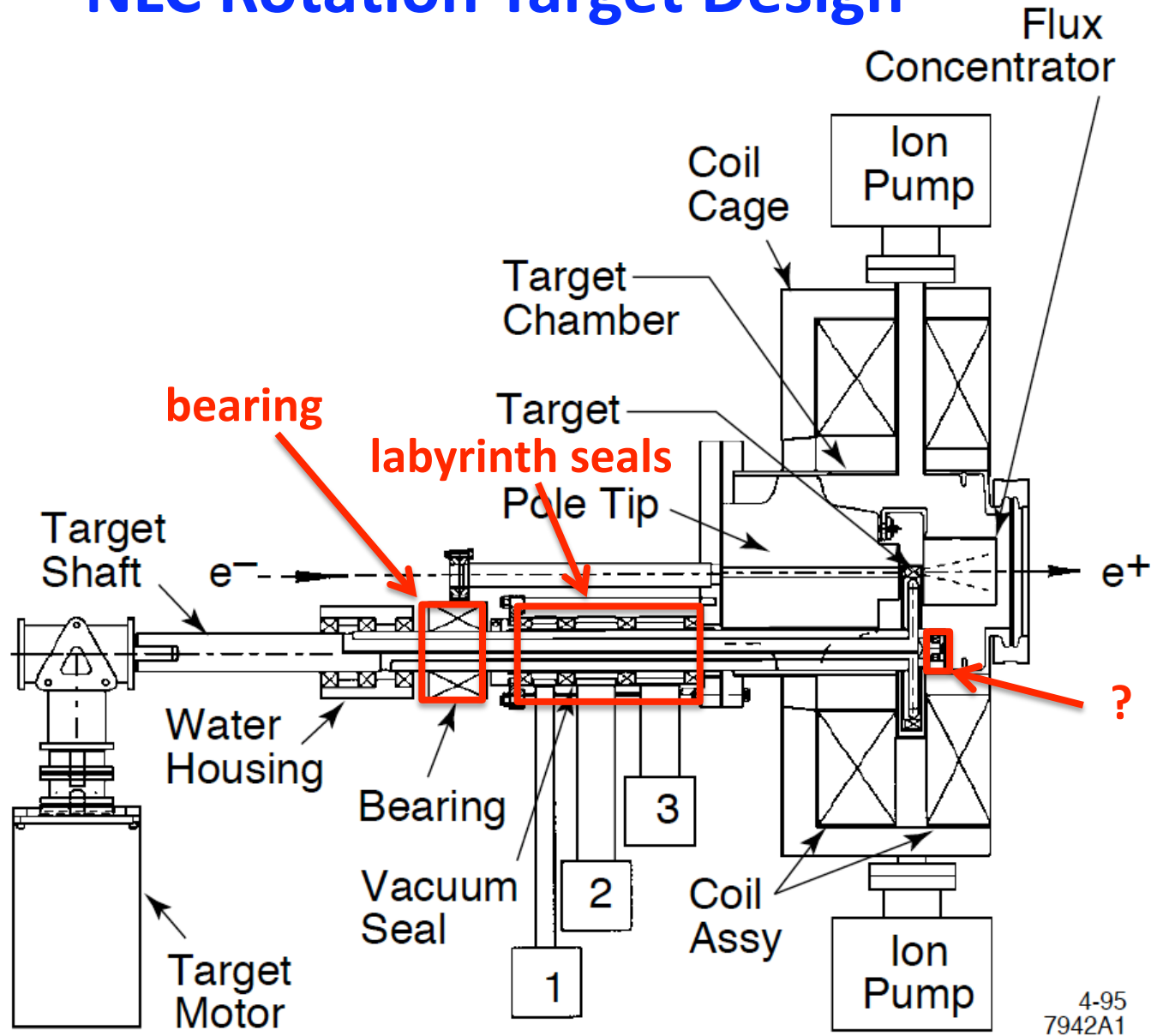But No Prototype**

