



# **Stripping Foil and instrumentation**

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**Technical meeting 21-mai-2014**

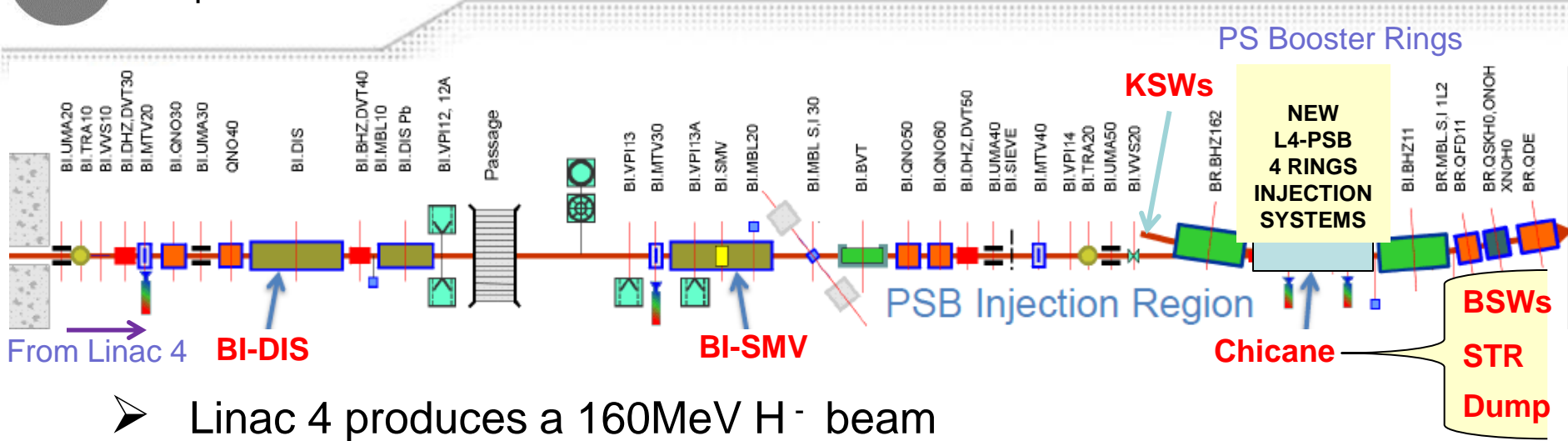


# L4 – PSB Injection: Stripping Foil System



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## Stripping Foil Function



- Linac 4 produces a 160MeV H<sup>-</sup> beam
- Beam is distributed in 4 PS Booster chicanes [BI.DIS + BI.SMV]
- KSWs produce a circulating beam painting bump
- BSWs produce the injection bump
- **Stripping foil** in chicane converts H<sup>-</sup> in H<sup>+</sup>
- H<sup>0</sup>/H<sup>-</sup> dump intercepts un-stripped H<sup>0</sup>/H<sup>-</sup>
- H<sup>+</sup> are introduced in the PSB ring

} Chicane

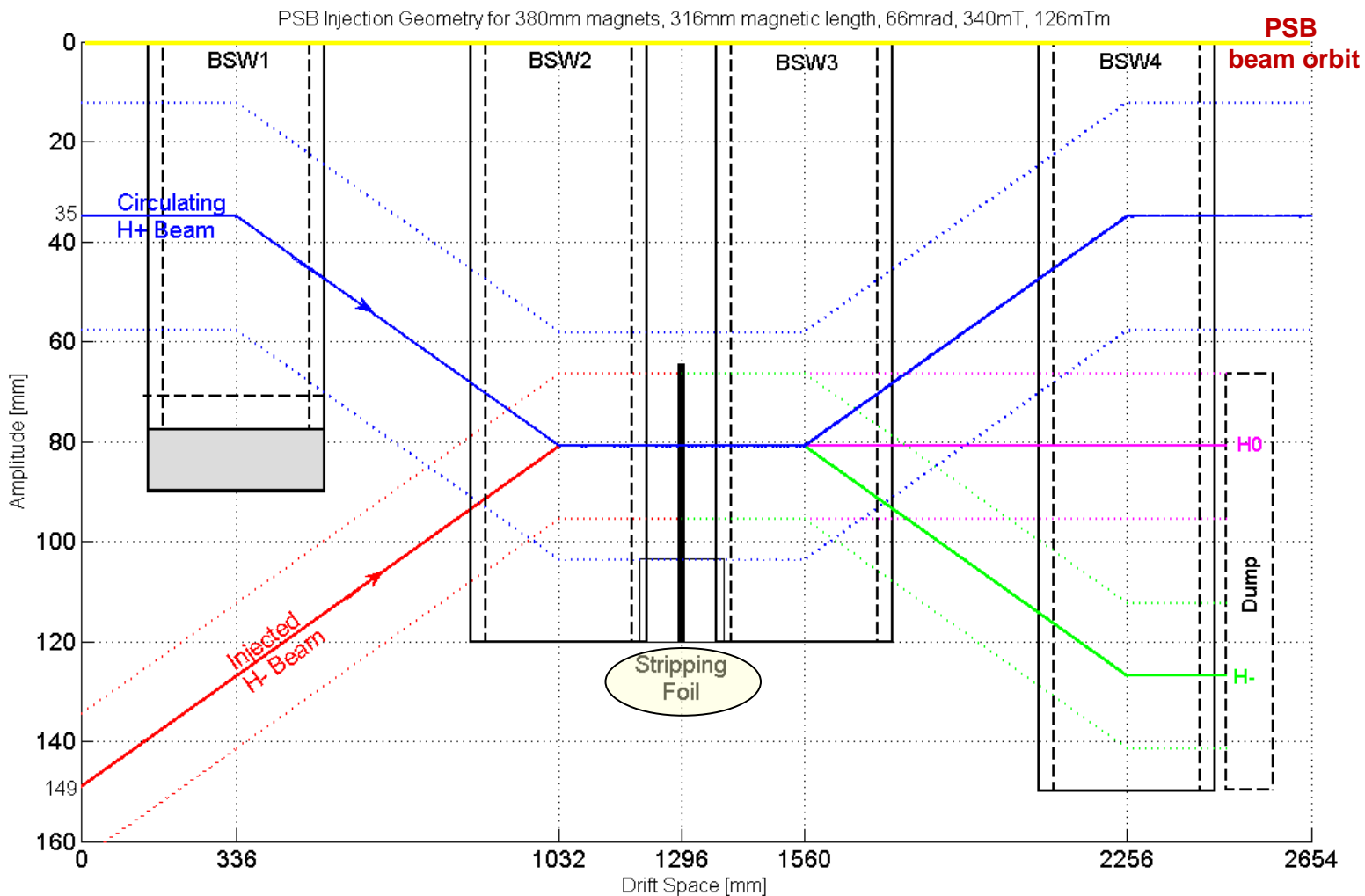


# L4 – PSB Injection: Stripping Foil System



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## Injection chicane principle



