

ÜÇ BOYUTLU (3D) KONFORMAL PROSTAT RADYOTERAPİSİNDE 3,4,5,6 ve 7 SAHALI TEDAVİ TEKNİKLERİNİN KARŞILAŞTIRILMASI

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Yasemin BÖLÜKBAŞI, Ayfer HAYDAROĞLU**

**EGE ÜNİVERSİTESİ TIP FAKÜLTESİ
RADYASYON ONKOLOJİSİ ANABİLİM DALI
İZMİR**

AMAÇ

Prostat ve seminal veziküllerin üç boyutlu konformal radyoterapisinde, doz sınırlayıcı organlar olan rektum, mesane ve femurların en az doz alması için, çeşitli saha sayıları ve gentri açıları kullanarak, optimum tedavi tekniklerinin belirlenmesi.

MATERYAL ve METOD

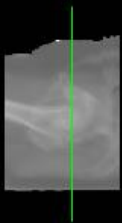
- 9 İnopere, 8 opere (T3, cerrahi sınır pozitif) hasta supine pozisyonda yatırılıp, eller bilekten tutularak başa dayalı, ayaklarının altında stopper, dizlerinin altında dizlik kullanılarak sabitlendi.
- TOSHİBA marka bilgisayarlı tomografi cihazında 5 mm aralıklarla BT kesitleri alındı.



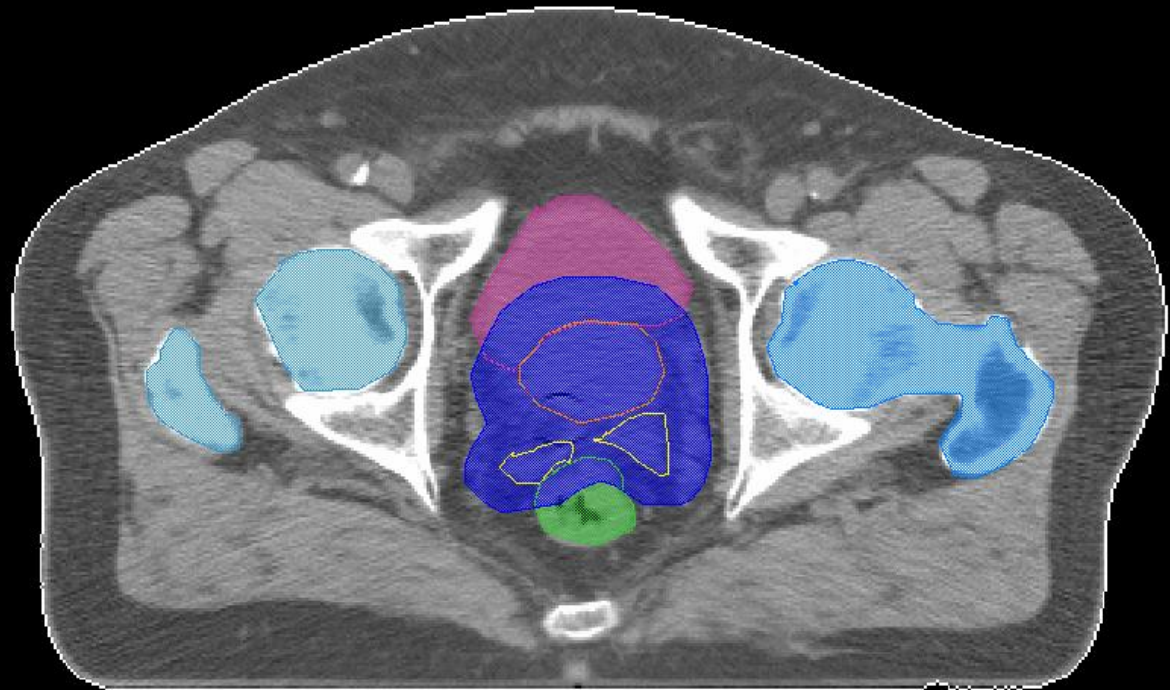
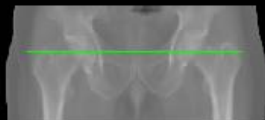
- BT görüntüleri İMPAC yardımıyla üç boyutlu planlama sistemine (Precise Plan) aktarıldı.
- CTV (prostat + seminal vezikül) ve doz sınırlayıcı organlar olan rektum, mesane ve femur başlarının konturları belirlendi.
- CTV'lere rektum tarafından 10 mm diğer yönlerden 15 mm marj verilerek PTV₁ ler oluşturuldu.

Transverse Z=-1.8 cm, T=-161.6 cm, CT=14

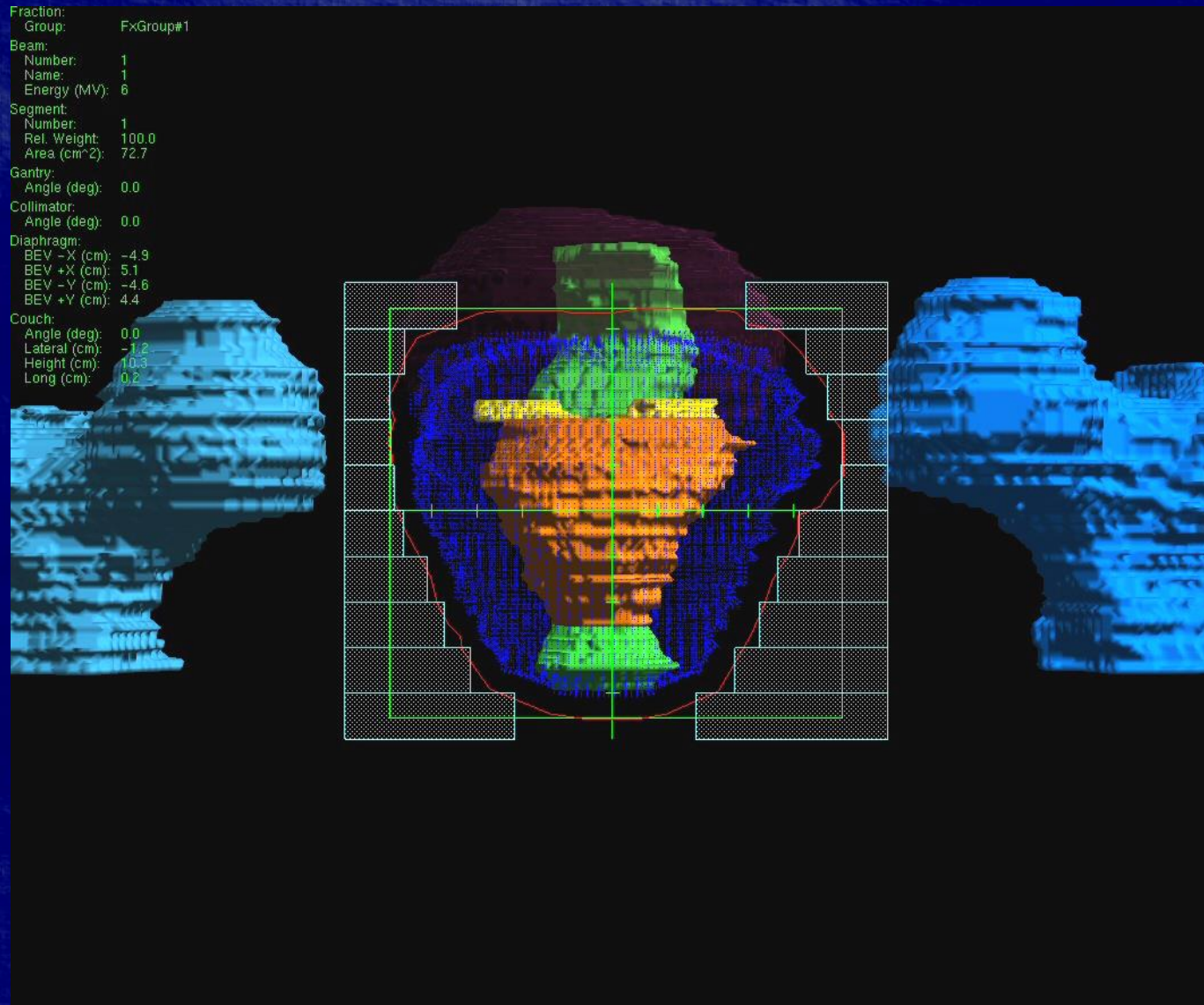
Sagittal



Coronal



➤ PTV₁ lere 5 mm penumbra marjı eklendi.



- İzomerkez PTV'lerin merkezi alındı.
- Opere ve inopere hastalarda başlangıçta günlük 2 Gy den 50 Gy doz verildi.
- Boost dozu inopere hastalara 24 Gy, opere hastalara ise 16 Gy verildi.
- 6 ve 18 MV enerjiler kullanıldı.

- Her bir hasta için 18 adet konformal planlama tekniği ele alındı.
- Her plan antero-posterior doğrultuya göre simetrik olacak şekilde saat yönünde gentri açıları ile isimlendirildi.

3A : (0/90), (0/105), (0/115), (0/120)

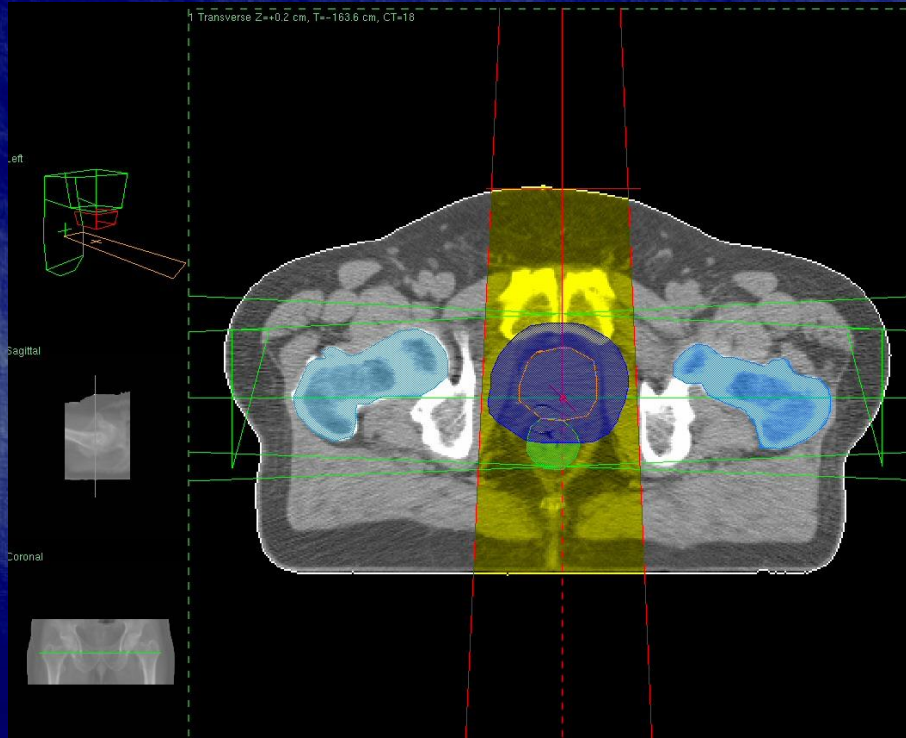
4A : (Box), (55/90), (45/90), (35/90), (45/135)

5A : (0/45/90), (0/55/95), (Homojen Gentri)

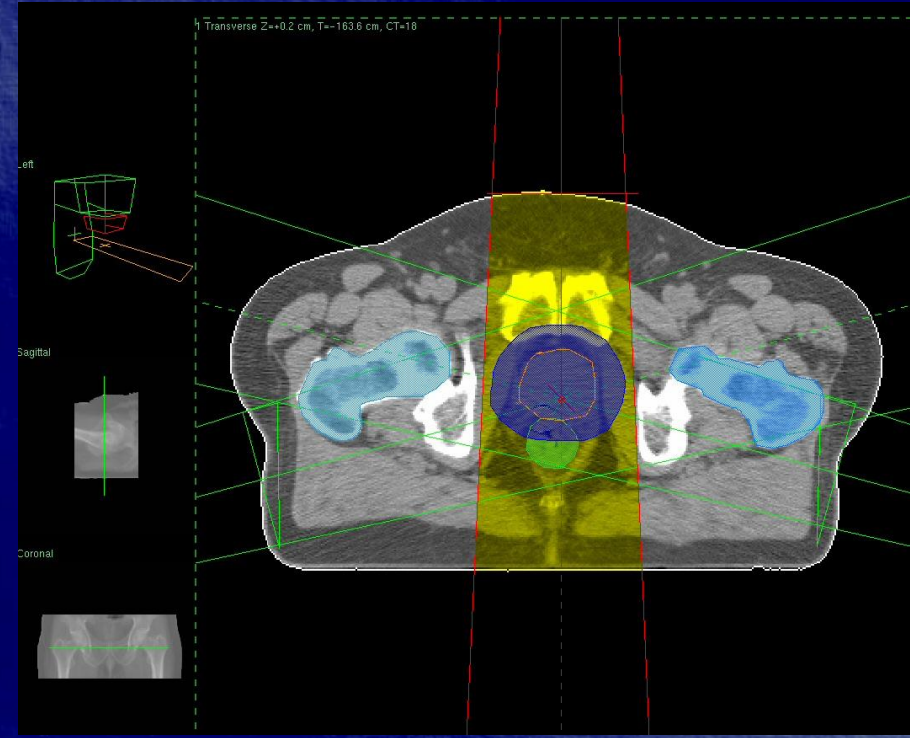
6A : (45/90/135), (55/90/125), (25/90/120)
(45/90/135 Double Weight)

7A : (0/45/90/135), (Homojen Gentri)

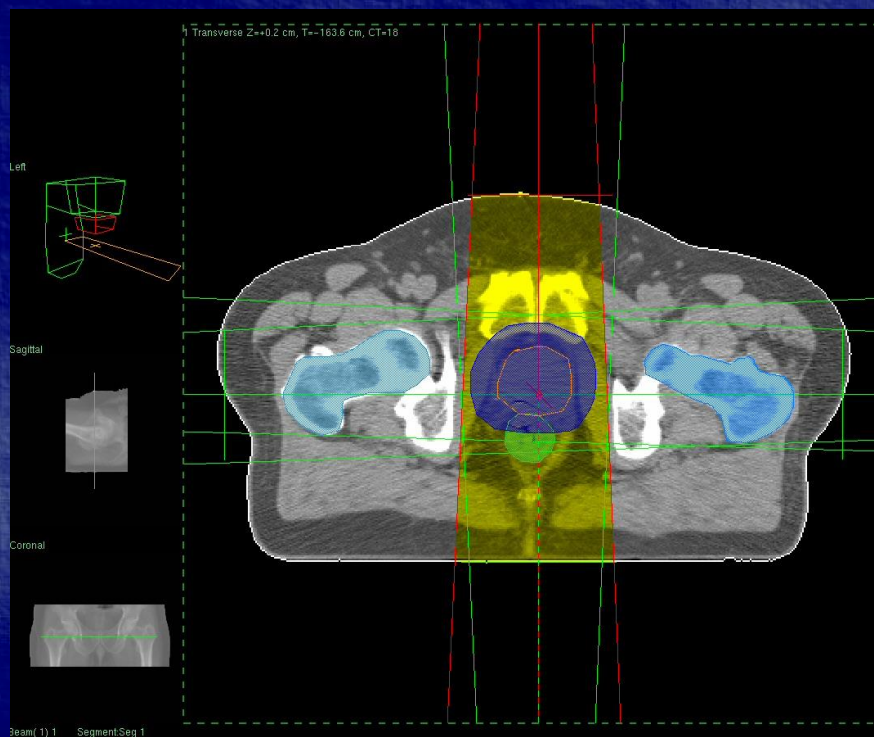
- Tedavinin ilk 50 Gy'lik bölümü için 3A ve 4A planlama teknikleri incelendi.



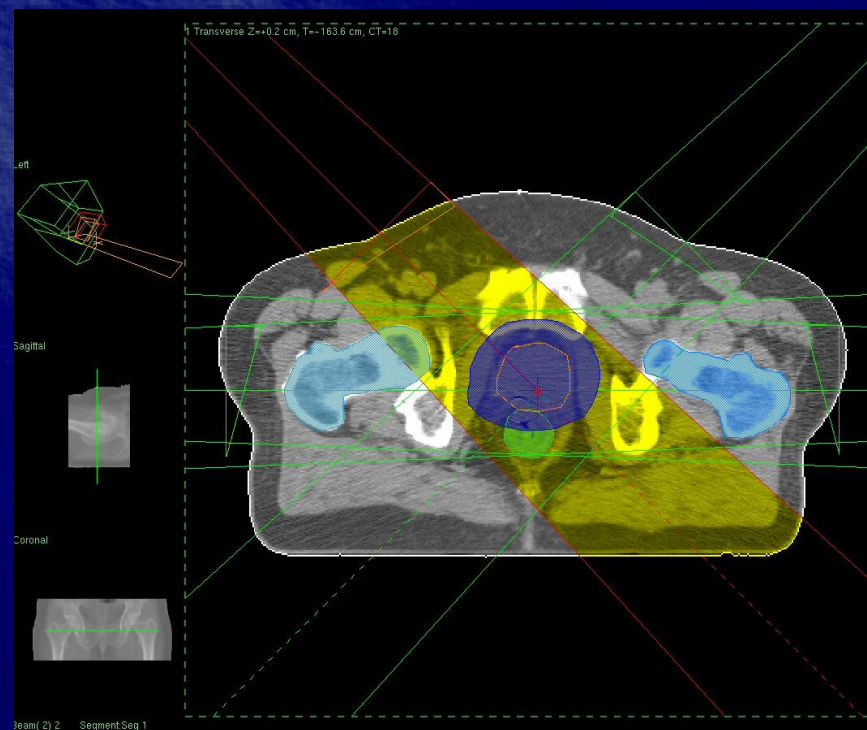
3A (0/90)



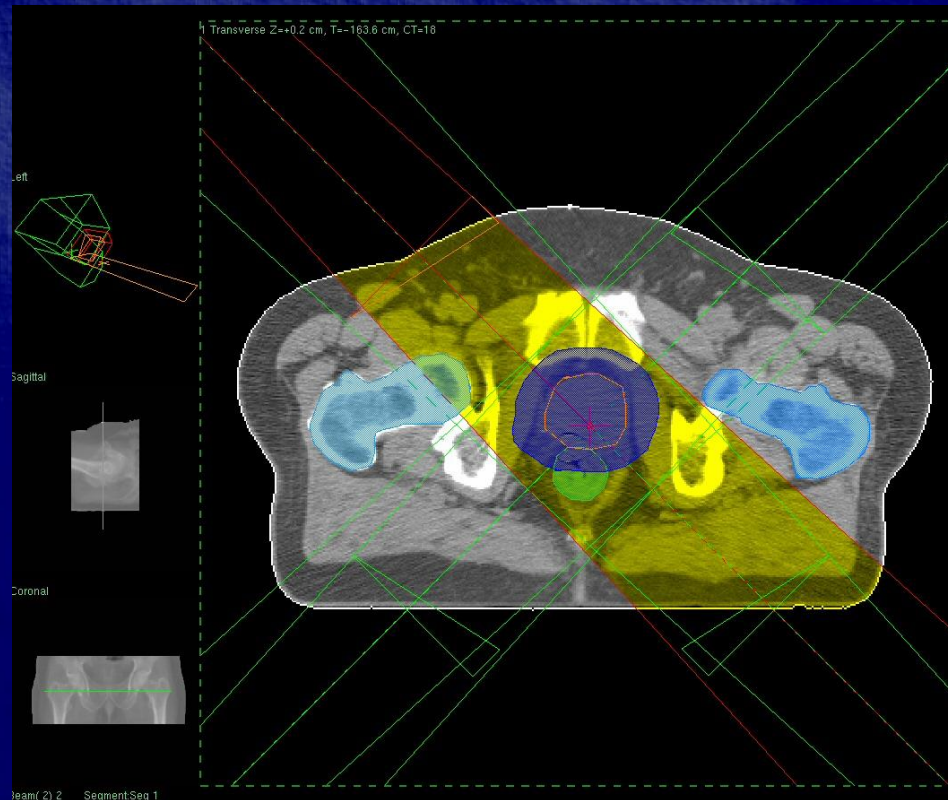
3A (0/105)



4A (BOX)

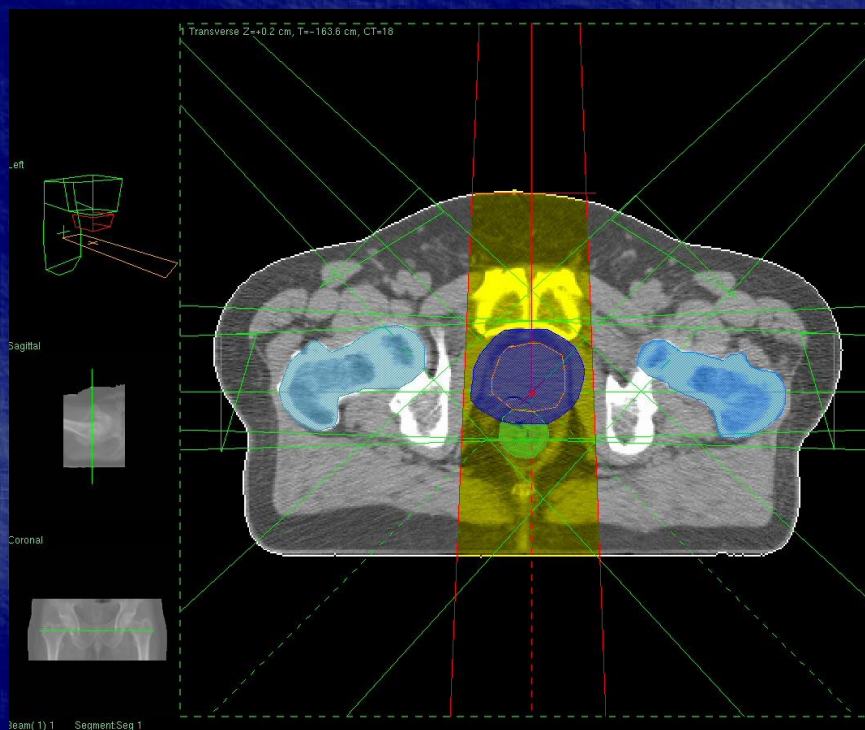


4A (45/90)

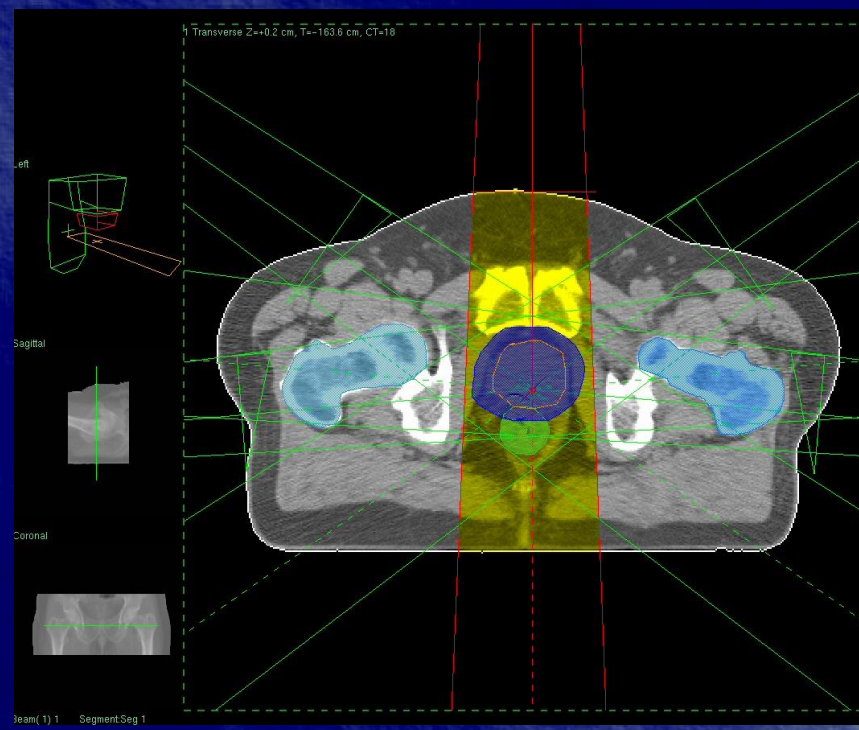


4A (45/135)

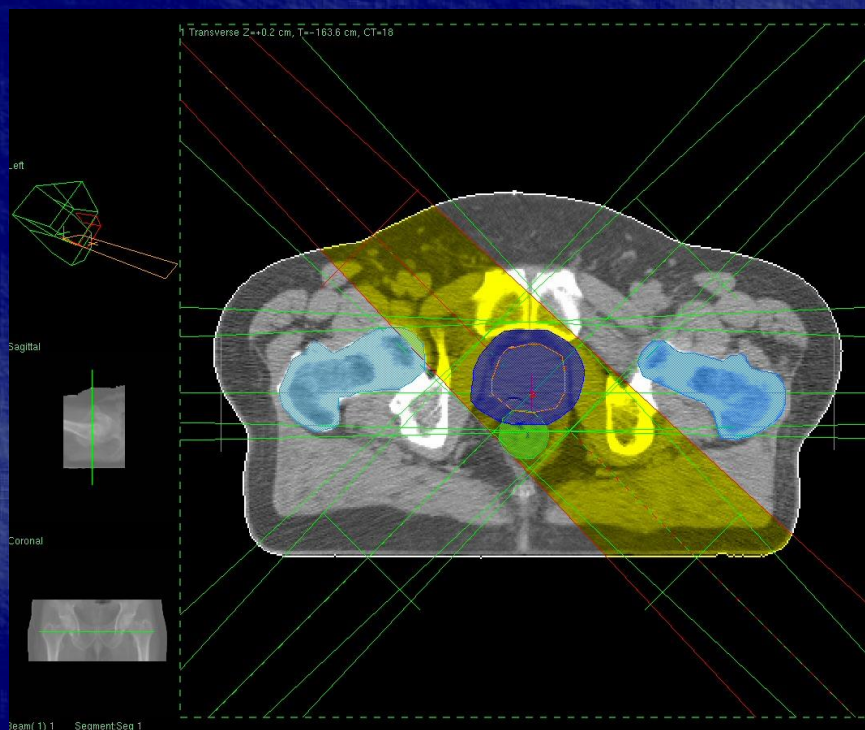
- Boost tedavileri için 5A, 6A, ve 7A planlamalar kullanıldı.
- CTV lere rektum tarafından 5 mm, diğer yönlerden 10 mm marjin verilerek PTV₂ ler oluşturuldu.
- PTV₂ lere 5 mm penumbra marjı eklendi.



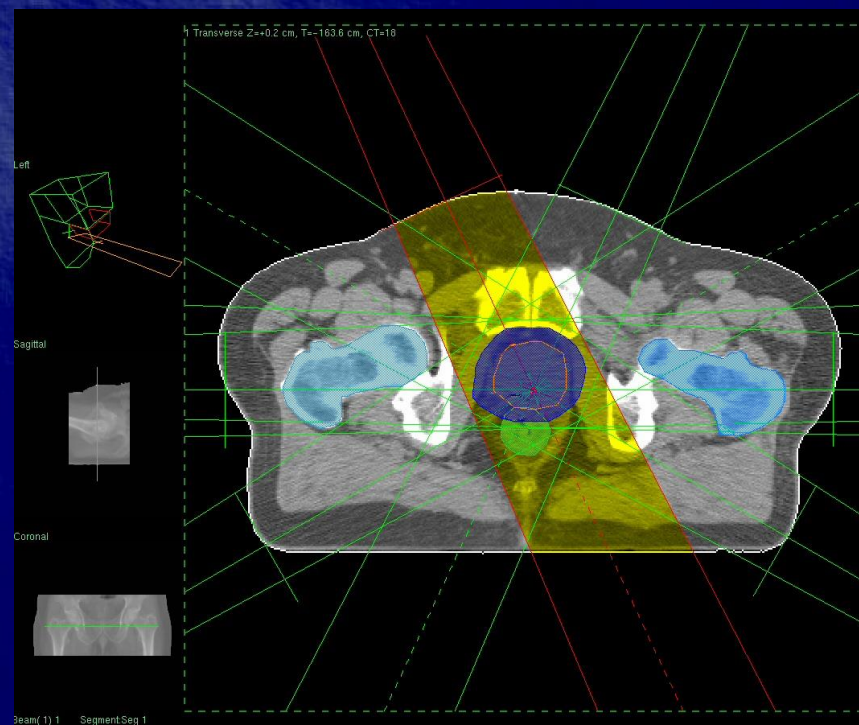
5A (0/45/90)



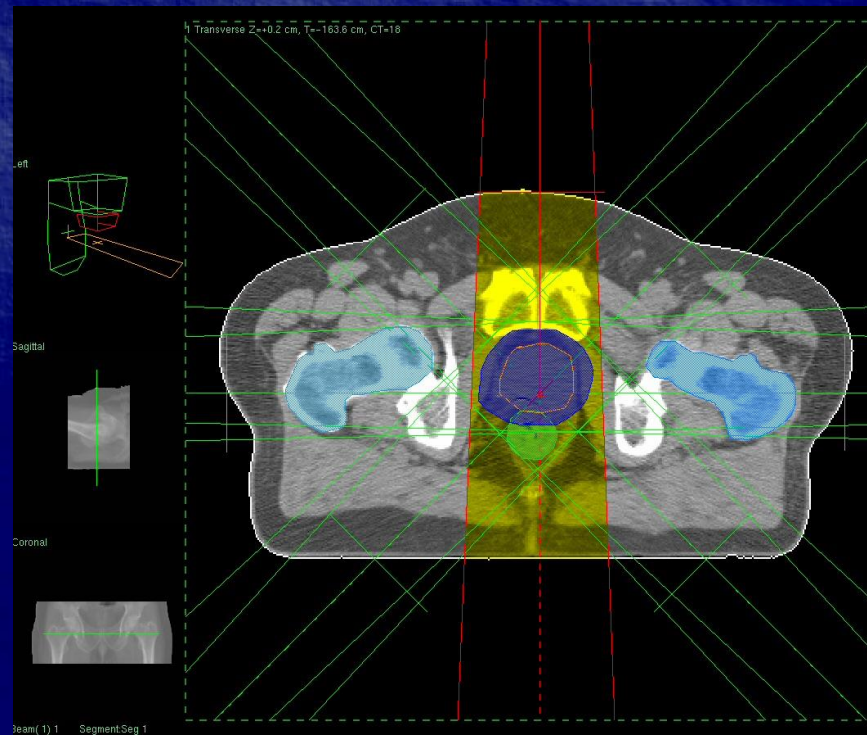
5A (0/55/95)



6A (45/90/135)



6A (25/90/120)



7A (0/45/90/135)

- Tüm planlamaların izodoz eğrileri, kümülatif Doz-Volüm Histogramları (cDVH) ve DRR ları çizdirildi.
- %95'lik izodozun PTV'yi kapsamasına ve %100'lük izodozun da PTV içinde homojen dağılmasına dikkat edildi.

Percent Dose

1 Transverse Z=+0.2 cm, T=-163.6 cm, CT=18

103.1

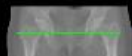
2 Coronal Y=+0.0 cm

103.5

Sagittal



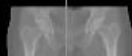
Coronal



3 Sagittal X=+0.0 cm

104.5

Coronal



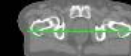
Transverse



Sagittal



Transverse



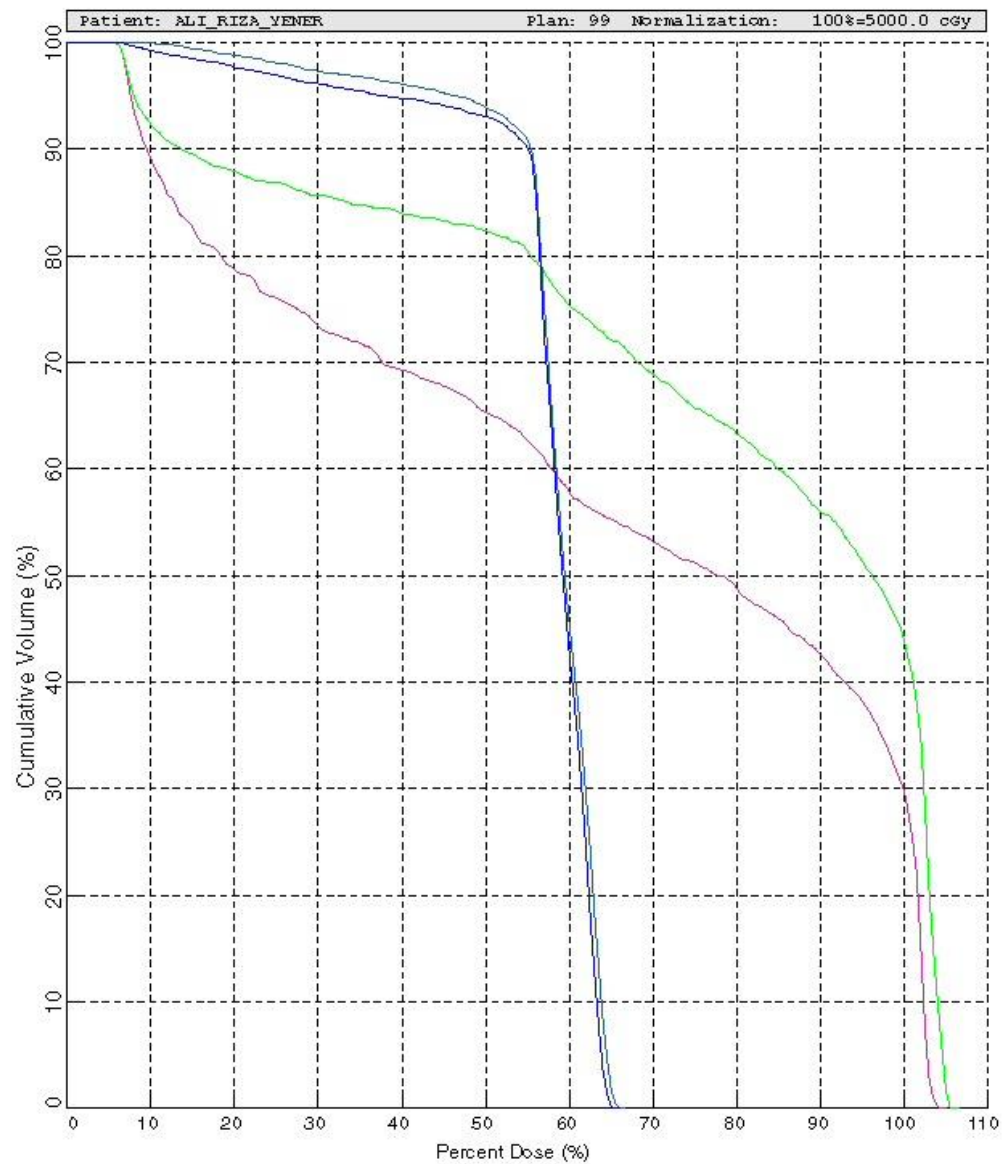
Sagittal

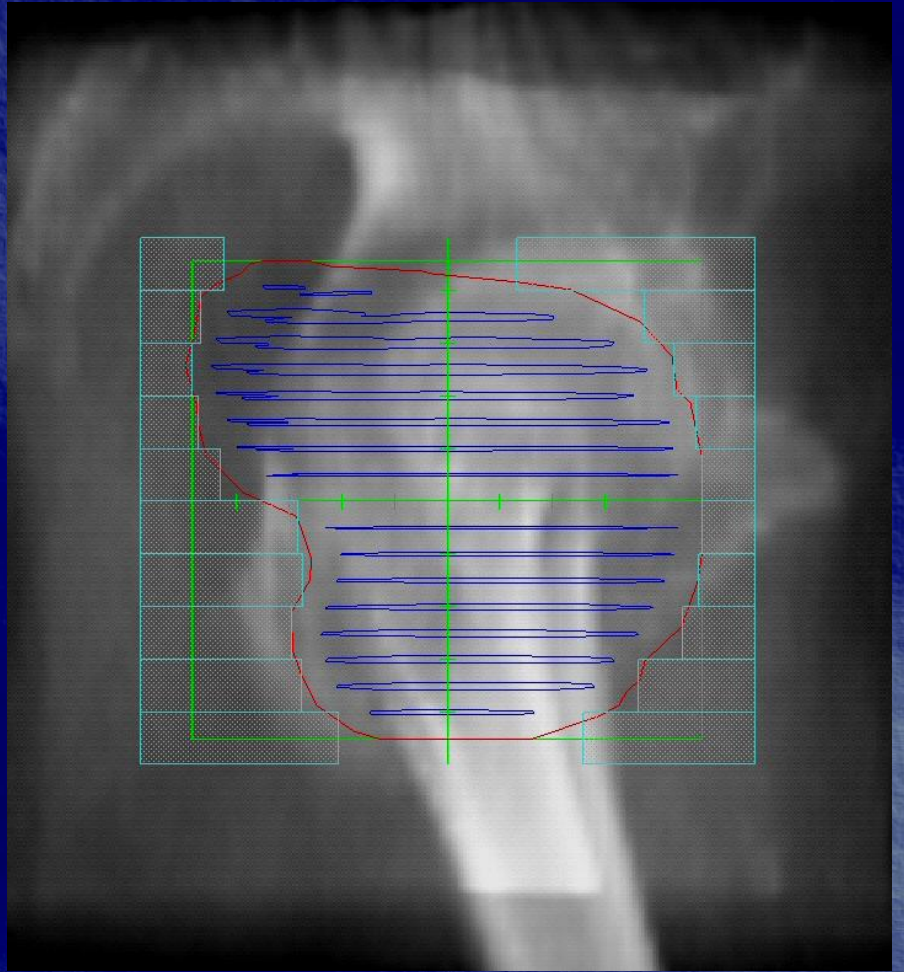
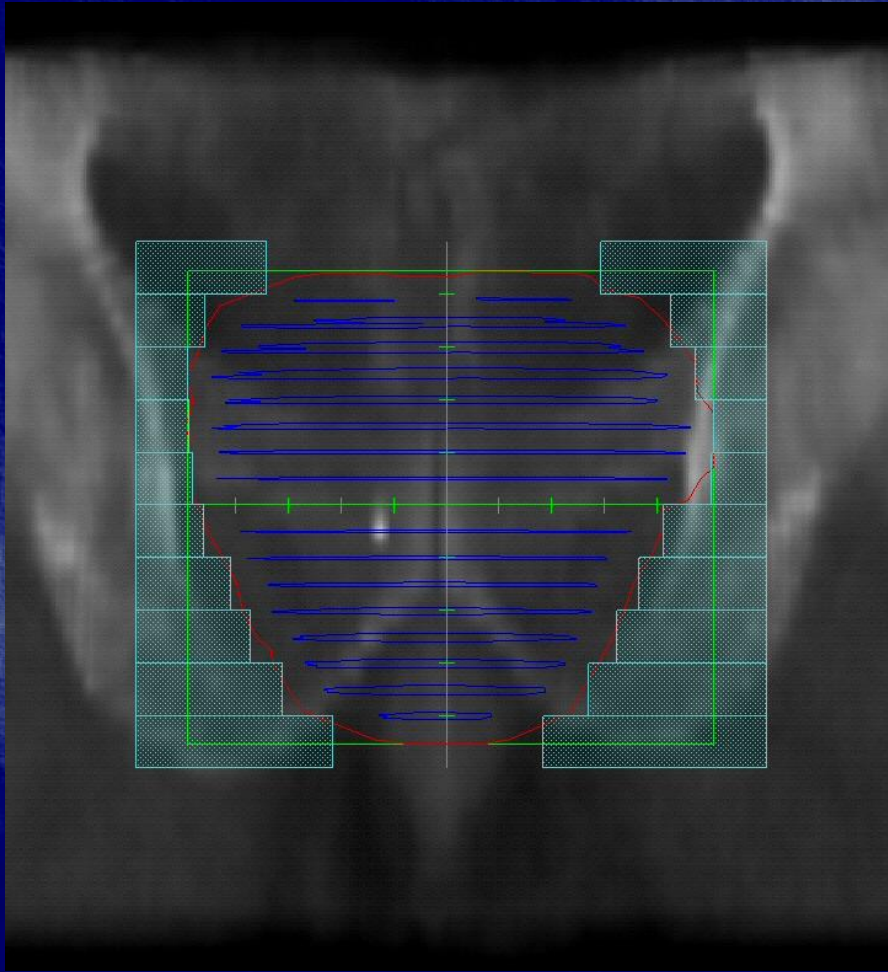


