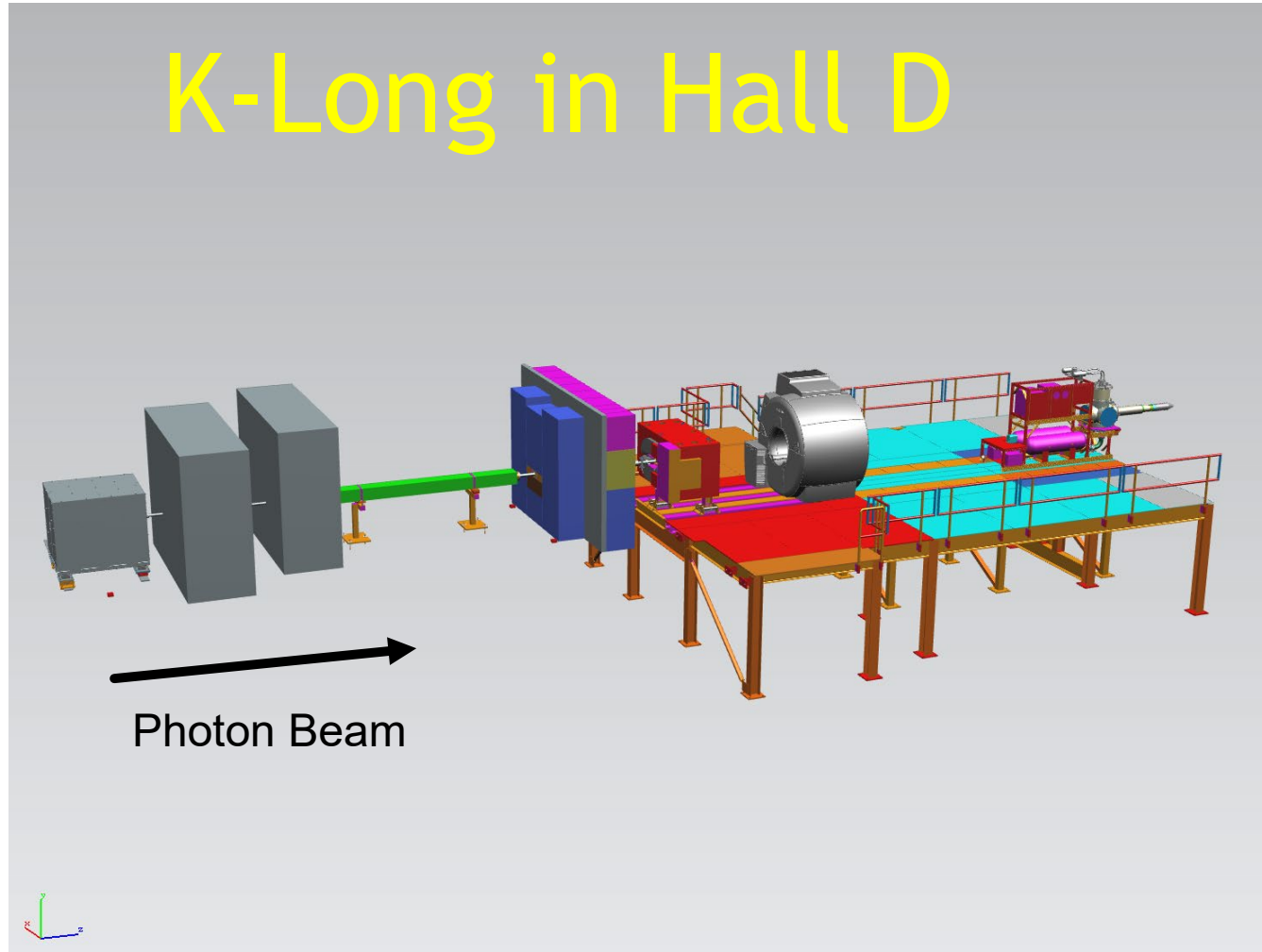


# Engineering Status

## K-Long in Hall D



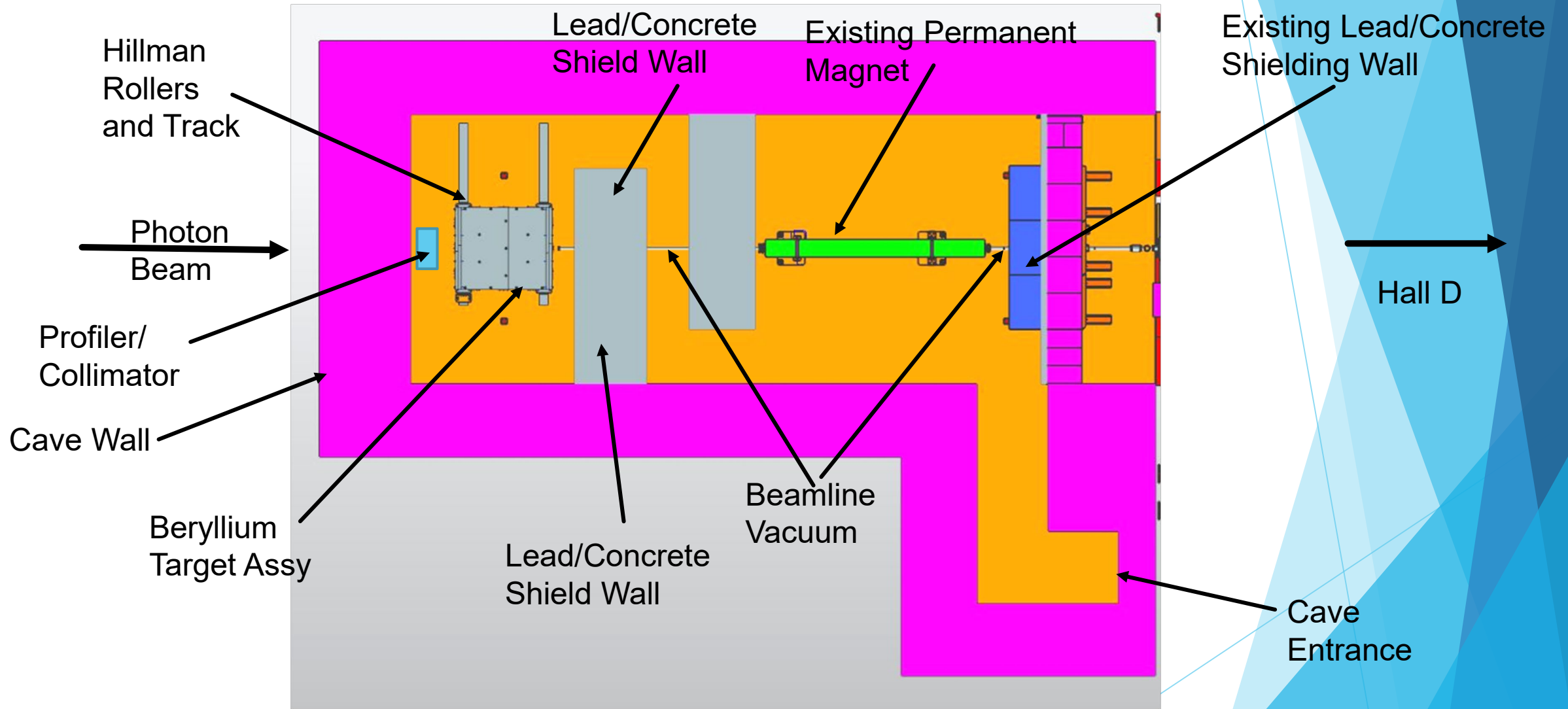
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# Topics