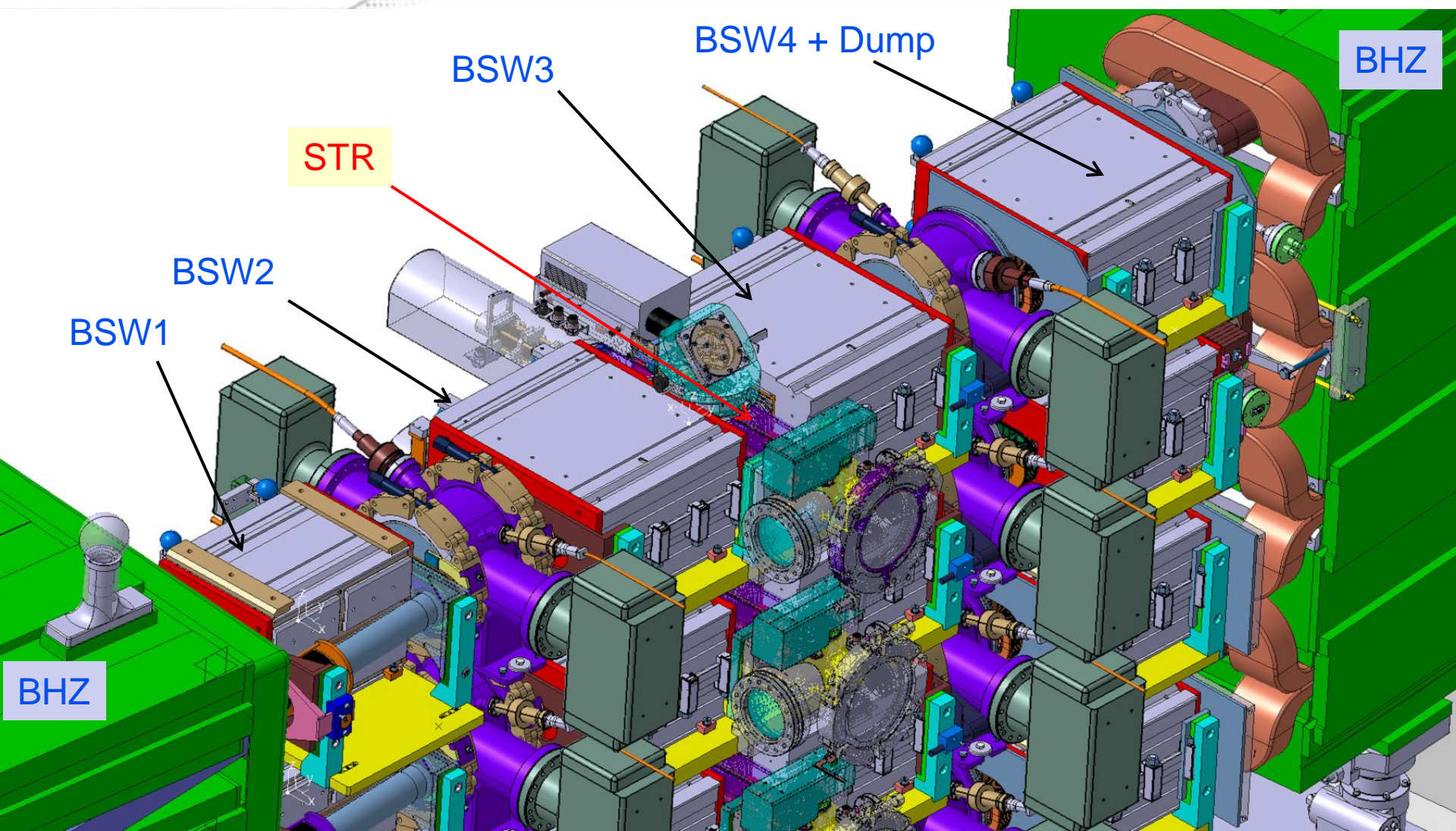


# L4 – PSB Injection: Stripping Foil System



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## Injection region [chicane]



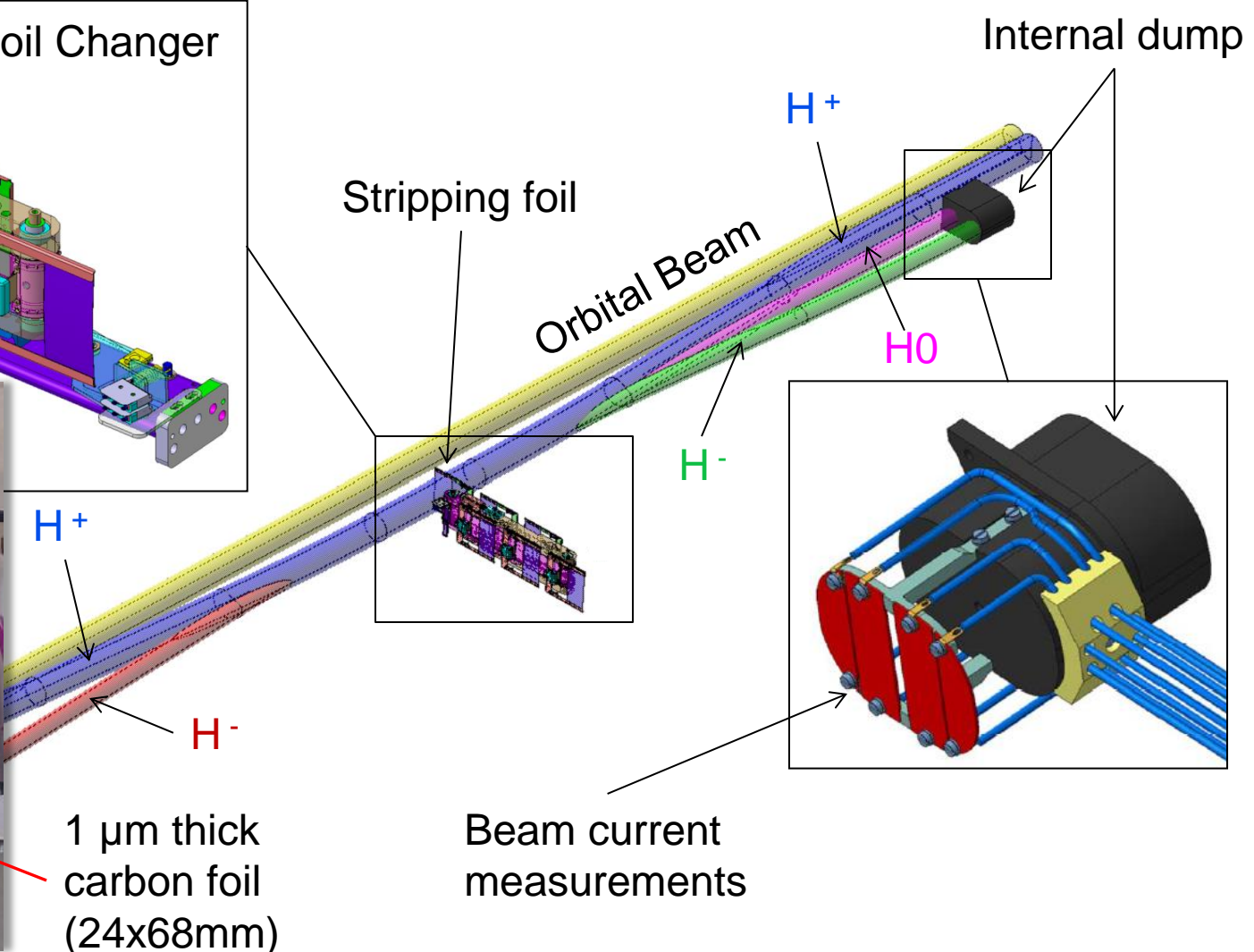
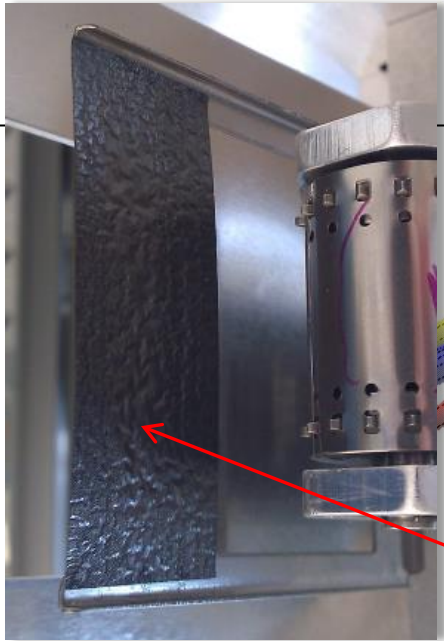
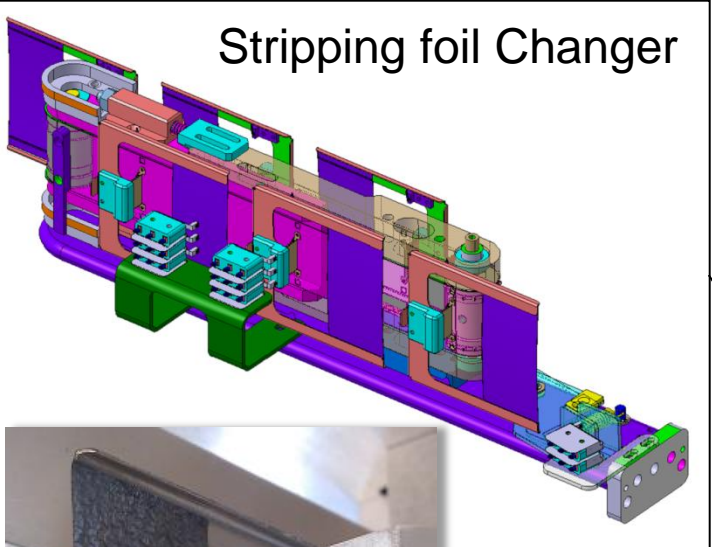