Coronal

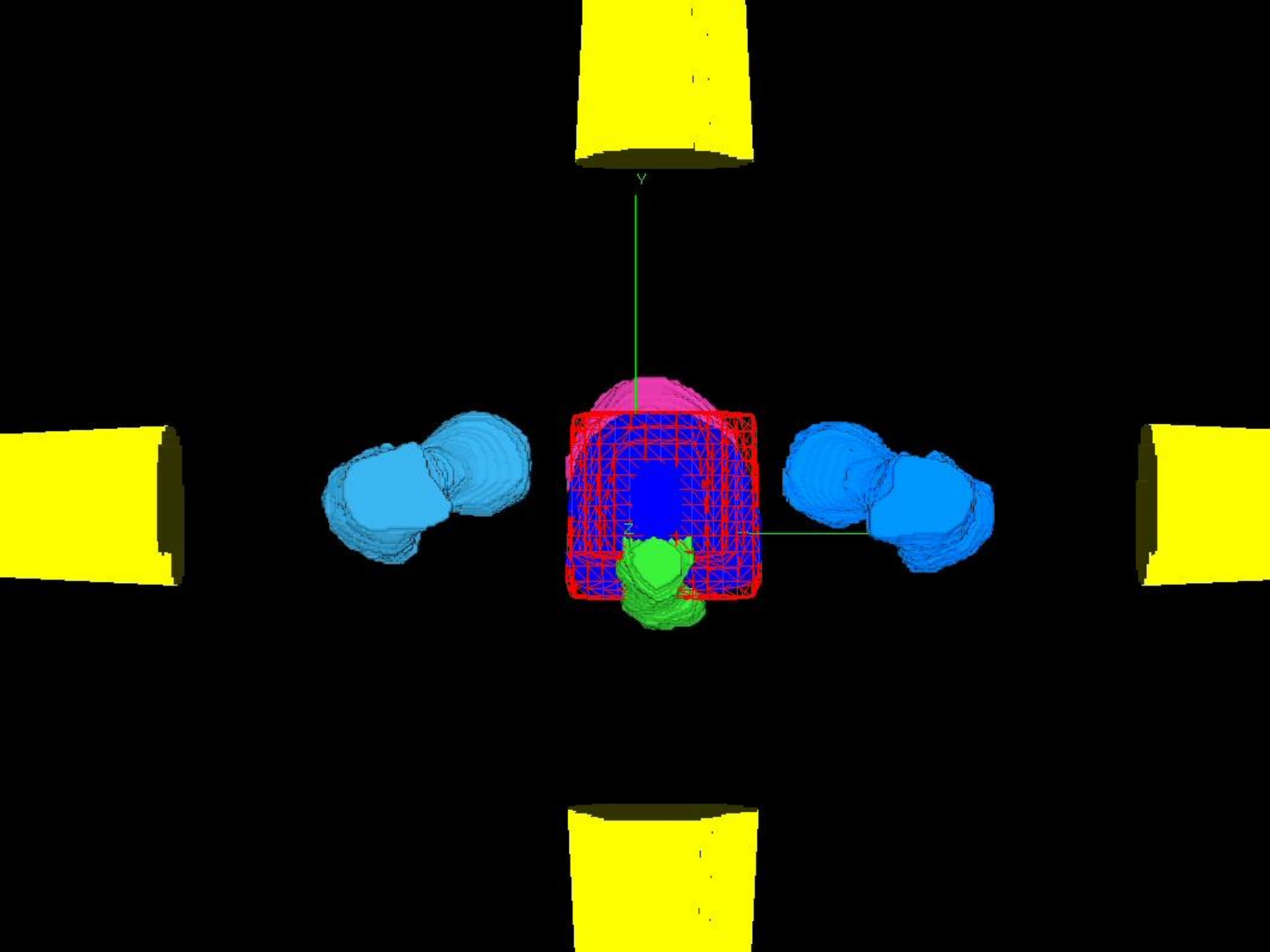


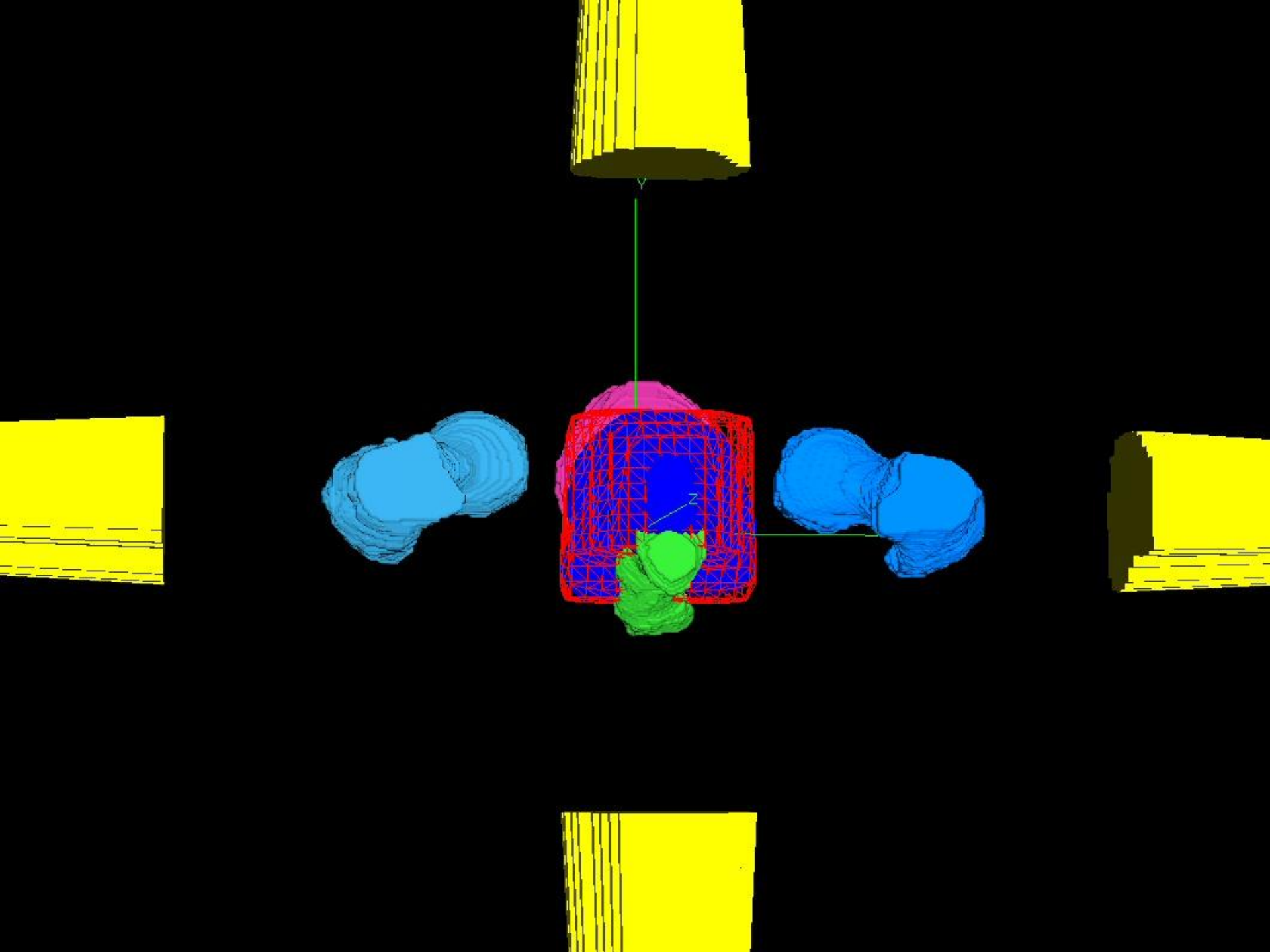
Key	Structure	Plan	Min Dose(%)	Max Dose(%)	Mean Dose(%)	Total Vol (cc)
	Bladder	ALI_RIZA_YENER(99)	6	104	65	196.4
	Rectum	ALI_RIZA_YENER(99)	6	106	78	62.0
	sag femur	ALI_RIZA_YENER(99)	9	66	58	159.7
	sol femur	ALI_RIZA_YENER(99)	6	65	57	175.0

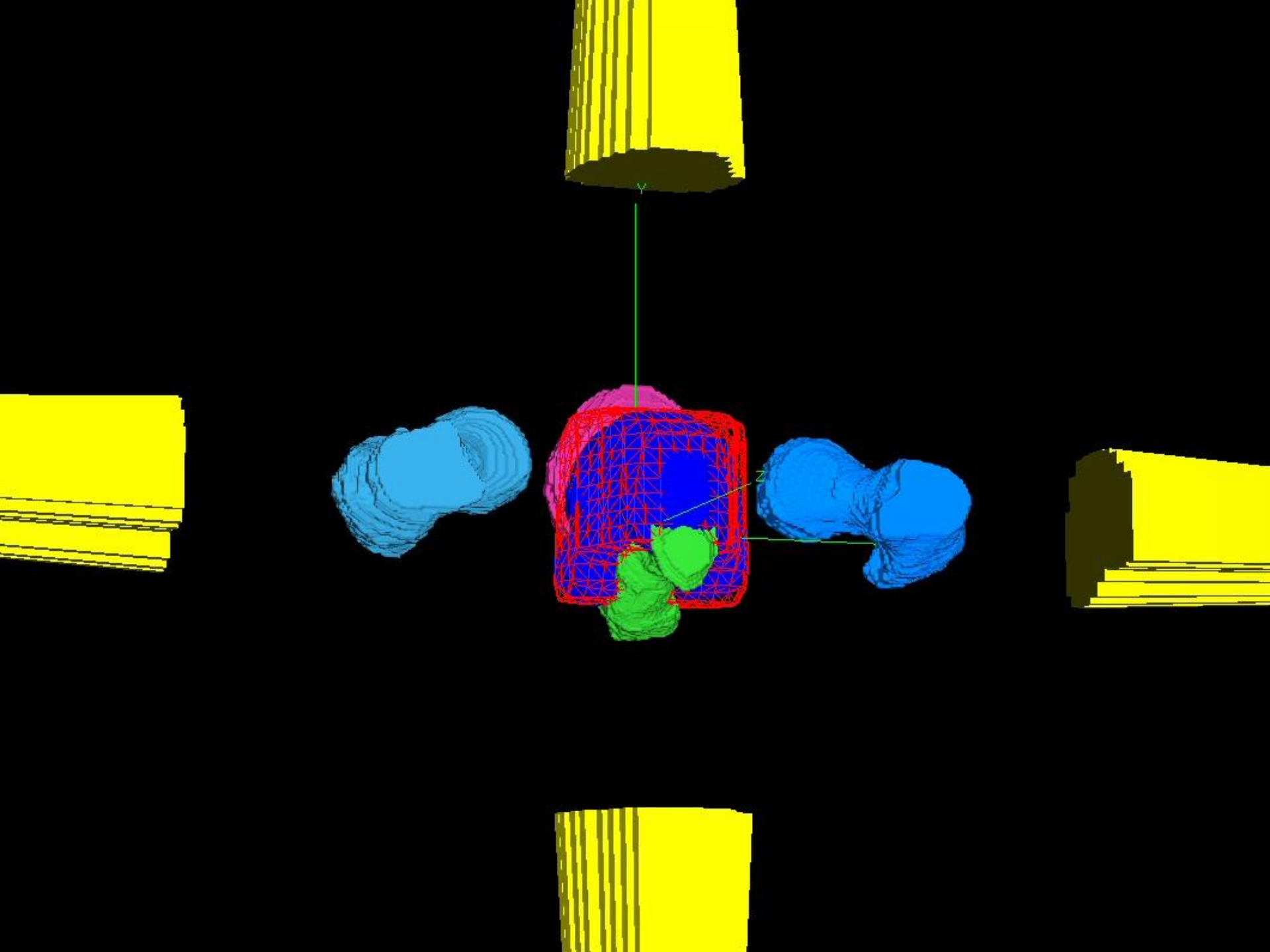


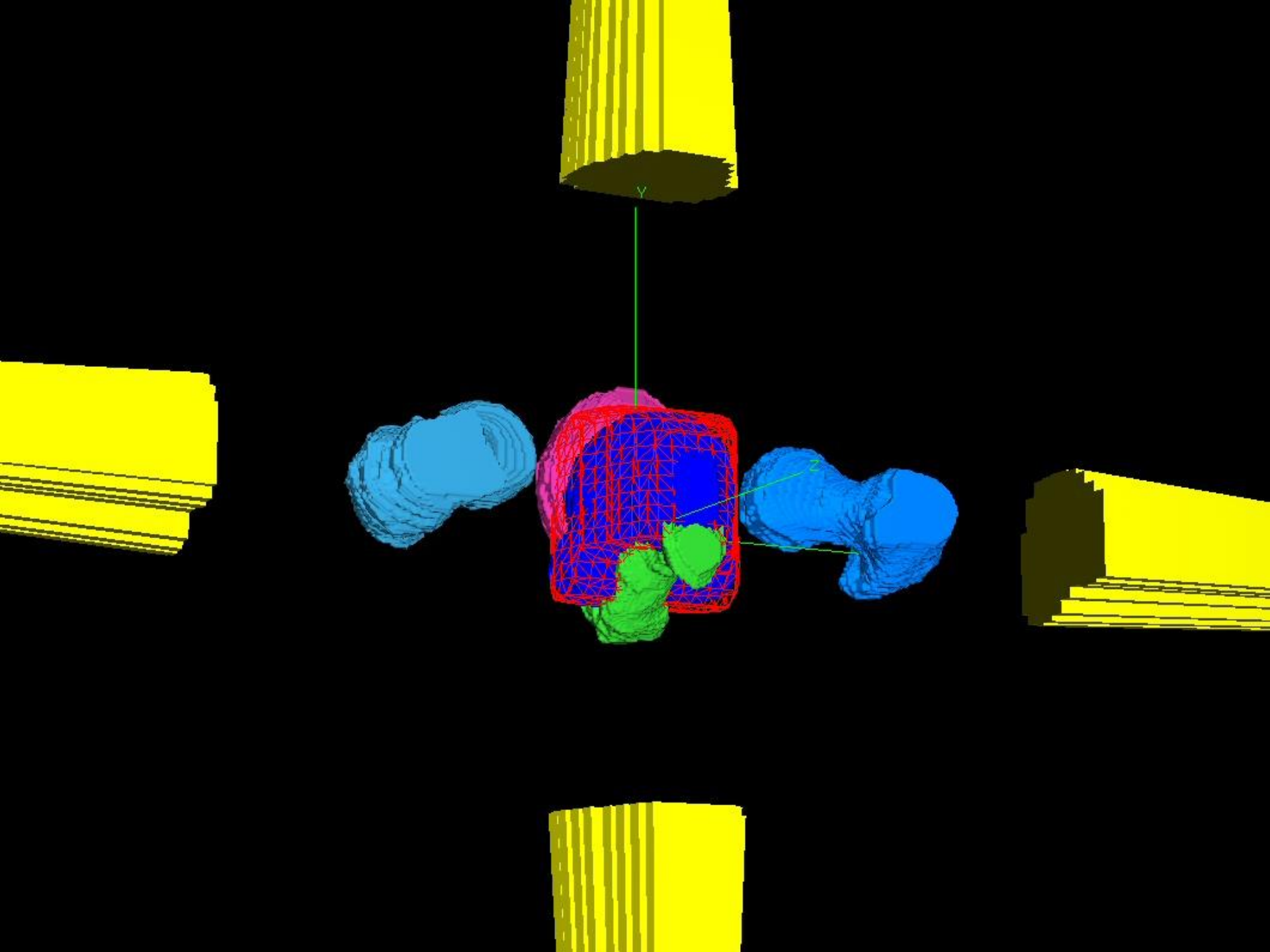


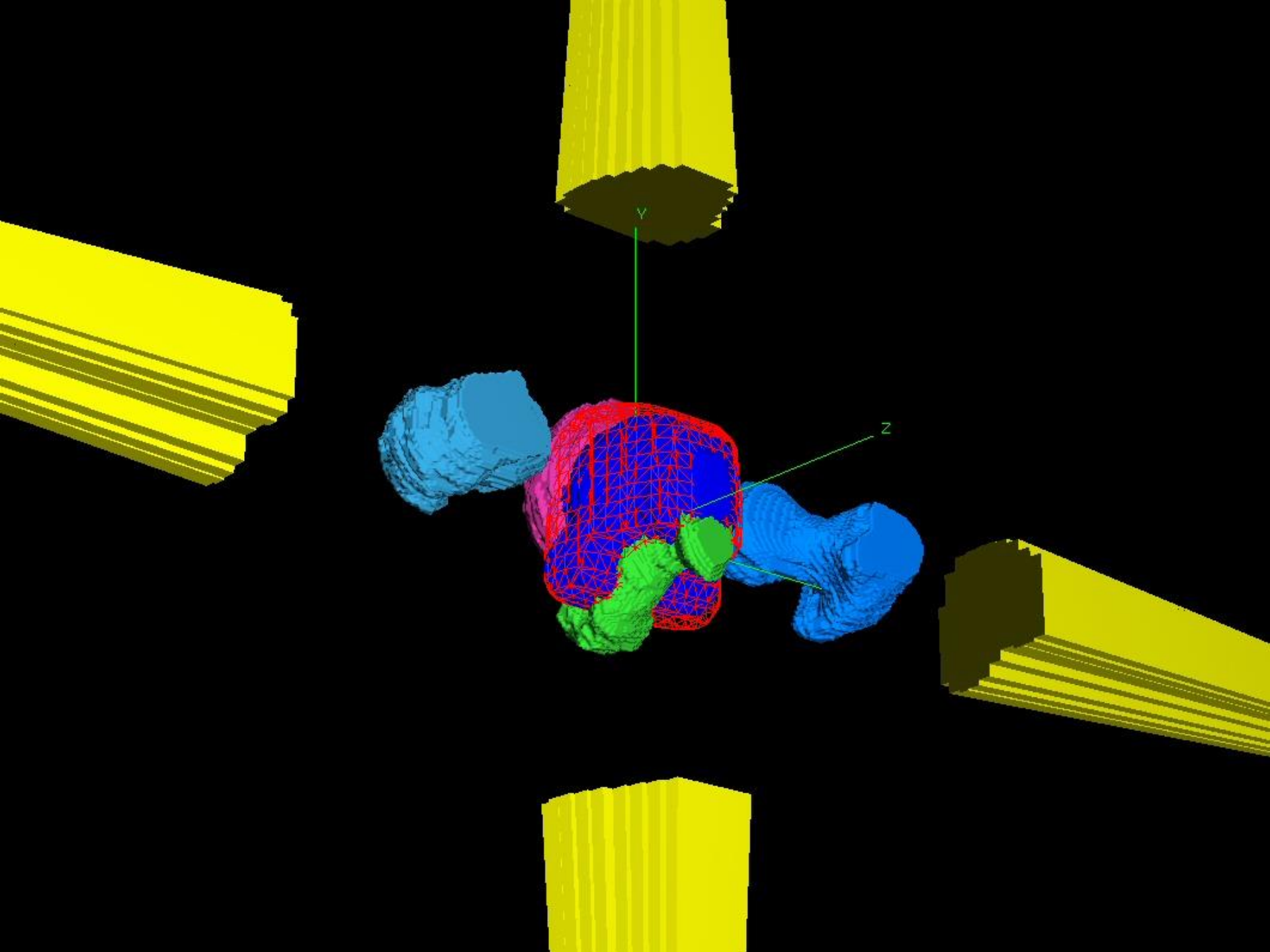
- PTV nin, belirlenen dozun %5'inden az %7'sinden fazla doz almamasına dikkat edildi. Ancak BT tabanlı üç boyutlu planlama sistemlerinde PTV nin kenarındaki küçük ($<5\%$) bir kısmın %95'ten daha az doz aldığı gözlenmiştir.