- ▶ KPT
  - ▶ Design Status
  - ▶ Cooling and Contamination
  - ▶ Civil Construction Requirements
  - ▶ Cost and Schedule
  - ▶ Decommissioning Plan
- ▶ CPS
  - ▶ Design Status
  - ▶ Cooling and Contamination
  - ▶ Civil Construction Requirements
  - ▶ Cost and Schedule
  - ▶ Decommissioning Plan
- ▶ Flux Monitor
  - ▶ Design Status

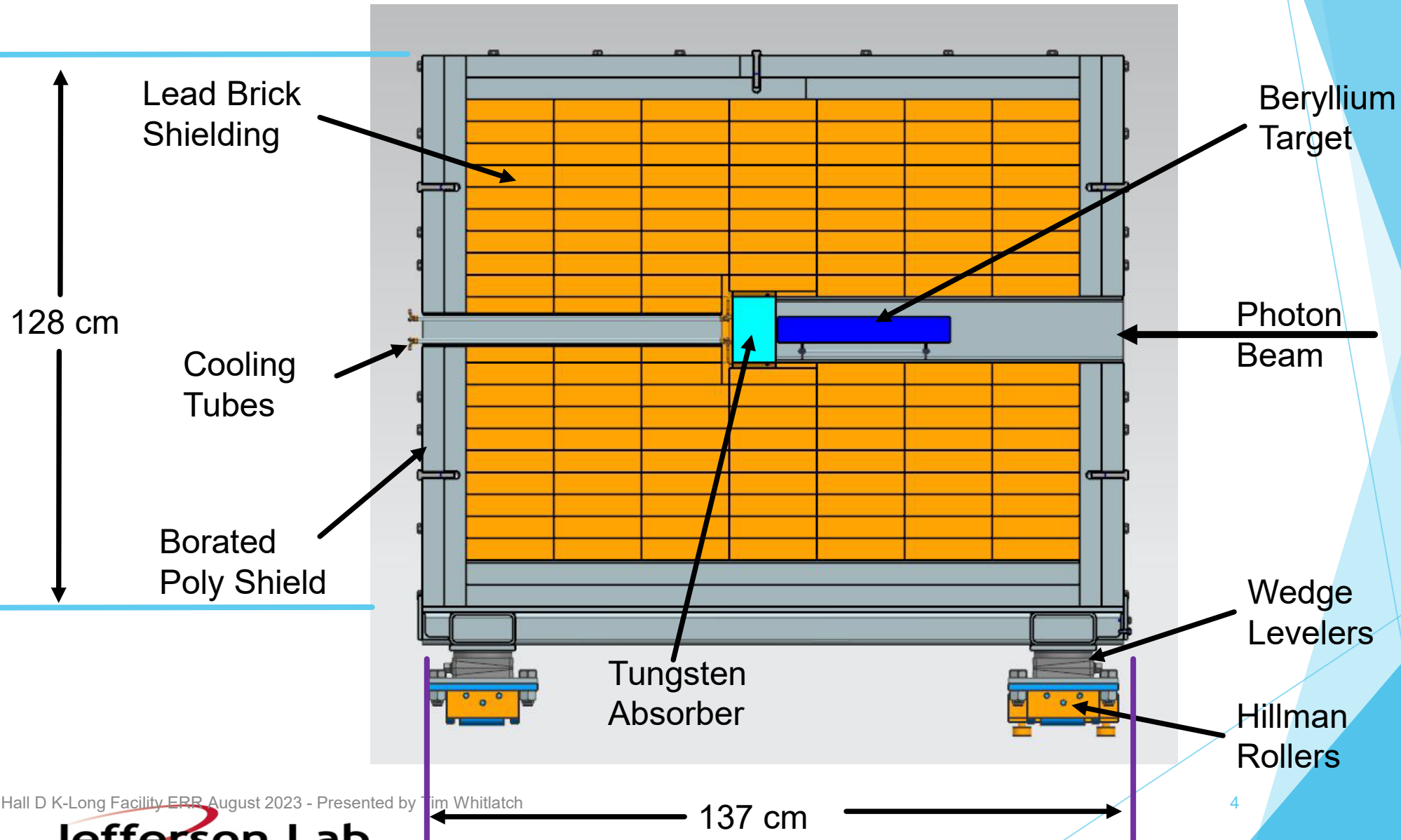
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# Hall D Collimator Cave Layout for KPT