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## Stripping foil position

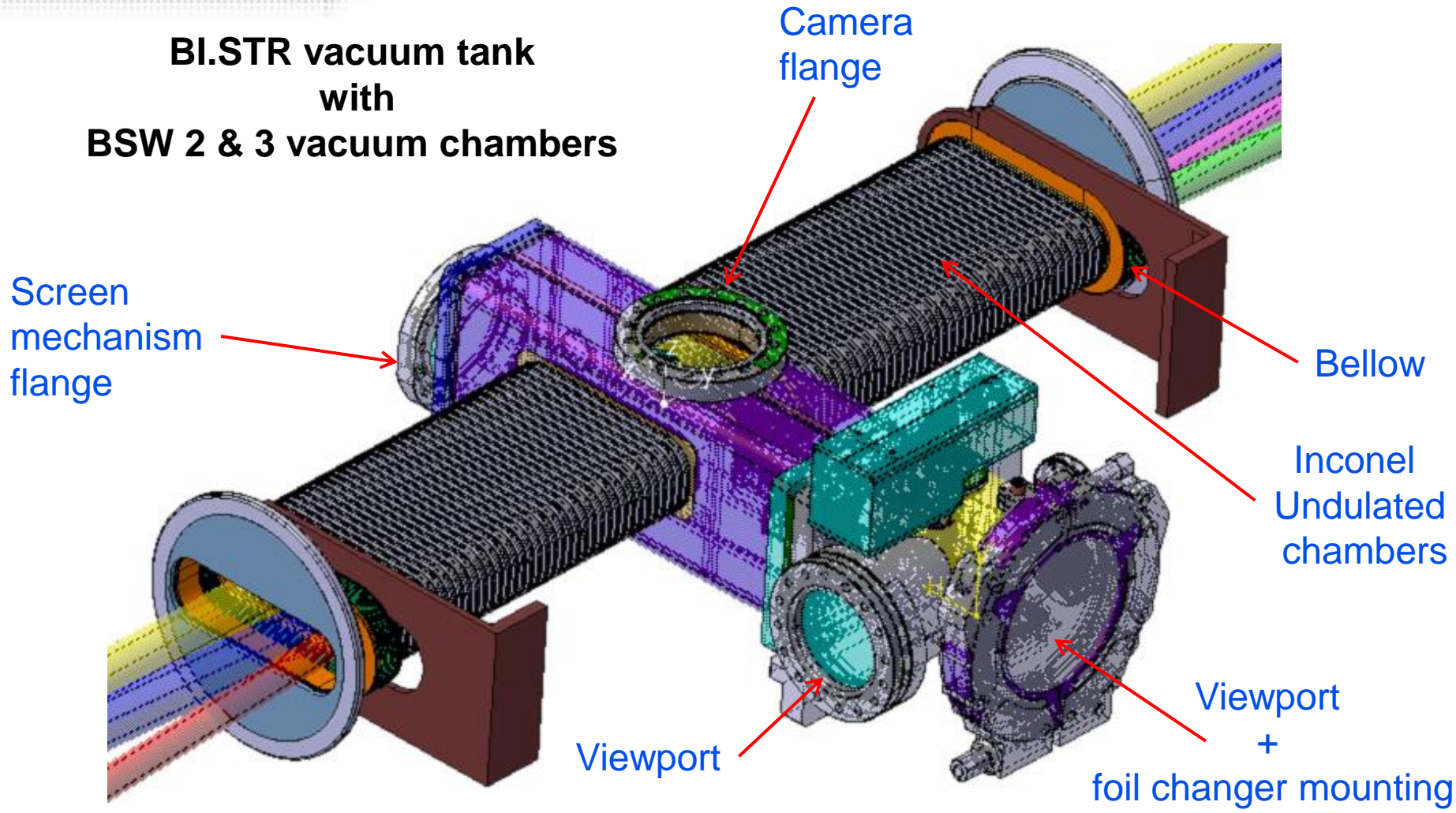




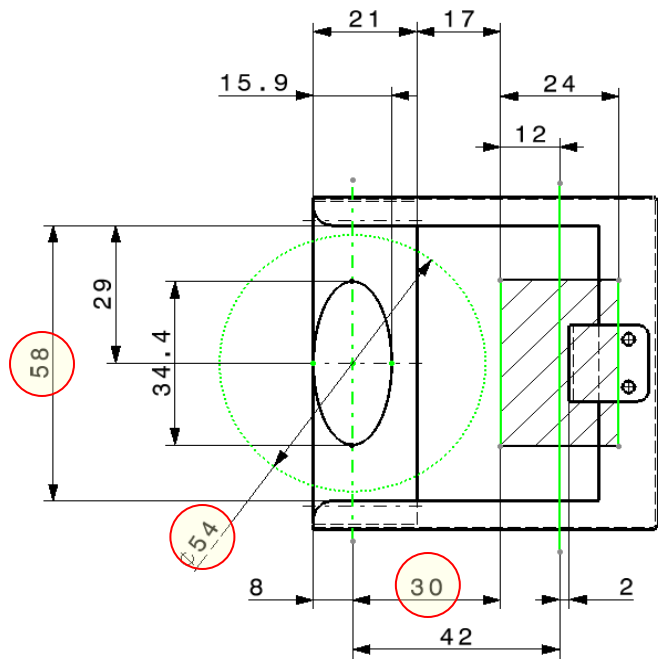
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# Stripping foil vacuum tank