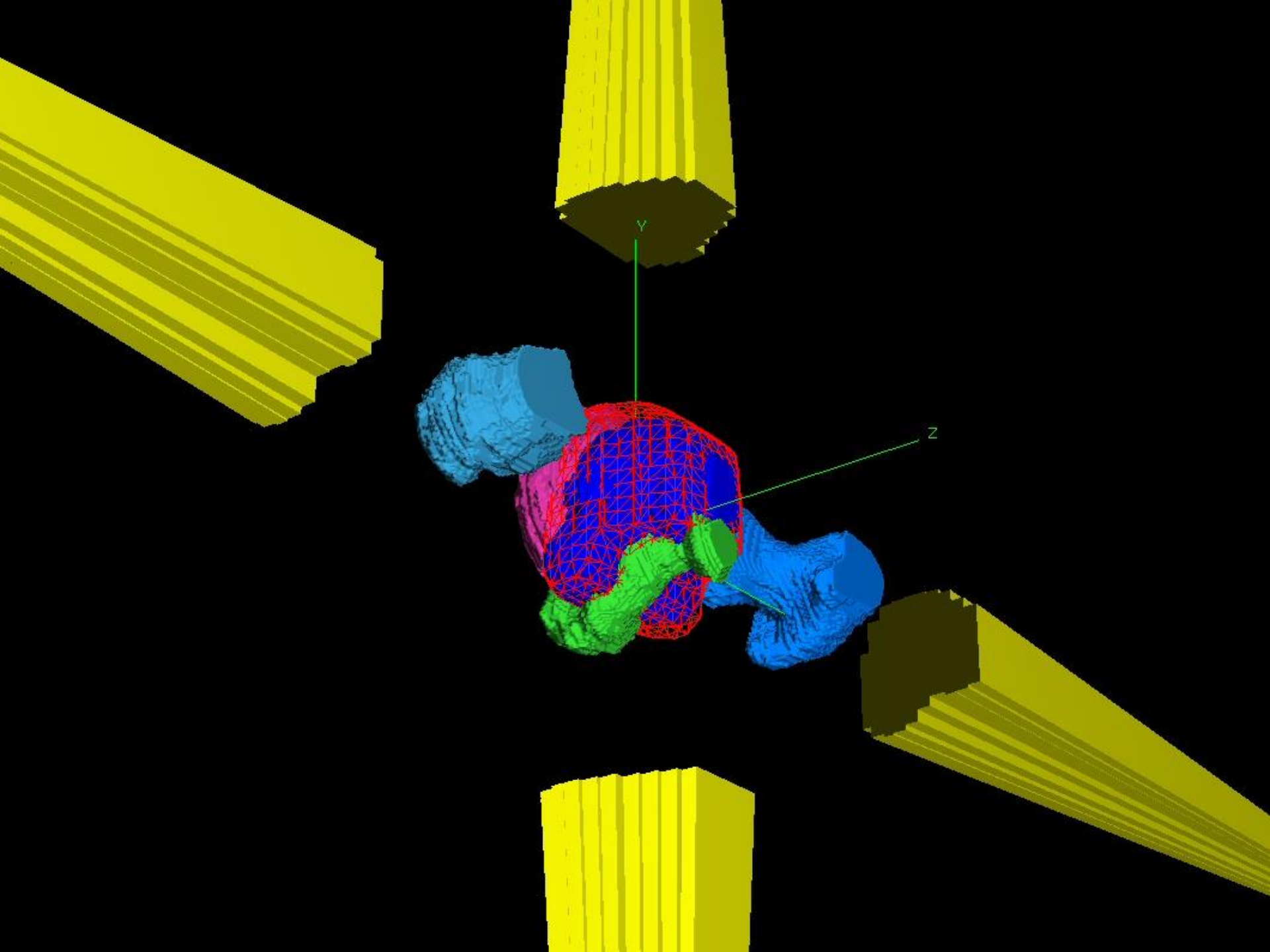


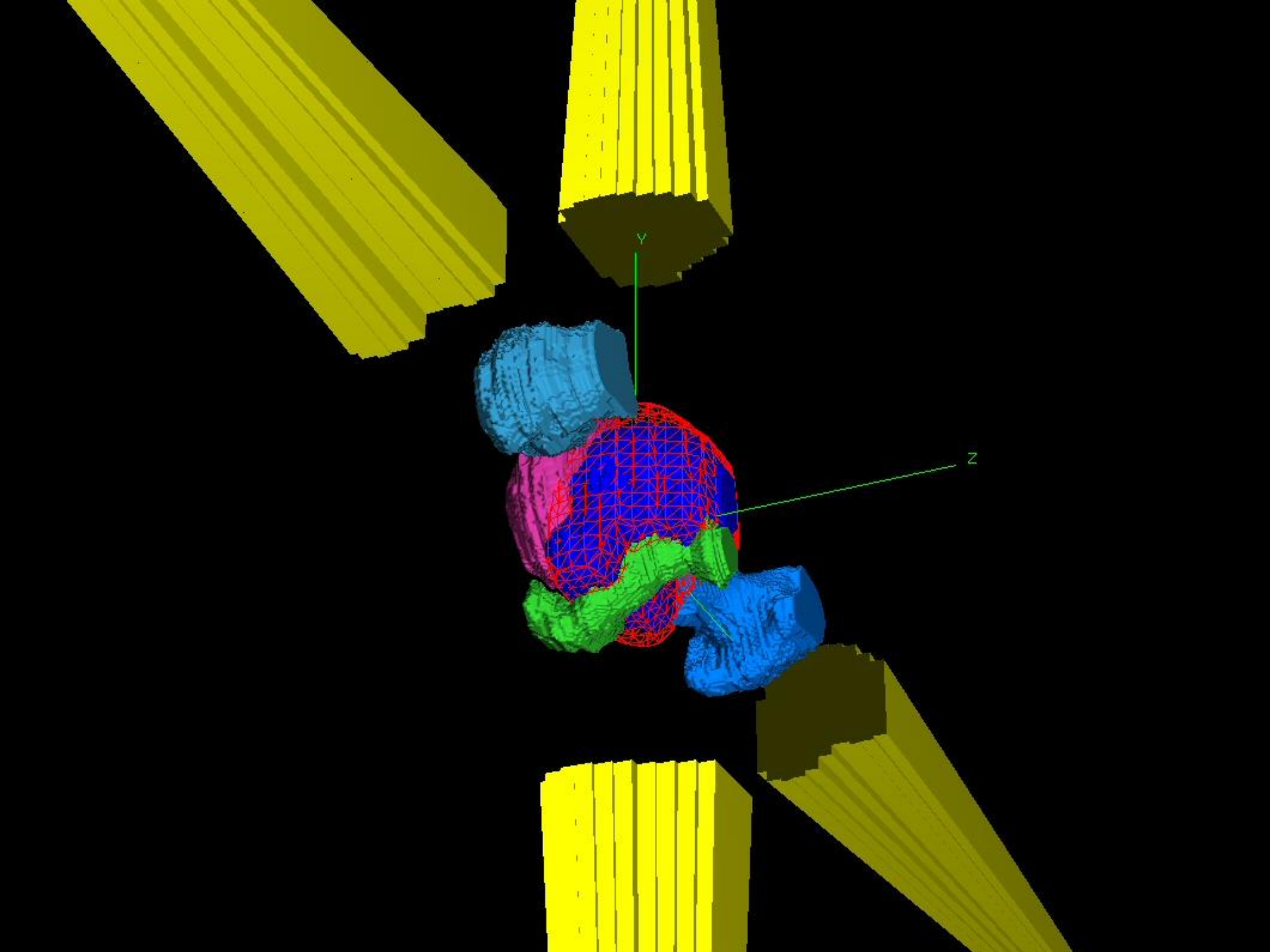


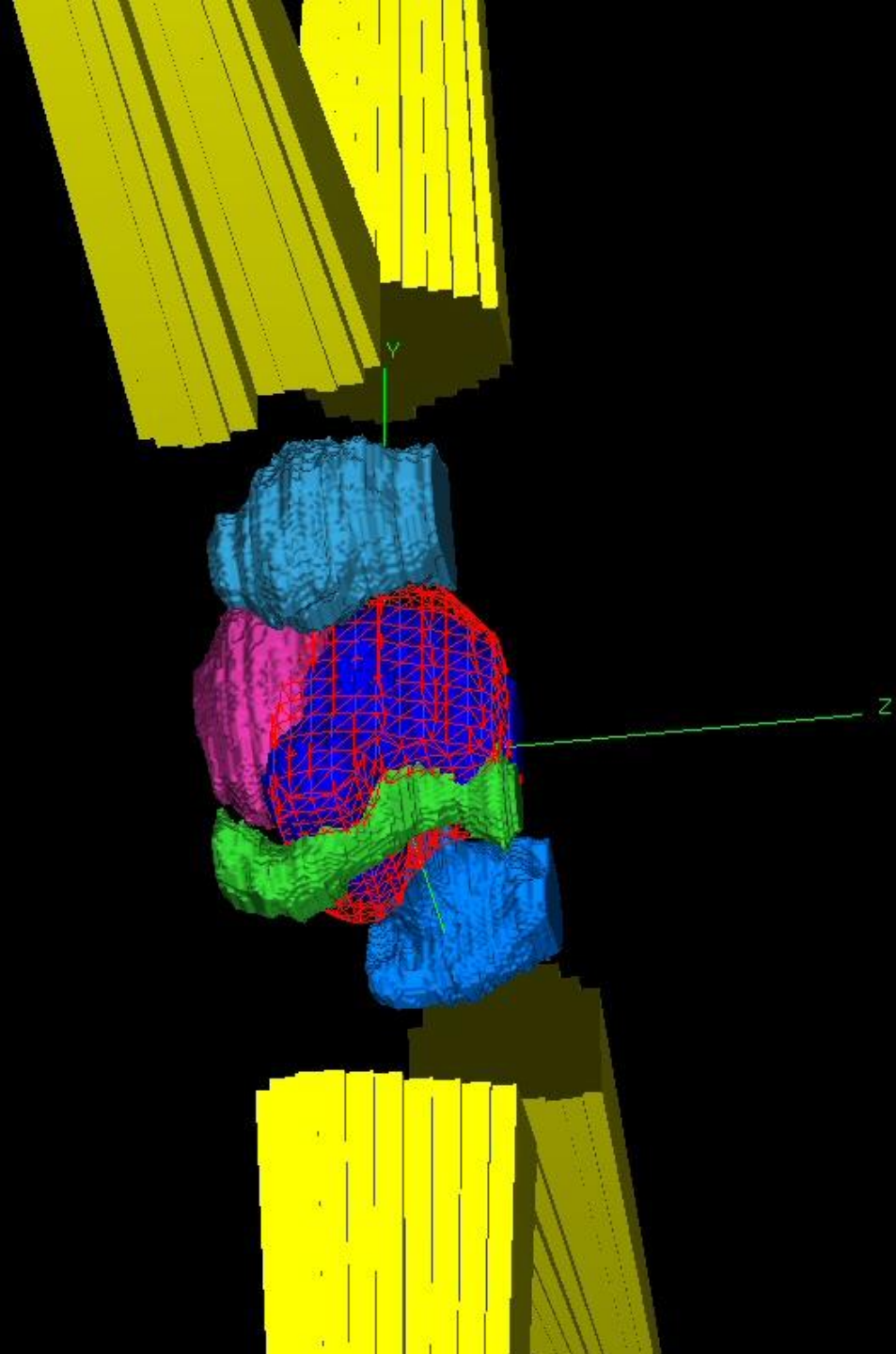


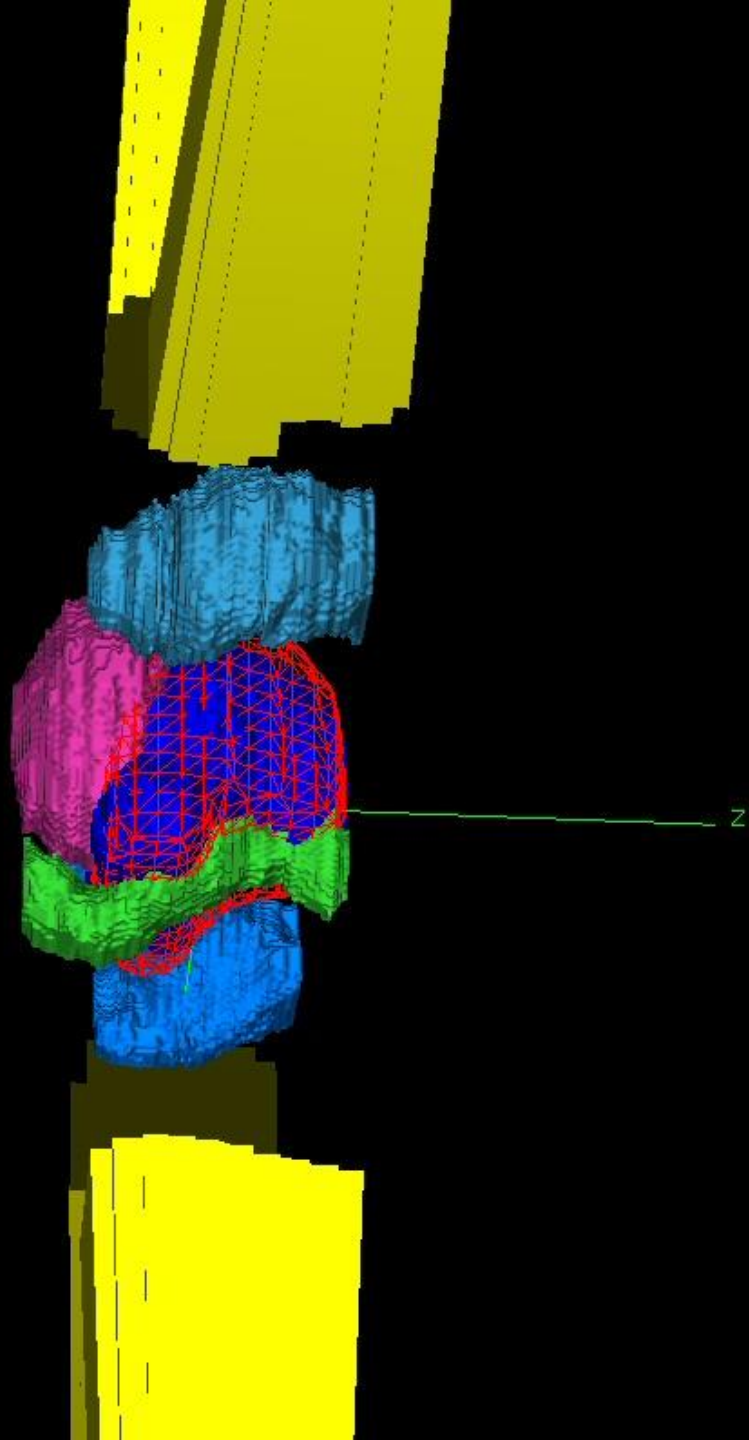


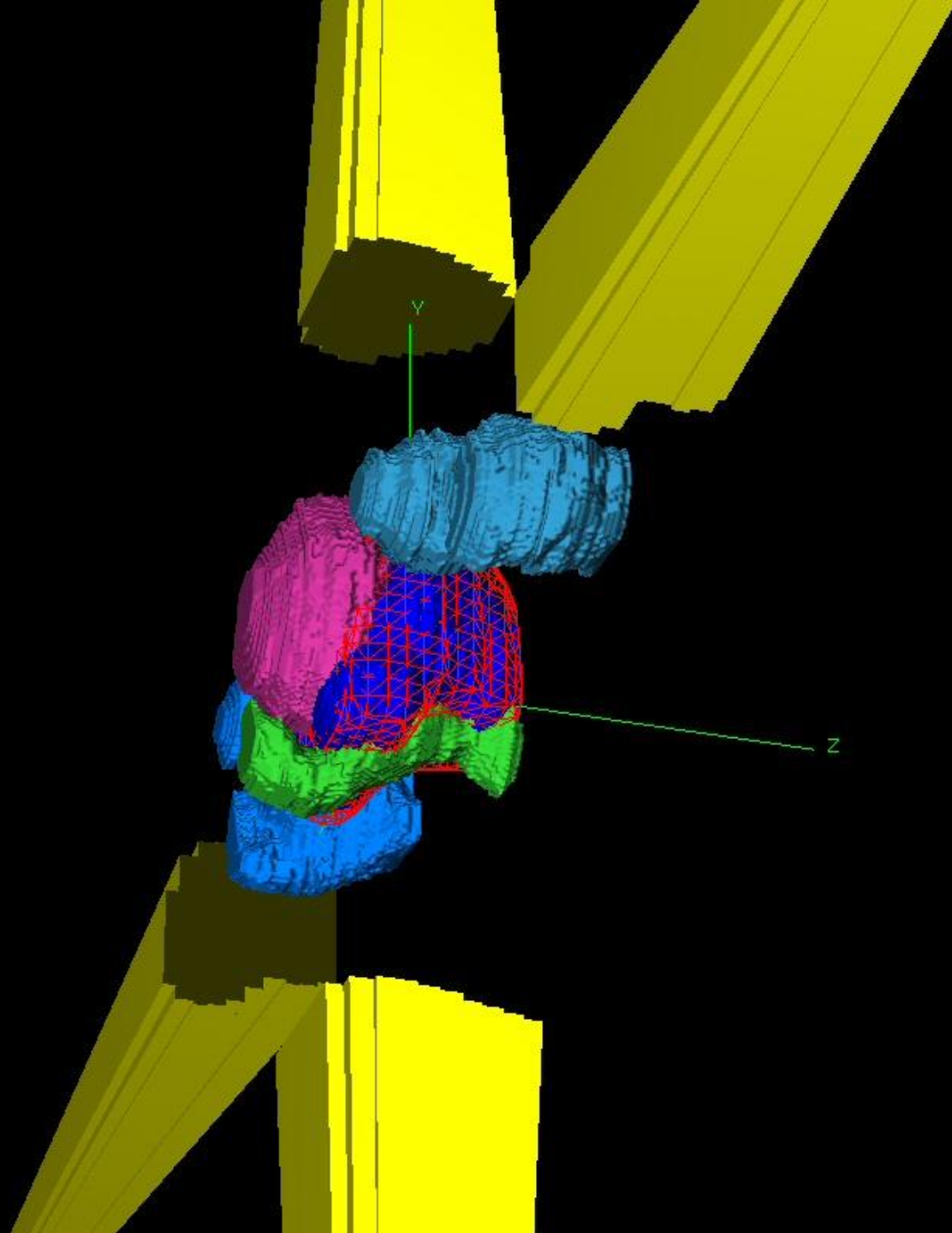


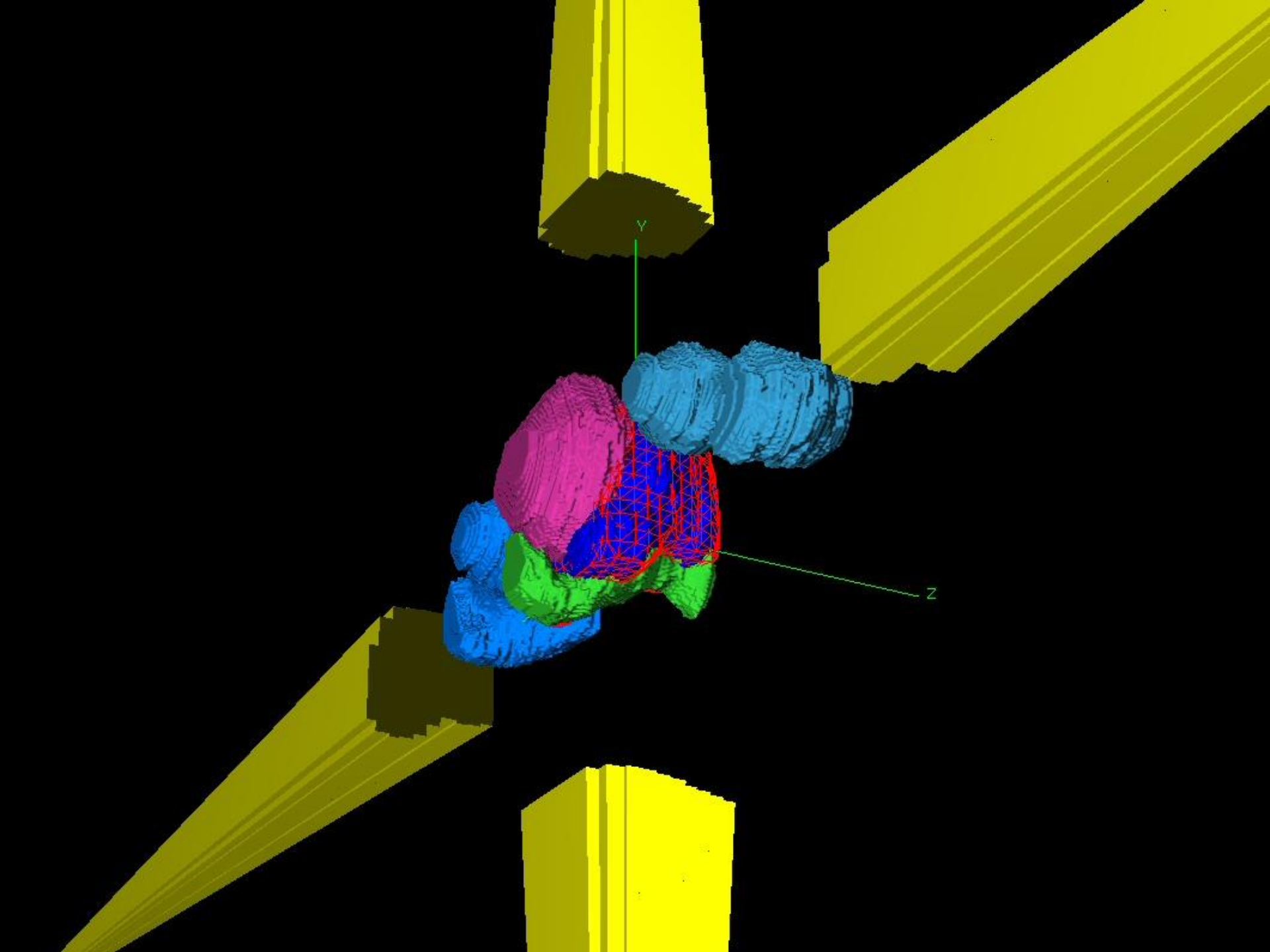


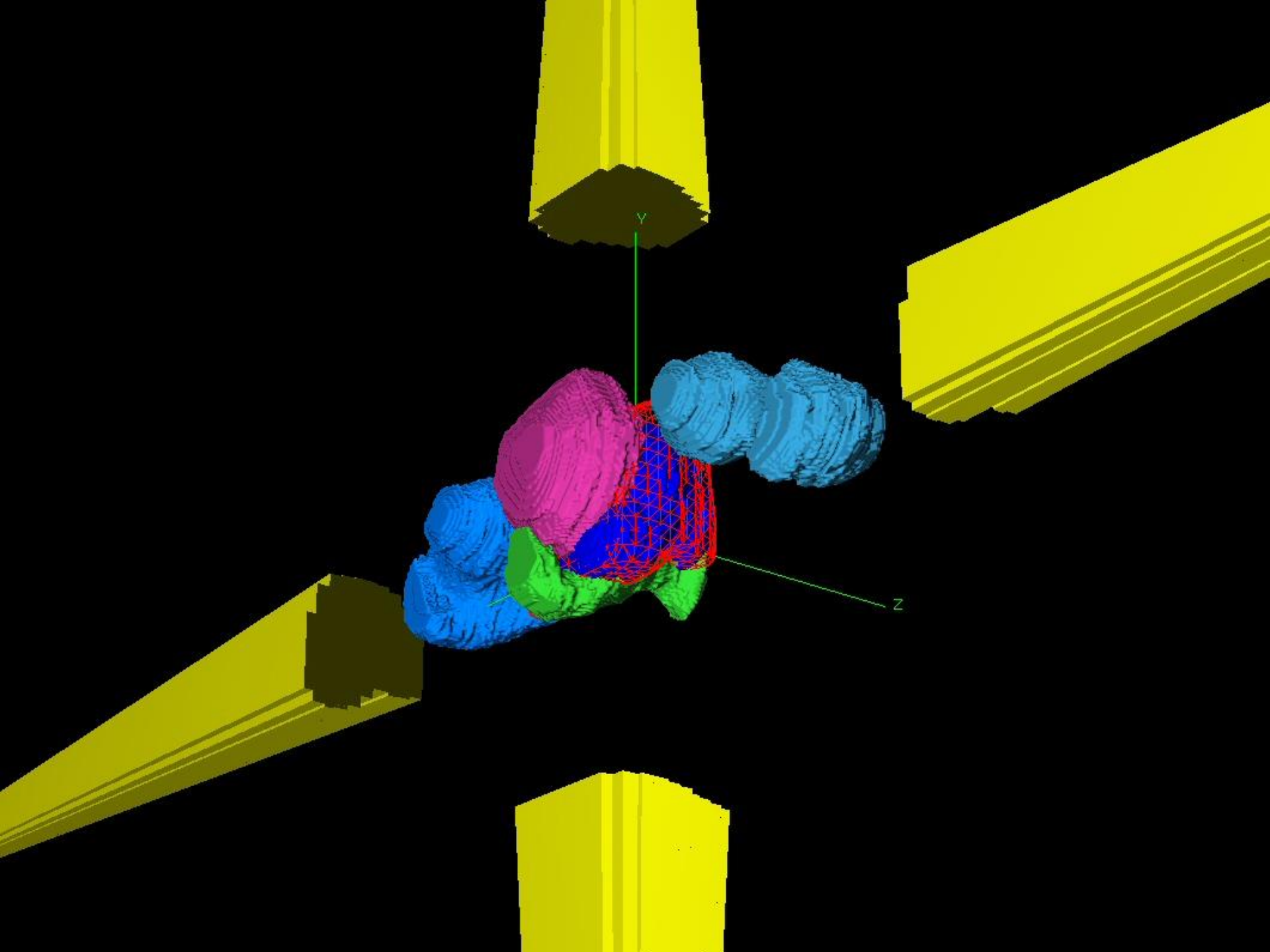


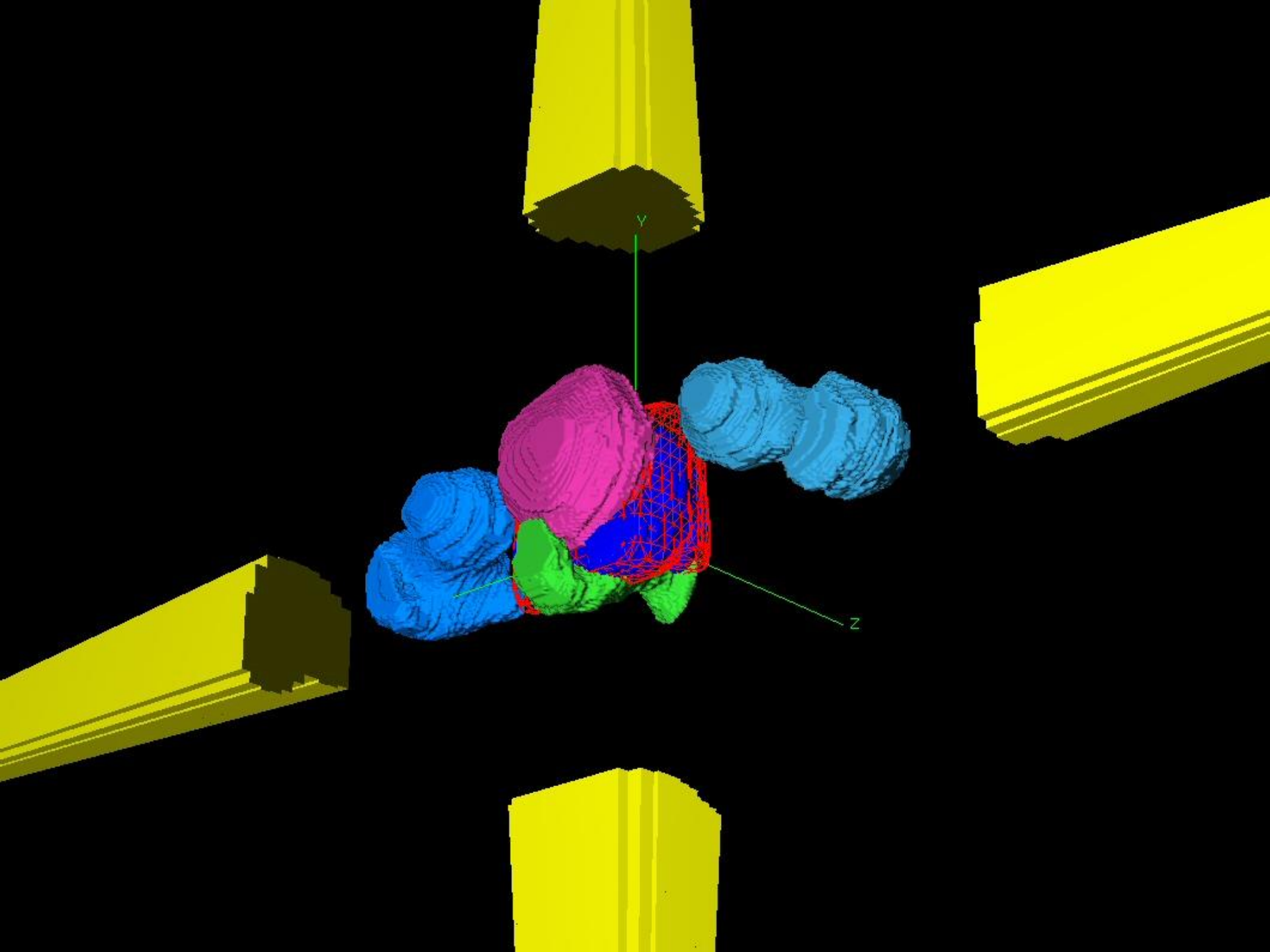


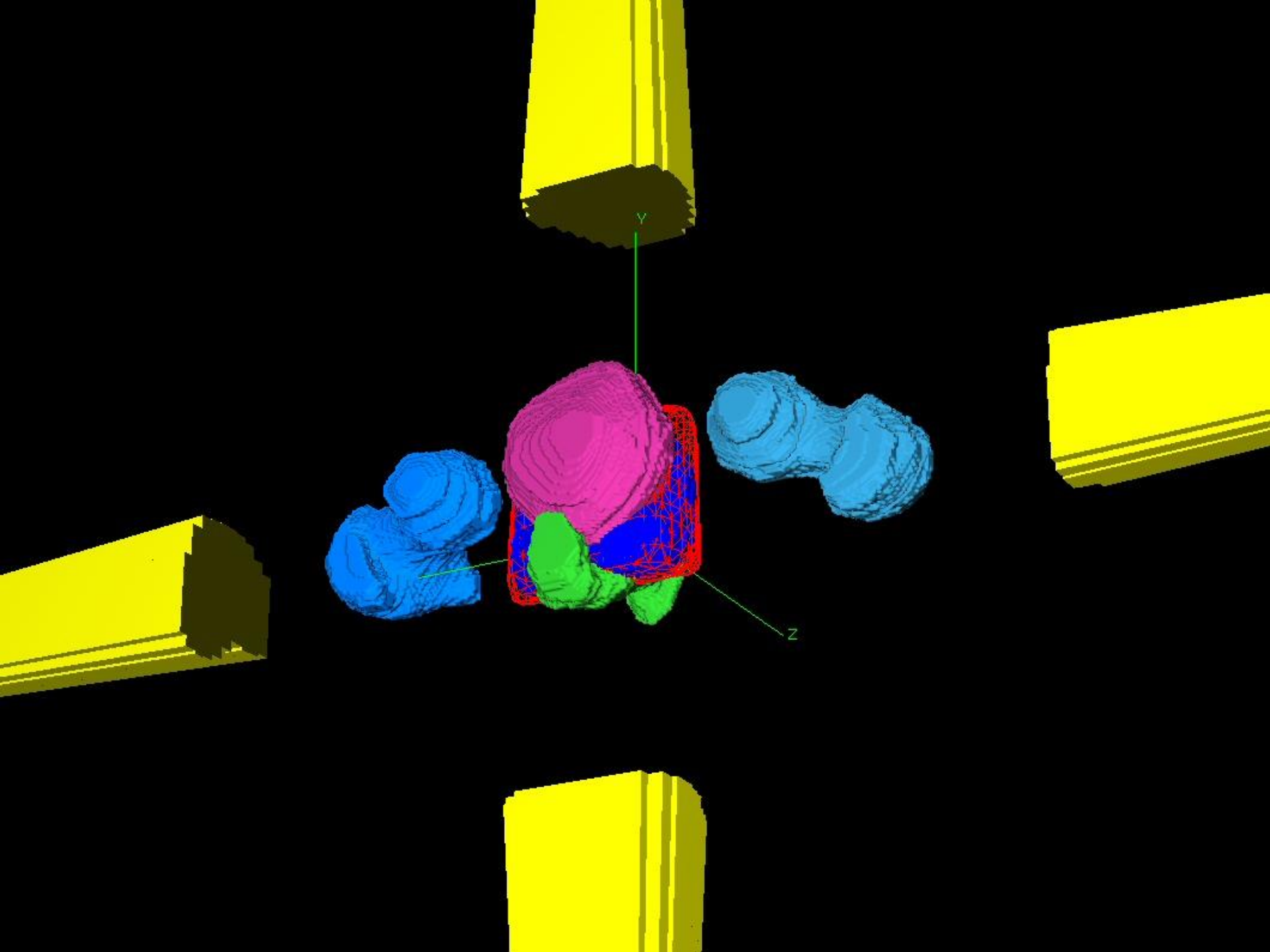


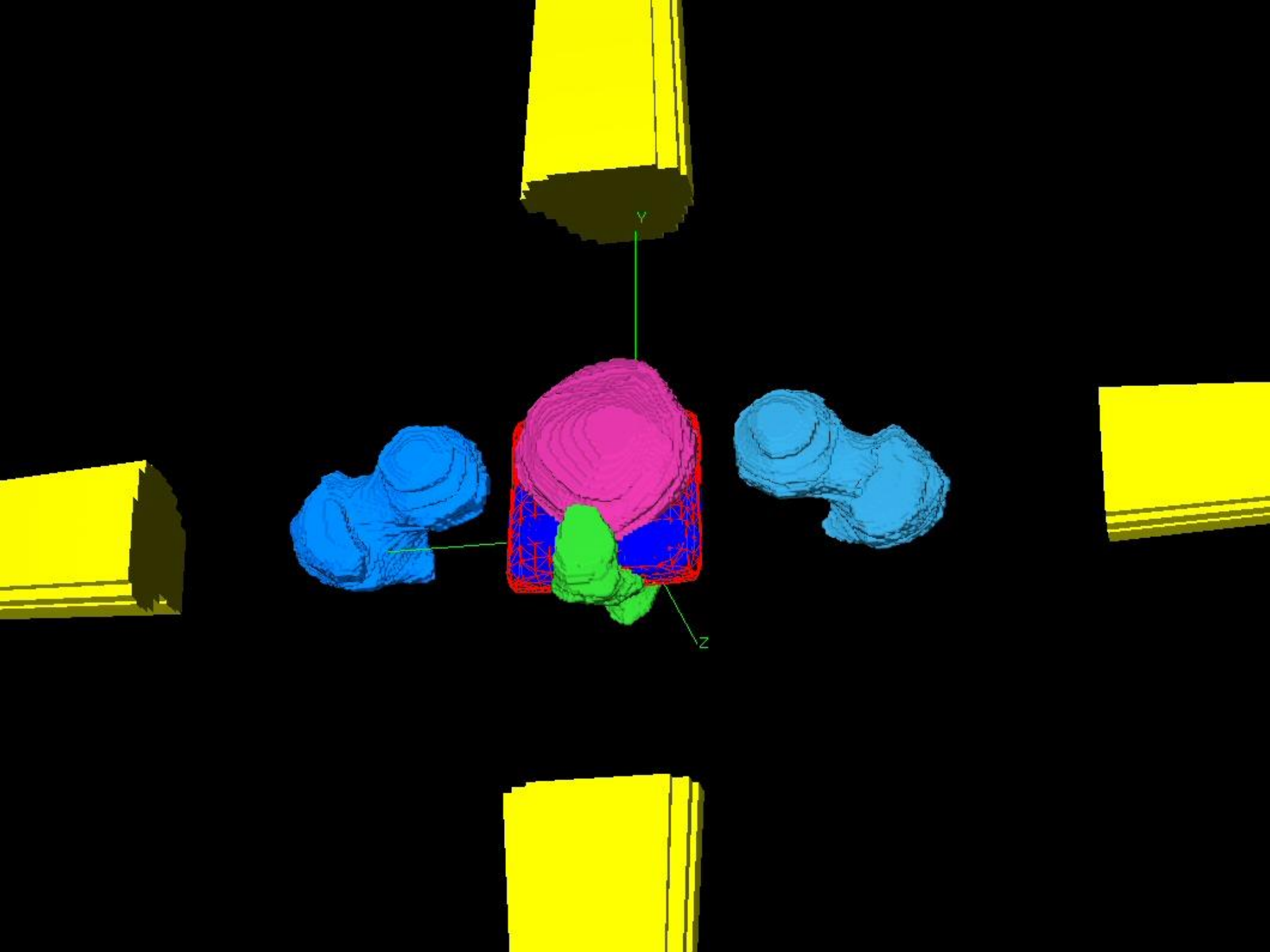


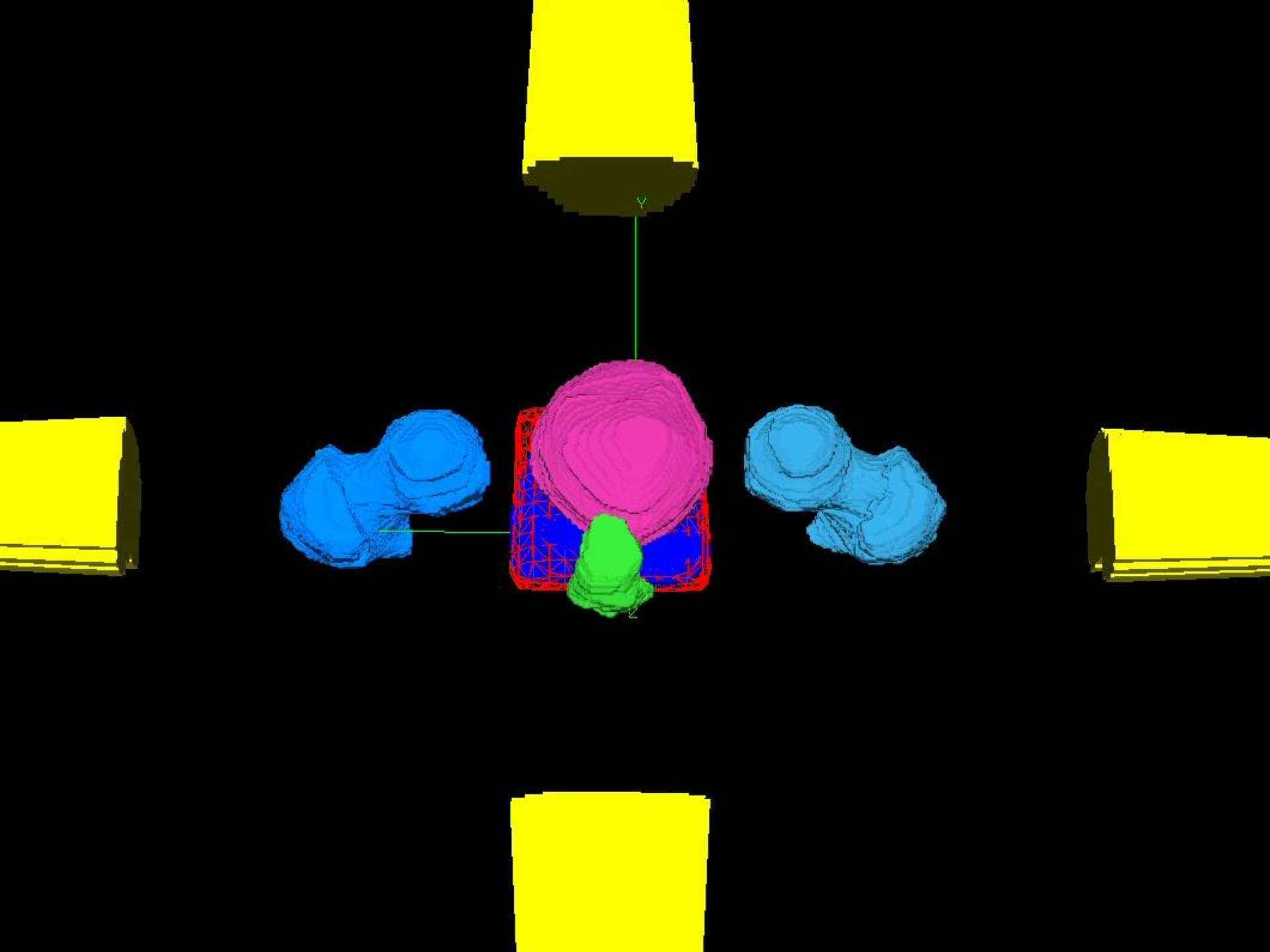


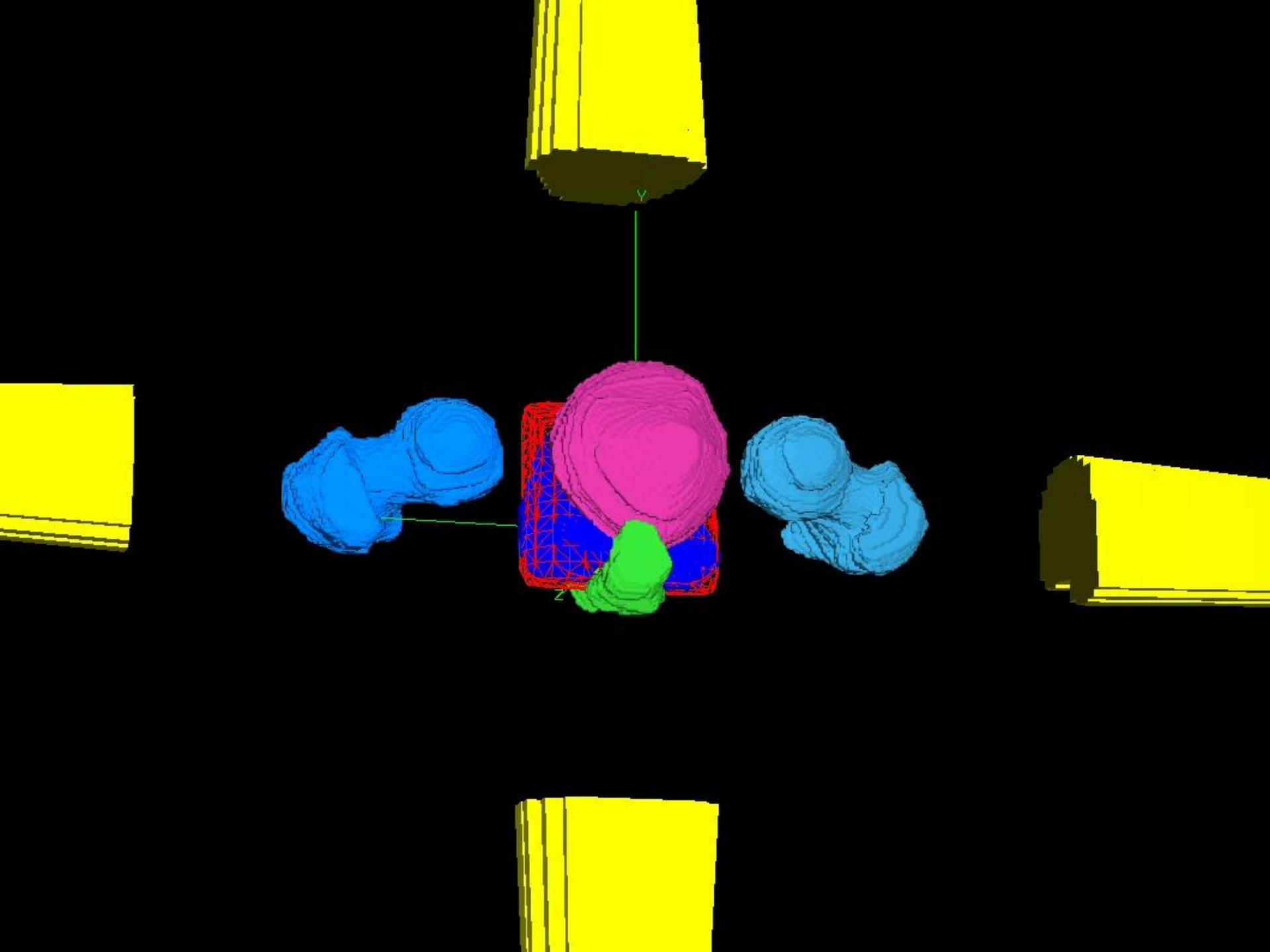


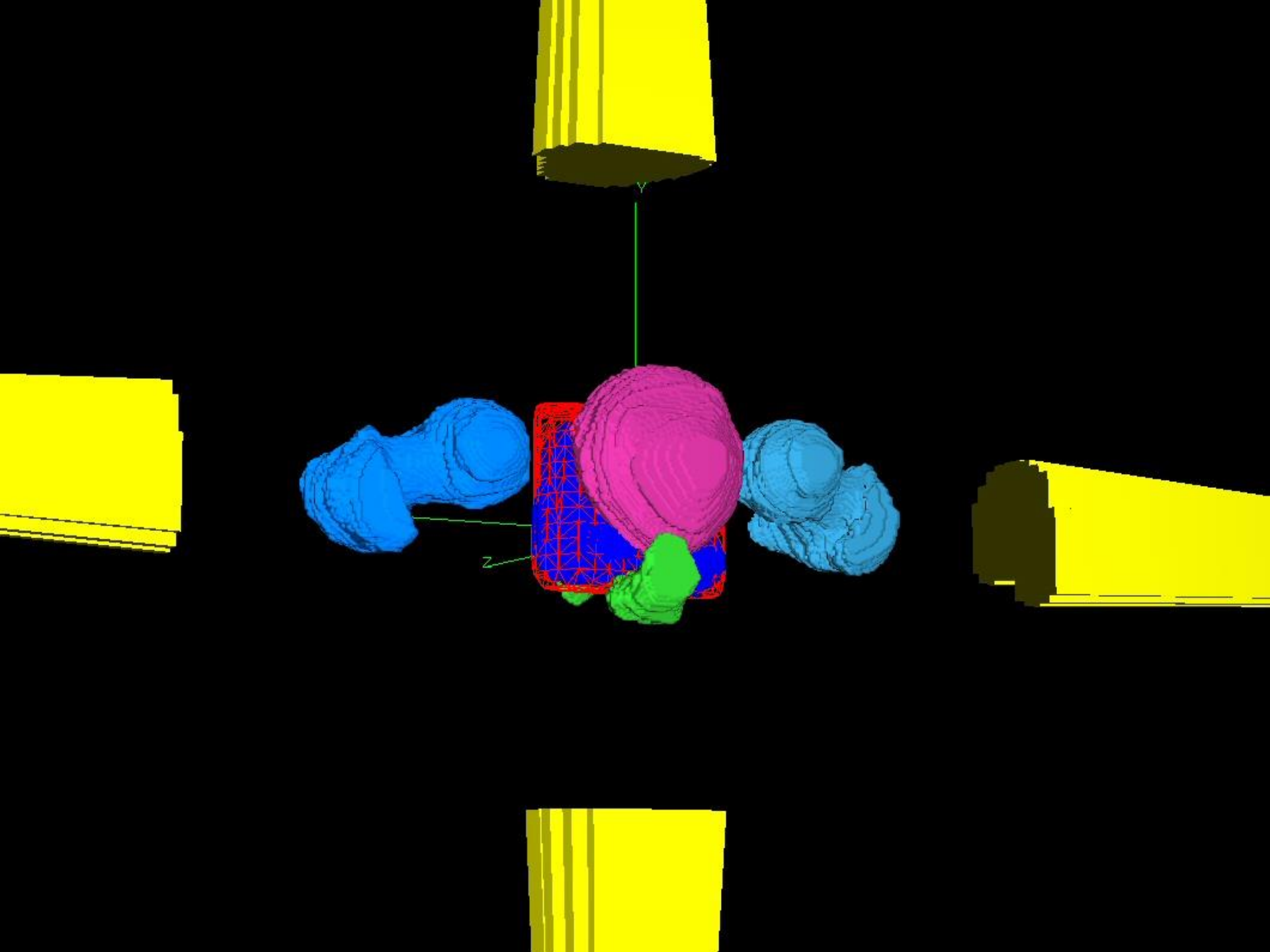