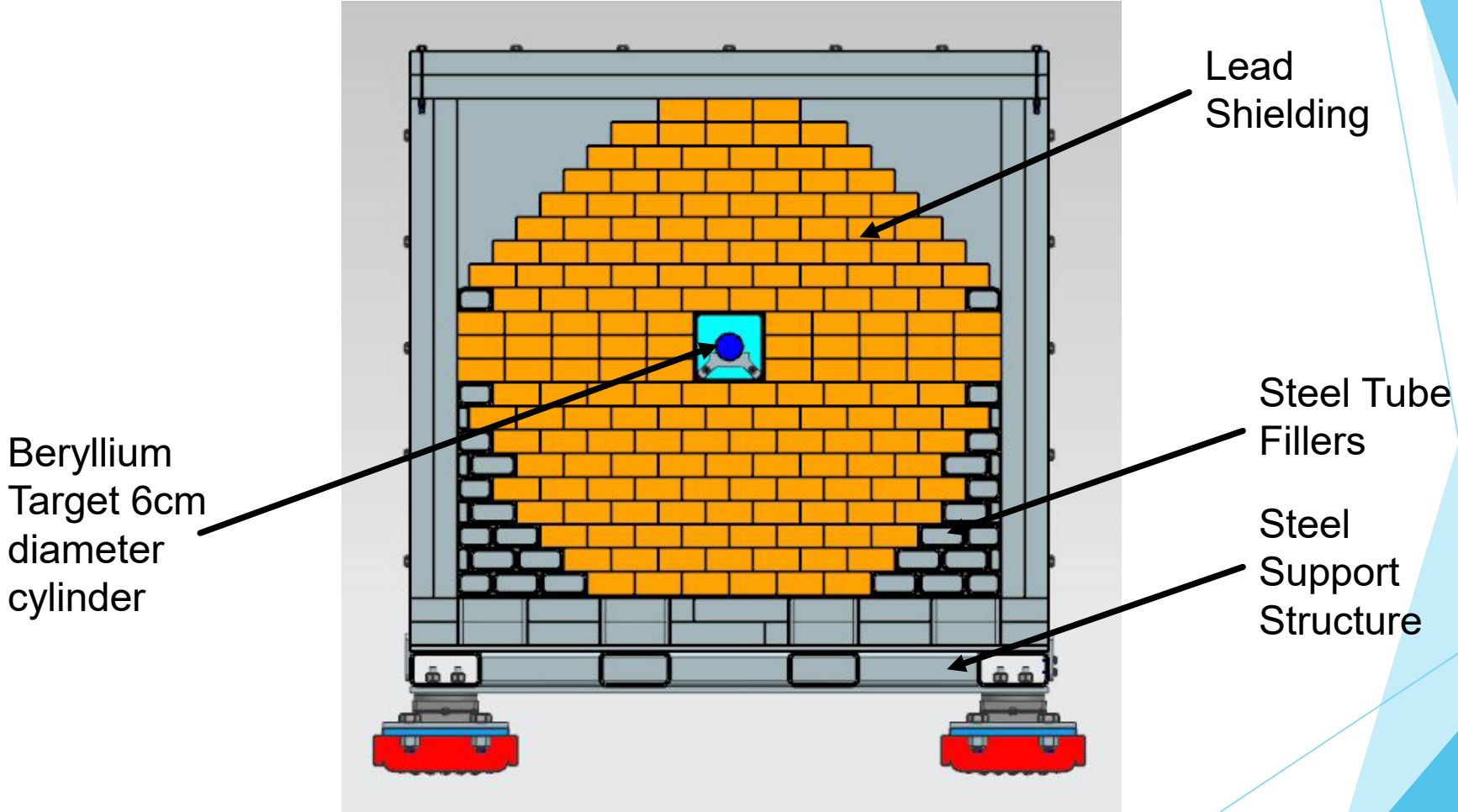


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# Beryllium Target Assy



# Beryllium Target Section



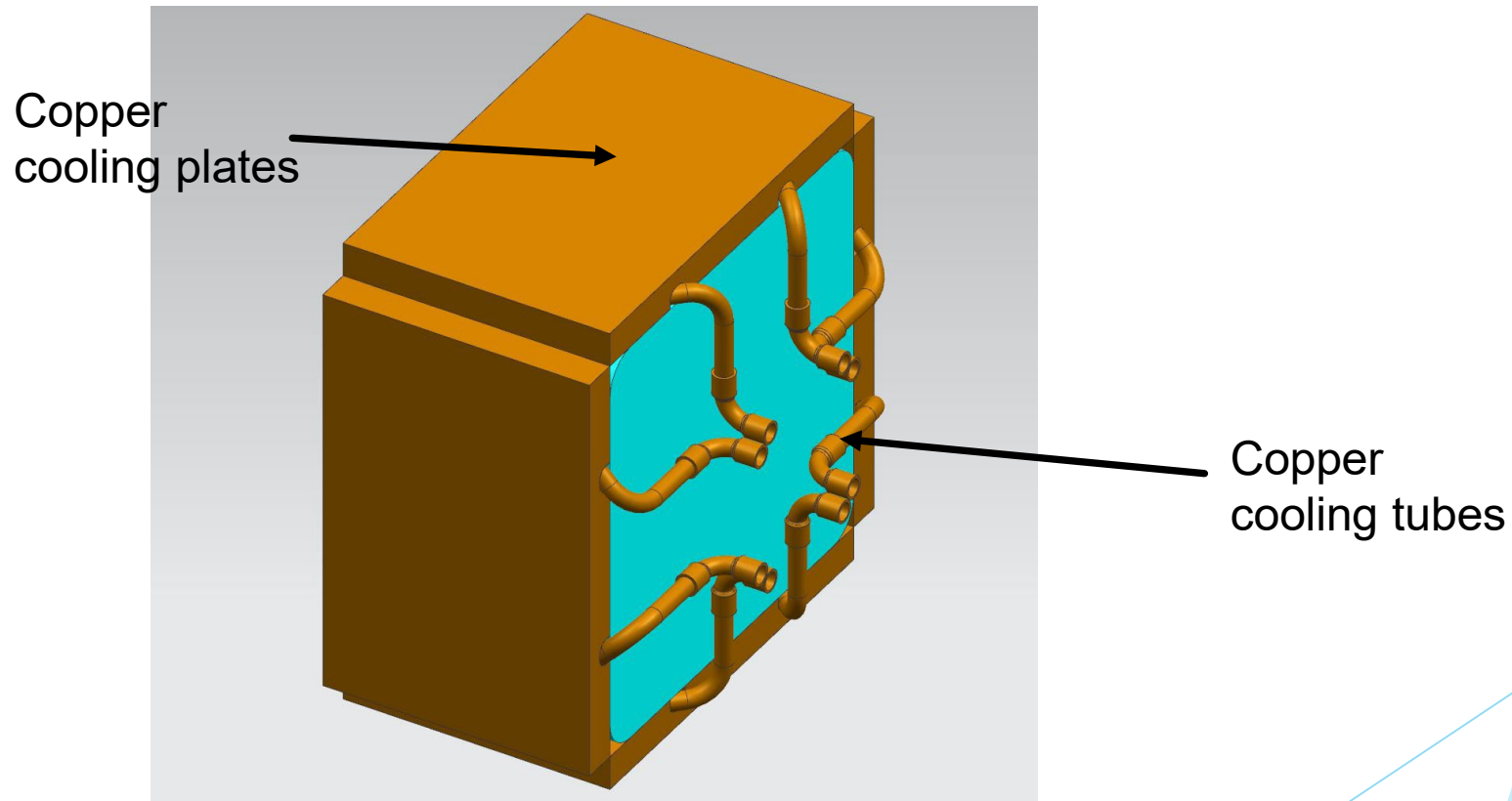
# Design Requirements/Specs

- Beryllium Target
  - 6cm diameter
  - 40 cm length
  - 300W power absorption
  - Water cooled- separate chiller system
- Tungsten absorber
  - 15.24 cm square
  - 10cm length
  - 5.2KW power absorption
  - Water cooled - separate Chiller system required

# Tungsten Absorber Thermal Analysis

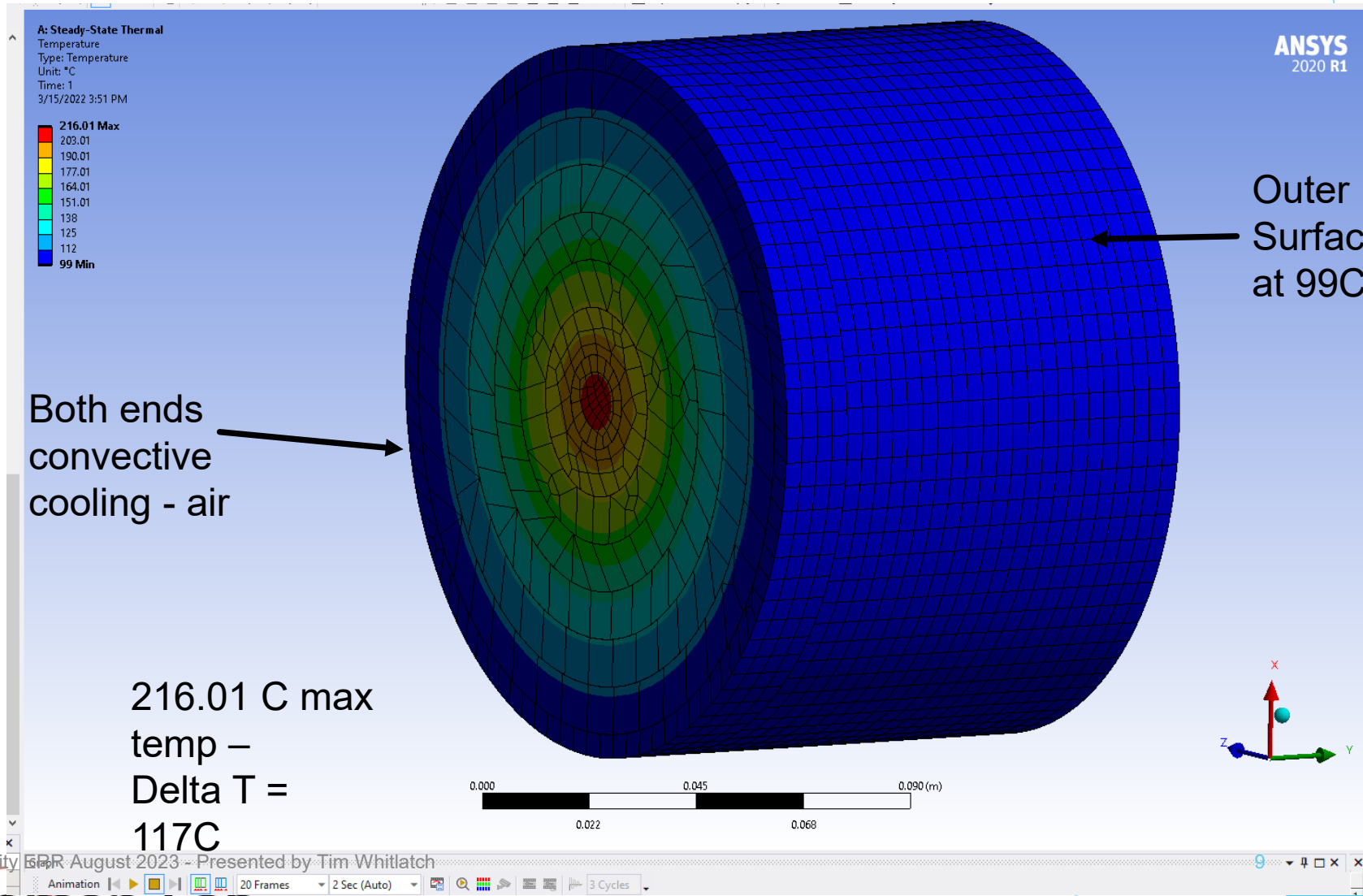
- ▶ Power absorption data provided by Vitaly Baturin
- ▶ Modelled in ANSYS Static Thermal
- ▶ Shows maximum delta T of 117C
- ▶ Outer Surface cooled with water under 100C
- ▶ Maximum Tungsten Temp 216C
- ▶ All can be accommodated