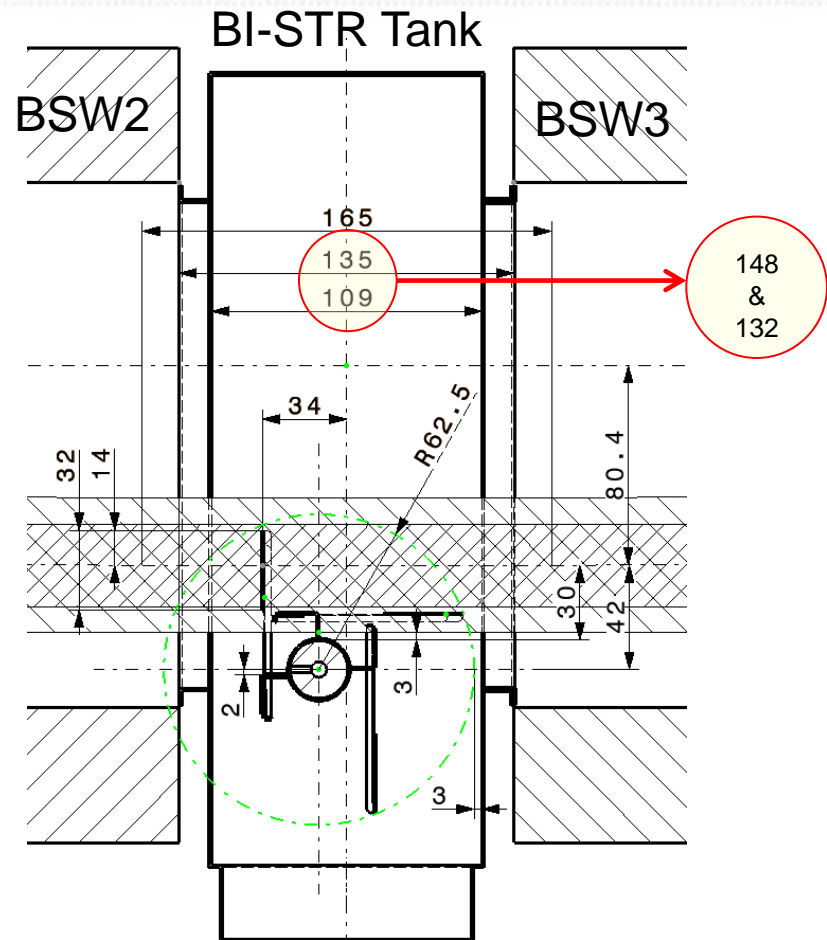
**BI.STR vacuum tank with BSW 2 & 3 vacuum chambers**



## Stripping foil specification



Foil & frame constraints



Top view of foil mechanism



# L4 – PSB Injection: Stripping Foil System



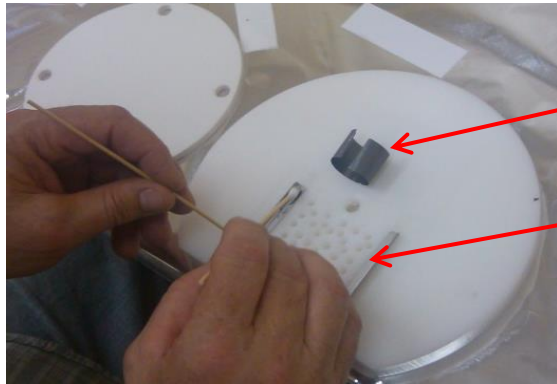
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## BI.STR Used cases

| Case                   | Description   | Method  |
|------------------------|---|---|
| 1 – Charger present    | Does the stripping foil system contain a charger.   | Have a switch to identify if a charger is (correctly) installed   |
| 2 – Zero position      | Define the foil band reference position (requested from controls).  | a) Use BTV camera<br>b) Use mechanical band indexation -> <b>Actuator</b>   |
| 3 – Index foils        | Set-up and indexation of all 6 stripping foils, or only new replaced stripping foils, with respect to the theoretical beam position and band reference. Also index 'empty' positions. | Use BTV to define theoretical beam spot, align foil edge, store in data-base.<br>Interlock or BTV IN, OR foil movement.-> <b>Potentiometer</b>  |
| 4 – Foil "X" "foil IN" | Move foil nr "X" into the theoretical beam position. This could be a 'fast' movement of 1-5 foils, with 'slow' movement for final positioning.  | Identify current foil index, calculate displacement for foil "X", move foil "X" in position. -> <b>Stepper Motor + micro-switches</b>   |
| 5 – Reference lost     | Reference position has been lost by stepping motor.   | Use mechanical band indexation -> <b>Actuator</b>   |
| 6 – Adjust foil        | Foil IN reference position is 2.5mm before rotation point of foil band.   | ±2mm movement of the foil allowing horizontal adjustment of the foil .-> <b>Potentiometer</b>   |
| 7 – No foil "foil OUT" | Intermediate position, no foil in beam.<br>To be used for pilot beams on H0/H- dump.<br>(Needs to be interlocked for higher intensities!)   | Rotation of foil band in both directions allowed?<br>Or make full turn to get back previous foil.-> <b>Yes</b>  |
| 8 – Broken foil        | In case a foil has stripping efficiency<90%, identified broken, etc.  | Signal from H0/H- dump monitor, or foil current (Case 10), interlock foil in data-base.<br>Check foil position to be IN or OUT-> <b>micro-switches</b>  |
| 9 – "BTV IN"           | In case BTV screen is in reading position, no movement of the foil is allowed.  | a) If foil IN, interlock BTV movement, foil movement allowed -> <b>micro-switches + potentiometer.</b><br>b) IF foil OUT, interlock foil movement, BTV movement allowed-> <b>micro-switches + potentiometer..</b> |
| 10 – Foil current      | Identify stripping efficiency change by changing signal of the foil.  | Isolate foil frame (or charger) from ground and measure signal from foil -> <b>macor spacers.</b>   |



## Stripping foil gluing



1  $\mu\text{m}$  thick  
carbon foil  
ACF-200  
(24x68mm)

Aquadag 18%

Stainless steel frame



### Available Foil types

- \_ Foil ACF-200 - (200 $\mu\text{g}$ -1 $\mu\text{m}$ ) 21mm x 68mm
- \_ Foil ACF-200 - (200 $\mu\text{g}$ -1 $\mu\text{m}$ ) 24mm x 68mm
- \_ Foil ACF-200 - (200 $\mu\text{g}$ -1 $\mu\text{m}$ ) 21mm x 68mm - collodion-coated
- \_ Foil ACF-400 - (400 $\mu\text{g}$ -2 $\mu\text{m}$ ) - 24mm x 68mm
- \_ Foil XCF-200 - (200 $\mu\text{g}$ -1 $\mu\text{m}$ ) 32mm x 68mm
- \_ Foil XCF-200 - (200 $\mu\text{g}$ -1 $\mu\text{m}$ ) 32mm x 68mm - collodion-coated
- \_ Foil DLC-13-2000-S (400 $\mu\text{g}$ -2 $\mu\text{m}$ ) 25mm x 65mm
- \_ Foil DLC-13-1000-S (200 $\mu\text{g}$  -1 $\mu\text{m}$ ) 25mm x 65mm



Aquadag 18% : 2 drops (Syringe)