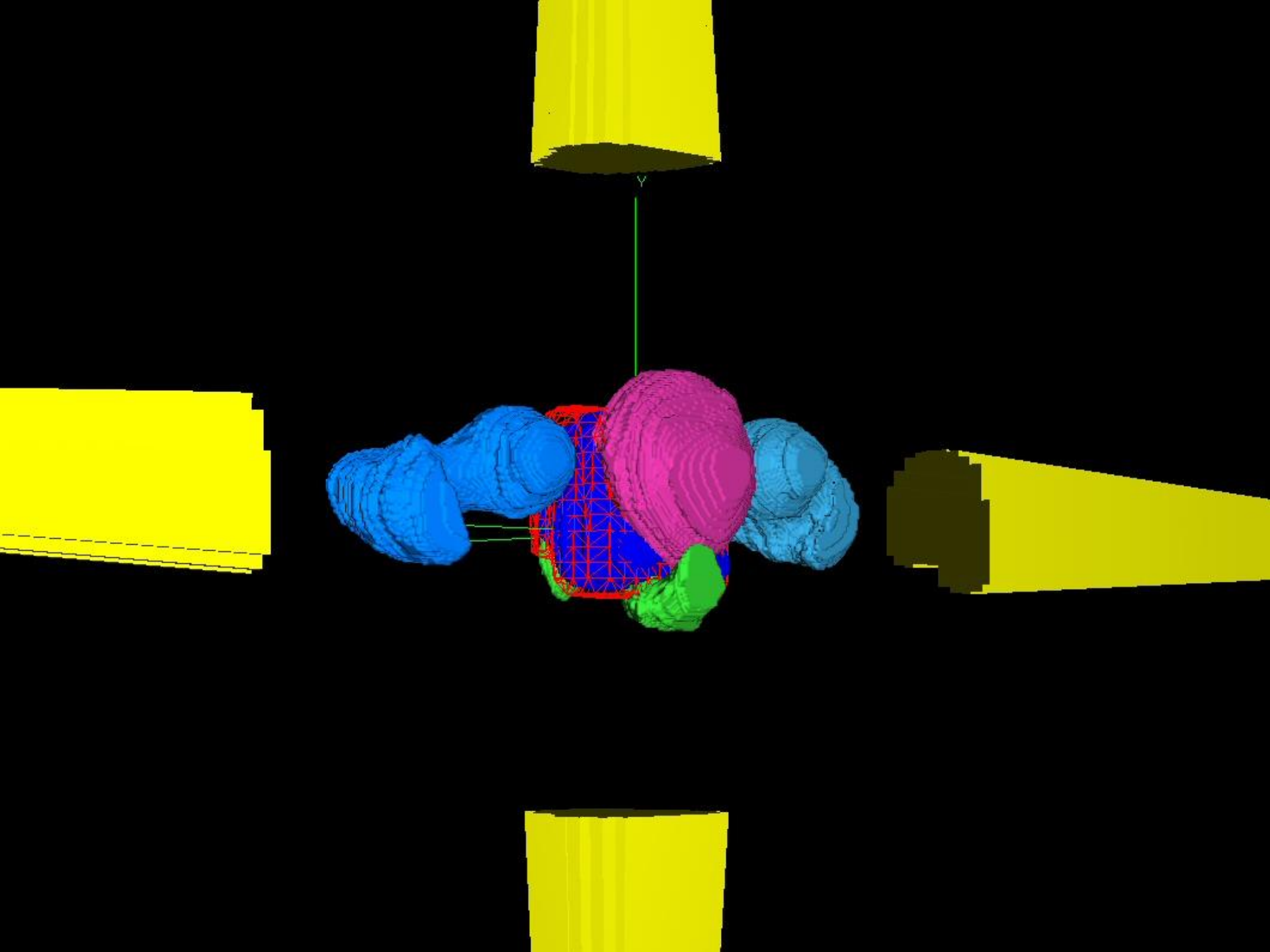


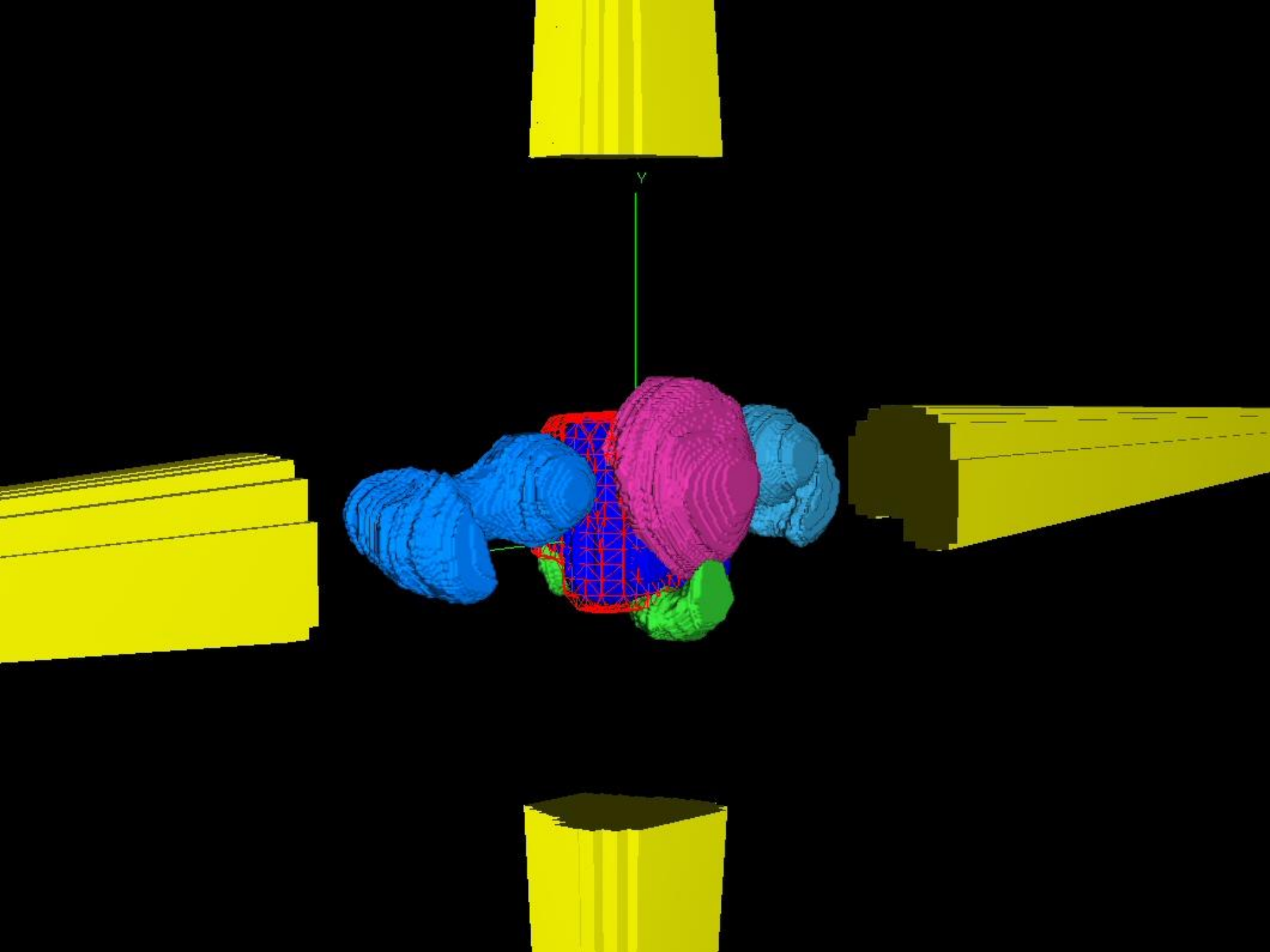


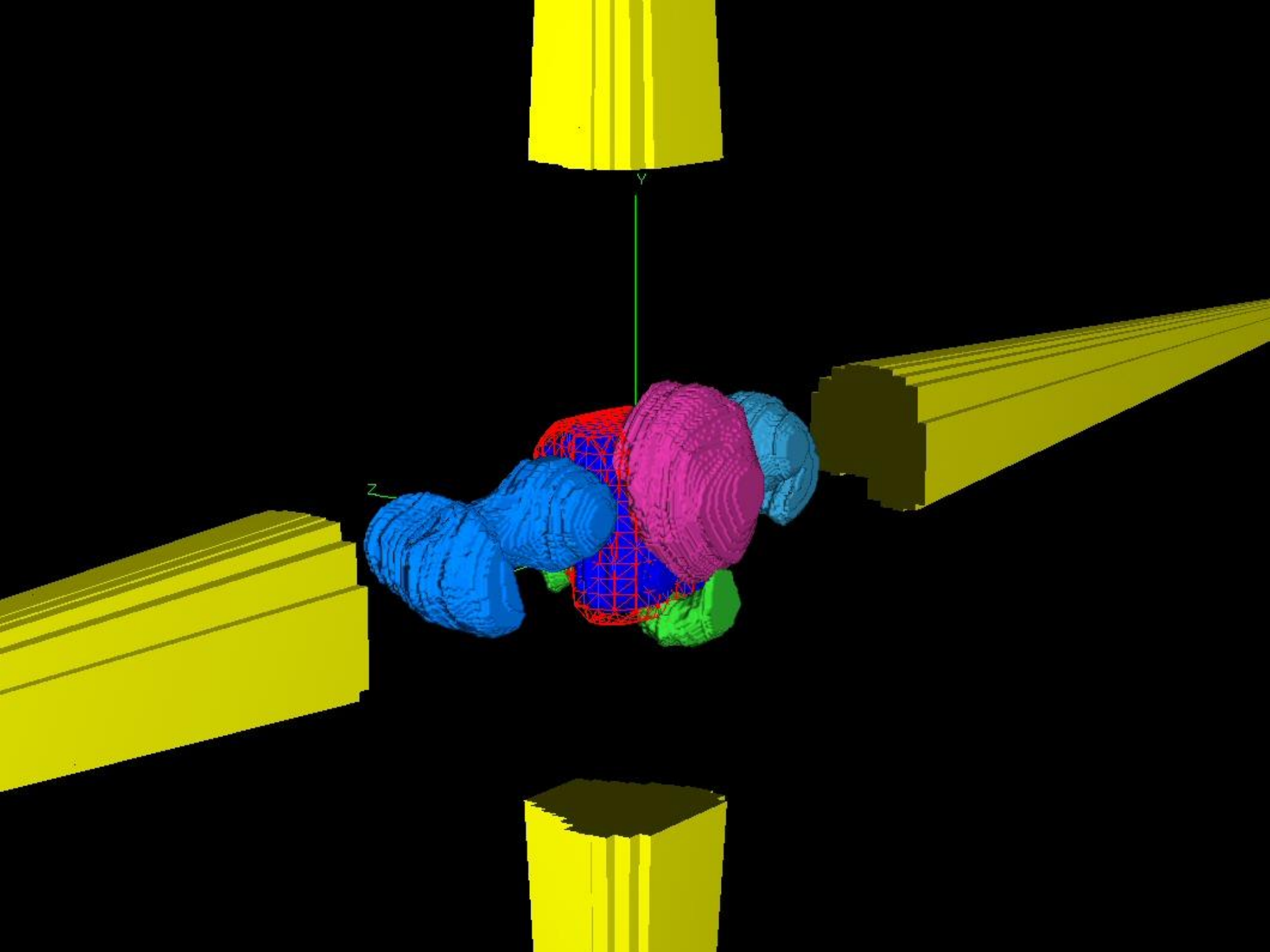


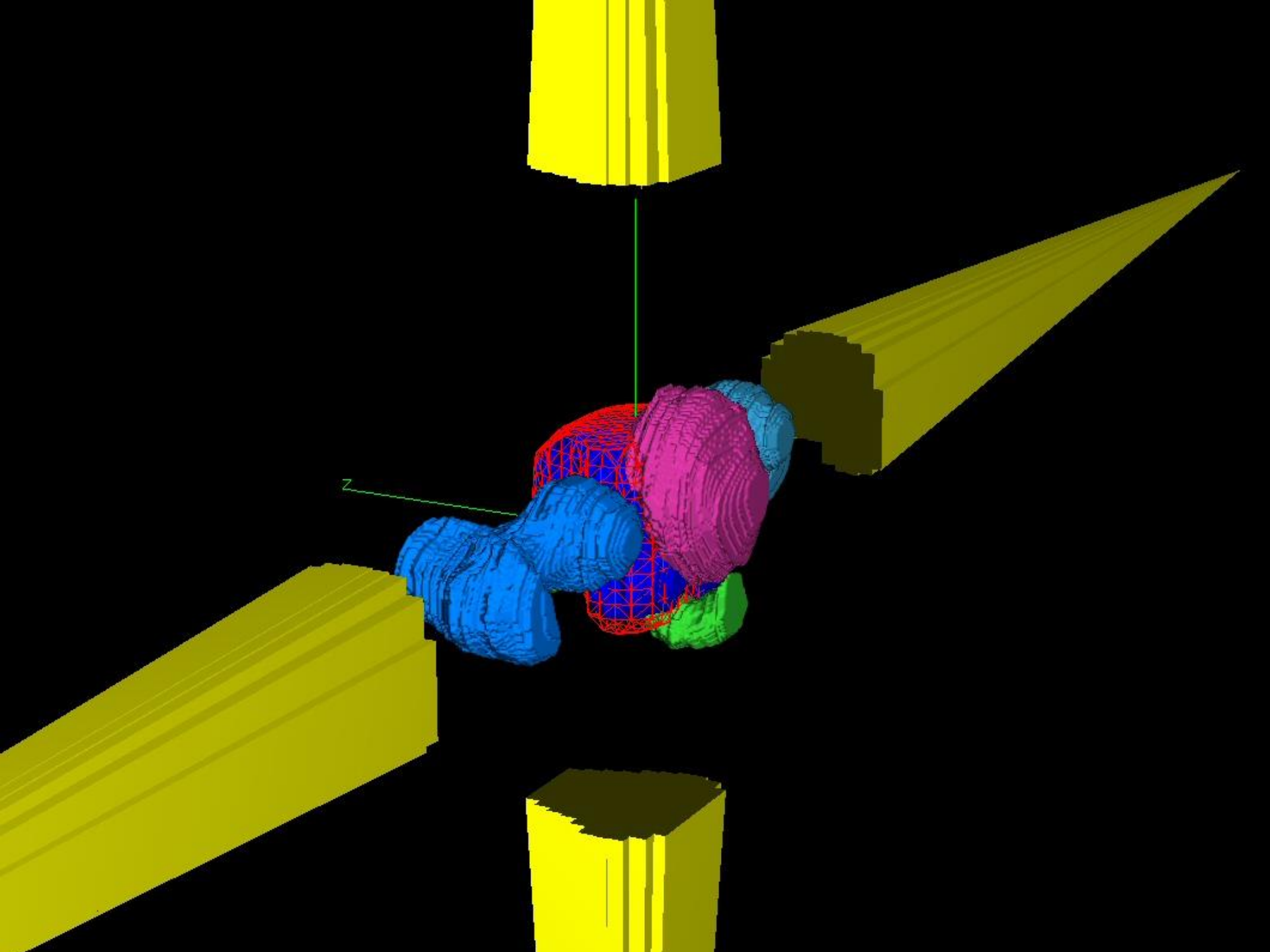


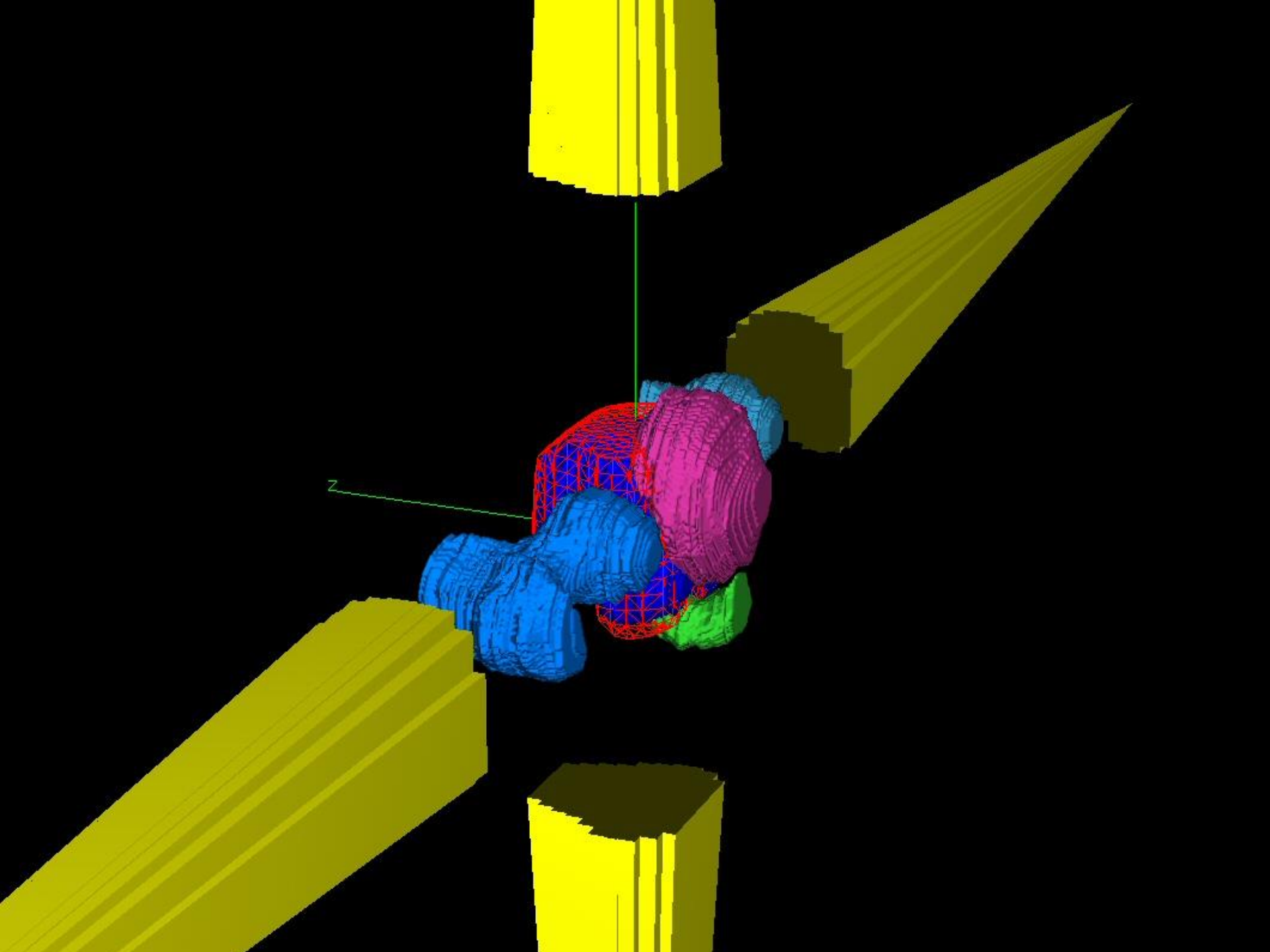


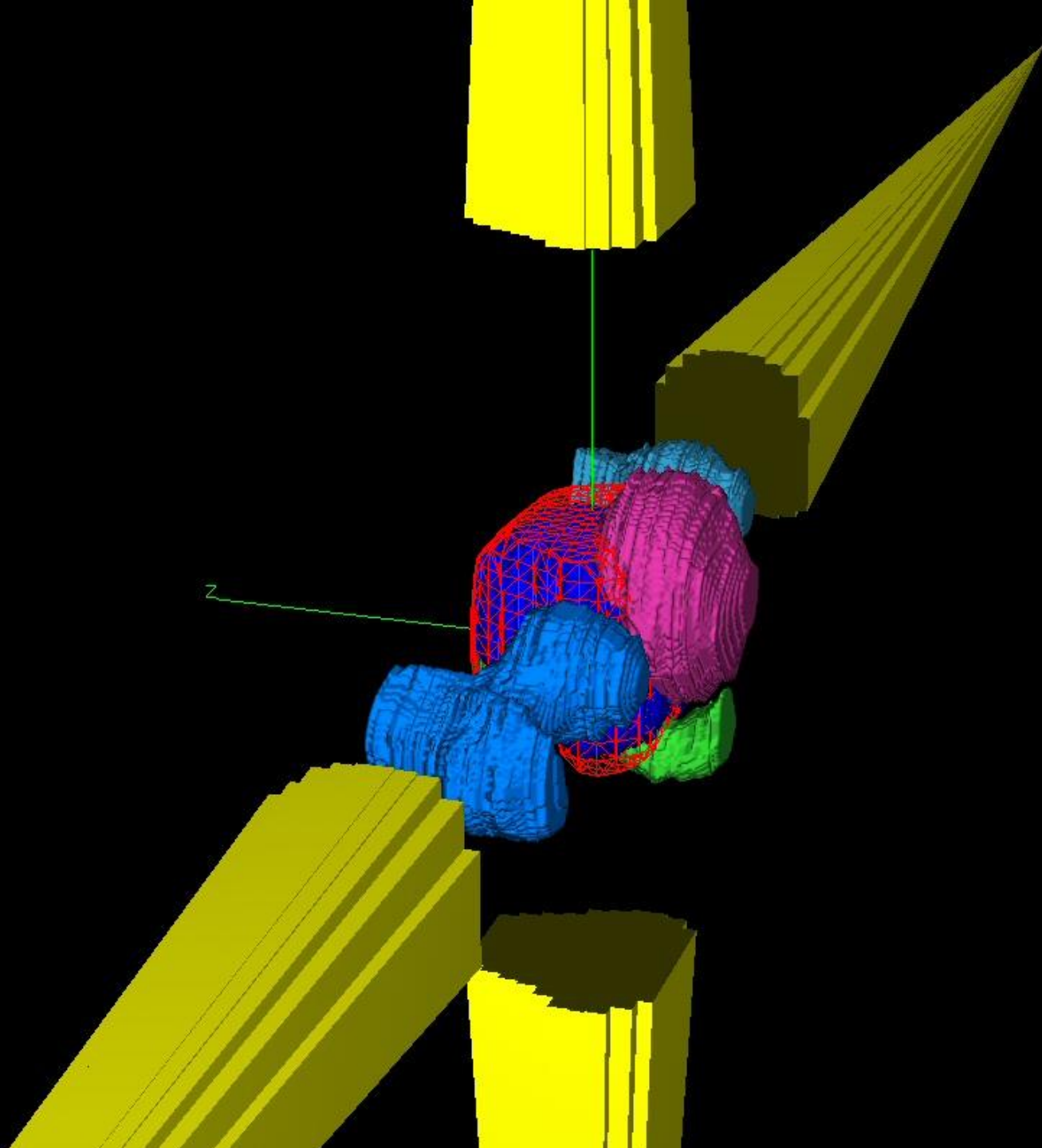


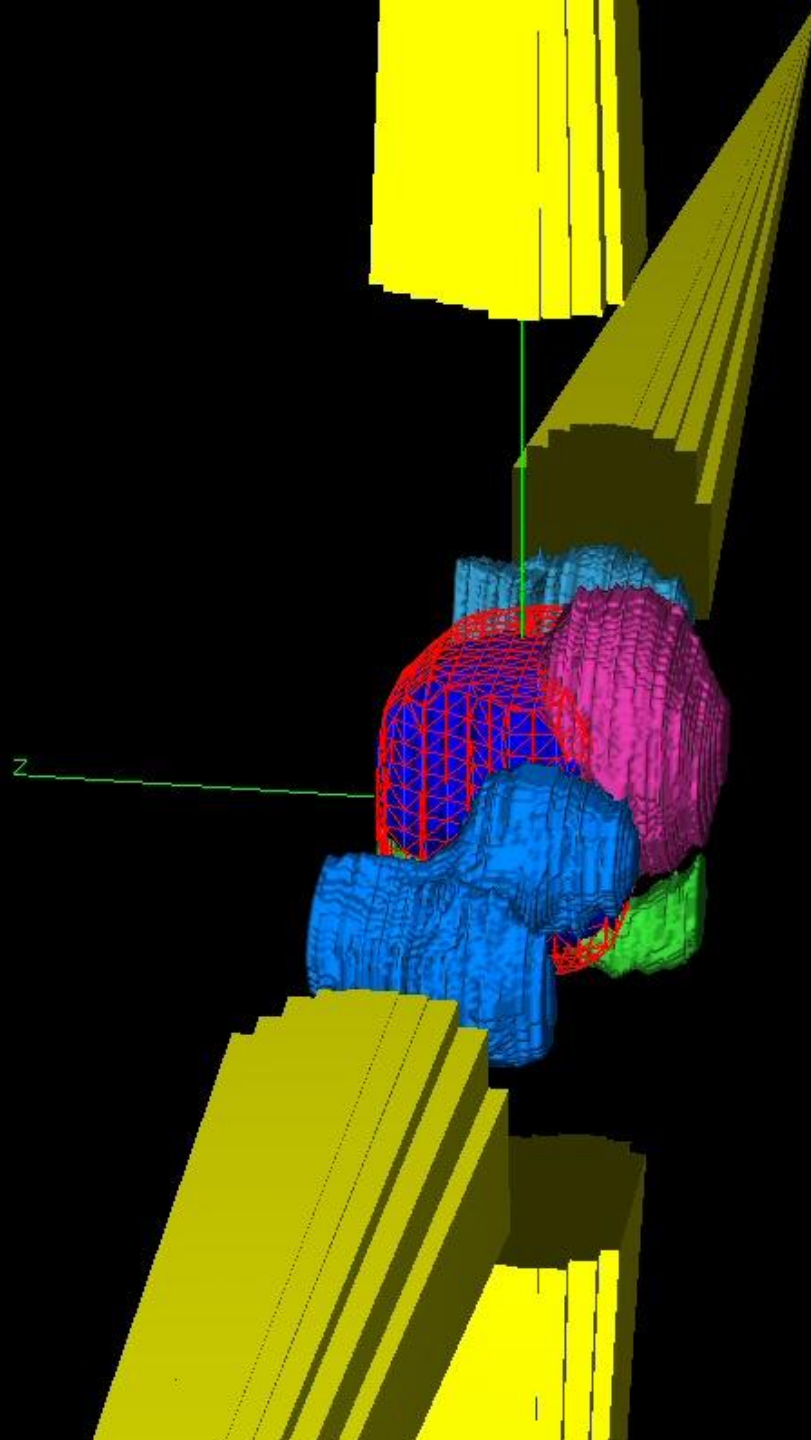


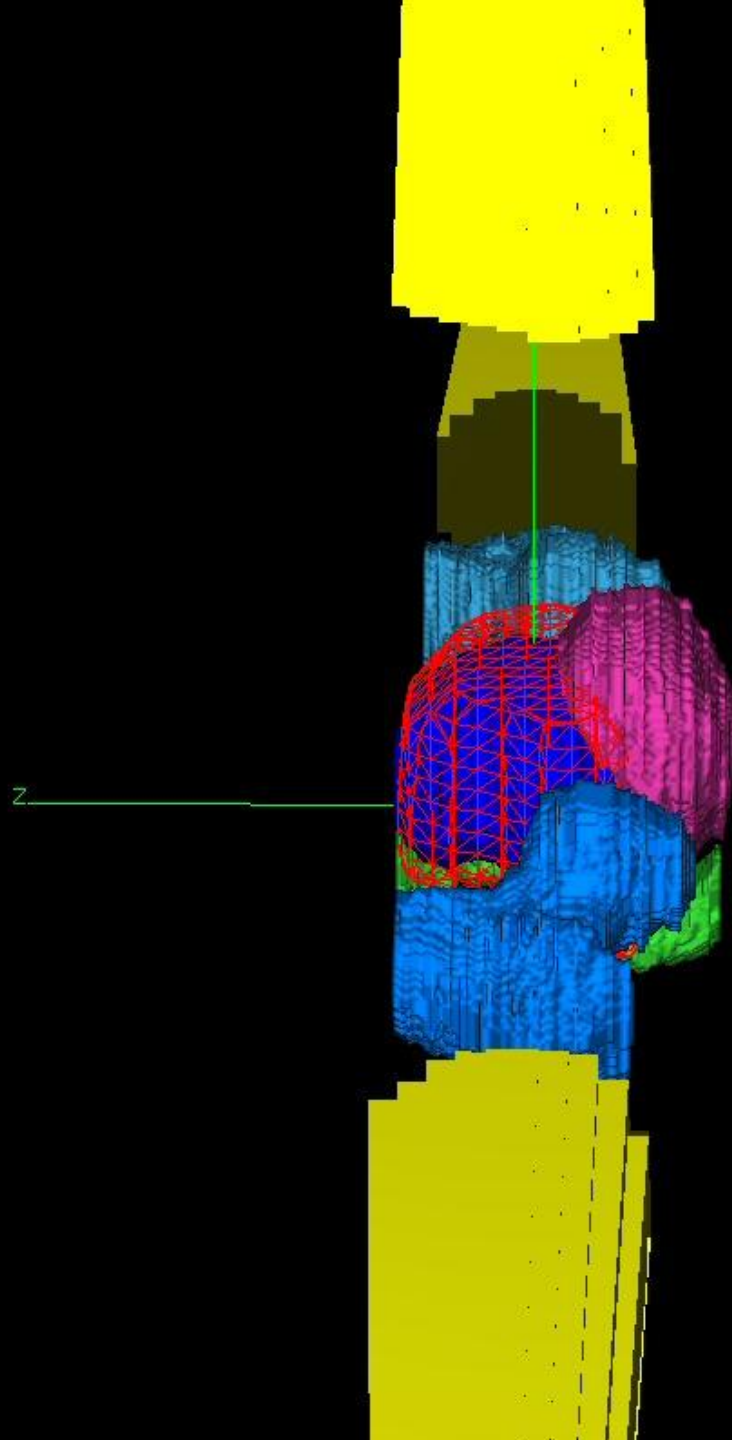


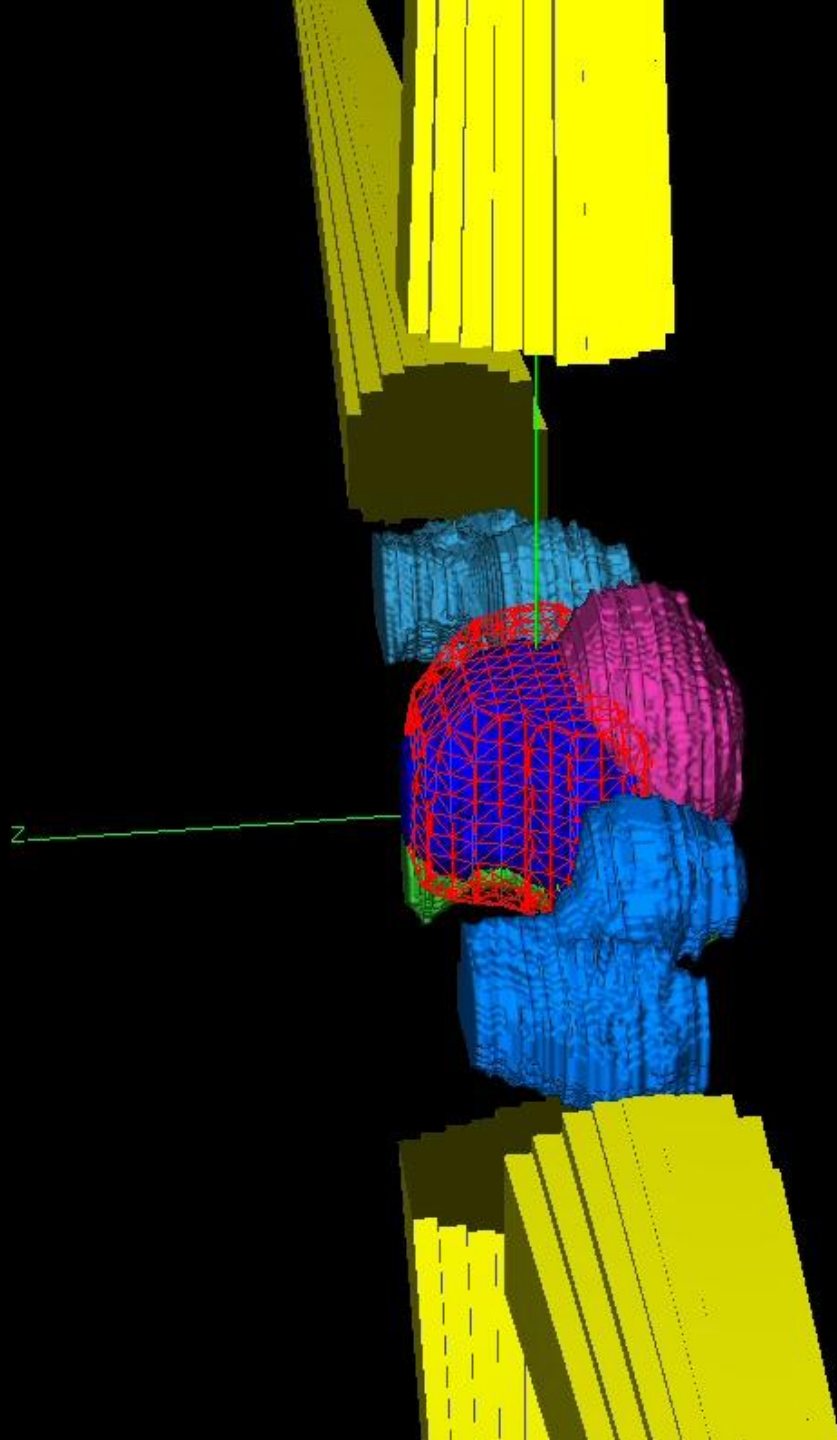


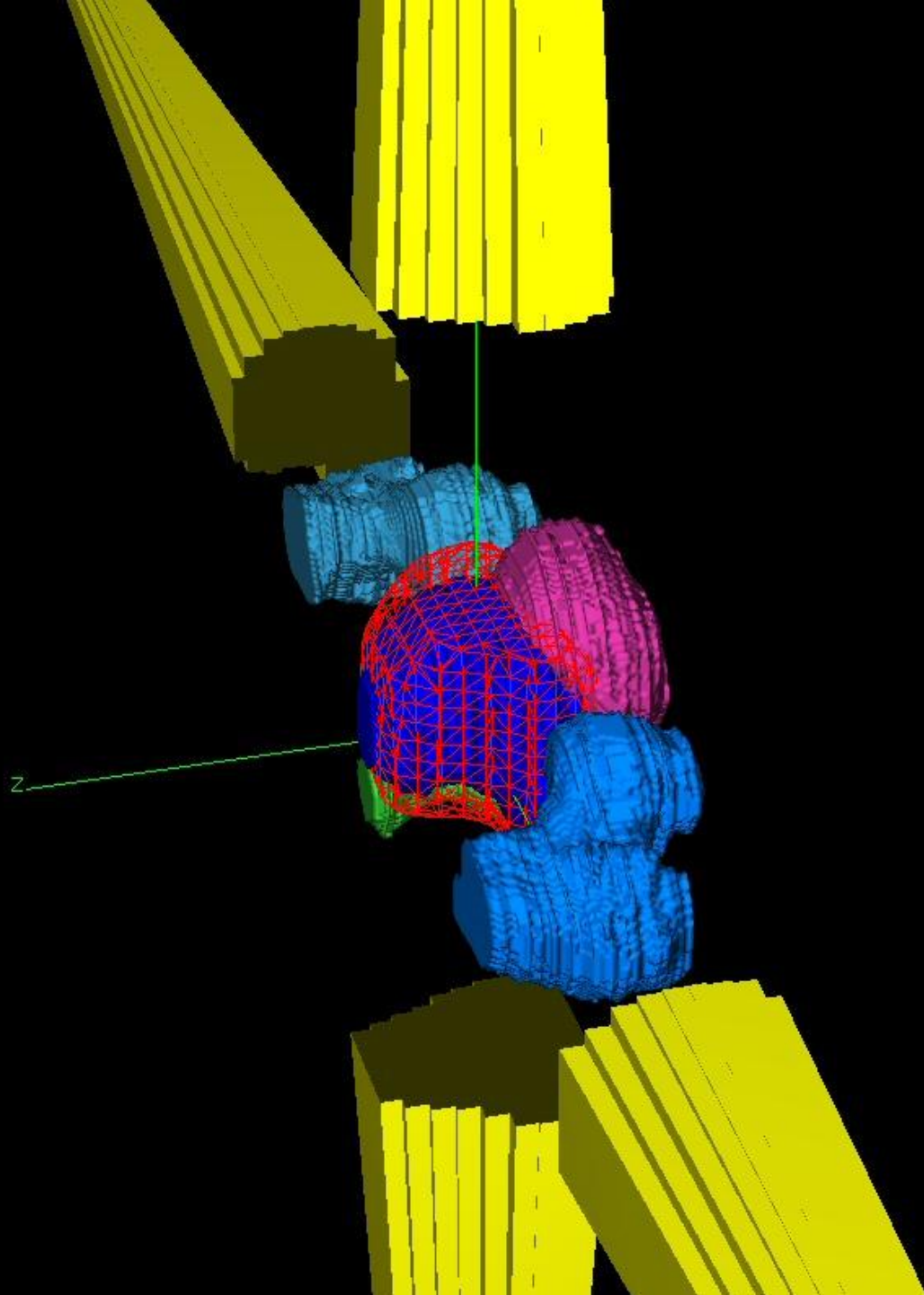


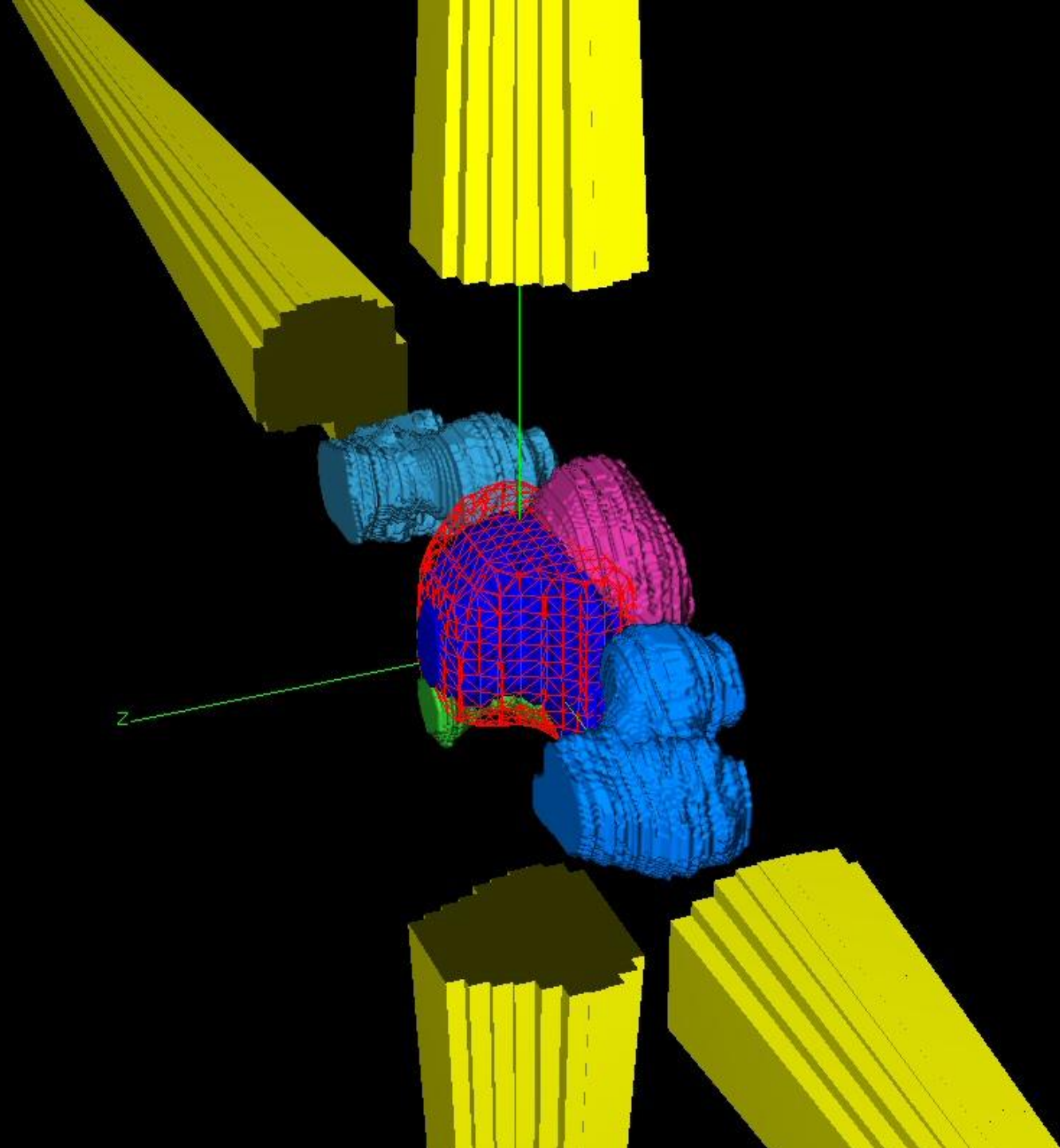


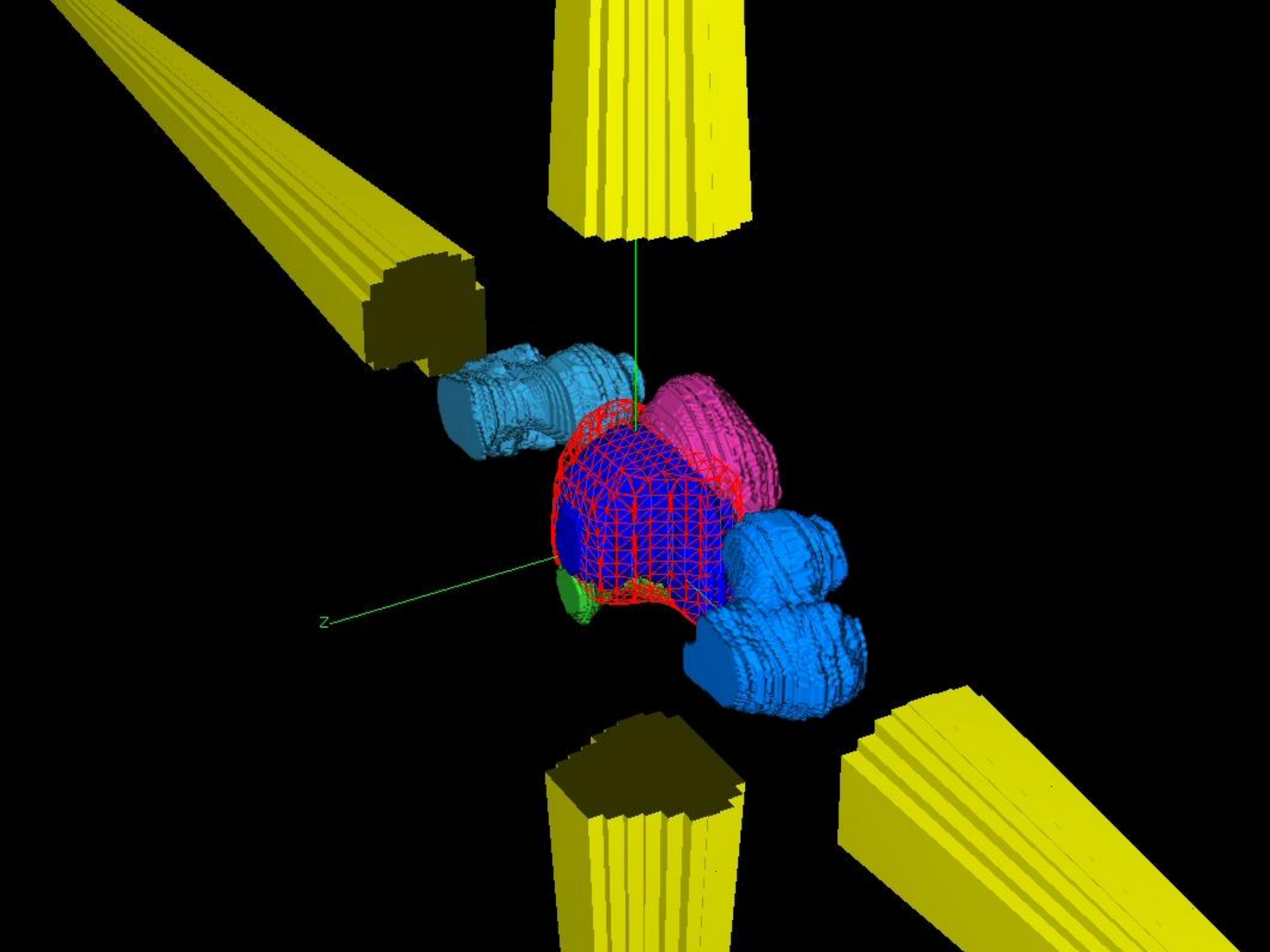