# 3D Rendering - cooling plates on 4 sides - Max water temp less than 50C - 4 circuits

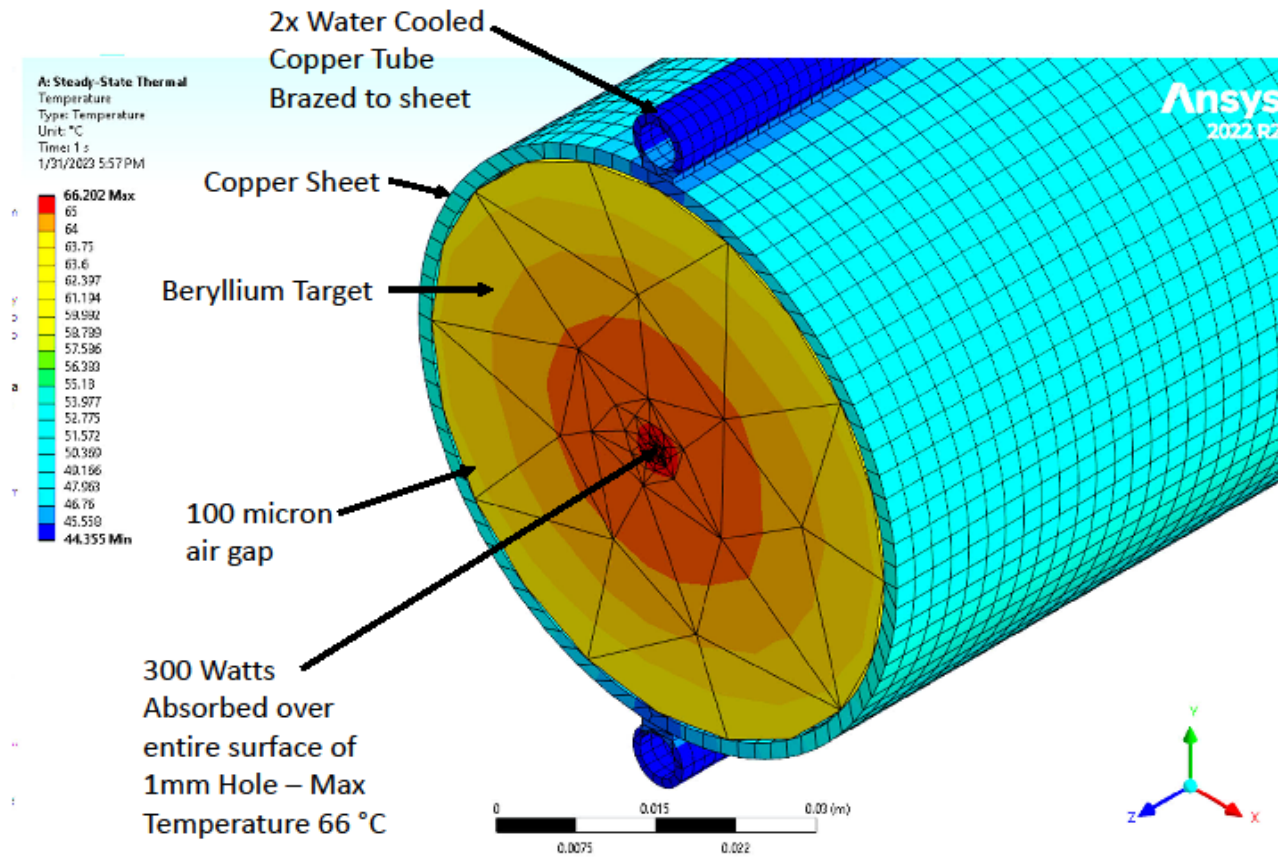




# Tungsten Absorber 5.2 KW total input - 2 W/m<sup>2</sup> convection US face - 80C air temp



# Beryllium Target Water Cooled

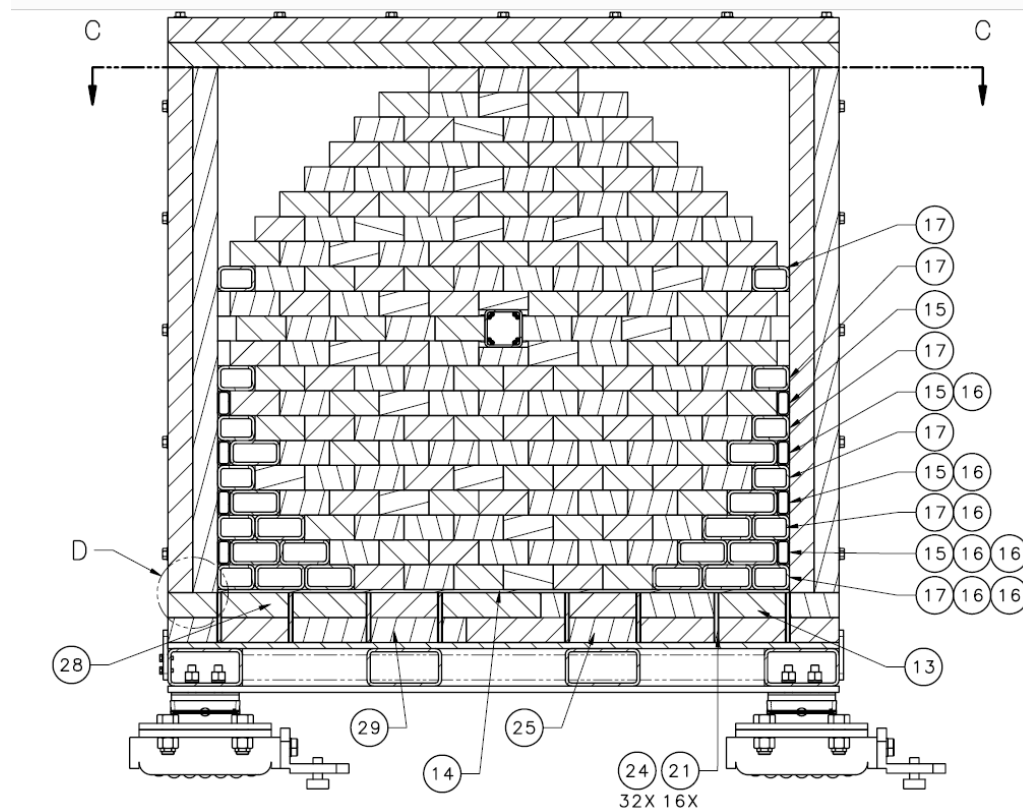


# Cooling System For KPT Target and Absorber

- ▶ 5.2 Kw from Tungstem
- ▶ 300 watts from Berylium
- ▶ Separate 6Kw Chiller - recirculated water stays in Hall
- ▶ <3 gpm required
- ▶ Delta T of water less than 10C
- ▶ Tungsten has 4 circuits, beryllium 1 circuit