*cotton stick manipulation (precision?)*

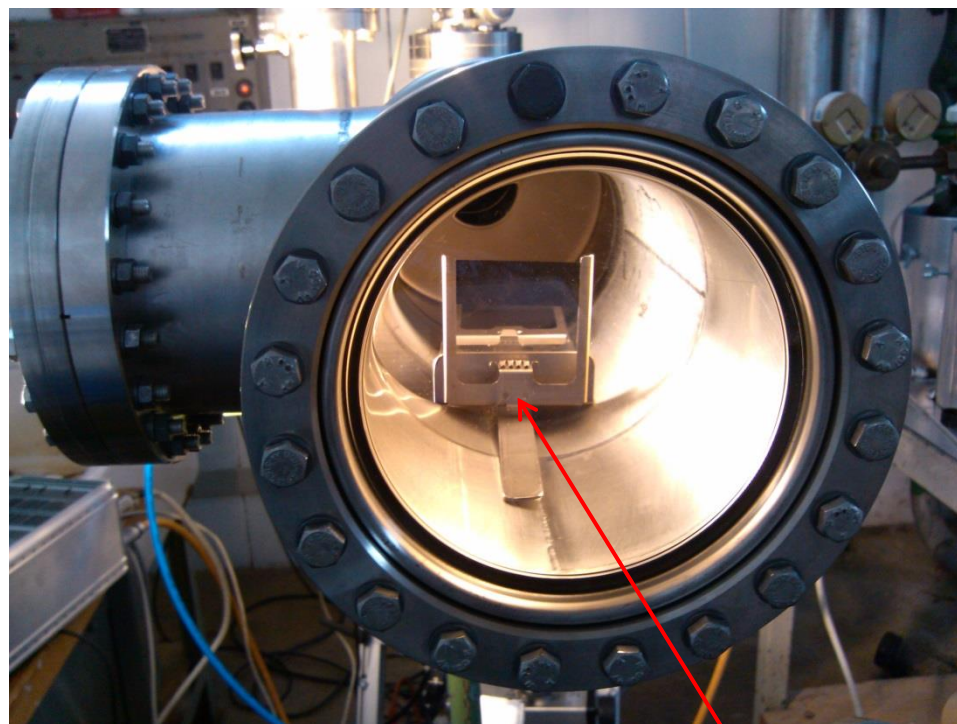
## Stripping foil vacuum test



1  $\mu\text{m}$  thick carbon foil (24x68mm)

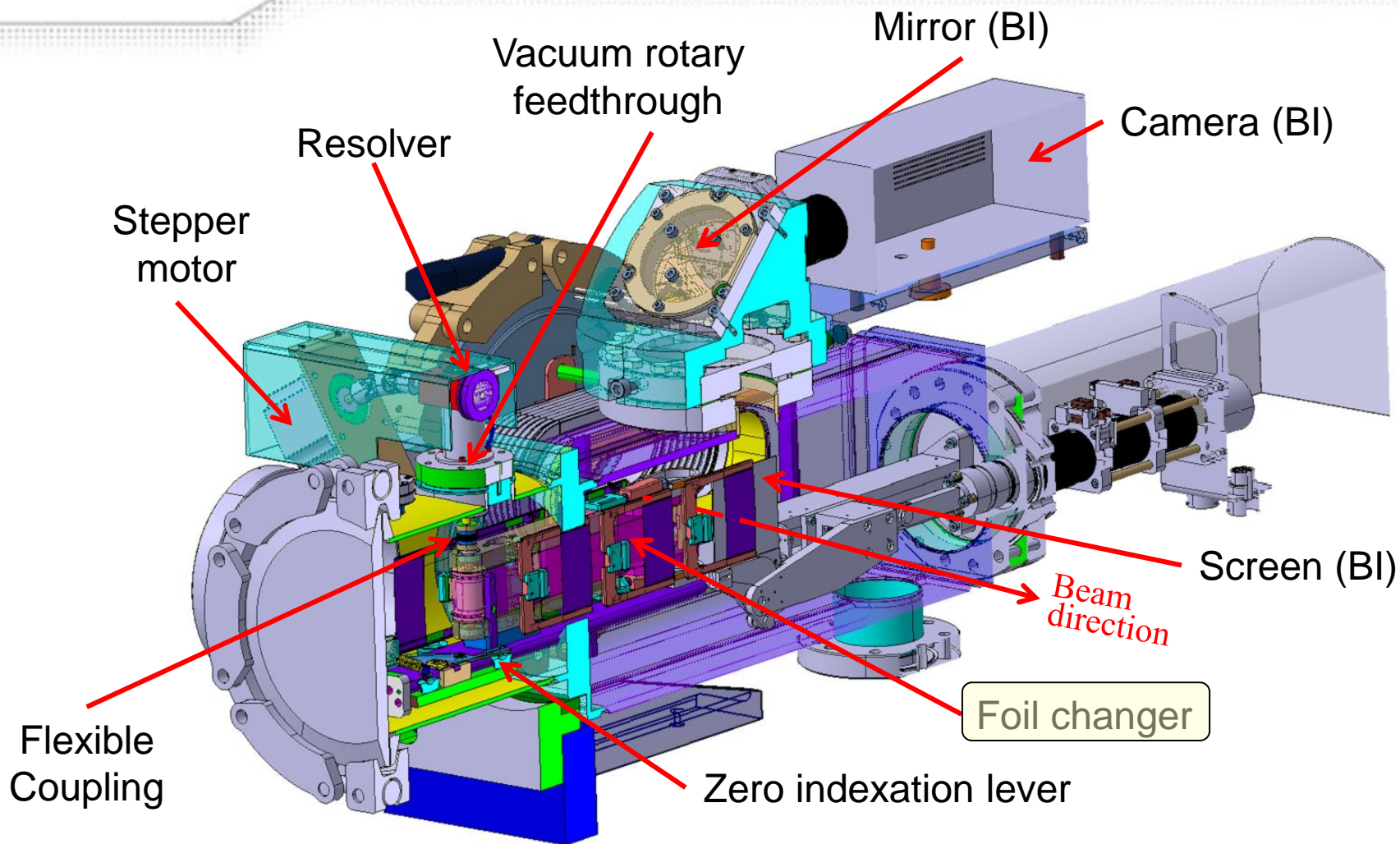
Foil types test = OK

- \_ Foil ACF-200 - (200 $\mu\text{g}$ -1 $\mu\text{m}$ ) 21mm x 68mm
- \_ Foil ACF-200 - (200 $\mu\text{g}$ -1 $\mu\text{m}$ ) 24mm x 68mm
- \_ Foil ACF-200 - (200 $\mu\text{g}$ -1 $\mu\text{m}$ ) 21mm x 68mm - collodion-coated
- \_ Foil ACF-400 (400 $\mu\text{g}$ -2 $\mu\text{m}$ ) - 24mm x 68mm