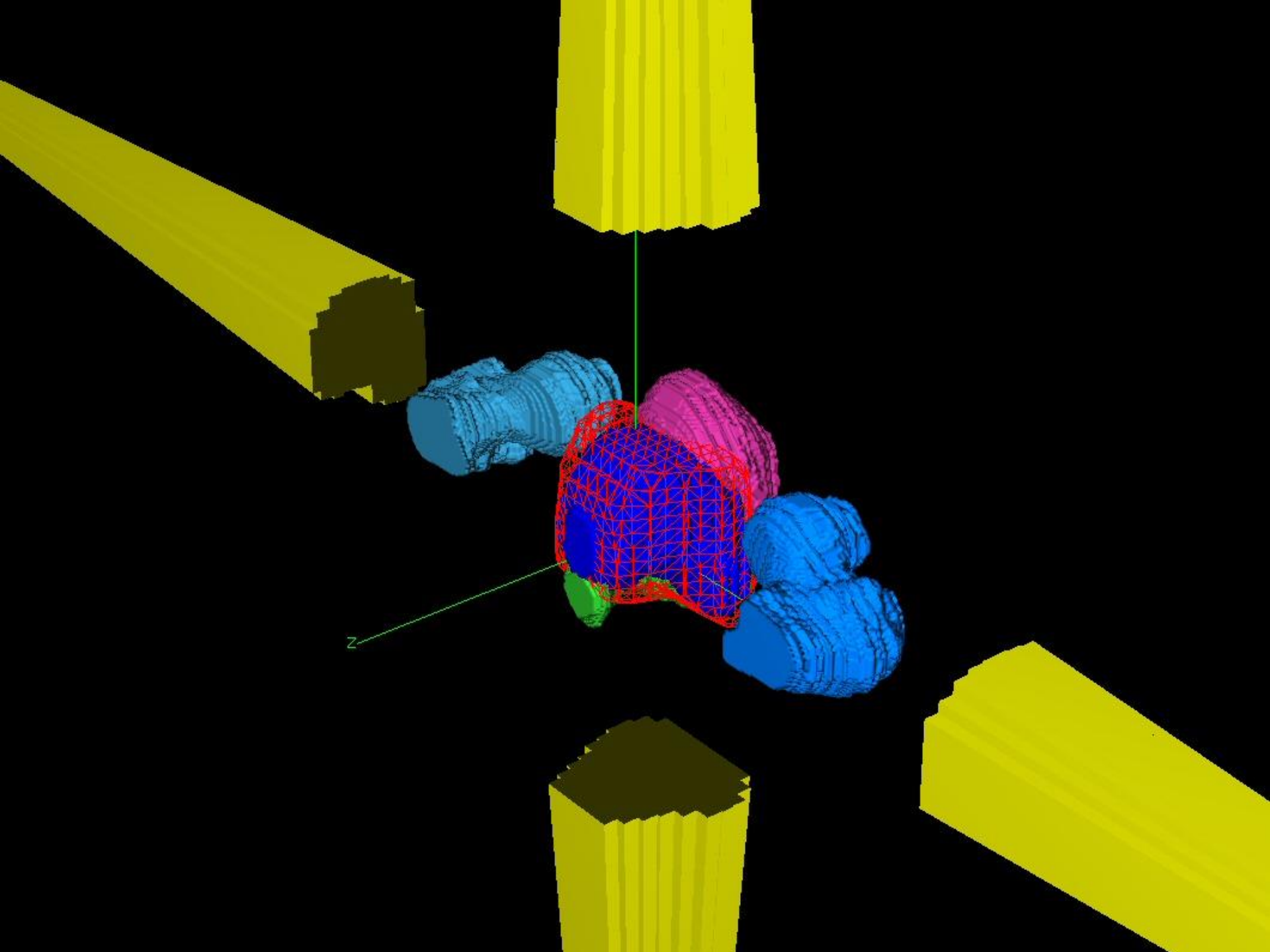


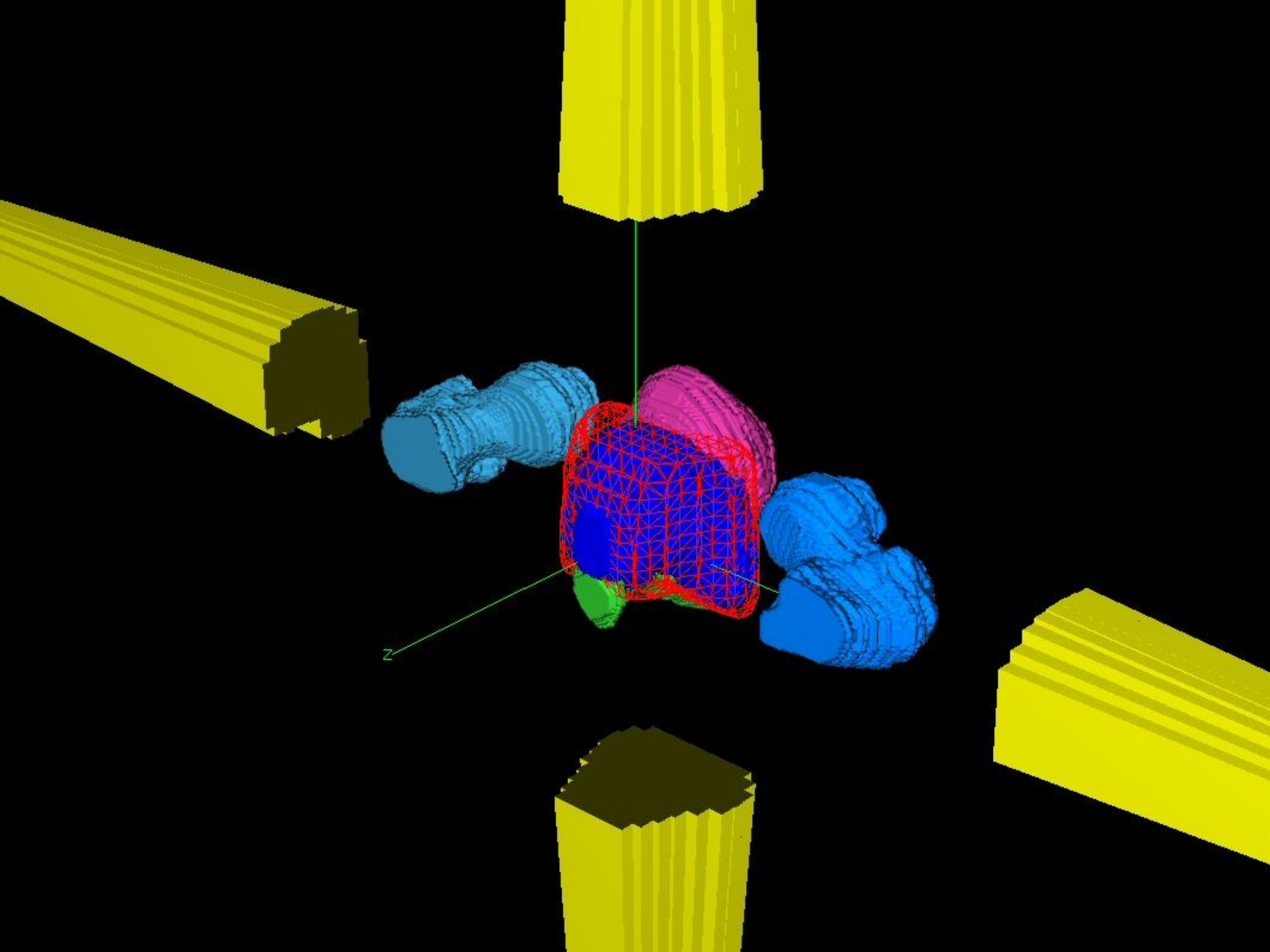


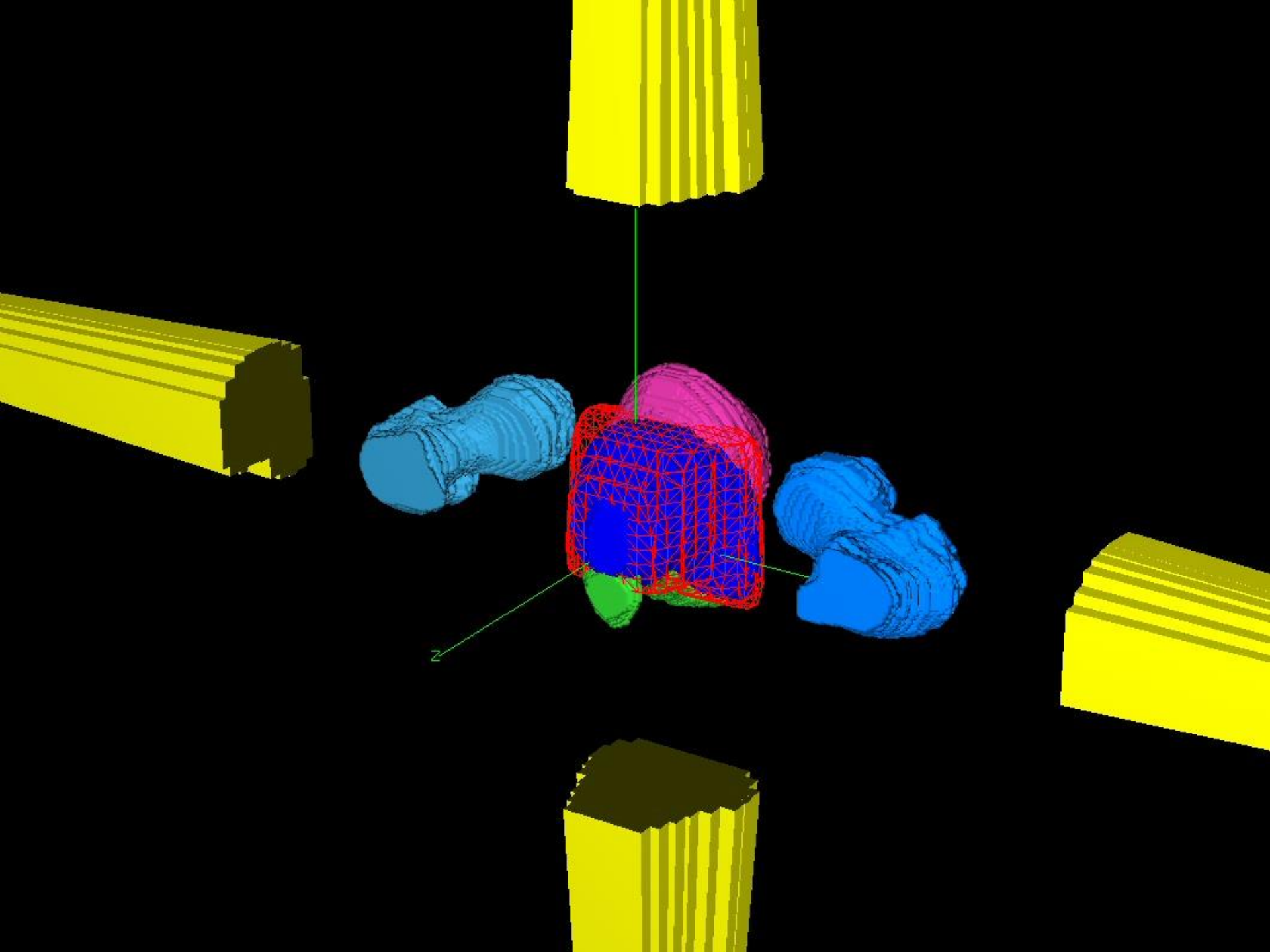


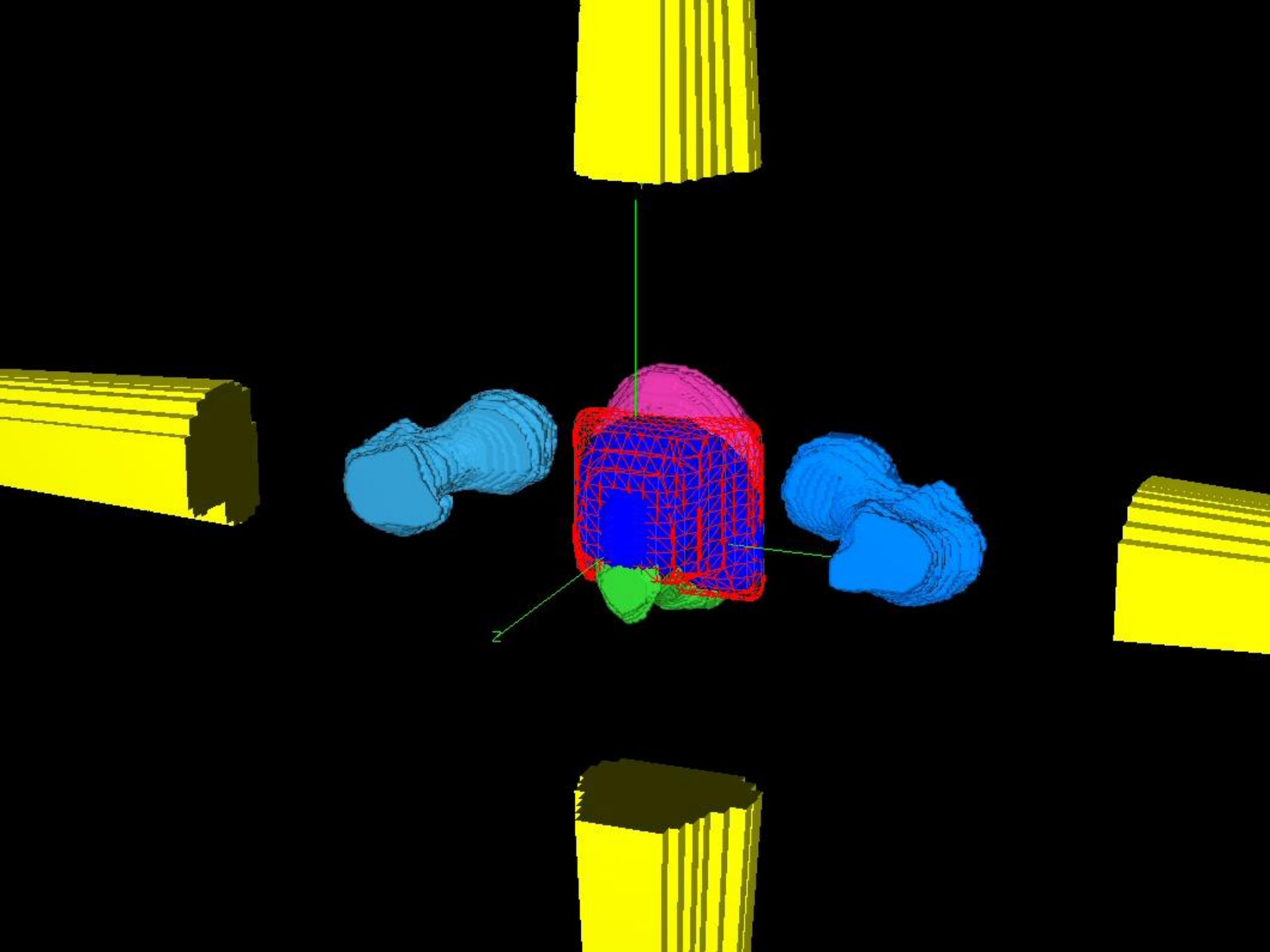


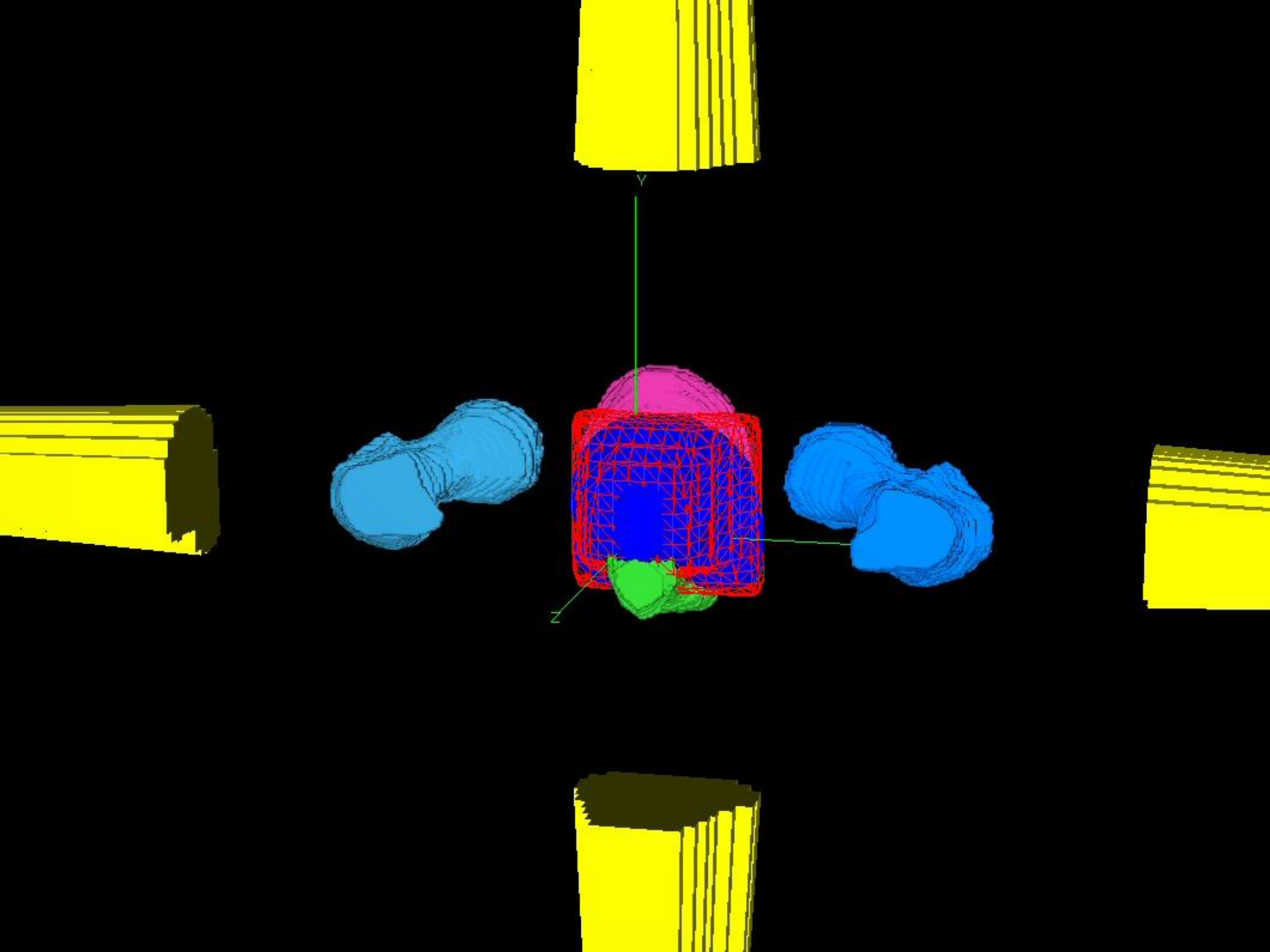


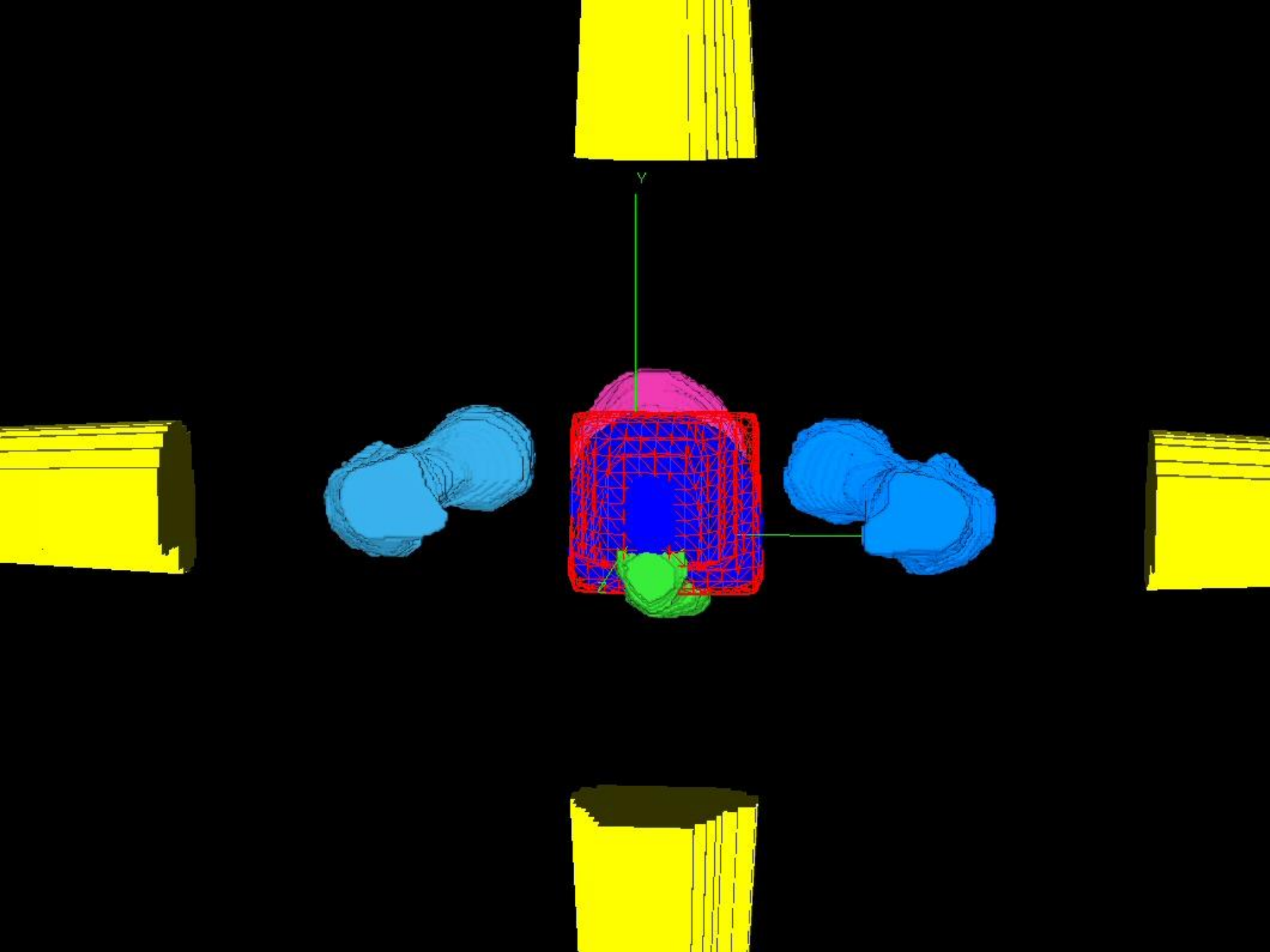


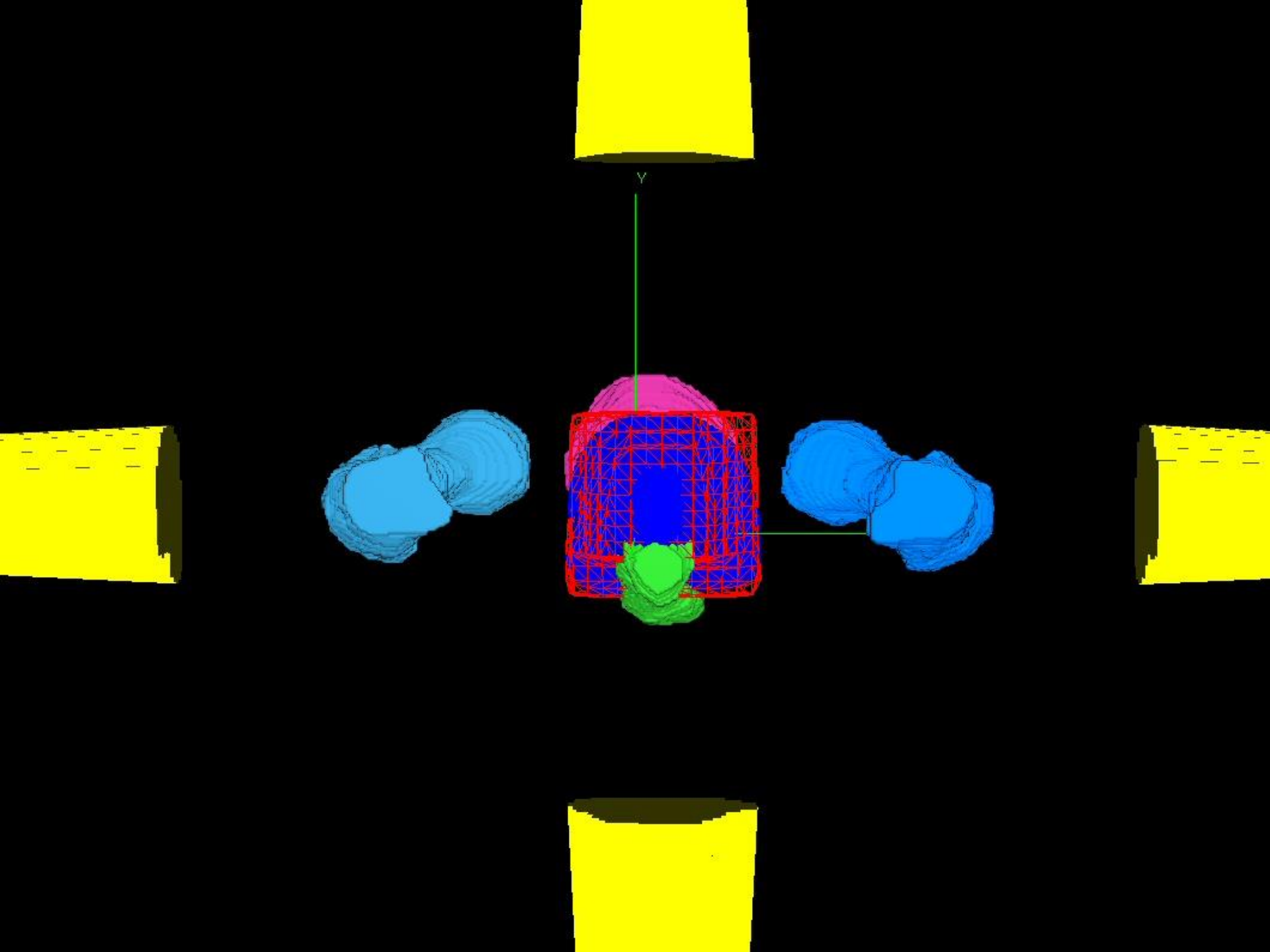


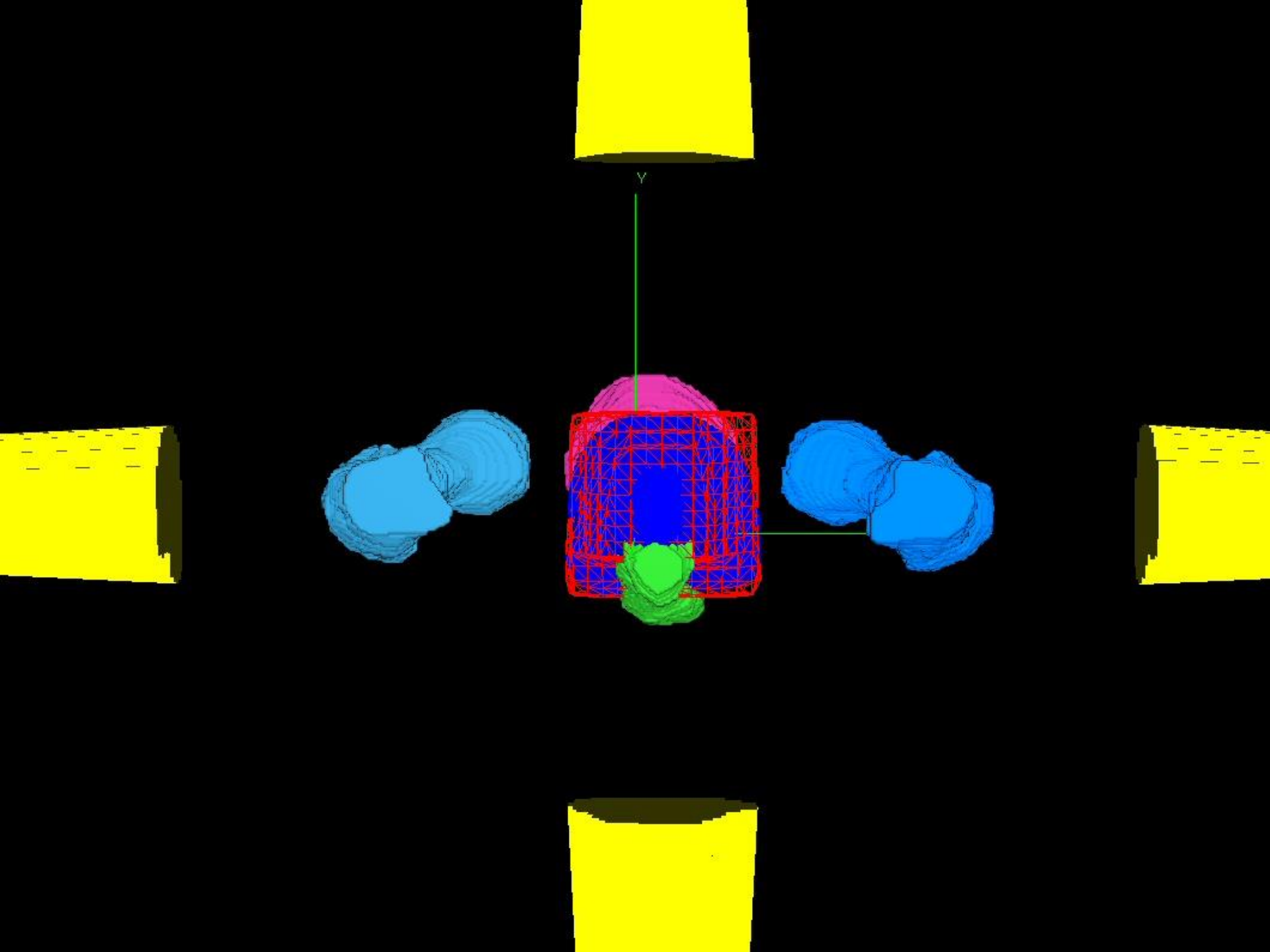


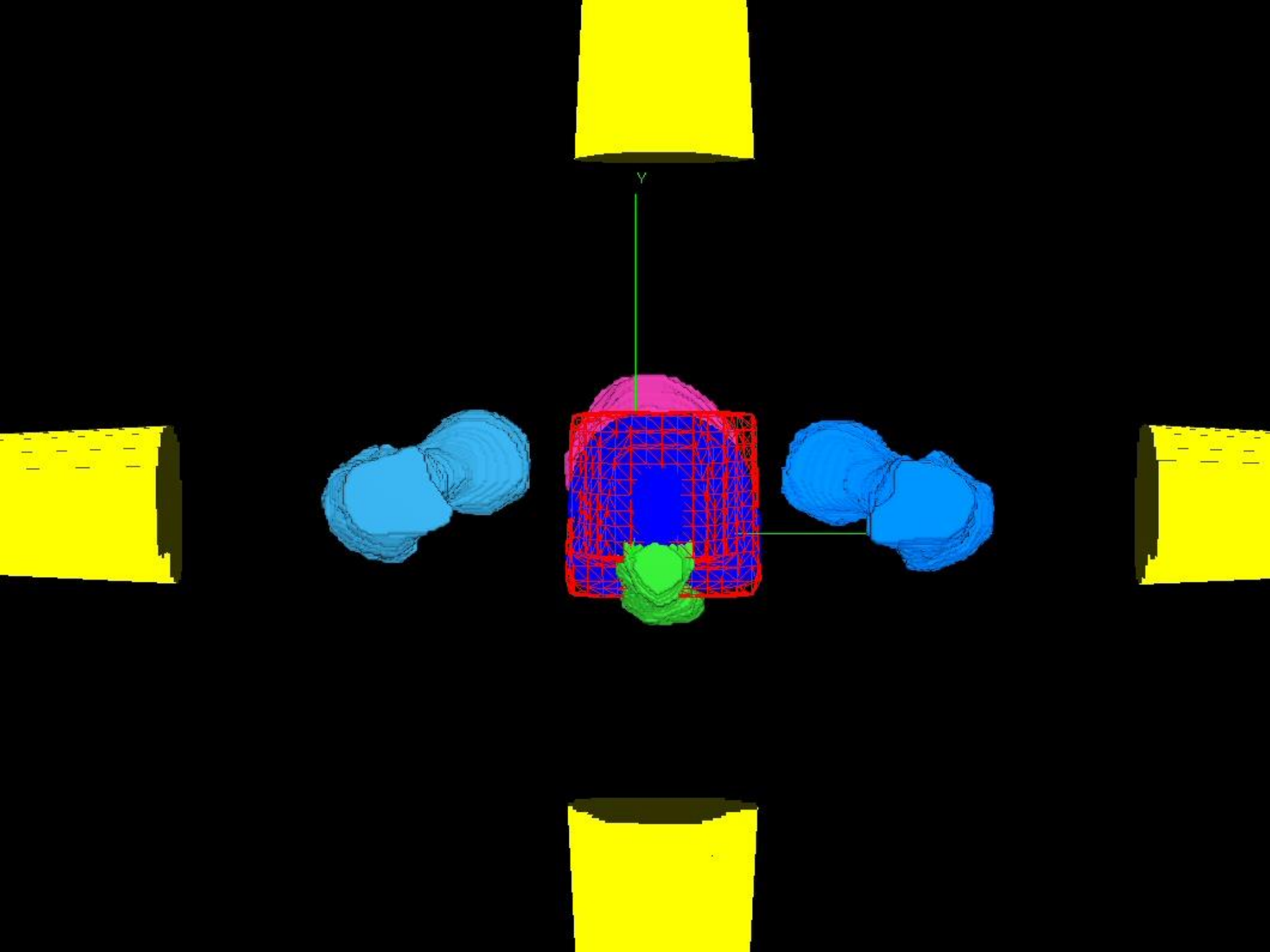


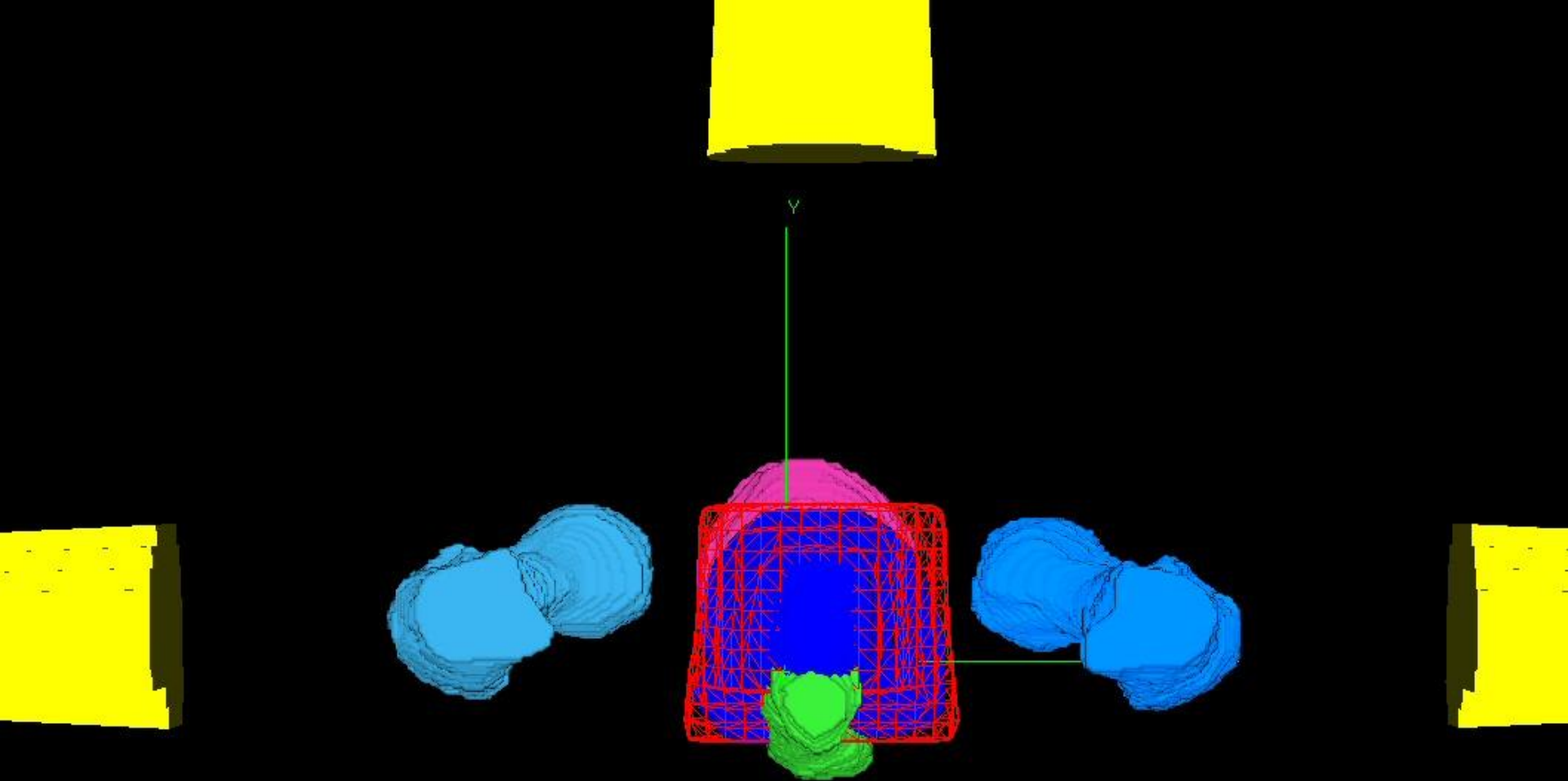


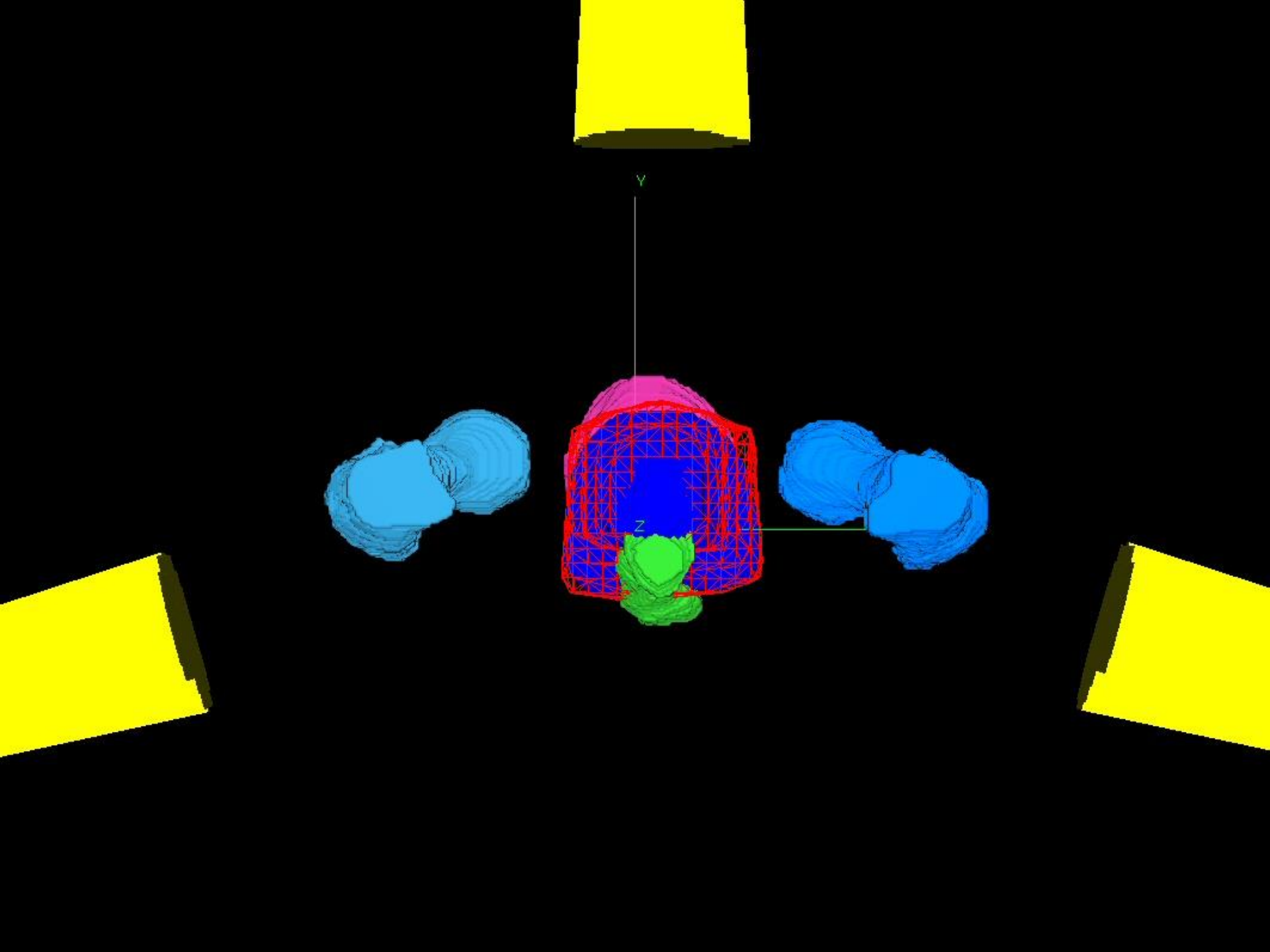


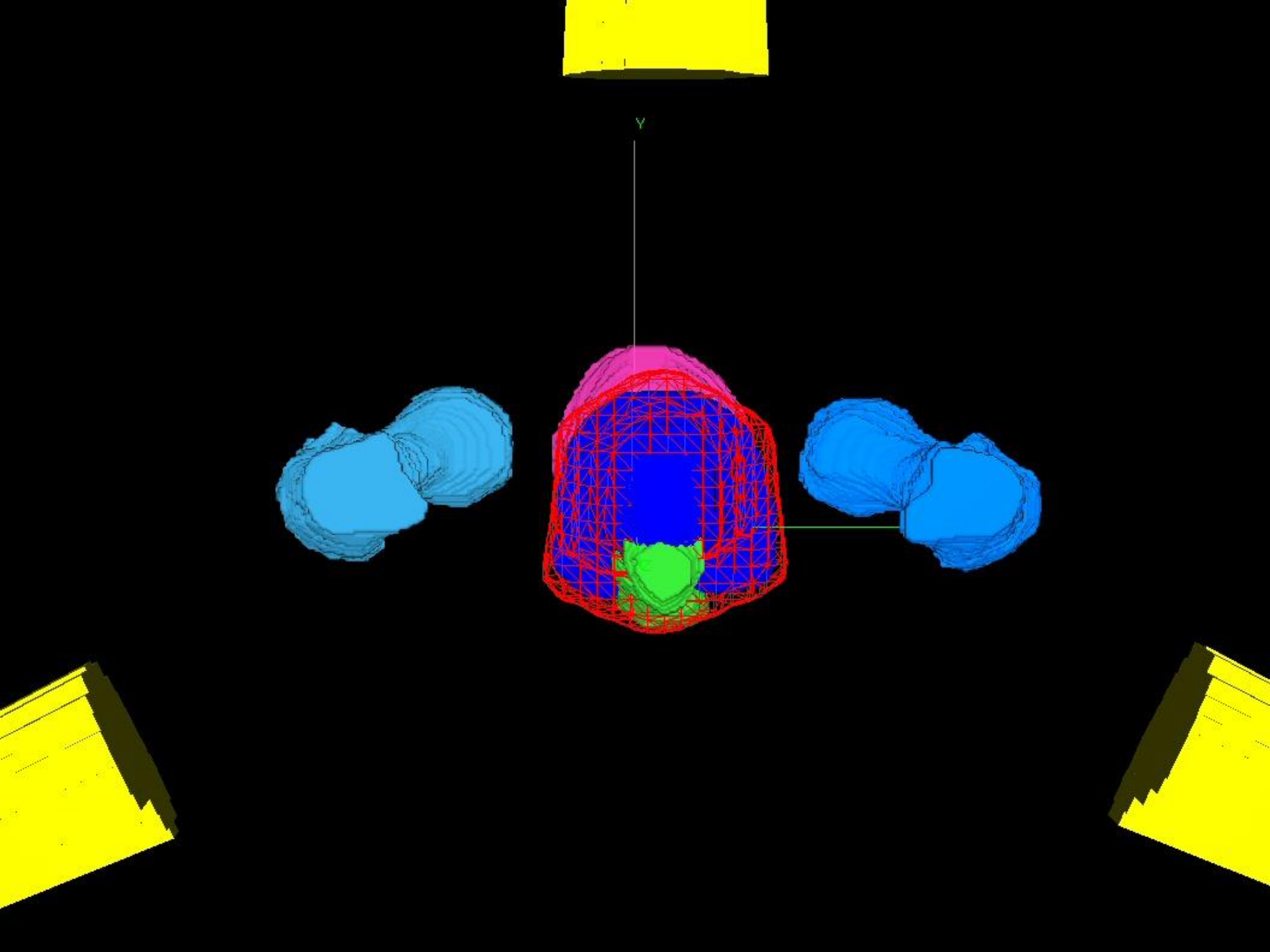


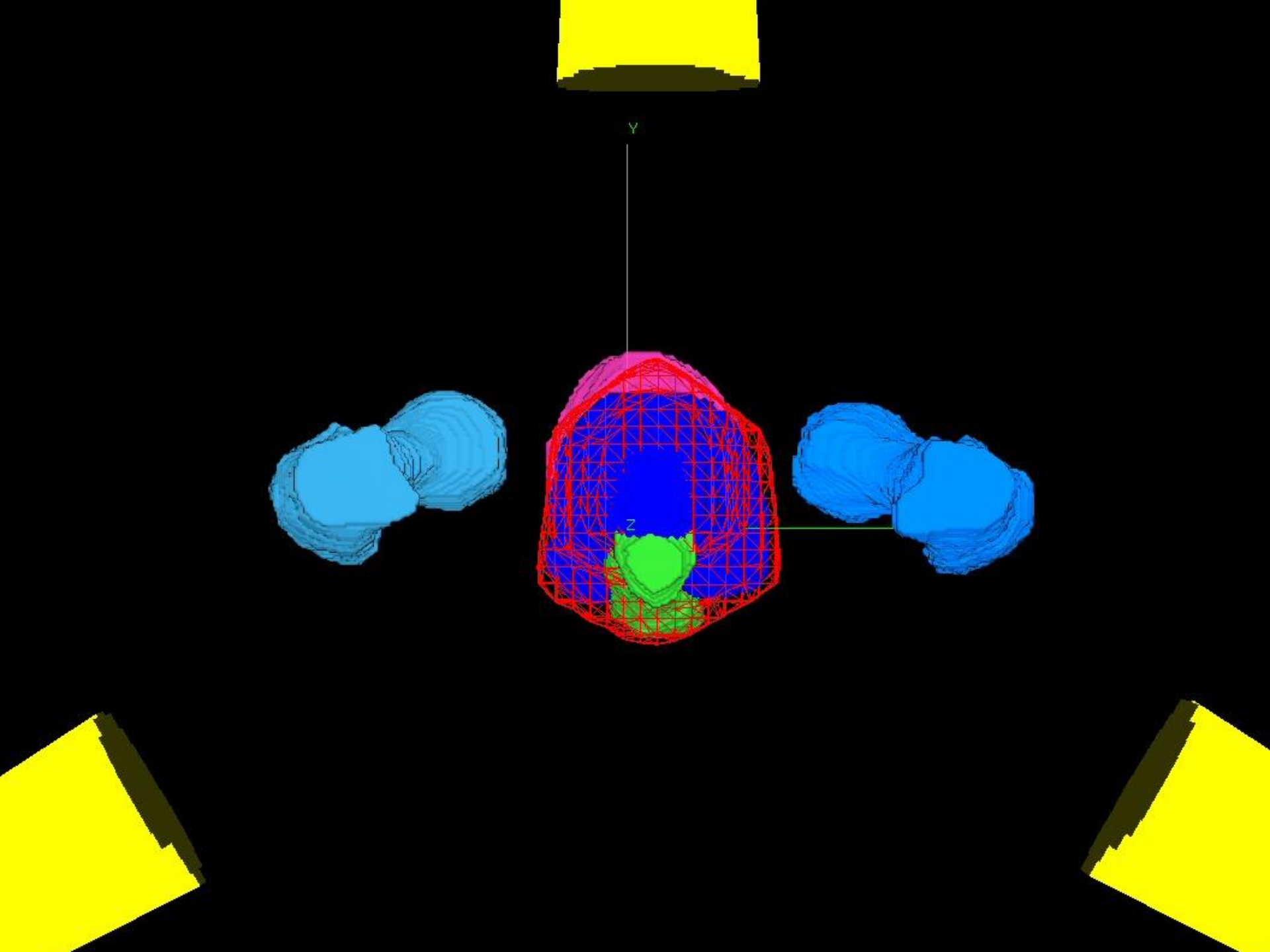