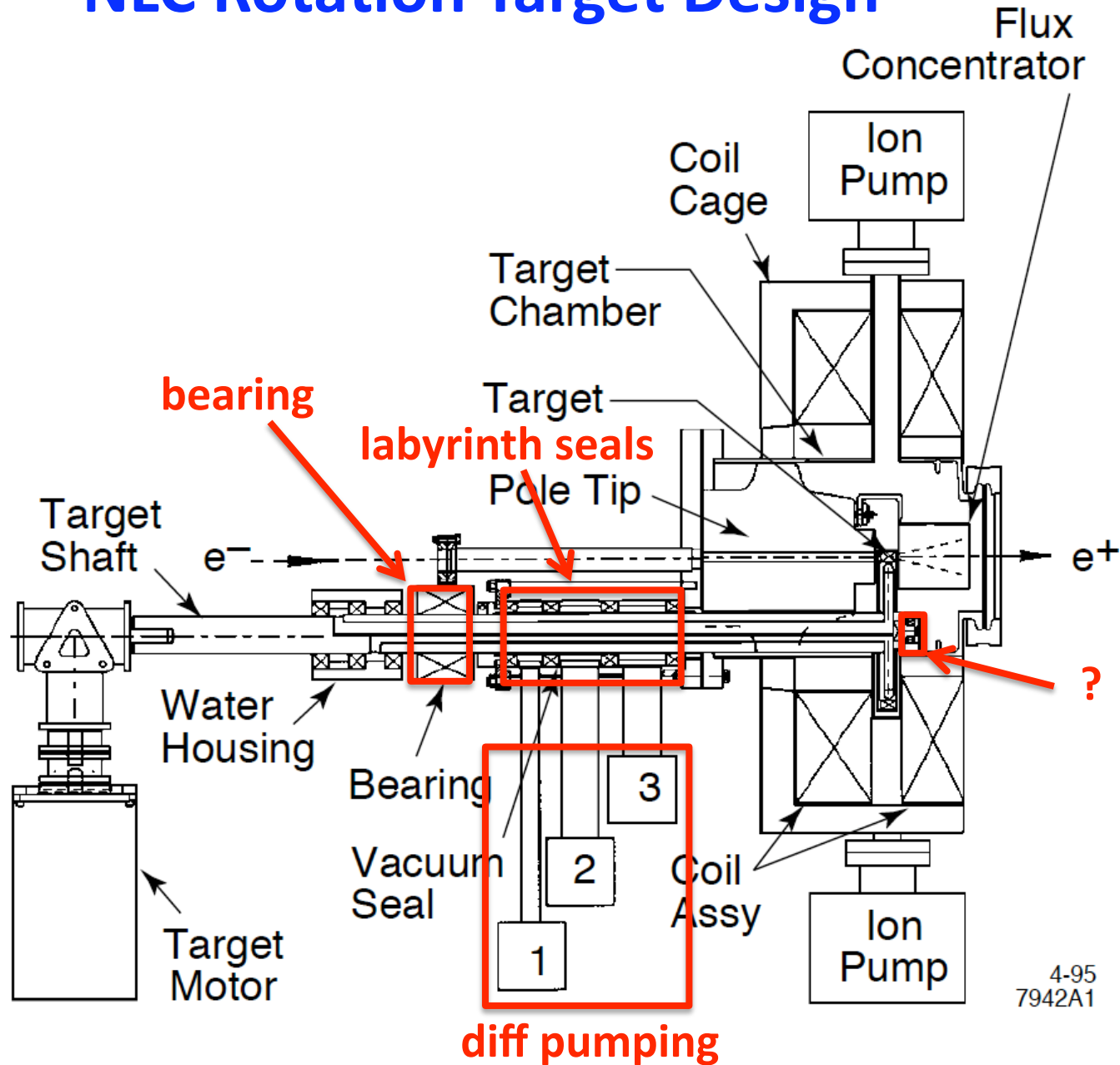