# KPT Design Status

- ▶ 95% Complete Final Design Drawings
- ▶ Need to finalize Collimator or Profiler



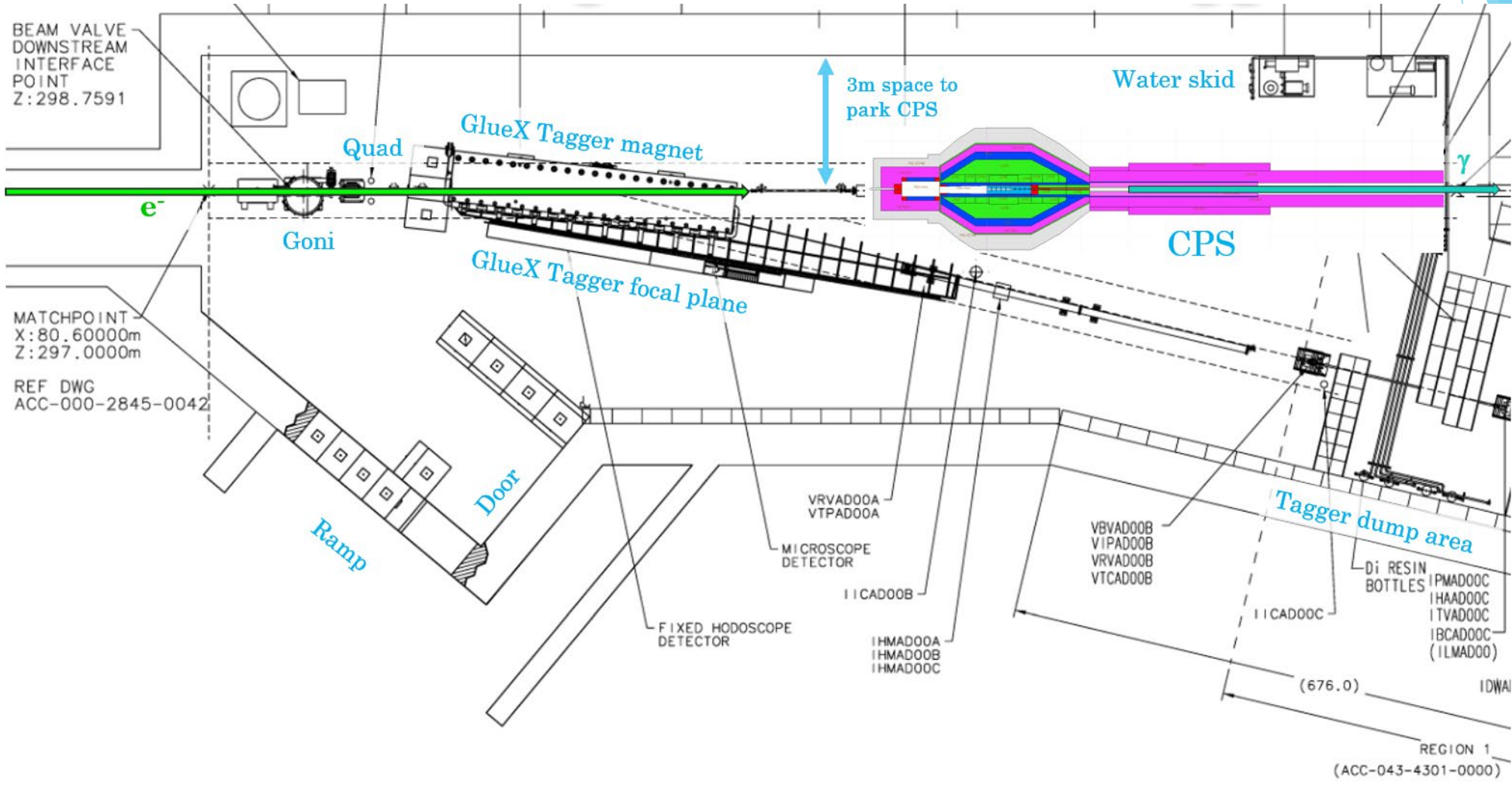
# KPT Costs

Equipment	qty	cost ea \$	Fab cost \$	Total cost \$
Beryllium target	1	11,000		11,000
Beryllium support	1	1,100		1,100
Tungsten absorber	1	12,000		12,000
Target Lead Bricks	1190	52	2000	63,880
Target Support structure	1	0	9000	9,000
Hilman rollers	4	850		3,400
Rails	2		1850	1,850
wedge levelers	4	700		2,800
leveler base plate	4		2100	2,100
borated poly sheets	24	800	4800	24,000
Central support tubes	2	800		1,600
Hardware	76	2.5		190
cooling plates	4	1240		4,960
Water cooling system	1	20000		20,000
Shielding wall lead bricks	792	52		41,184
vacuum beamline	1	5000		5,000
Concrete block shielding wall	1188	6		7,128
Water cooling for beryllium	1	1000		1,000
Active collimator stand	1	10000		10,000
PLC	1	2000		2,000
Temperature sensors and PLC co	6	150		900
Support for shield wall	2	3300		6,600
<b>Total cost</b>				<b>231,692</b>

# KPT Installation

Task	Days Duration	# Eng	# Tech	FTE Eng	FTE Tech	FTE Facilities	FTE S&A
<b>Remove old Equipment</b>							
Beamline		2	0.1	3	0.0008	0.02	
Profiler		1	0.1	2	0.0004	0.01	
Primary Collimator		1	0.1	2	0.0004	0.01	
Secondary Collimator		2	0.1	3	0.0008	0.02	
Move North Cable Tray		1	0.1	2	0.0004	0.01	
Permanent Magnet		2	0.1	3	0.0008	0.02	
Polarimeter		2	0.1	3	0.0008	0.02	
Stands		2	0.1	2	0.0008	0.02	
<b>Install KPT</b>							
Rails on Floor		3	0.2	2	0.0024	0.02	0.01
Target Support Structure		2	0.3	3	0.0024	0.02	0.01
Bottom layers of target shielding		10	0.2	4	0.008	0.16	
Beryllium Target		1	0.2	2	0.0008	0.01	
Tungsten Absorber		1	0.2	2	0.0008	0.01	0.01
Hook up cooling system and leak check		5	0.1	2	0.002	0.04	
Remaining target shielding		10	0.3	4	0.012	0.16	
New Profiler/Collimator		3	0.2	2	0.0024	0.02	0.01
1st shielding wall		10	0.2	4	0.008	0.16	
2nd shielding wall		10	0.1	4	0.004	0.16	0.01
Permanent magnet		4	0.1	4	0.0016	0.06	0.01
Beamline		5	0.1	3	0.002	0.06	0.01
Test all systems		10	0.2	1	0.008	0.04	
<b>Totals</b>		<b>87</b>			<b>0.0596</b>	<b>1.07</b>	<b>0 0.04</b>
<b>Duration in months</b>		<b>4.35</b>					
<b>Techs required for duration (ave)</b>		<b>2.95</b>					
<b>Eng required for duration (ave)</b>		<b>0.16</b>					
<b>Designer for needed modifications</b>		<b>0.1</b>					
<b>Techs with overhead for safety and training</b>		<b>3.54</b>					