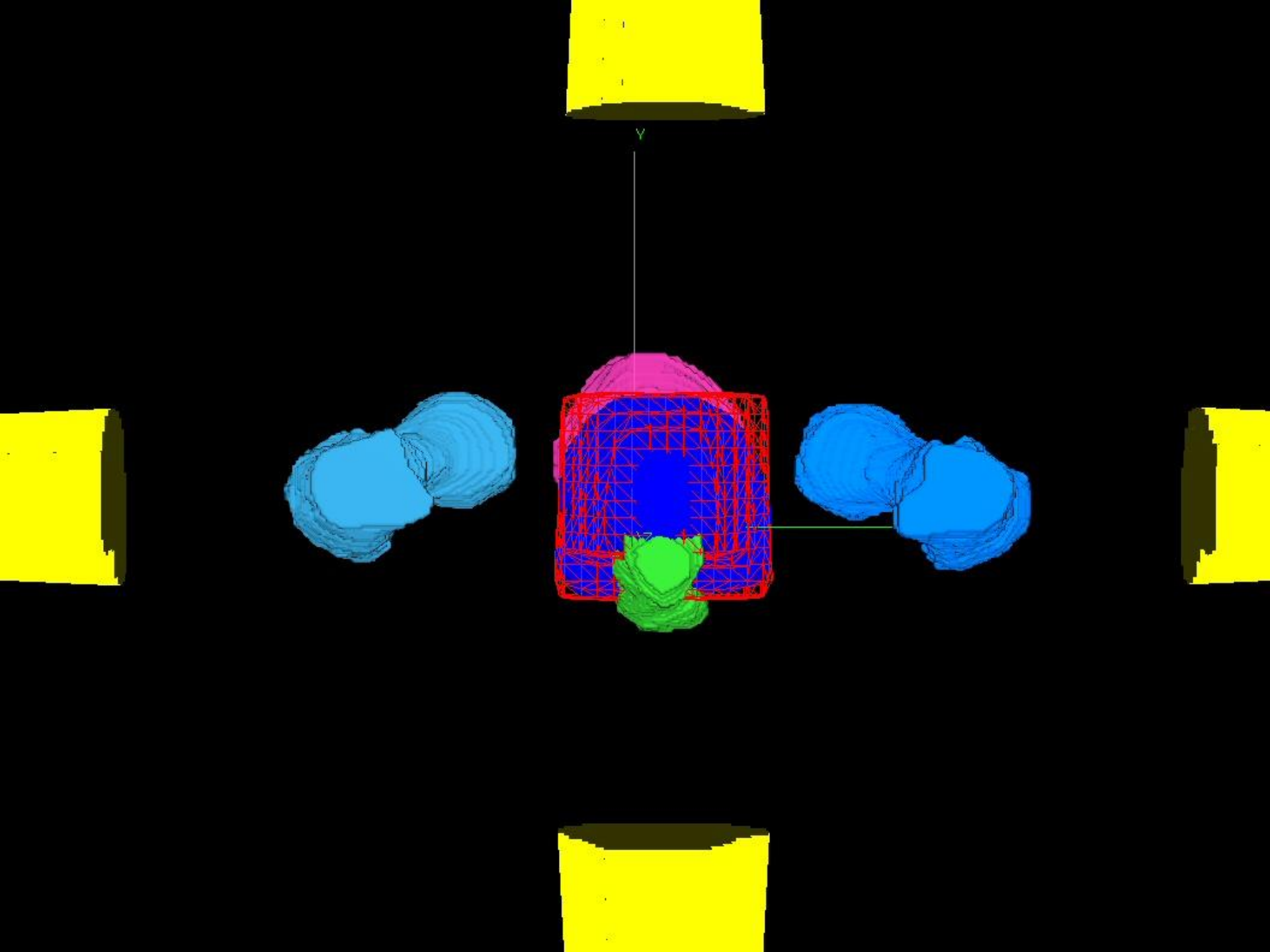


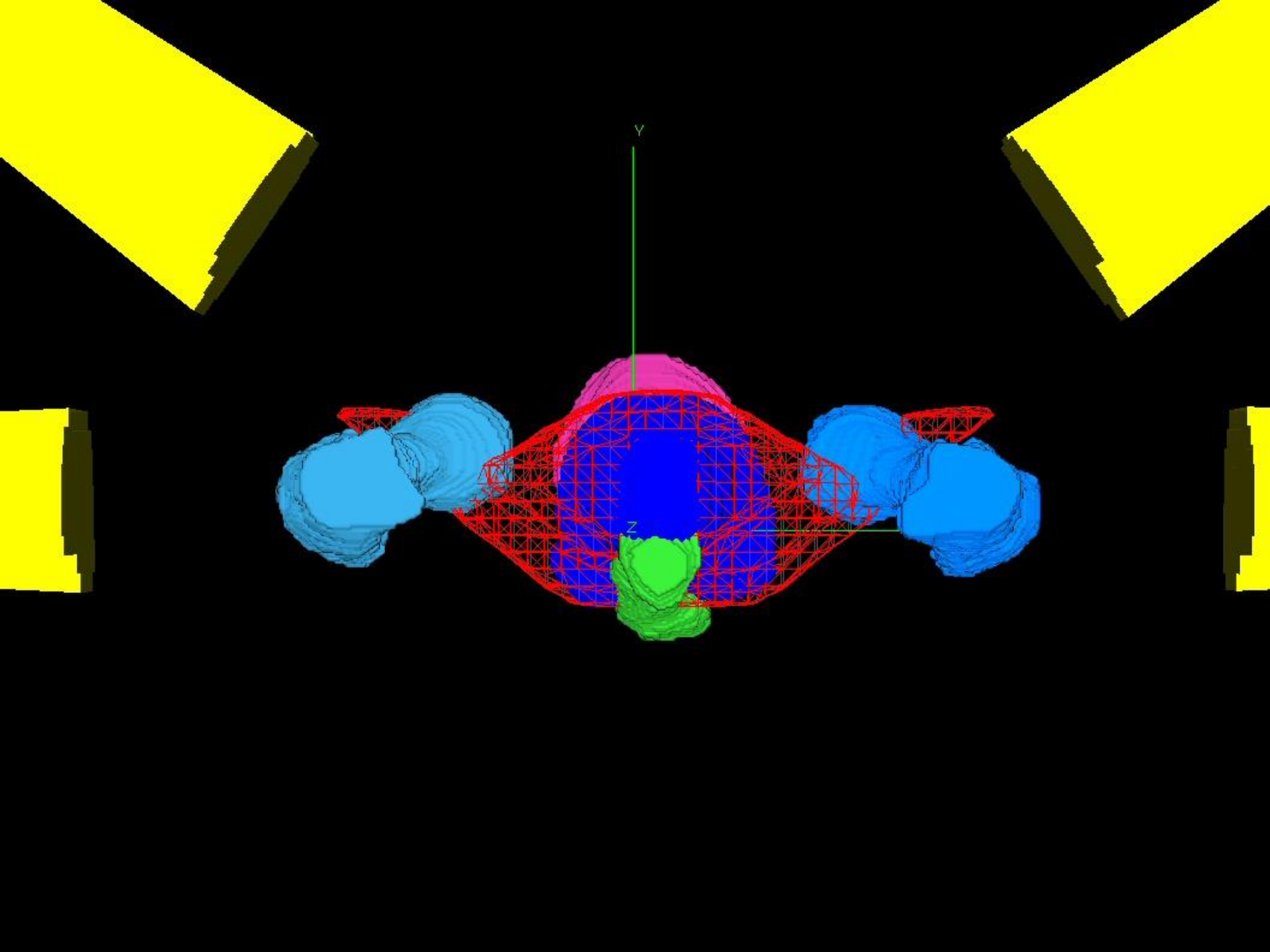


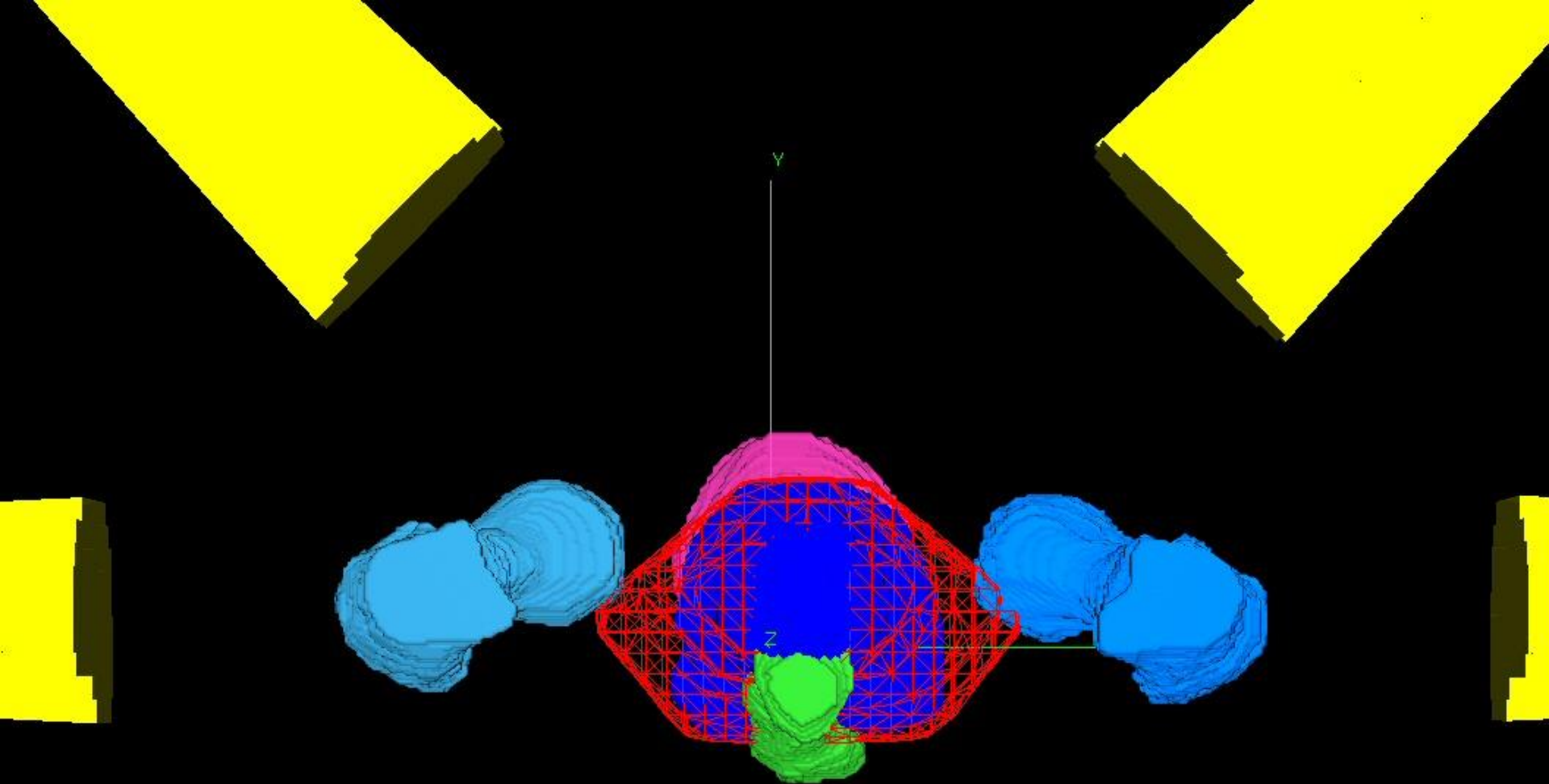


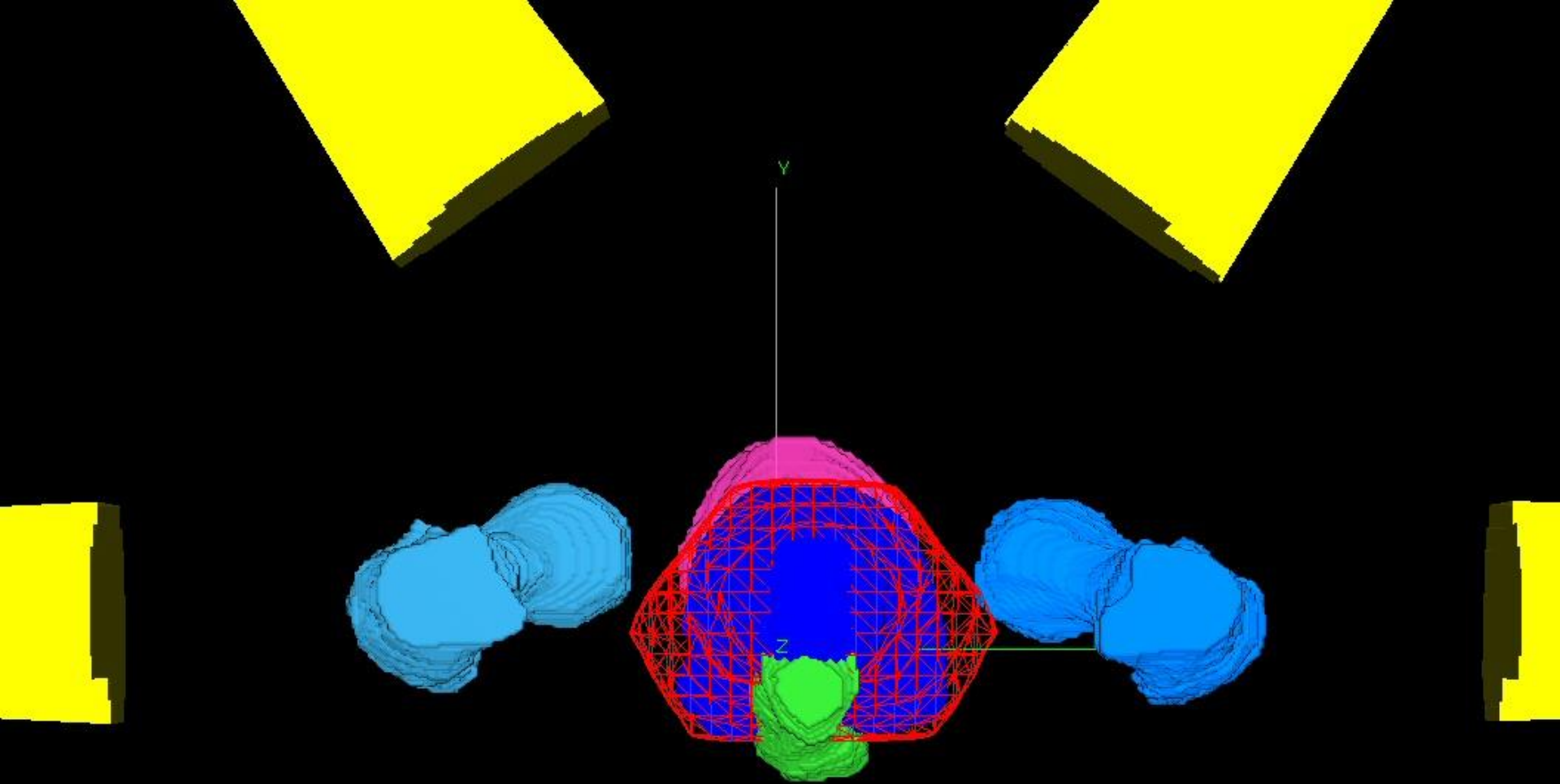


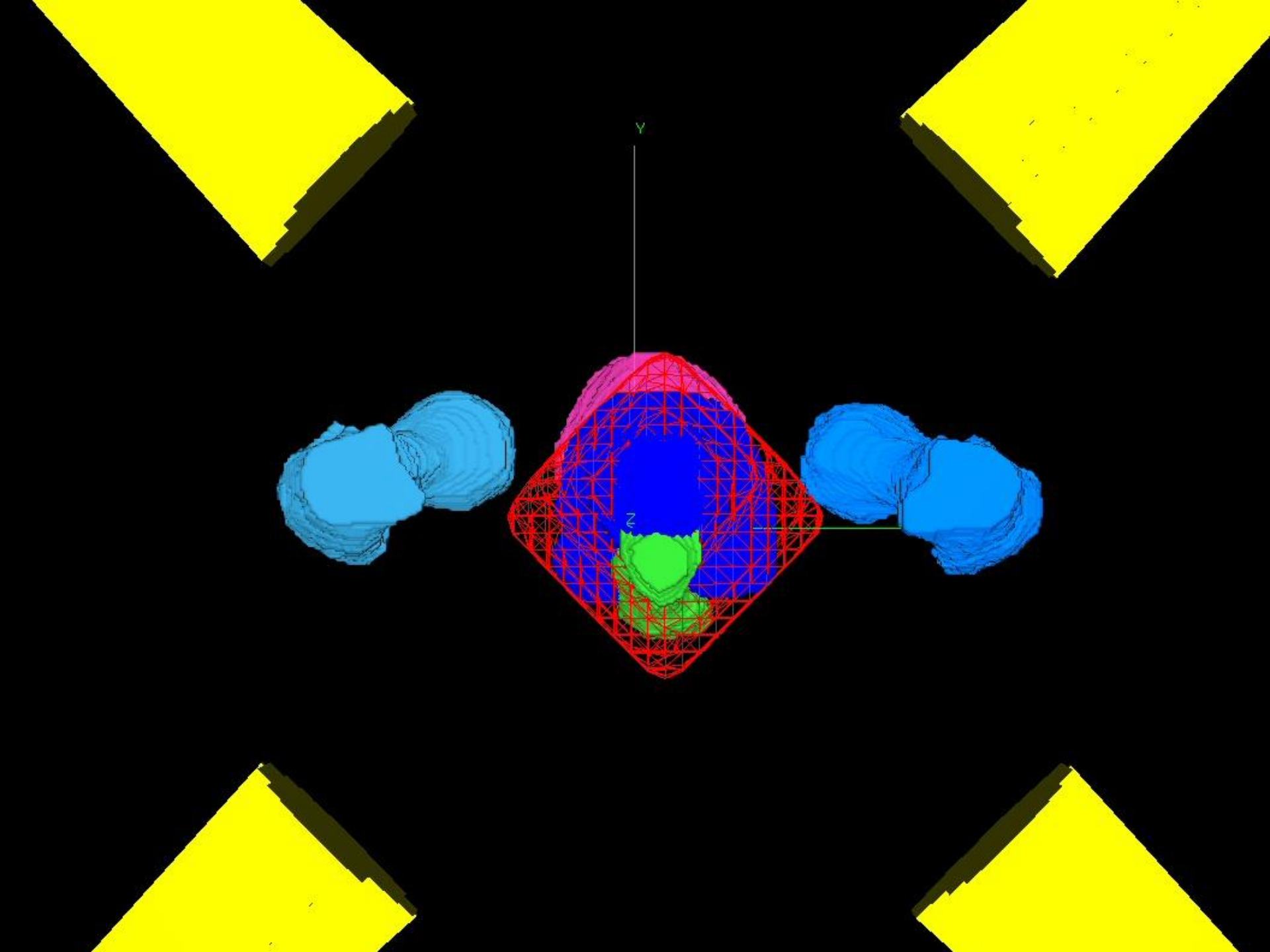


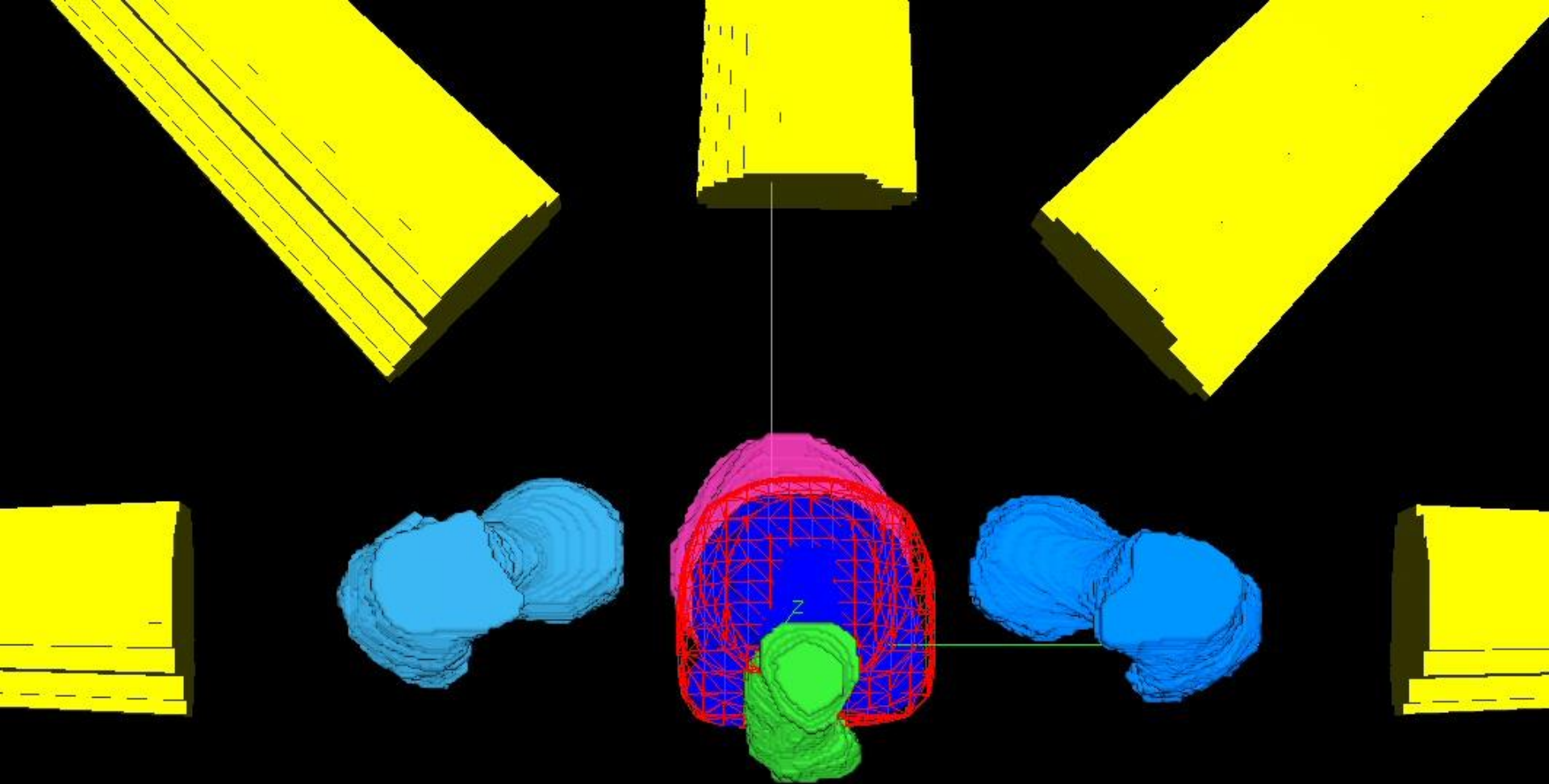


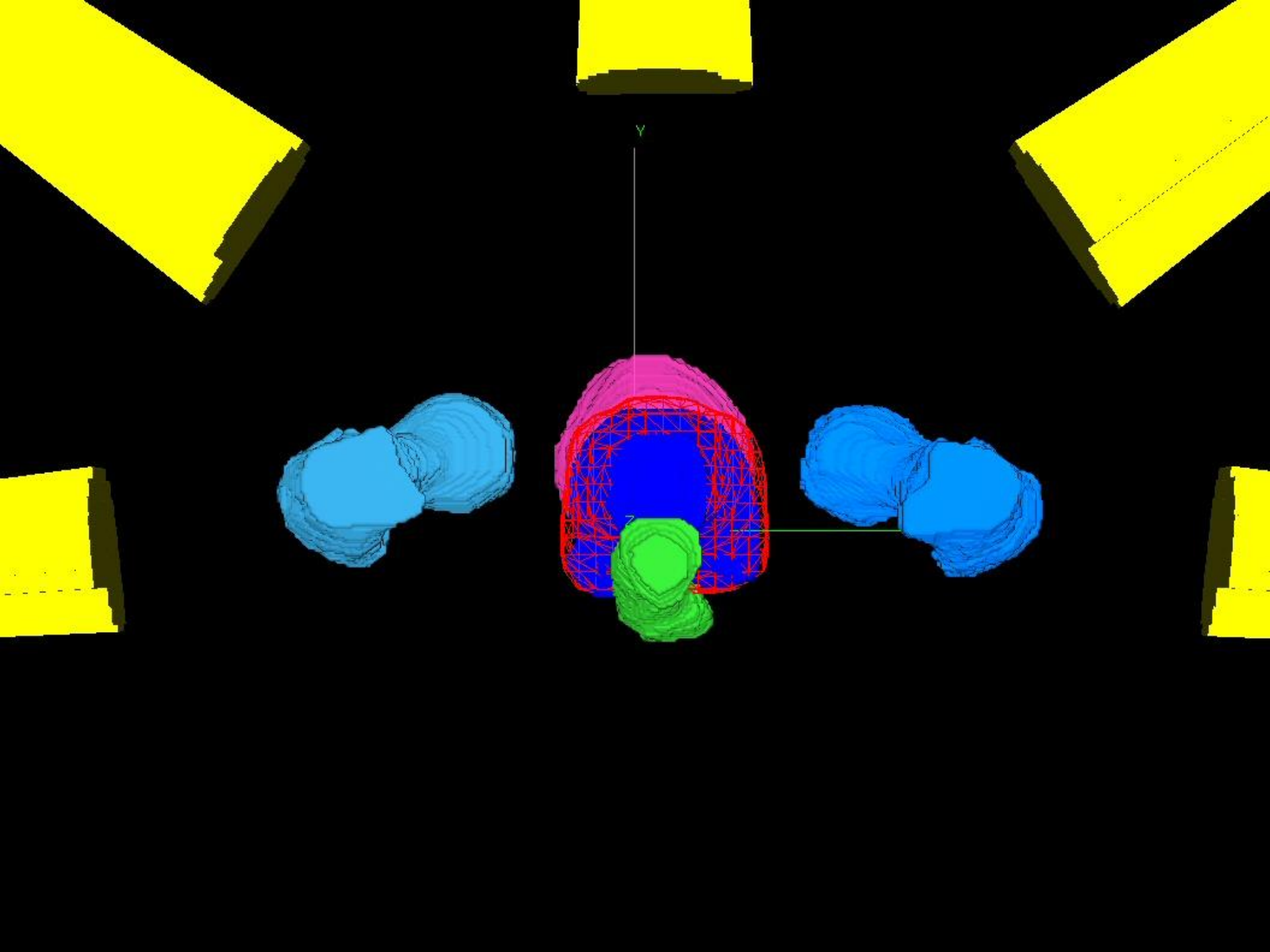


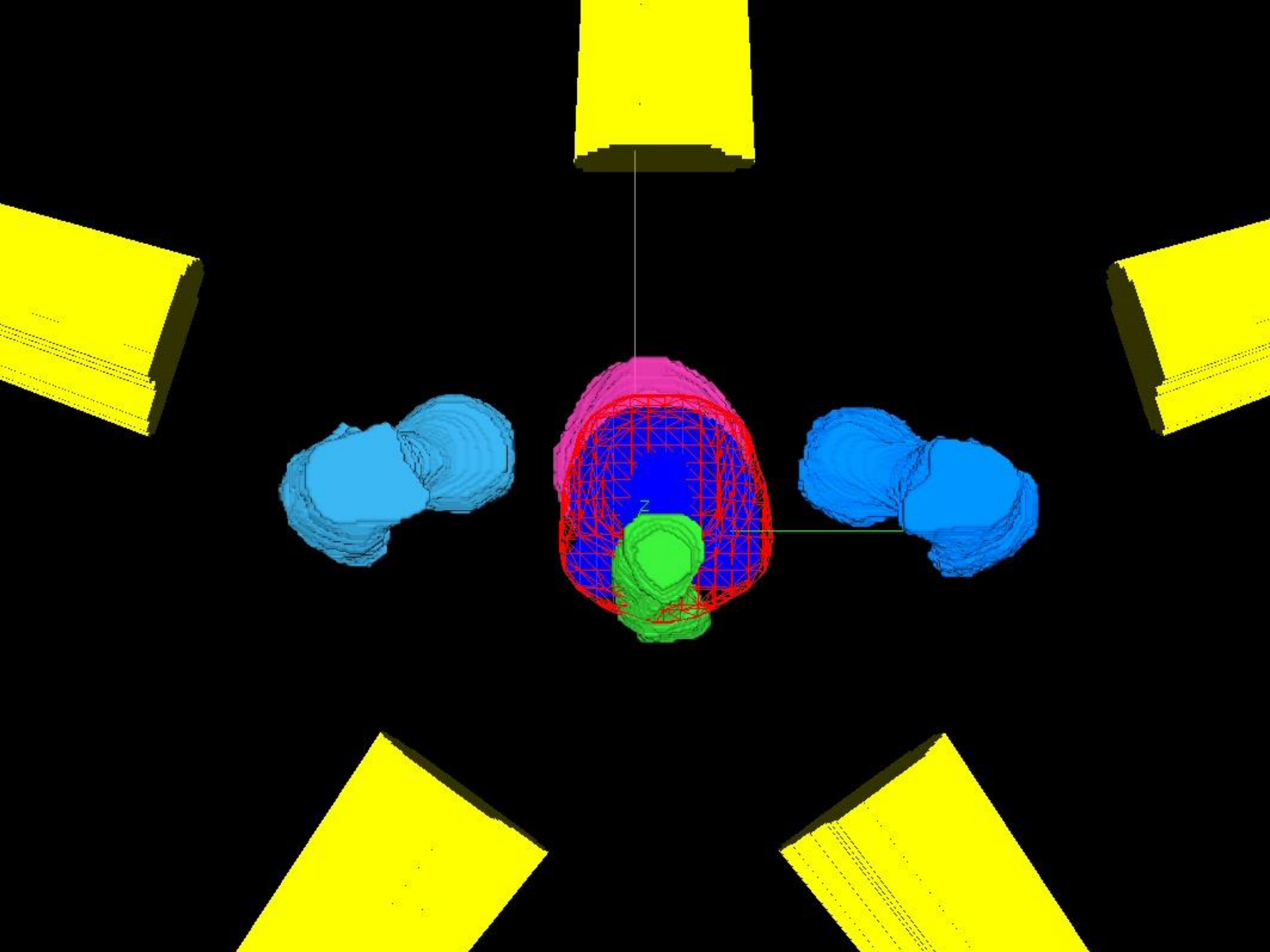


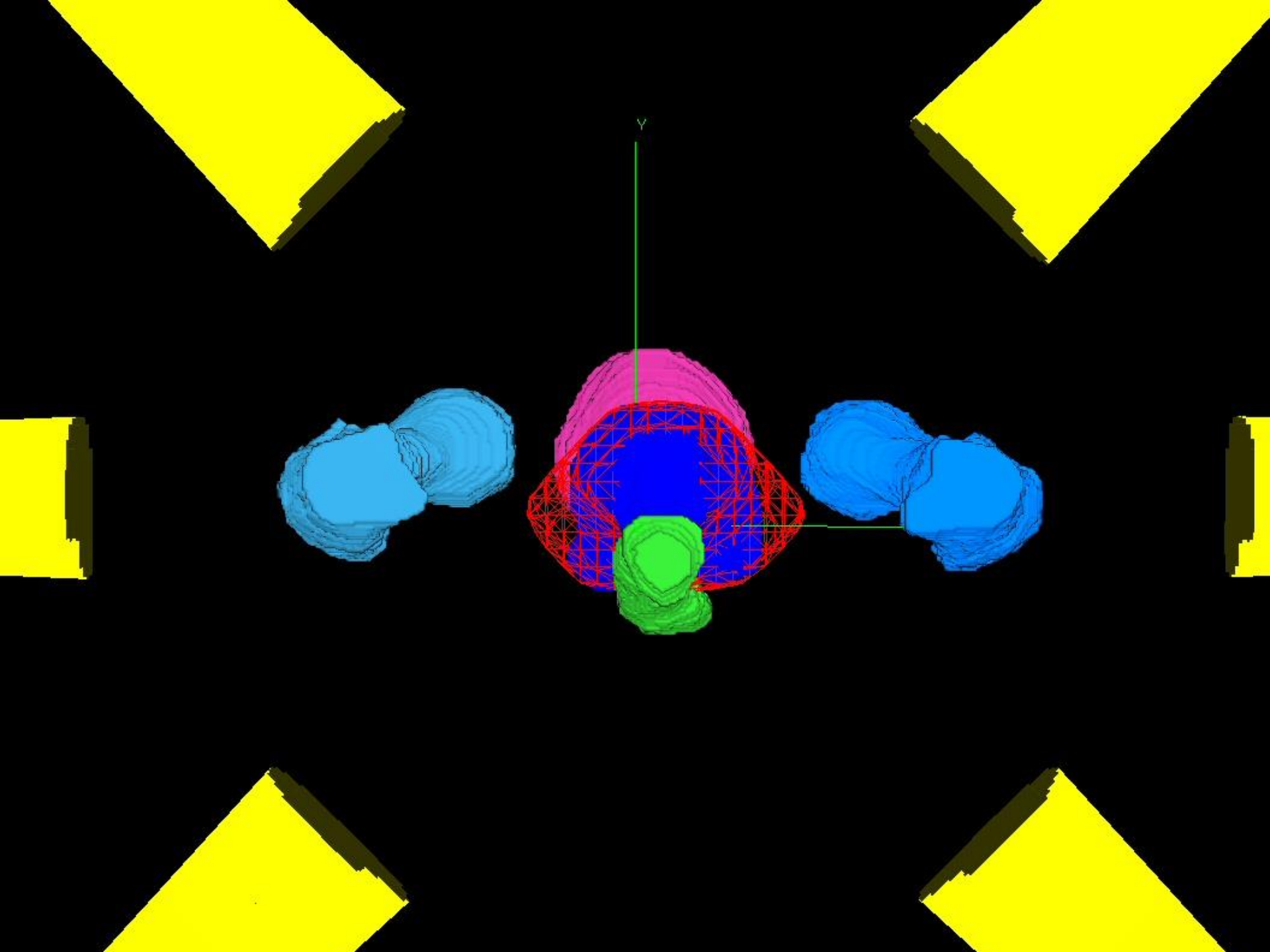


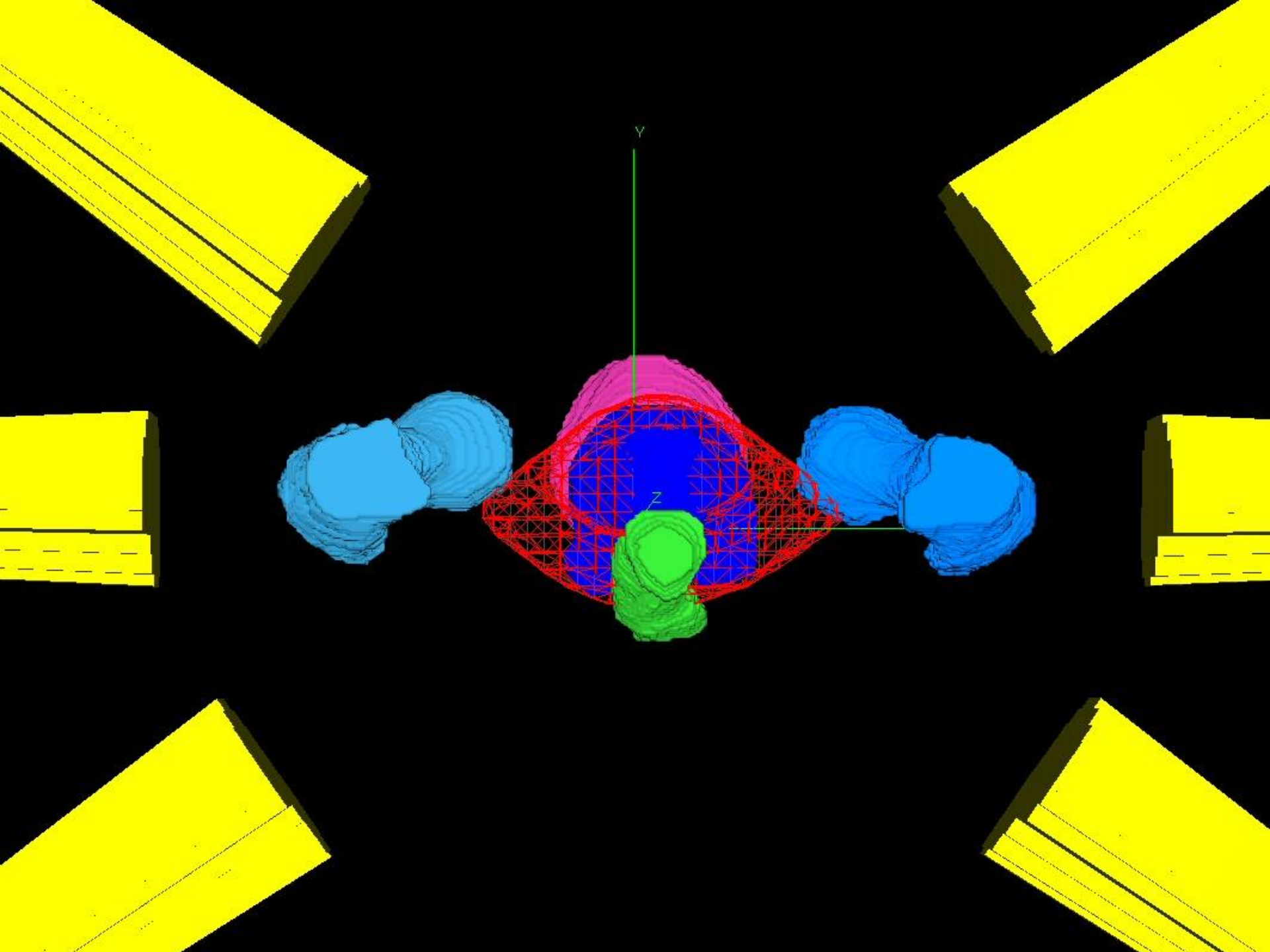


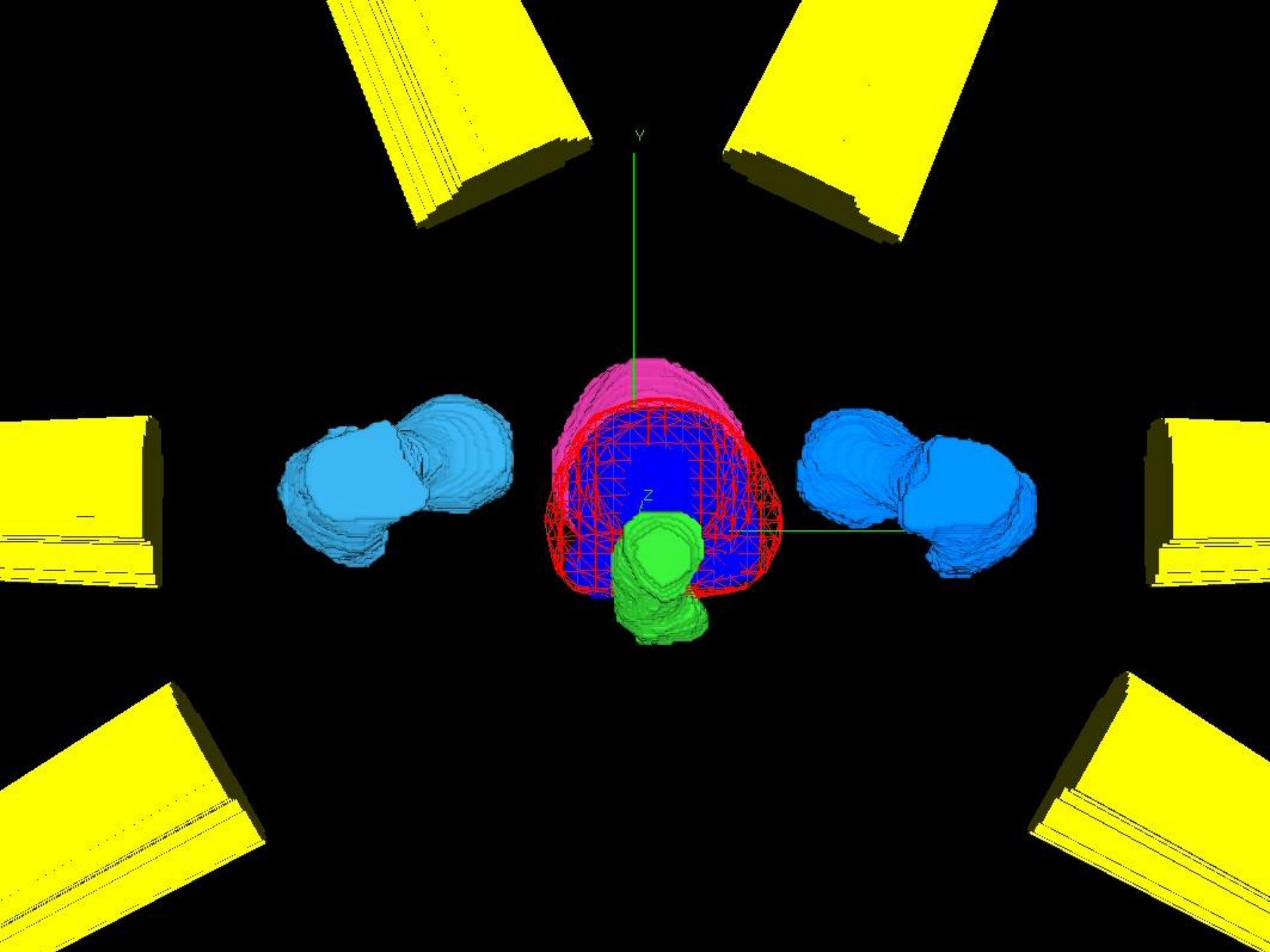


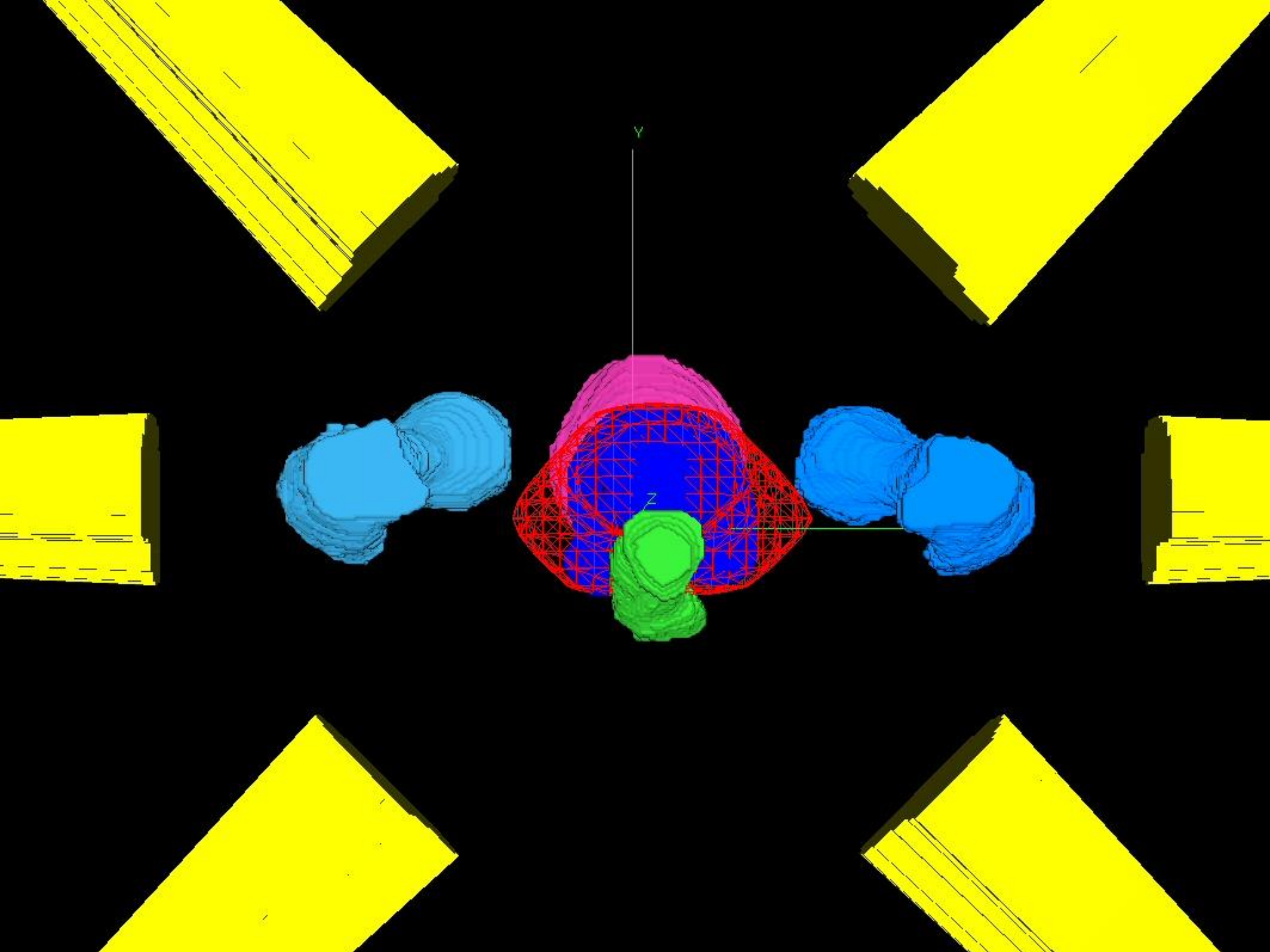