Successful  $\Delta p$  vacuum tests

## BI.STR mechanism in vacuum tank



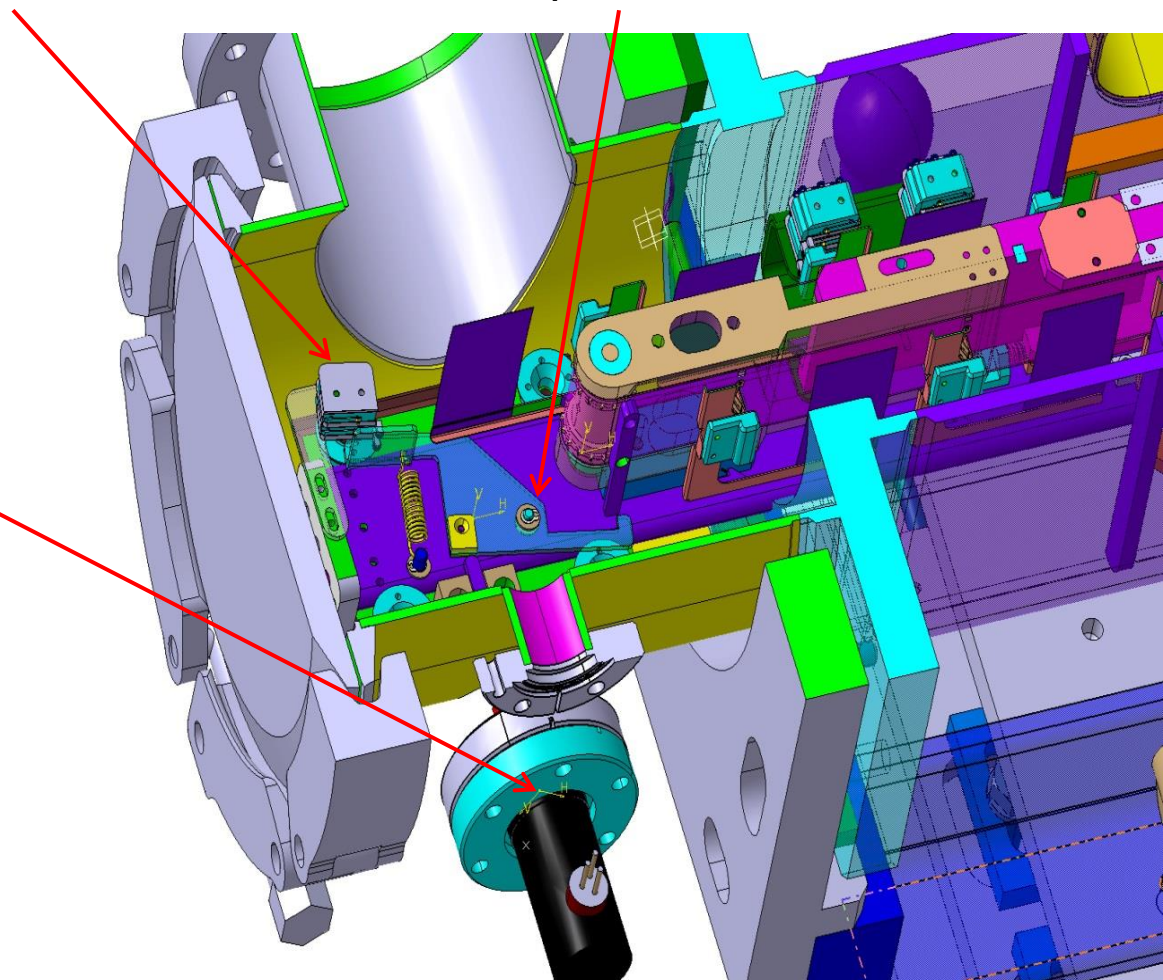
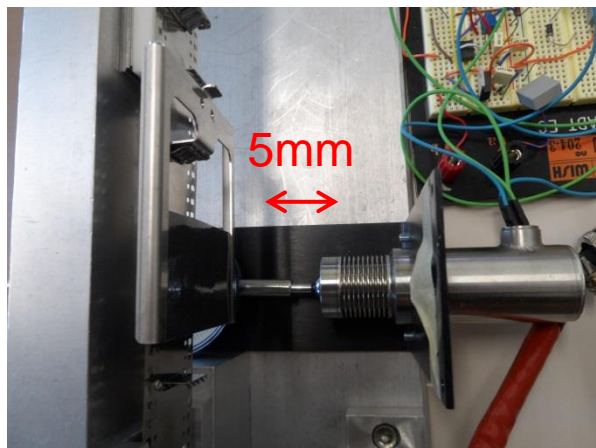
## Zero Reference Position Mechanism

Micro-switch

Stop Lever



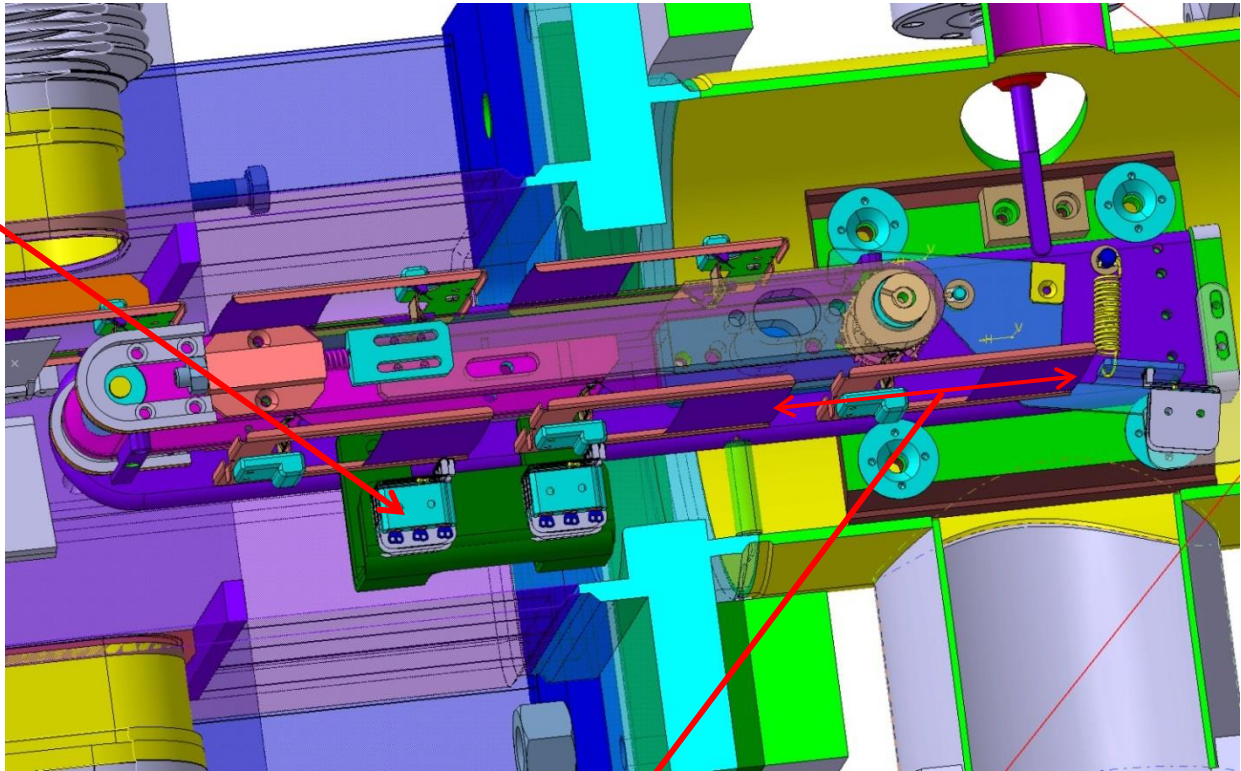
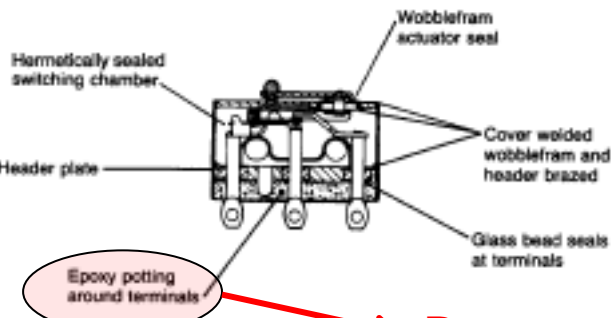
Radiation hard  
Vacuum actuator  
3.5V, 250mA