# CPS in Tagger Hall



# Pavel 75 Keyhole Model 52Kw

C: Steady-State Thermal

Temperature

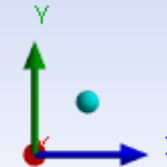
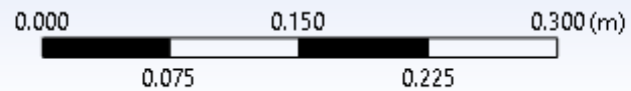
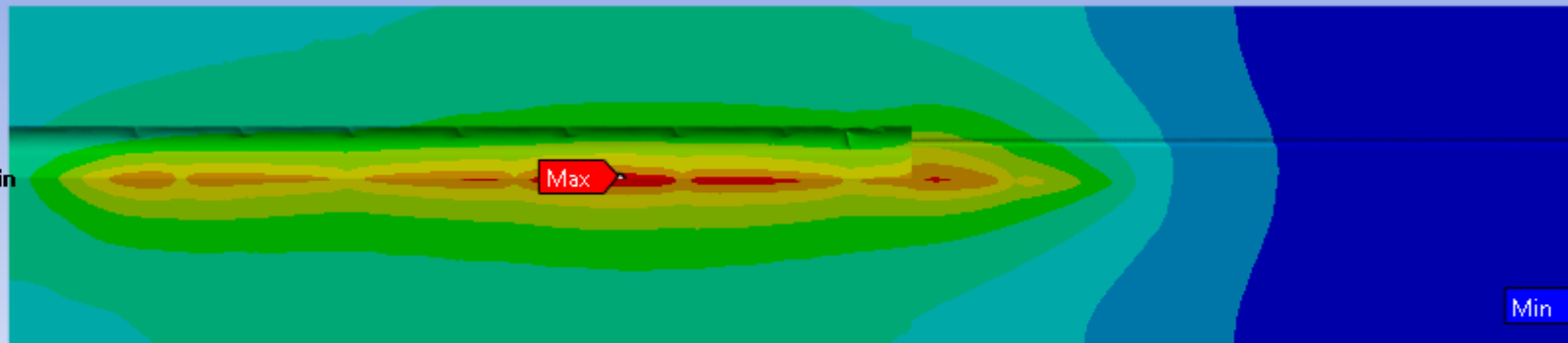
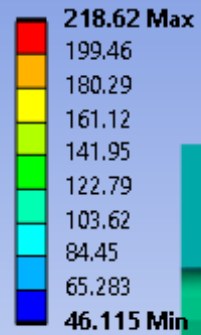
Type: Temperature

Unit: °C

Time: 1 s

7/24/2023 12:28 PM

Ansys  
2022 R2

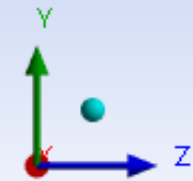
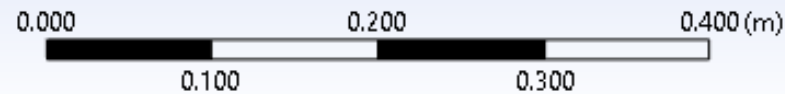
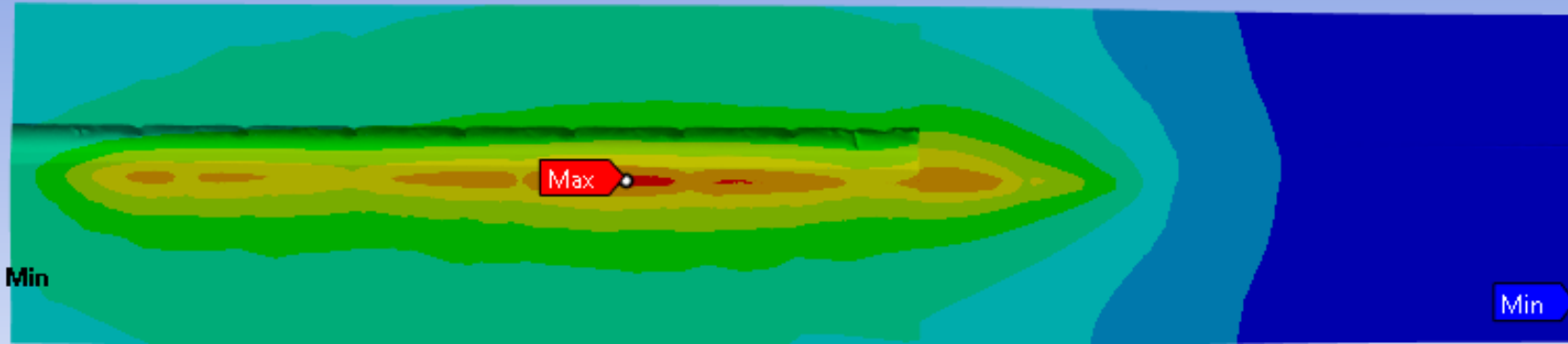
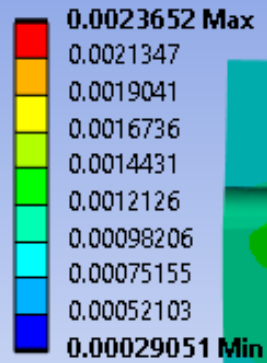




# Pavel 75 Keyhole Model 52Kw Thermal Strain

**D: Static Structural**  
Thermal Strain  
Type: Thermal Strain(X Axis)  
Unit: m/m  
Global Coordinate System  
Time: 1 s  
7/24/2023 12:33 PM