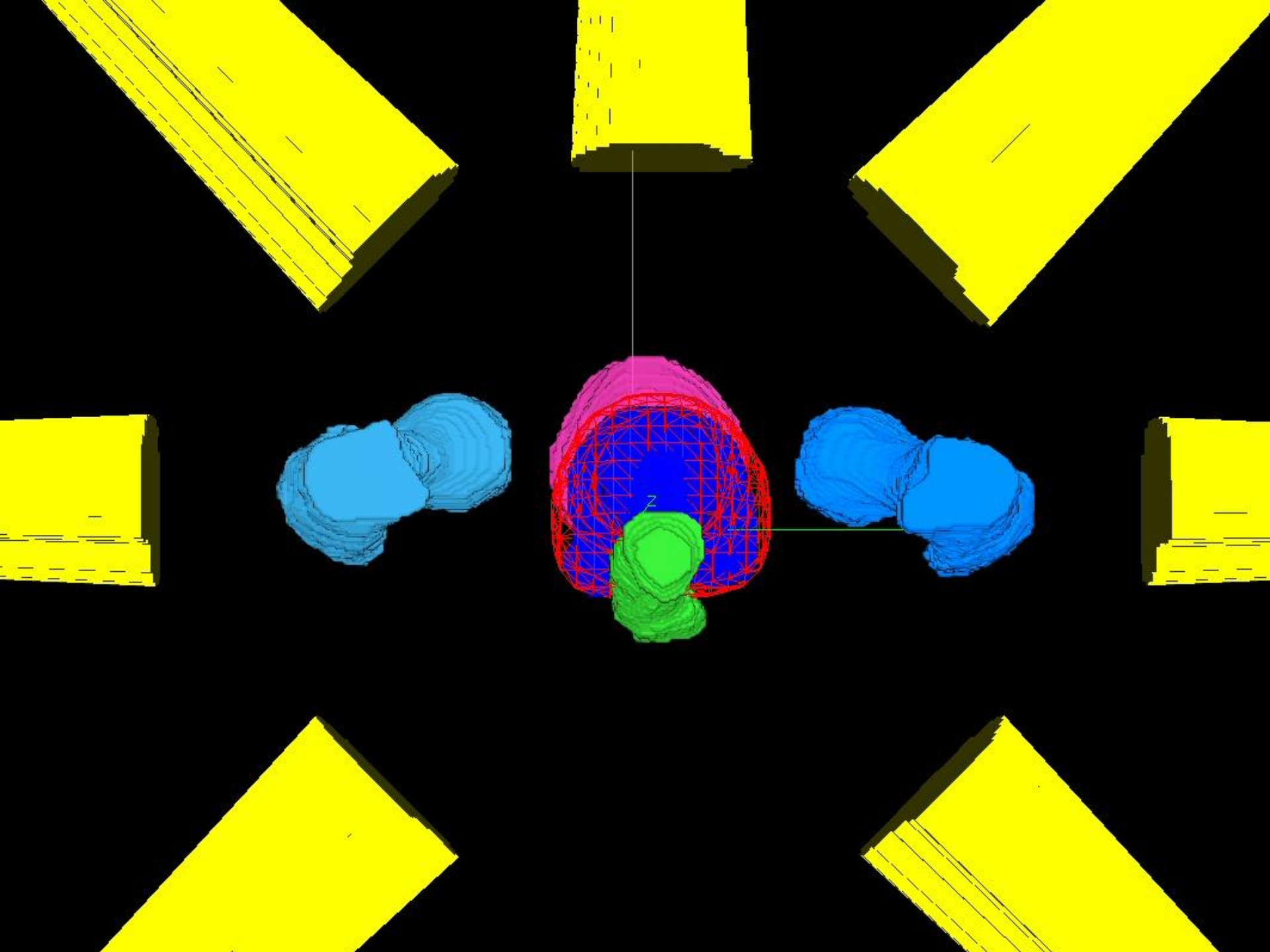


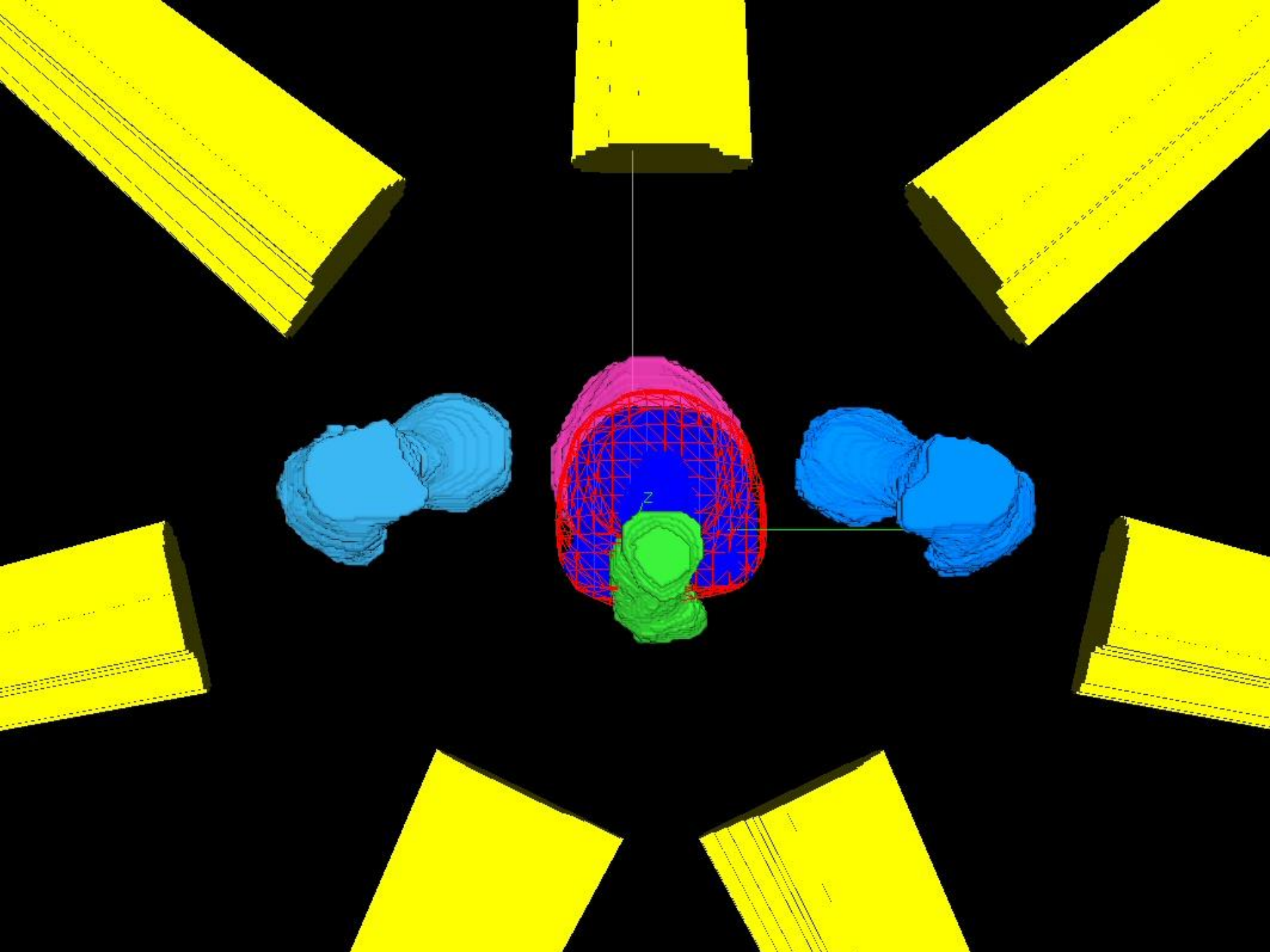










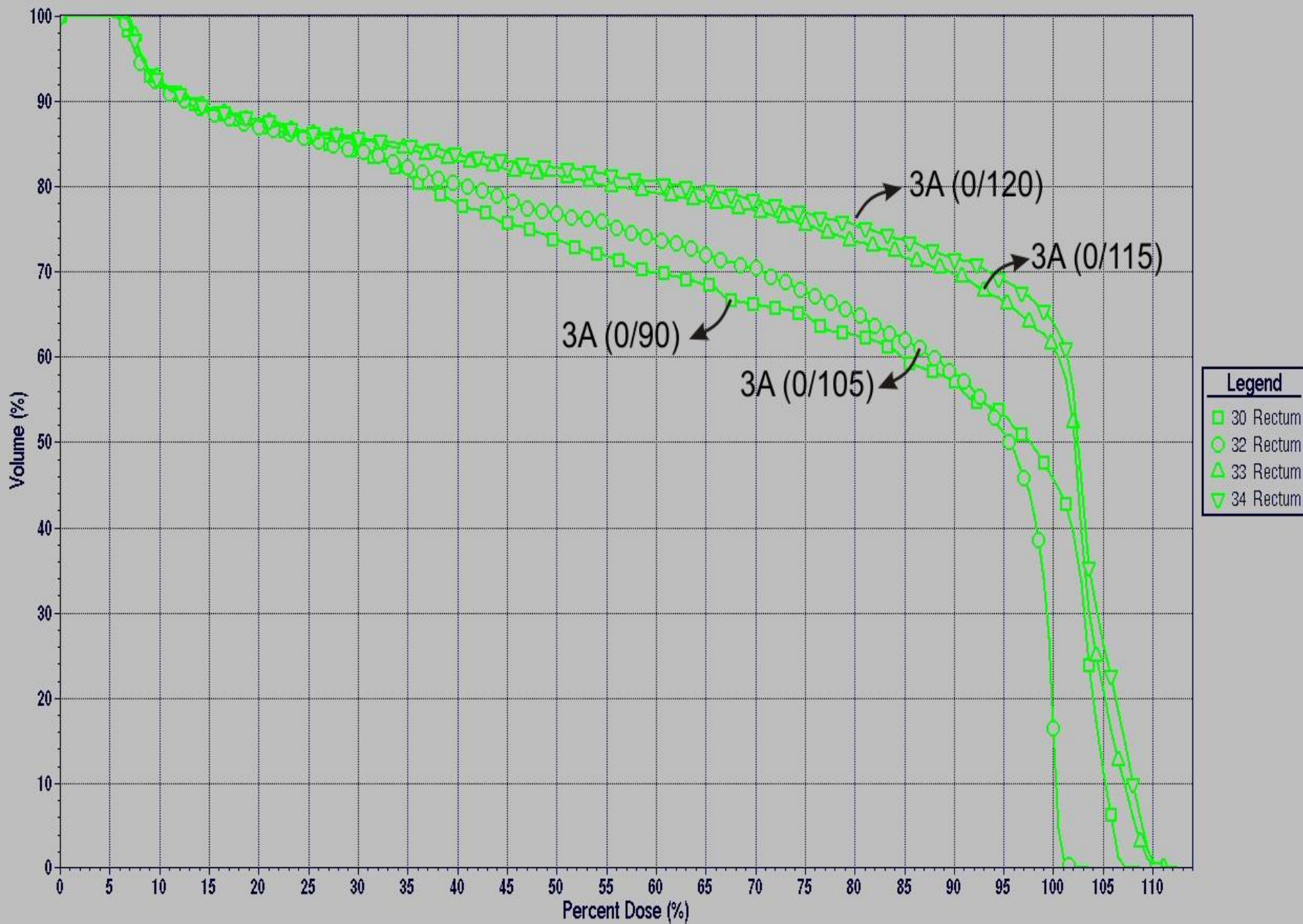


- Belirlenen dozun %50, %80 ve %90'ından fazla doz alan rektal volümler sırasıyla V_{50} , V_{80} , V_{90} olarak kaydedildi. Mesane için de aynı yöntemle V_{70} ve V_{90} değerleri alındı.
- 60 Gy için 5 yıllık rektal komplikasyon olasılığı %5'tir. Bu değer 74 Gy'in %80'ine 66 Gy'in %90'ına karşılık gelmektedir.
- Femur başlarının 52 Gy'den fazla doz alan hacminin %10'u geçmemesi kriter olarak ele alındı.