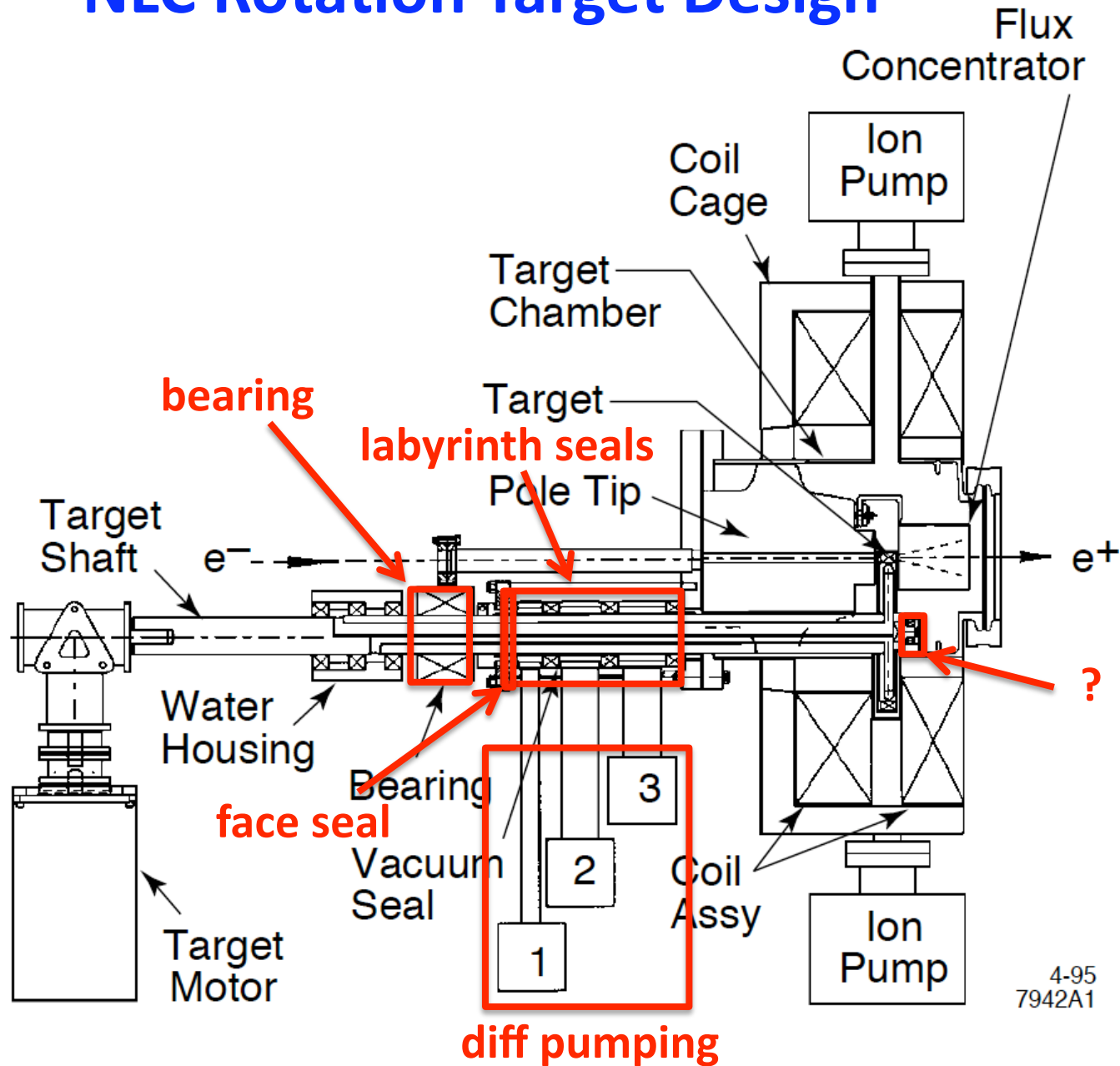# NLC Rotation Target Design