**Ansys**  
2022 R2

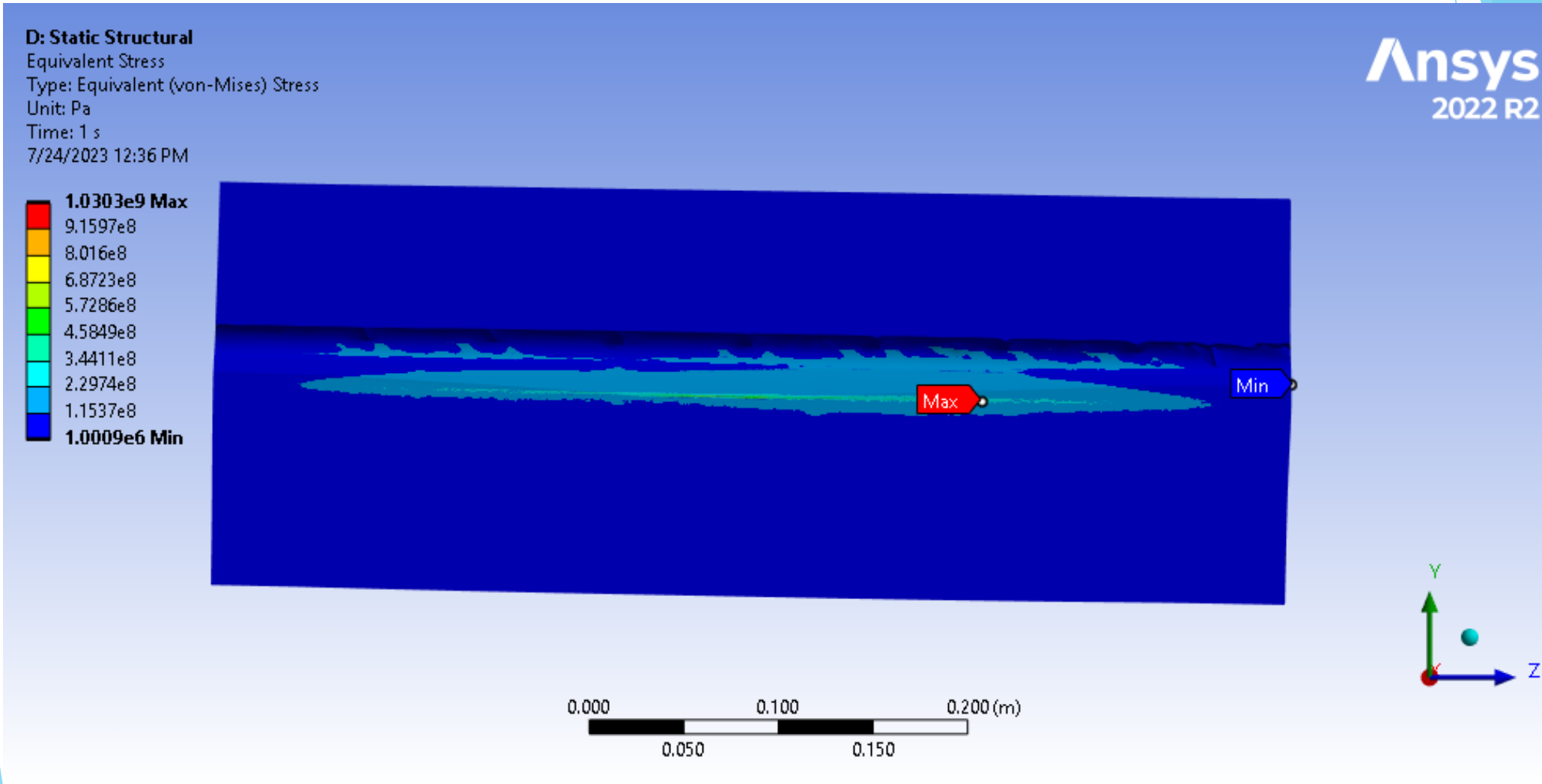


# Thermal Stress - copper absorber C101

## Full Hard

- ▶ Strain = Alpha \* delta T
- ▶ Stress = Youngs Modulus \* Strain
- ▶ Strain =  $1.674 \times 10^{-5} / \text{C} * 172\text{C} = .0029$
- ▶ Stress =  $1.26 \times 10^{11} \text{ Pa} * .0029 = 365 \text{ MPa}$
- ▶ Allowable yield stress = 283 Mpa
- ▶ Model Shows higher
- ▶ More work to be done to understand/reduce stresses

# Pavel 75 Keyhole Model 52Kw - Total Stress

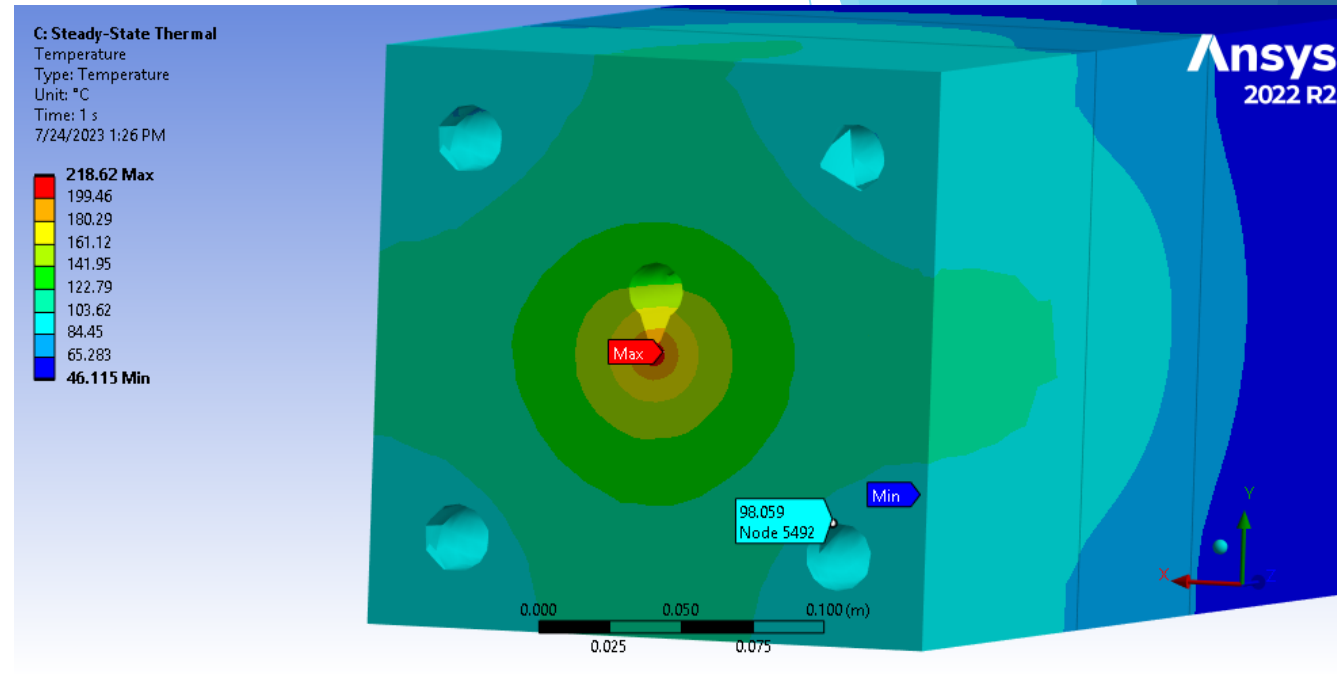


# CPS Cooling Requirements

- ▶ 54KW to be removed
- ▶ Use existing Tagger Dump Cooling Skids (60 KW)
  - ▶ 30 gpm total available for 2 skids
  - ▶ Local recirculation LCW
- ▶ 2 circuits needed

# Cooling System For CPS

- ▶ 52 Kw from Copper Absorber
- ▶ Use existing dump cooling system - recirculated water stays in Hall
- ▶ 30 gpm required
- ▶ Delta T of water less than 8C
- ▶ 4 water cooling channels
- ▶ Maximum temperature at water cooling channels 98C
- ▶ 2 parallel circuits



# CPS Cost Estimates

Klong Compact Photon Source - Pavel

Component	qty	Lbs	Kg	cost ea \$	Fab cost \$	Total cost \$
Copper absorber	1	1916	869.864	33000	0	33,000
WCu absorbers	138.32	3458	1569.93	1,400		193,648
Lead Bricks	2220.423	57731	26209.9	52	2000	117,462
borated poly sheets	89.48125	14317	6499.92	800	35792.5	107,378
Iron core	1	3370	1529.98	16850	0	16,850
Iron shield	1	27555	12510	137775	0	137,775
Barite concrete (CPS and beamline)	893.926	55132	25029.9	10	10,000	18,939
Adjustment components	3			2800		8,400
Support Structure	1			30000		30,000
Rail System	1			4000		4,000
Water Cooling System	1			5000		5,000
Beamline Plus girder	1			10000		10,000
Radiator (3 position remotely)	1			15000		15,000
Magnet	1	2202.65	1000	110000		110,000
Power Supply	1			100000		100,000
Machining of shielding components	1			15000		15,000
Concrete pier	1			20000		20,000
Temperature sensors and wires	20			200		4,000
Vacuum Pump and controllers	1			20000		20,000
PLC modules and shielding	5			1500		7,500
<b>Total Materials</b>		<b>165681.65</b>	<b>75219.5</b>			<b>973,952</b>

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# CPS Required Design Manpower