## Foil Displacement Control

Micro-switches Honeywell:

- \_ Stainless Steel
- \_ Prepared for UHV
- \_ Tested by TE/VSC

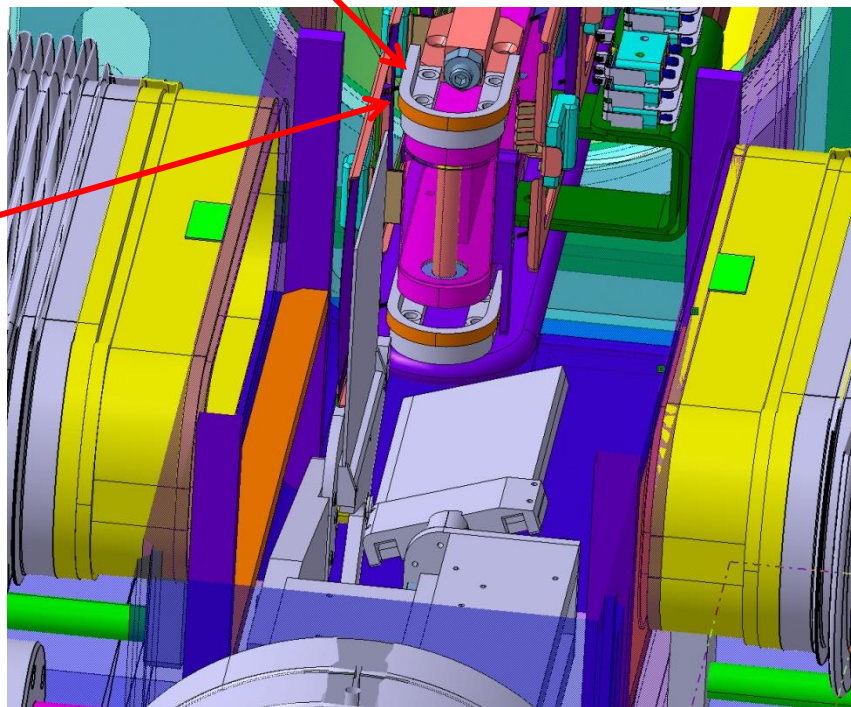


Function: Control of foil stroke displacement  
Speed: Stroke 90.25mm in ~ 20s (1 rotation in ~2mn)

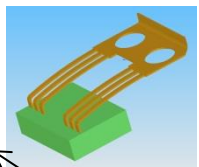
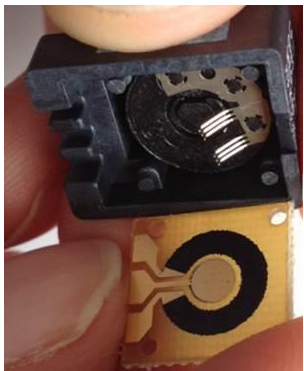
Removed with methylene chloride

## Stripping foil position control

- Membrane potentiometer:
- \_ Vacuum tests ongoing
  - \_ Position tolerance +/-0.5mm



Wiper contact



5mm



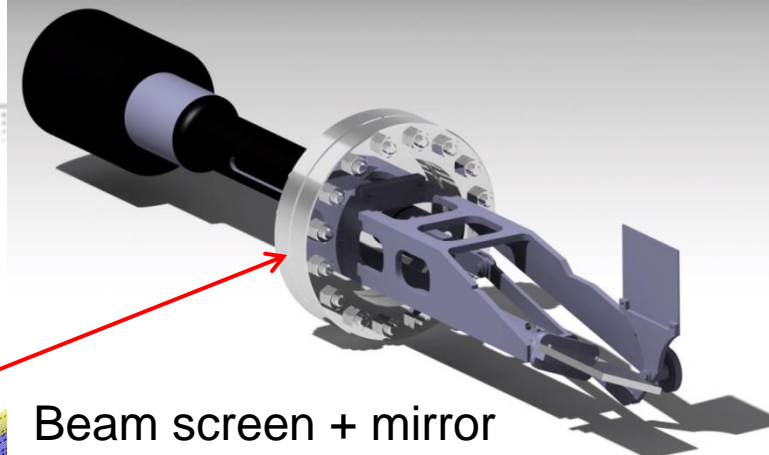
# L4 – PSB Injection: Stripping Foil System



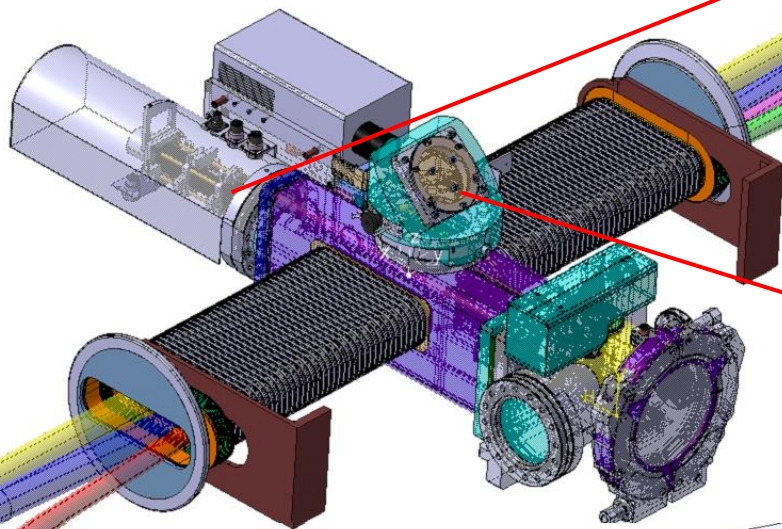
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## Instrumentation

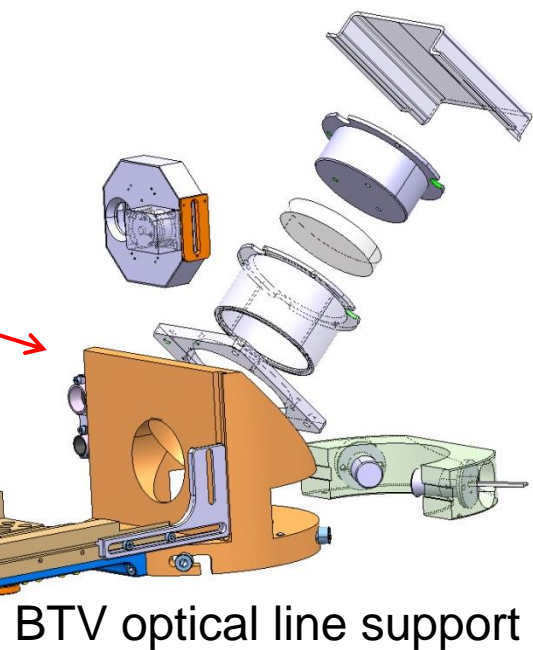
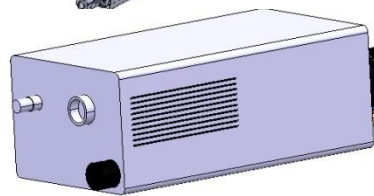
Developed by BI