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NLC Rotation Target Design

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NLC Rotation Target Design

Flux Concentrator

Ion Pump

Coil Cage

Target Chamber

bearing

labyrinth seals

Target

Pole Tip

Coil Assy

Ion Pump

Target Shaft

e⁻

e⁺

Water Housing

face seal

Bearing Vacuum Seal

diff pumping

1 2 3

Target Motor

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Vacuum Seal Design of NLC Rotation Target

Vacuum Vessel

Air

Vacuum

Shaft

w

w

pumping   pumping   pumping

Vacuum Seal Design of NLC Rotation Target

Vacuum Vessel

Air

Vacuum

labyrinth seals

Shaft

w

w

10 – 15 micron

pumping   pumping   pumping

Vacuum Seal Design of NLC Rotation Target

Vacuum Vessel

Air

Vacuum

labyrinth seals

Shaft

10 – 15 micron

face seal
carbon contacting ring
& bellows style spring

pumping   pumping   pumping
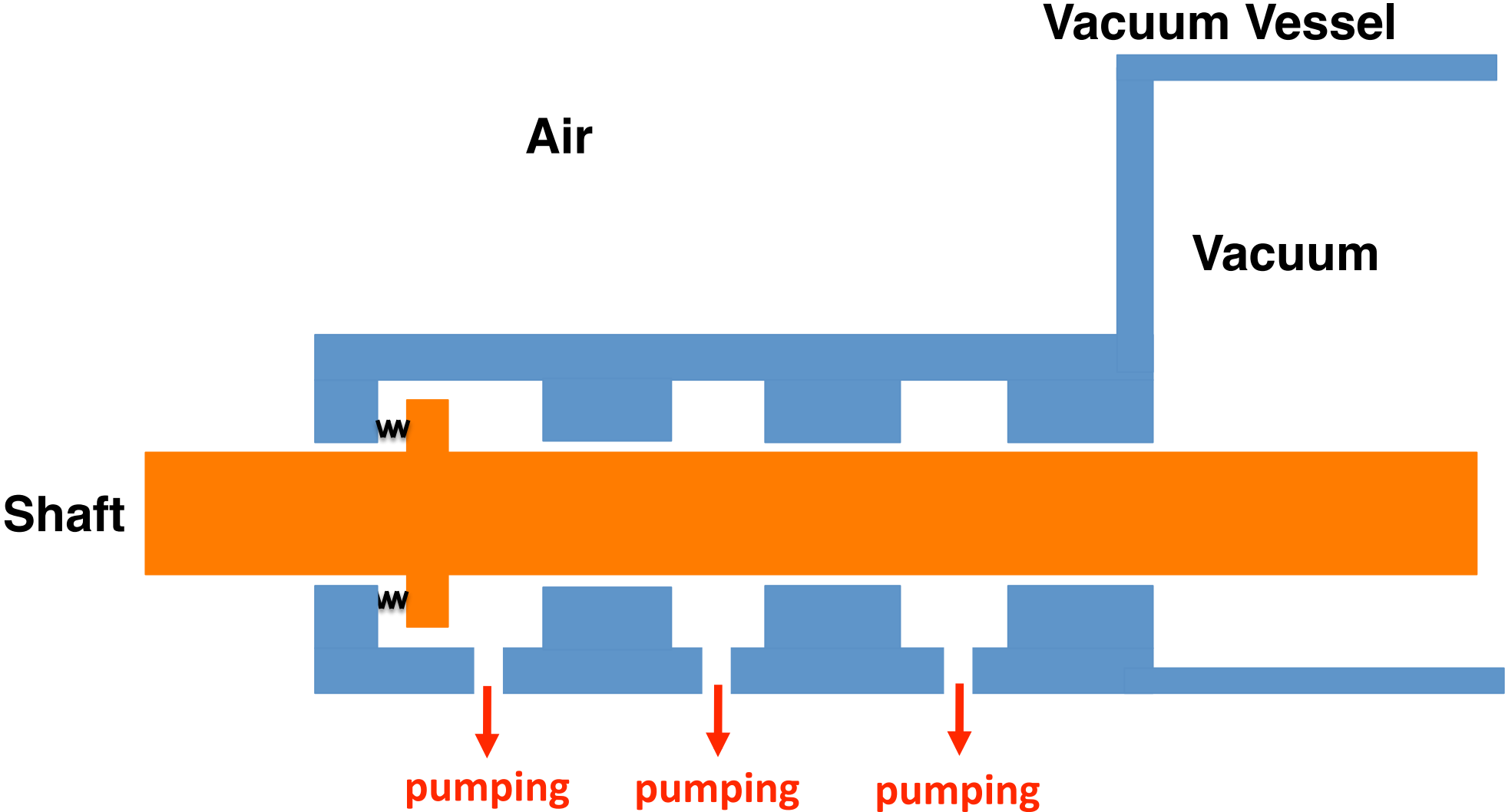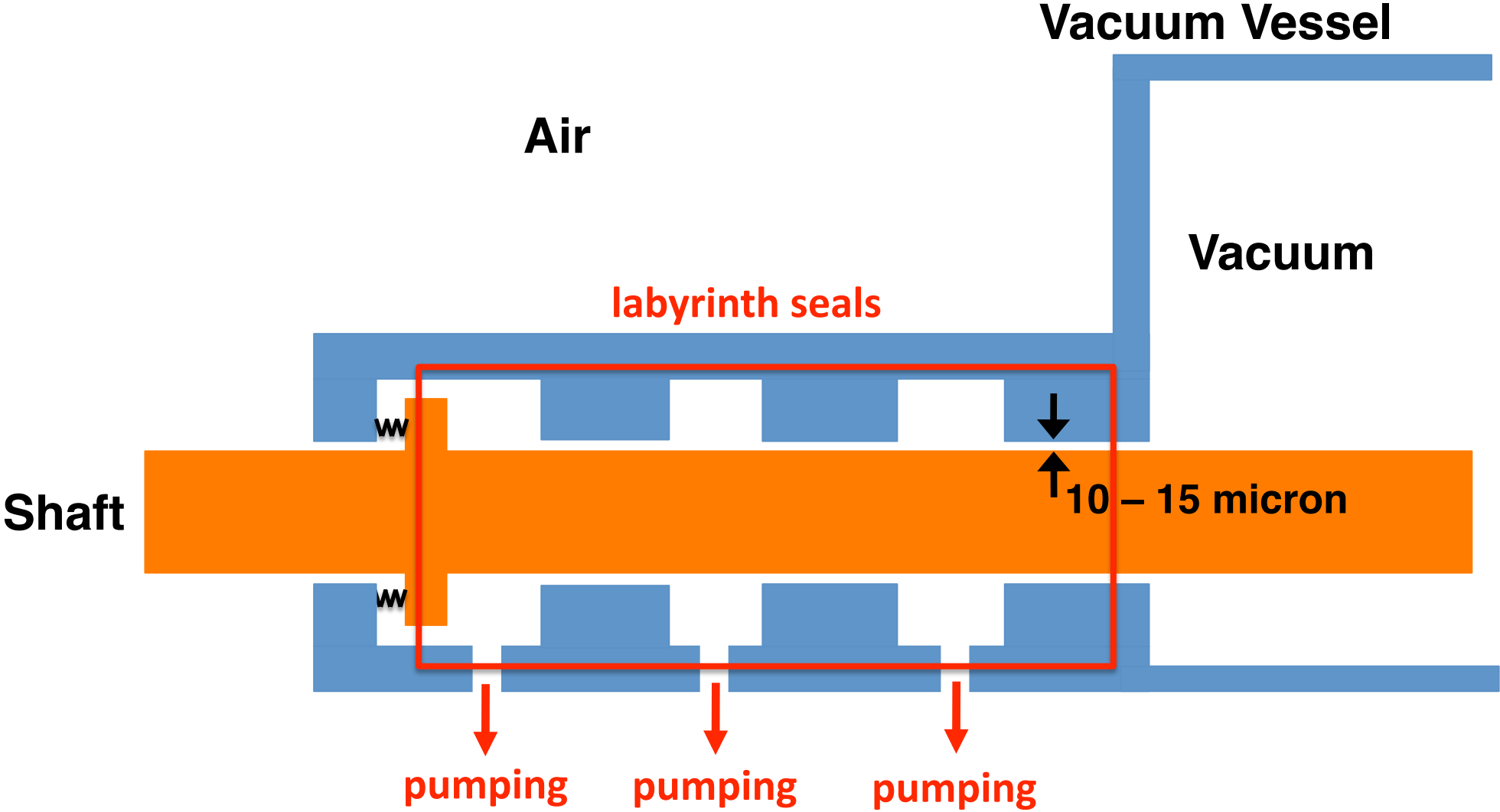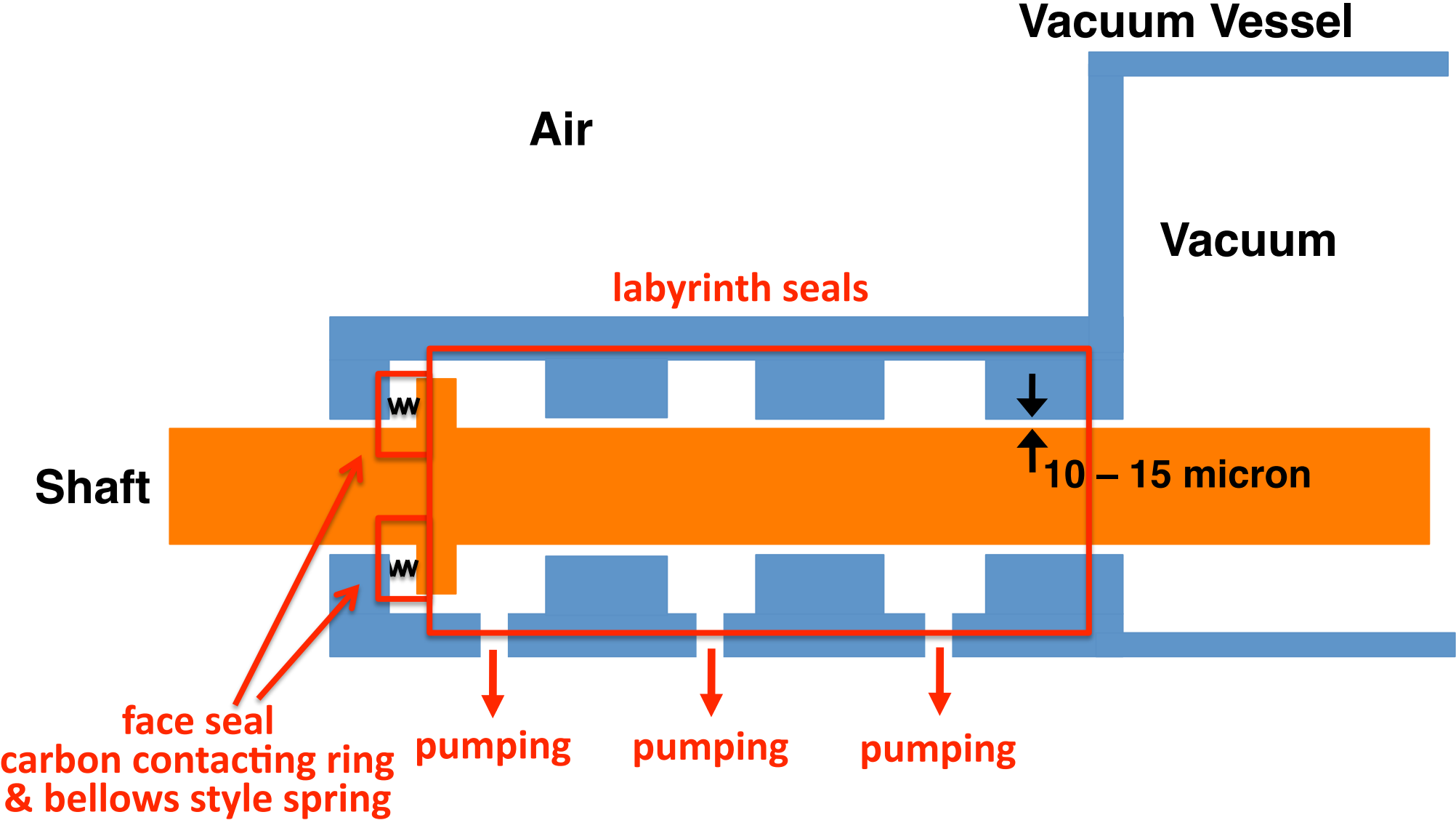
ILC Rotation Target

Specification
 - **Diameter**   **: 1 m**
 - **Rotation Speed**   **: 2000 rpm** (depends on paper/document)
 - **Tangential Speed : 100 m/s**
 - **Vacuum Seal**   **: ferromagnetic fluid**

Our challenge is more difficult than NLC and SLC.

Summary

- We need to develop rotation vacuum seal for ILC. It is challenging issue.
  - Try ferromagnetic seal again? (failed in SLC)
  - Try labyrinth seal?   (planed in NLC)
  - New Idea?