KLONG CPS Design						
	Days	#	#	FTE	FTE	FTE
Task	Duration	Eng	Des	Eng	Des	Facilities
<b>Design new beamline</b>						
Beamline layout	10	0.1	1	0	0.04	
Perm Magnet setup	2	0.1	1	0	0.01	
Vacuum pump setup	2	0.1	1	0	0.01	
Final Beamline drawings	25	0.2	1	0.02	0.1	
Component procurement	200	0.05	0.05	0.04	0.04	
<b>Design CPS</b>						
Design Concrete Base	30	0.2	1	0.02	0.12	0.12
Design rails	15	0.3	1	0.02	0.06	
Design support structure/strongback	25	0.4	1	0.04	0.1	
Design adjustment system	25	0.1	1	0.01	0.1	
Design magnets	65	0.4	1	0.1	0.26	
Procure Magnets and Power Supplies	250	0.1	0.1	0.1	0.1	
Design radiator	25	0.1	1	0.01	0.1	
Design shielding	120	0.2	1	0.1	0.48	
Test Magnets	5	0.2	2	0	0.04	
Design alignment system	45	0.2	1	0.04	0.18	
Design cooling system	30	0.4	1	0.05	0.12	
Procure all shileding components	200	0.1	0.05	0.08	0.04	
Procure rails, strongback and cooling	200	0.1	0.05	0.08	0.04	
Procure radiator components	80	0.1	0.05	0.03	0.02	
Installation Drawings	40	0.1	1	0.02	0.16	
<b>Totals</b>	<b>424</b>	<b>Days</b>		<b>0.76</b>	<b>2.11</b>	<b>0.12</b>
<b>Duration in months</b>	<b>21.2</b>					
<b>Des required for duration (ave)</b>	<b>1.20</b>					
<b>Eng required for duration (ave)</b>	<b>0.43</b>					

# CPS Installation

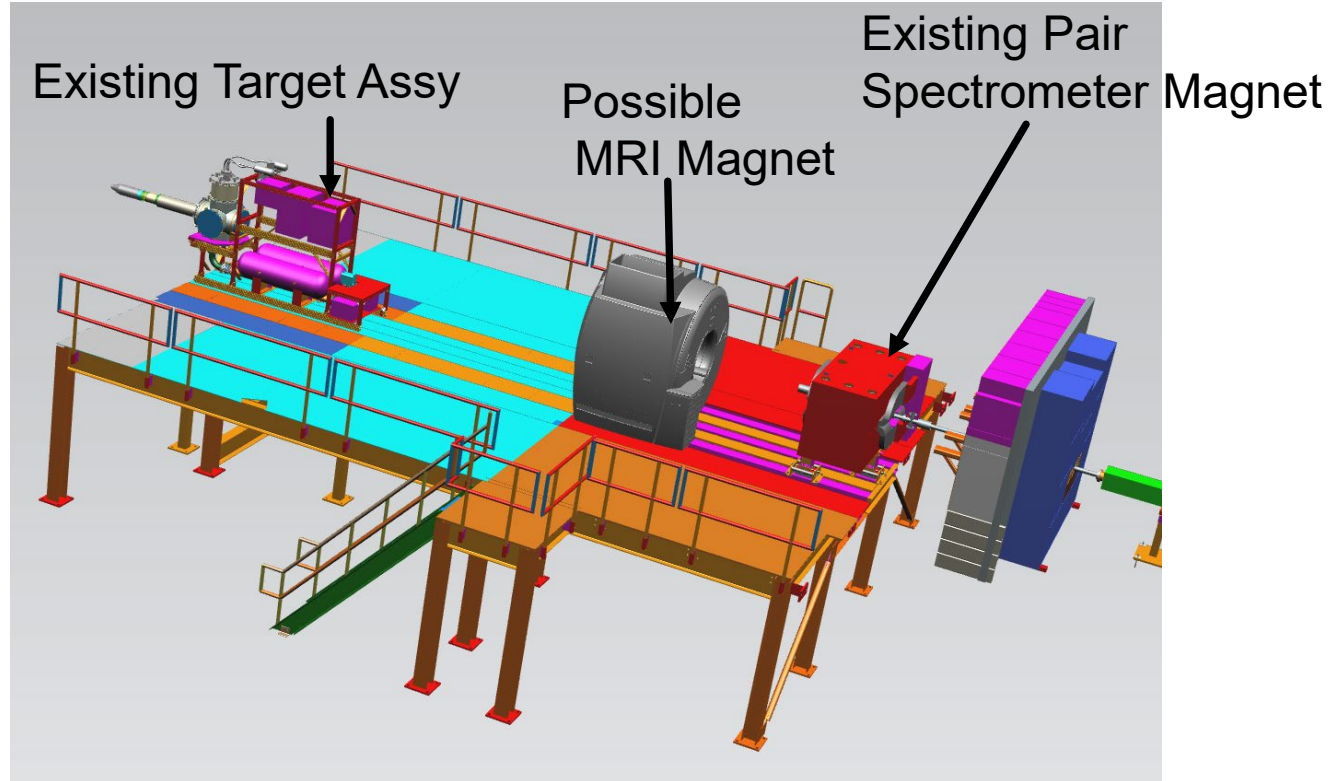
KLONG CPS Installation							
Task	Days Duration	# Eng	# Tech	FTE Eng	FTE Tech	FTE Facilities	FTE S&A
Remove old equipment							
Crates		5	0.1	3	0.002	0.06	
microscope		3	0.1	3	0.0012	0.04	
Hodoscope		3	0.1	2	0.0012	0.02	
Beamline		5	0.2	3	0.004	0.06	
Install CPS							
Install Concrete Base		10	0.1	1	0.004	0.04	0.12
Install rails		4	0.3	3	0.0048	0.05	0.01
Install support structure		10	0.3	3	0.012	0.12	0.02
Install magnets		10	0.2	3	0.008	0.12	
Install Power Supplies		5	0.1	3	0.002	0.06	
Survey and alignment		2	0.2	1	0.0016	0.01	0.01
Install radiator		2	0.3	2	0.0024	0.02	0.01
Install partial shielding		20	0.2	4	0.016	0.32	
Test Magnets		5	0.2	2	0.004	0.04	
Survey and Alignment		2	0.2	1	0.0016	0.01	0.01
Install remaining shielding		20	0.2	4	0.016	0.32	
Install cooling system		10	0.4	3	0.016	0.12	
Install Perm Magnet		4	0.2	3	0.0032	0.05	0.01
Install beamline & windows		5	0.2	3	0.004	0.06	
Install New Girder		3	0.1	3	0.0012	0.04	0.01
Setup and test controls		20	0.1	1	0.008	0.08	
Final Survey		2	0.1	1	0.0008	0.01	0.01
<b>Totals</b>		<b>150</b>			<b>0.114</b>	<b>1.63</b>	<b>0.12</b>
<b>Duration in months</b>		<b>7.5</b>					
<b>Techs required for duration (ave)</b>		<b>2.61</b>					
<b>Eng required for duration (ave)</b>		<b>0.18</b>					
<b>Techs with overhead for safety and training</b>		<b>3.13</b>					



# Civil requirements

- ▶ Collimator Floor Capable of supporting additional 120+ Tons
- ▶ Tagger Hall Floor Capable of supporting additional 120+ Tons
  - ▶ Facilities will re-evaluate when final weight is determined
  - ▶ Facilities to install concrete pier

# Conceptual Flux Monitor Setup in Hall D



MRI Magnet can fit in existing space

# Decommissioning

- ▶ CPS
  - ▶ Roll CPS to South wall in the Tagger Vault
  - ▶ Remove CPS beamline and shielding
  - ▶ Reinstall GlueX beamline
  - ▶ Reinstall Hodoscope, Microscope and electronics
  - ▶ Reinstall Dump cooling
  - ▶ 6 months duration
- ▶ KPT
  - ▶ Roll Target to North wall
  - ▶ Remove KPT shielding and beamline
  - ▶ Reinstall GlueX beamline
  - ▶ 4 months duration
- ▶ KFM
  - ▶ Remove KFM setup
  - ▶ Reinstall Gluex beamline, detectors and target
  - ▶ 1-3 months duration

# Status

- ▶ Collimator Cave Final Drawings 95% Complete
- ▶ Preliminary Thermal Analysis Complete for CPS
- ▶ Final Stress analysis for CPS required
- ▶ Integrated Installation Plan Needed
- ▶ Flux Monitor in Conceptual Phase - Proposed MRI will fit
- ▶ CPS Design Work to start Following ERR Approval

# Backup

# Cave Layout Elevation