Beam screen + mirror



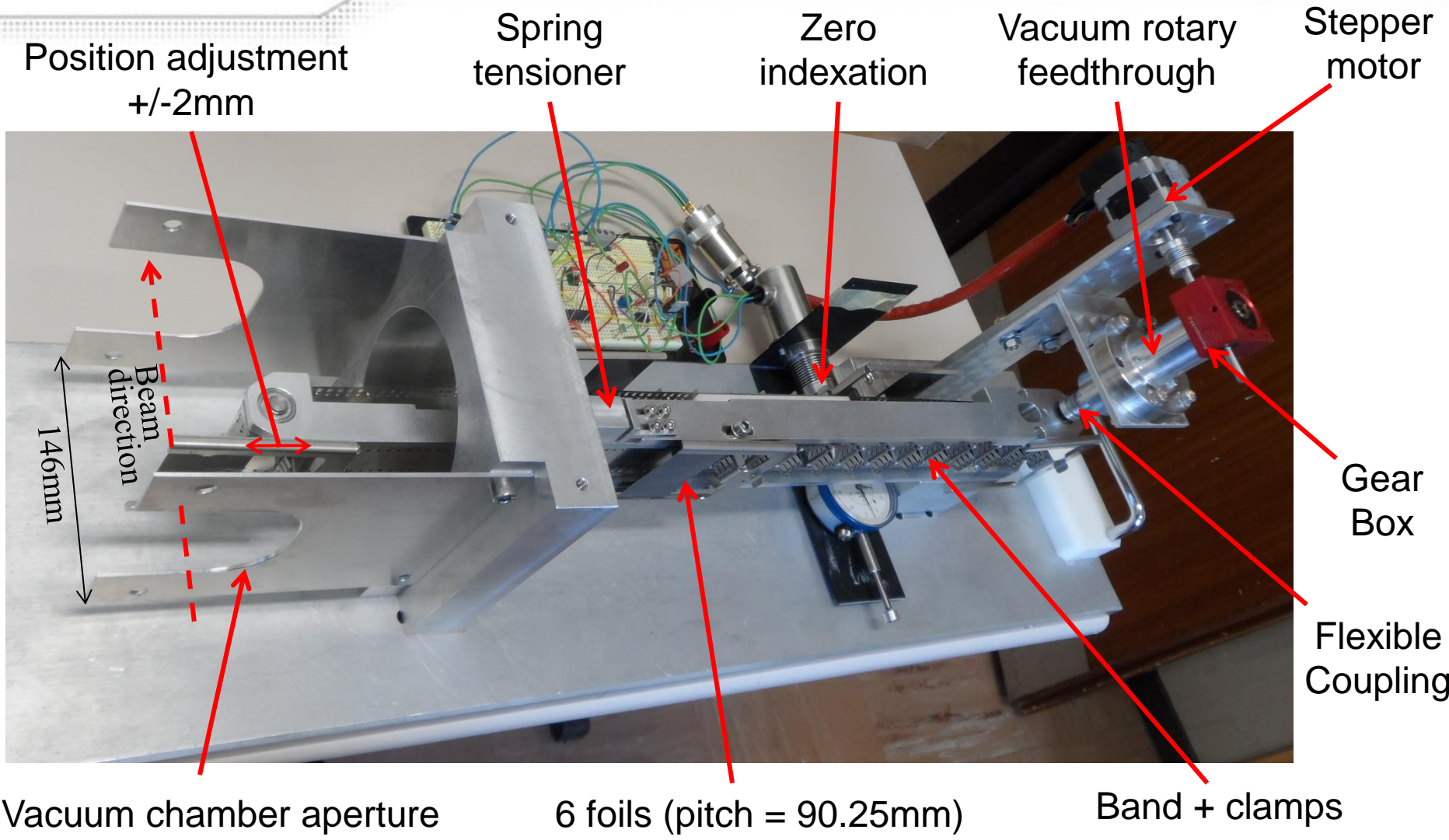
Camera



BTV optical line support



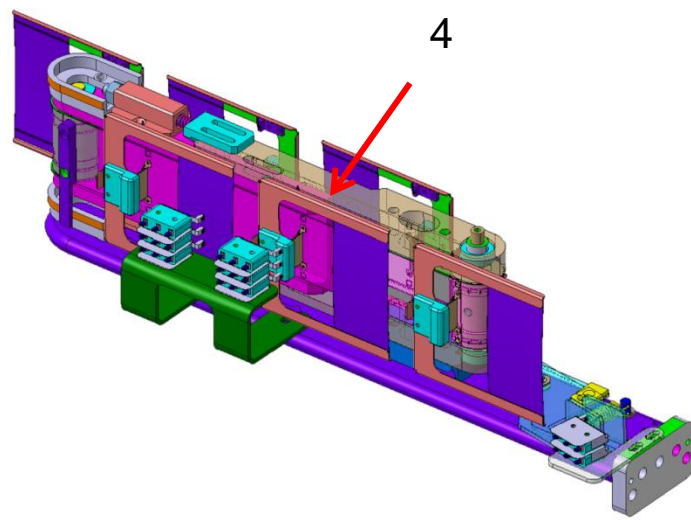
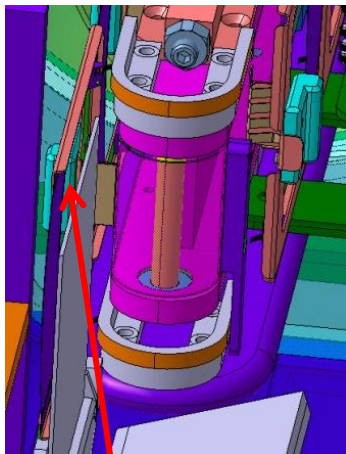
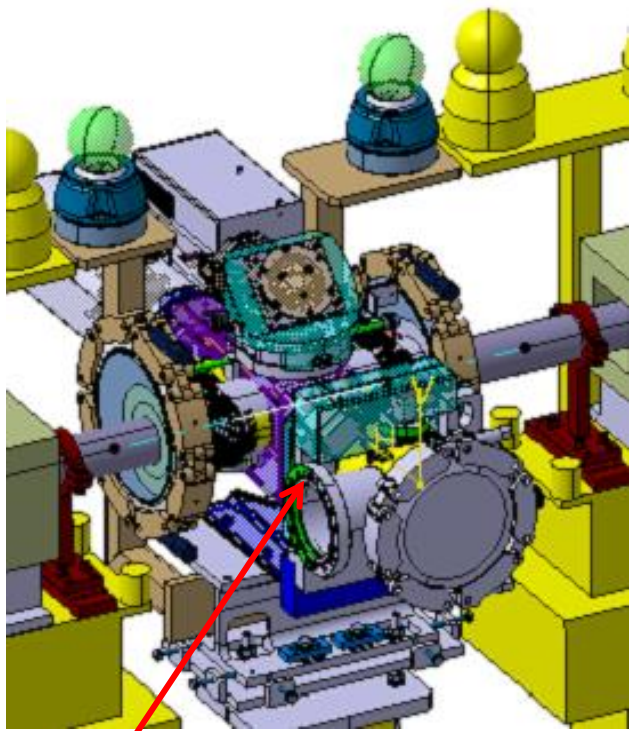
## Stripping Mechanism Prototype





## Next steps for stripping foil system

- 1) vacuum tank for prototype (L4 beam line)
- 2) membrane potentiometer + support (TE/VSC)
- 3) foil current measurement
- 4) foil changer
- 5) improve gearbox for reference position actuator



2 + 3

4

1

5



## L4 – PSB Injection: Stripping Foil System



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# Questions?

A large, 3D, light blue graphic of the words "THANK YOU" in a bold, sans-serif font. The letters are rendered with a slight perspective, giving them a three-dimensional appearance. They are set against a black rectangular background that is tilted slightly to the right. The entire graphic is centered on a solid blue background.