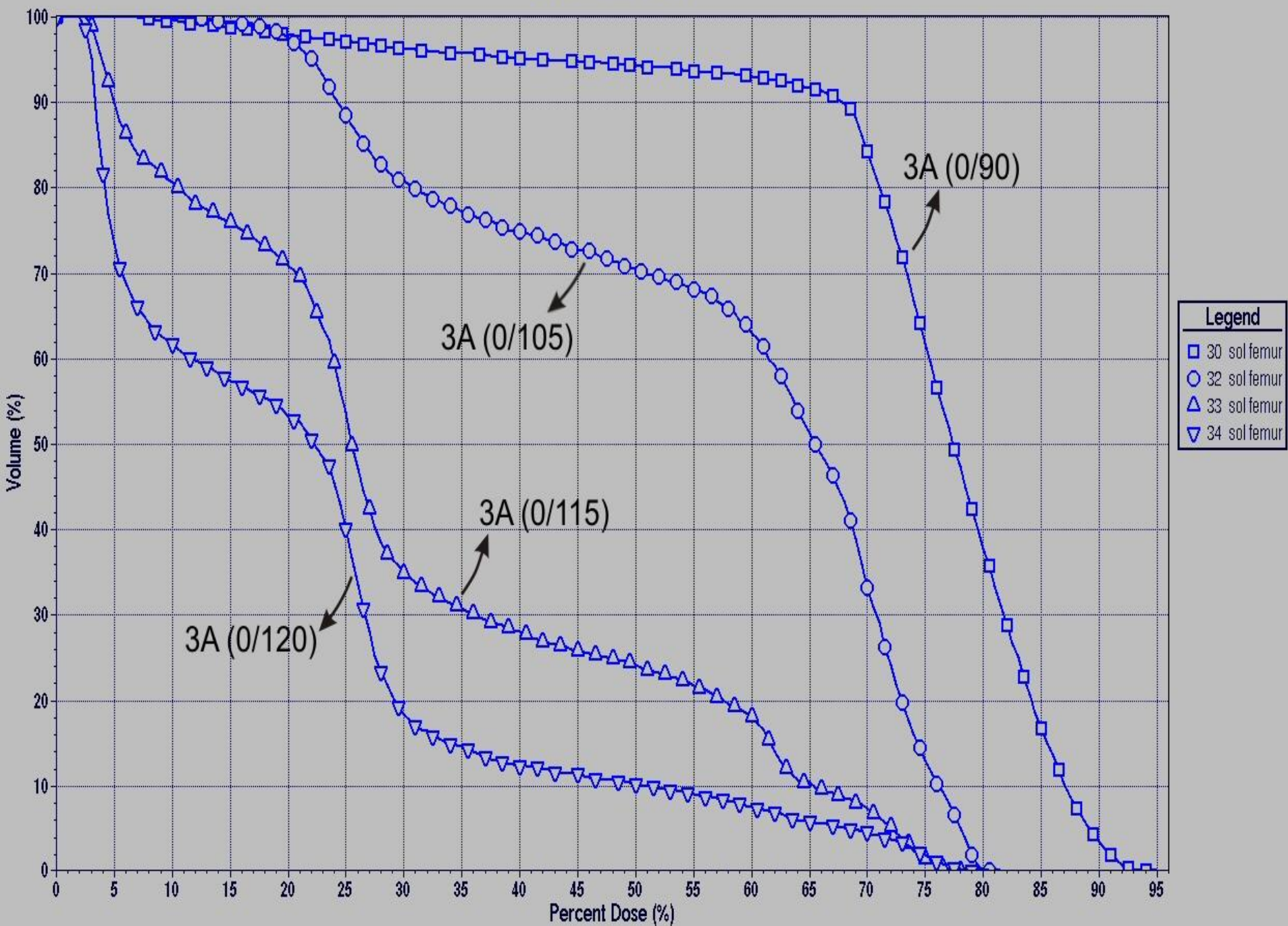
BULGULAR

- Farklı tedavi tekniklerinin DVH'leri çizdirilip rektum, mesane ve femur başlarının doz değerleri kaydedildi.

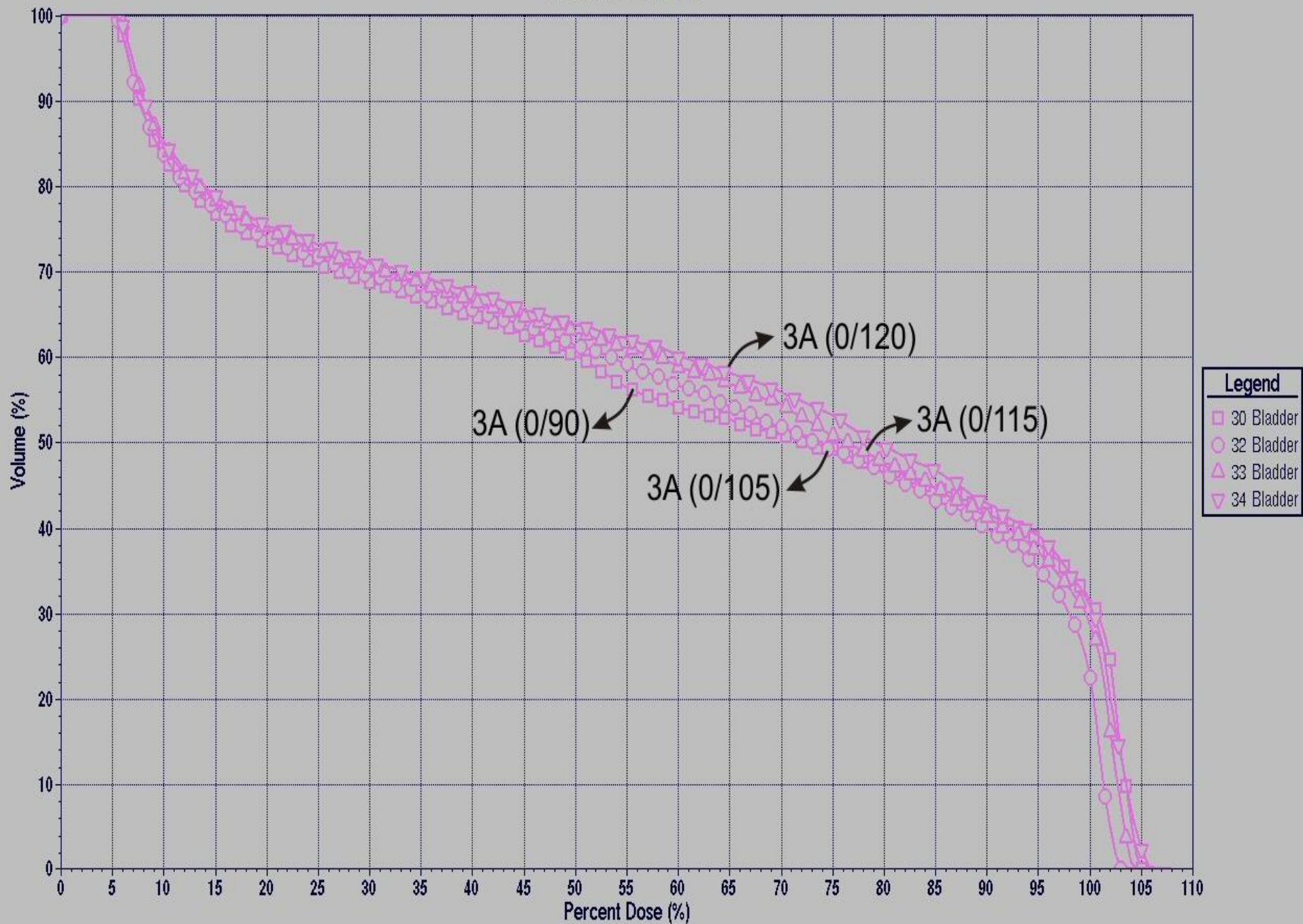
Cumulative DVH



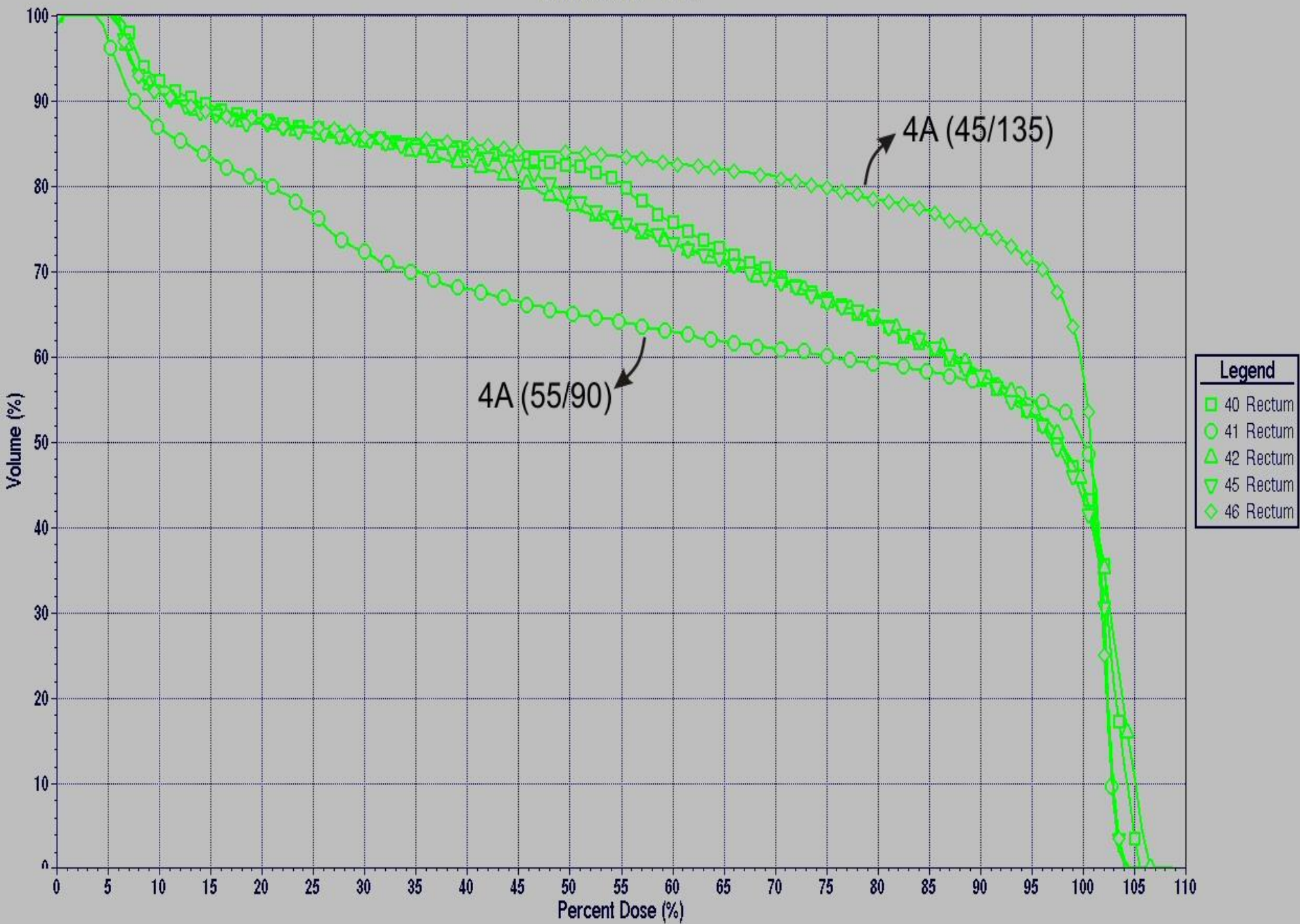
Cumulative DVH



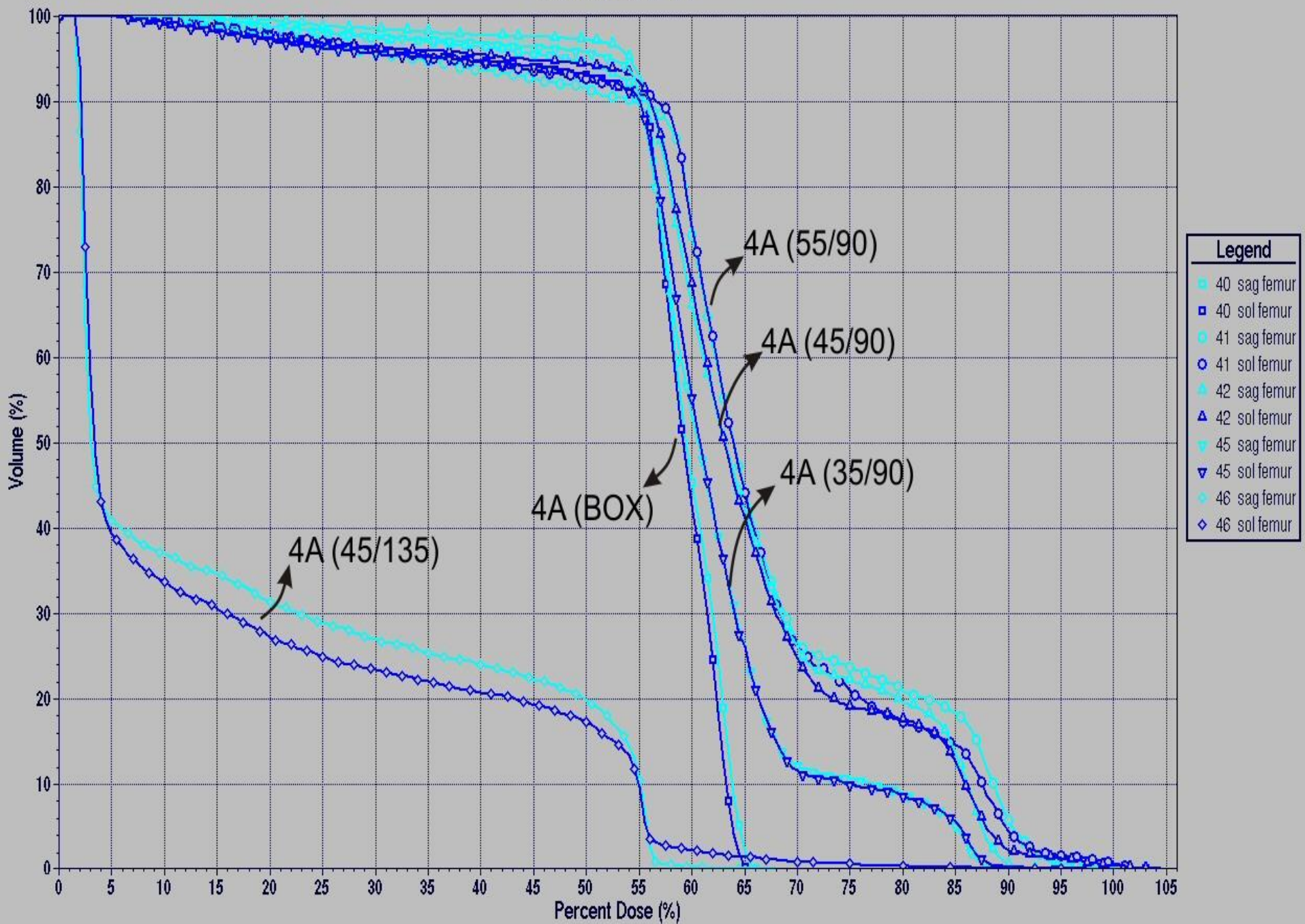
Cumulative DVH



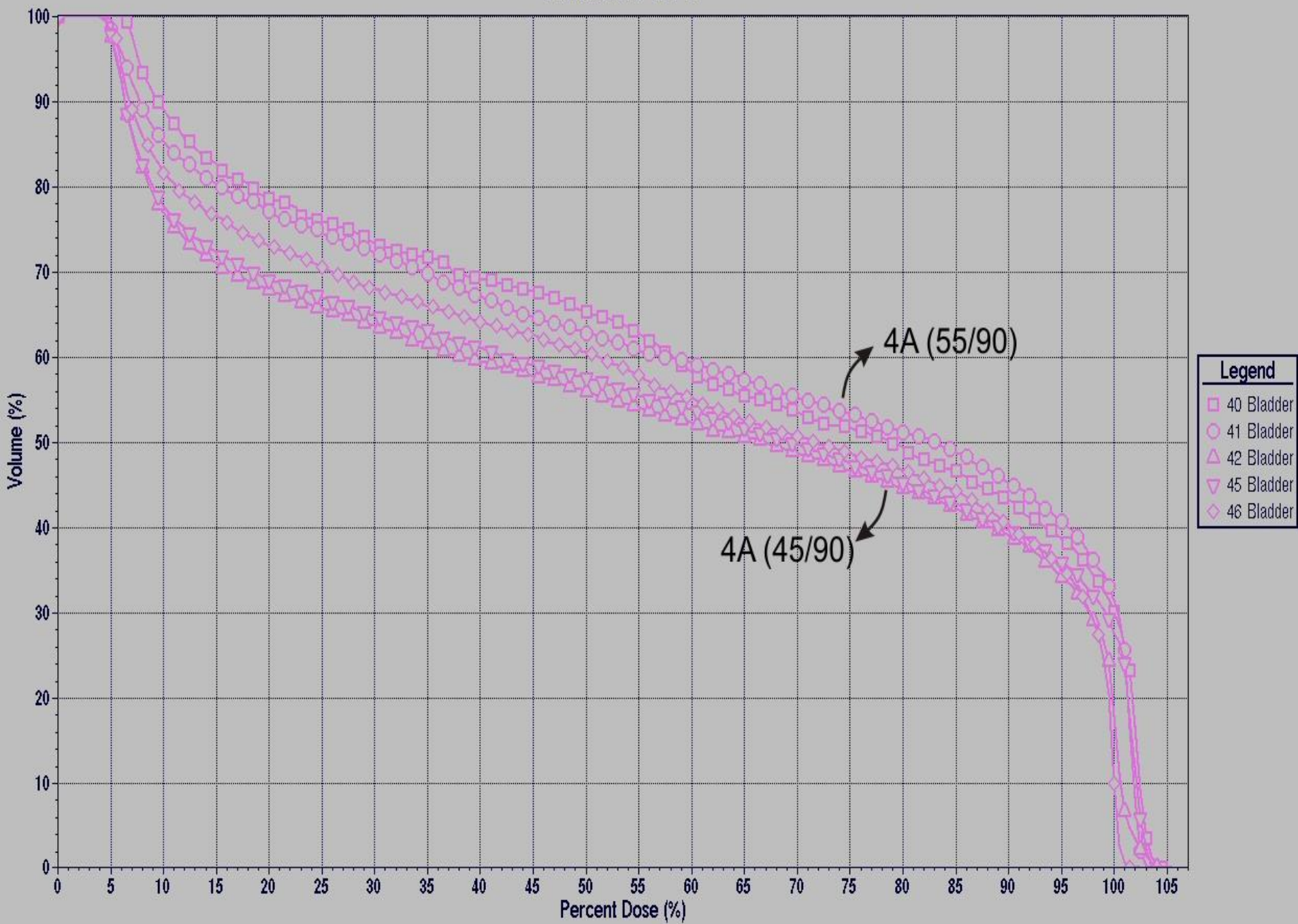
Cumulative DVH



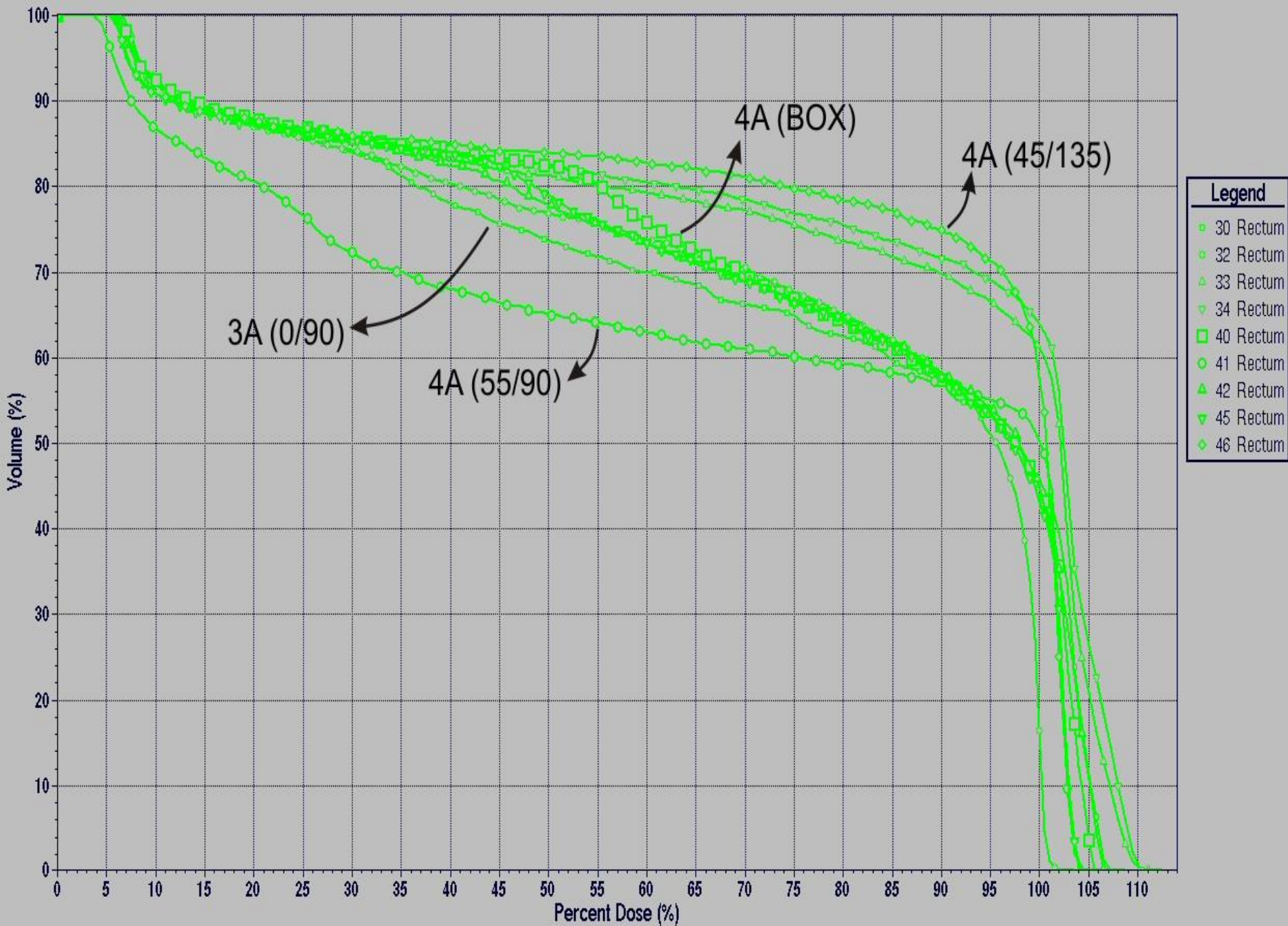
Cumulative DVH



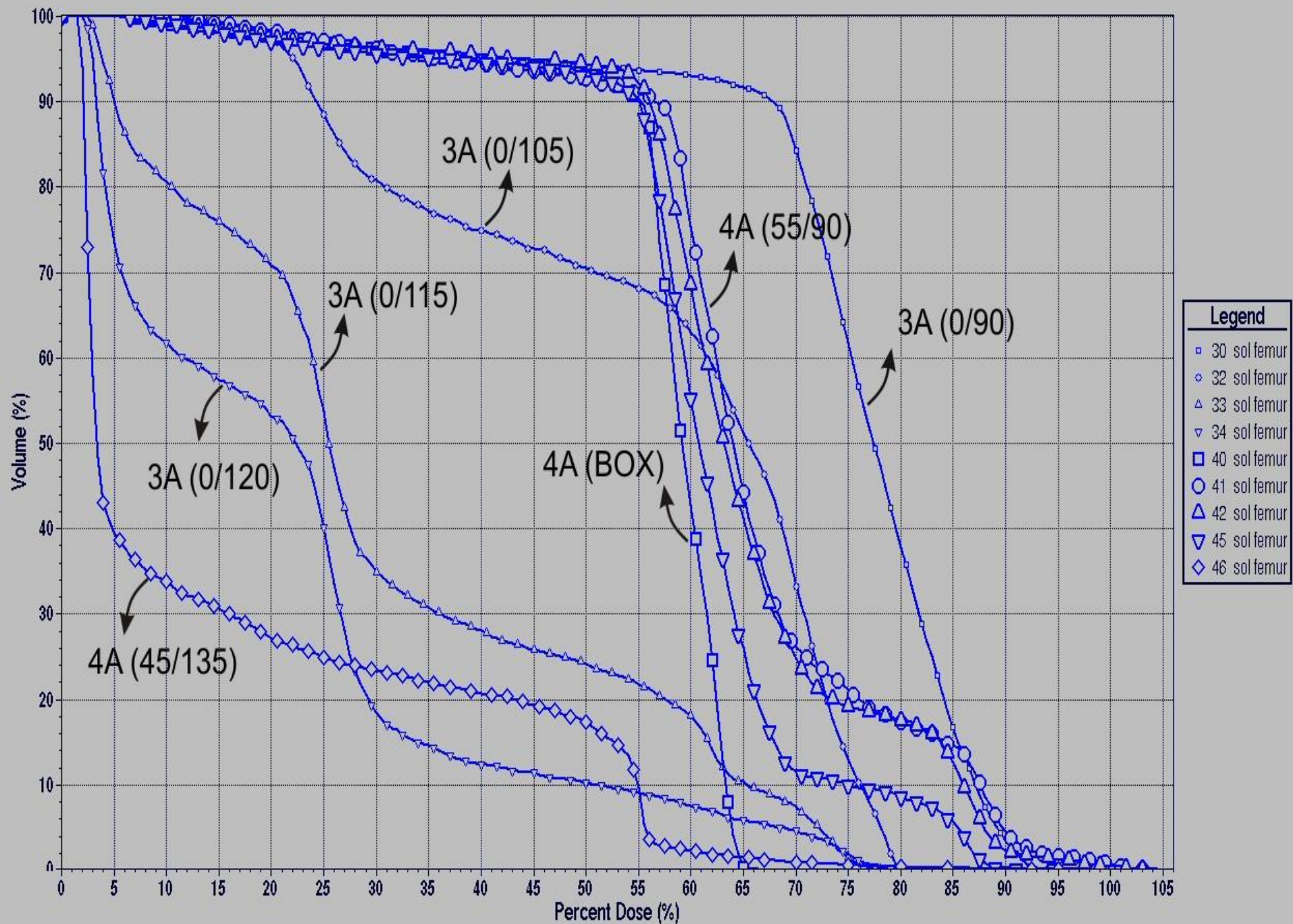
Cumulative DVH



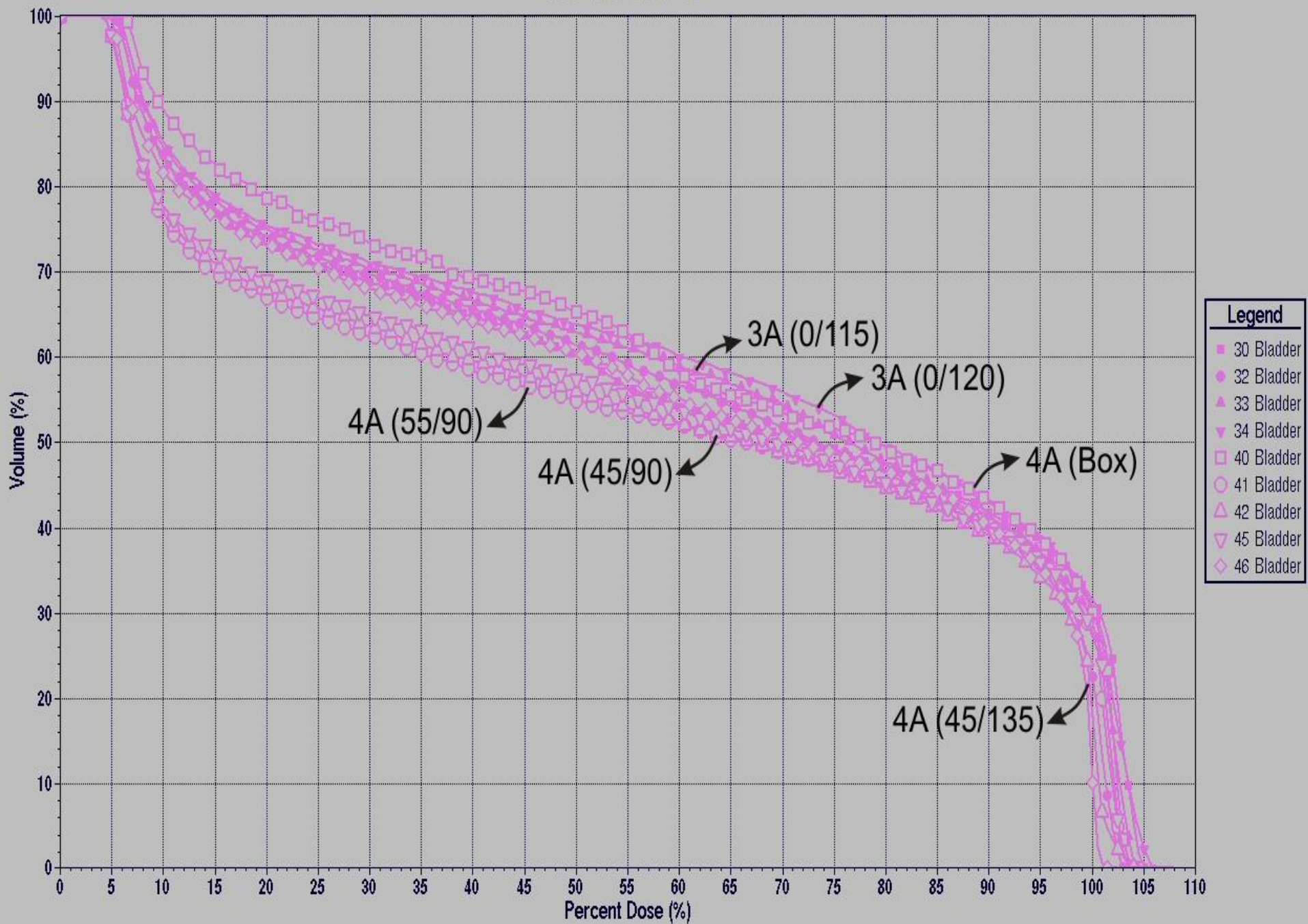
Cumulative DVH



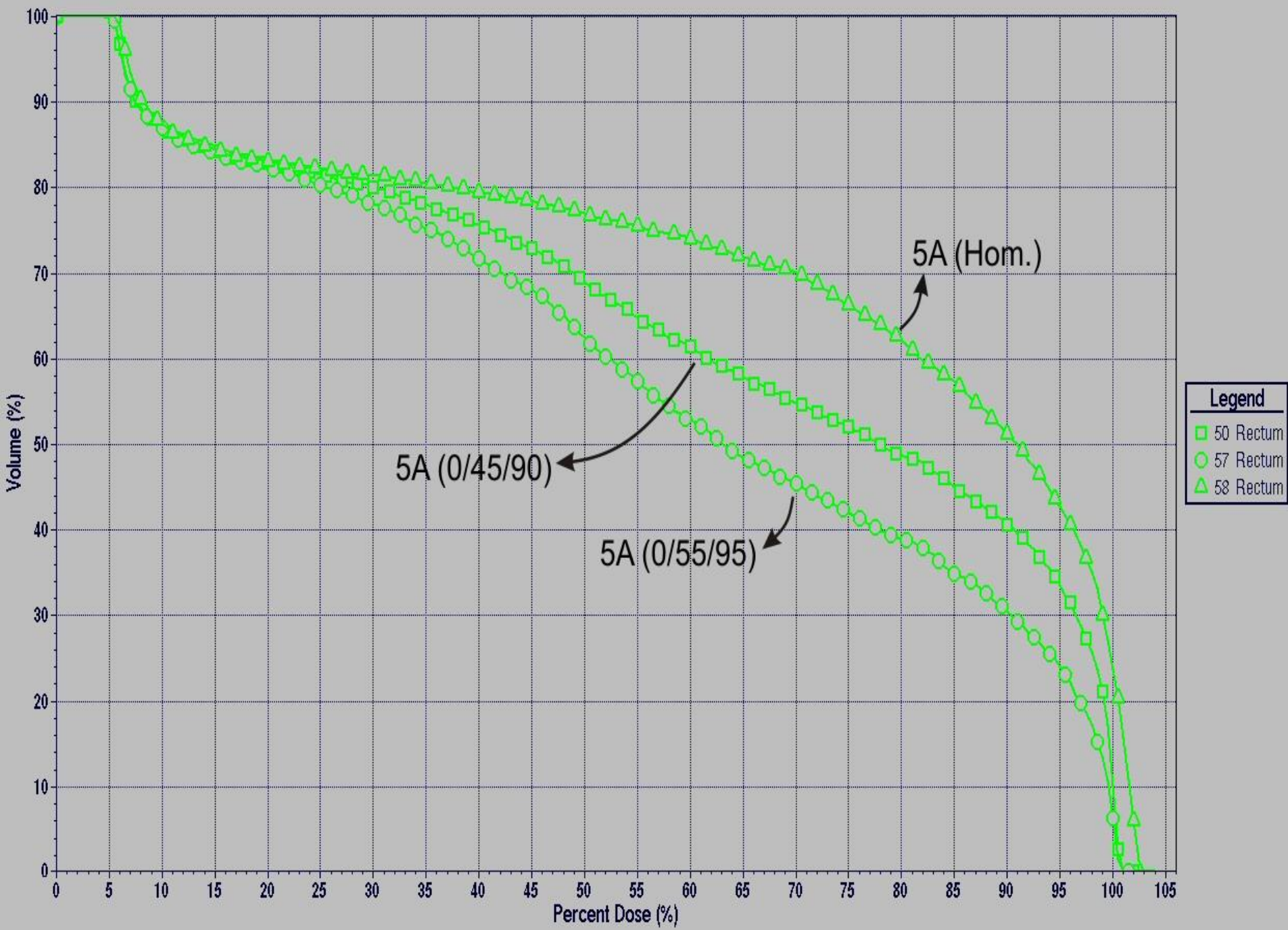
Cumulative DVH



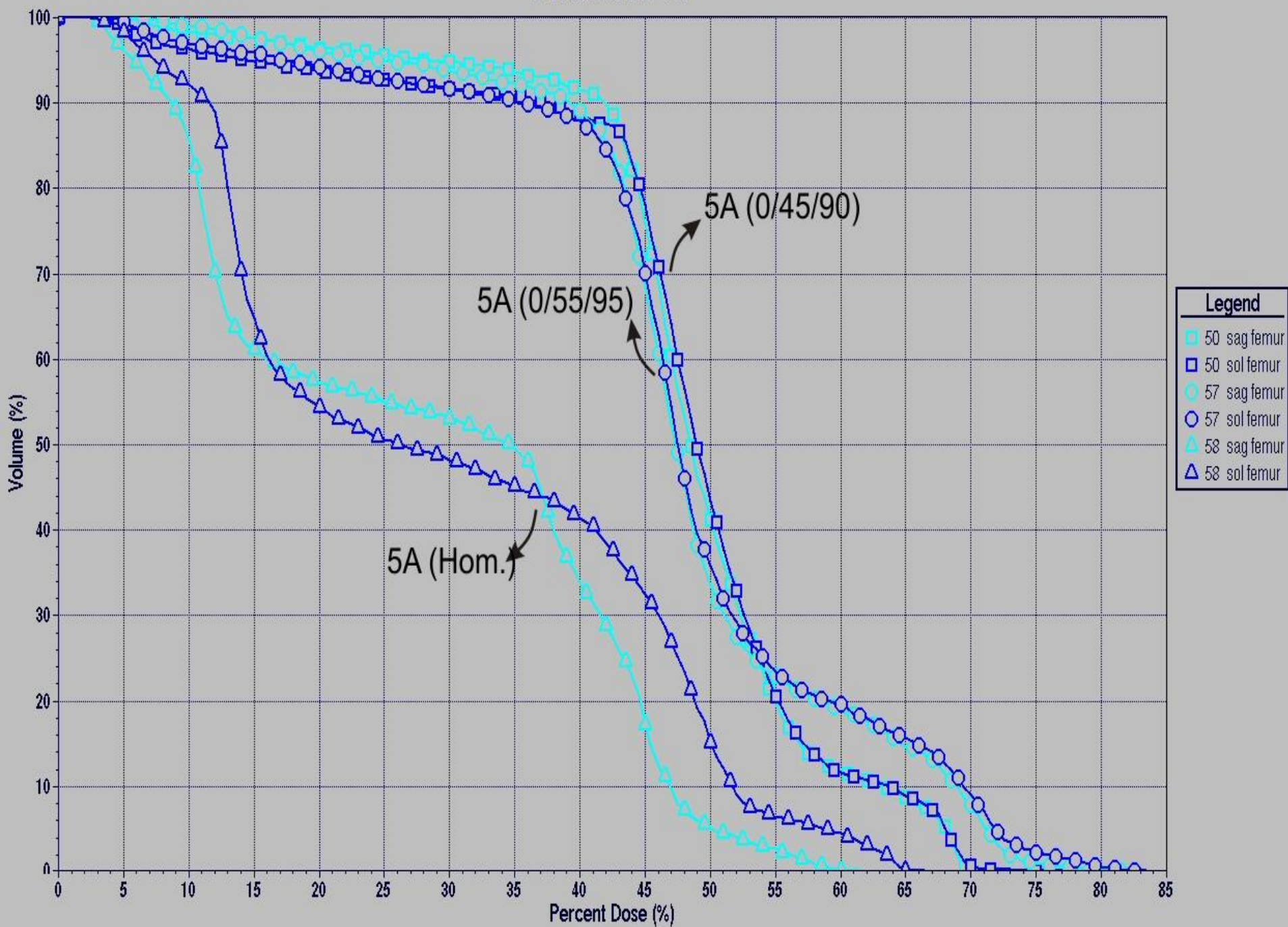
Cumulative DVH



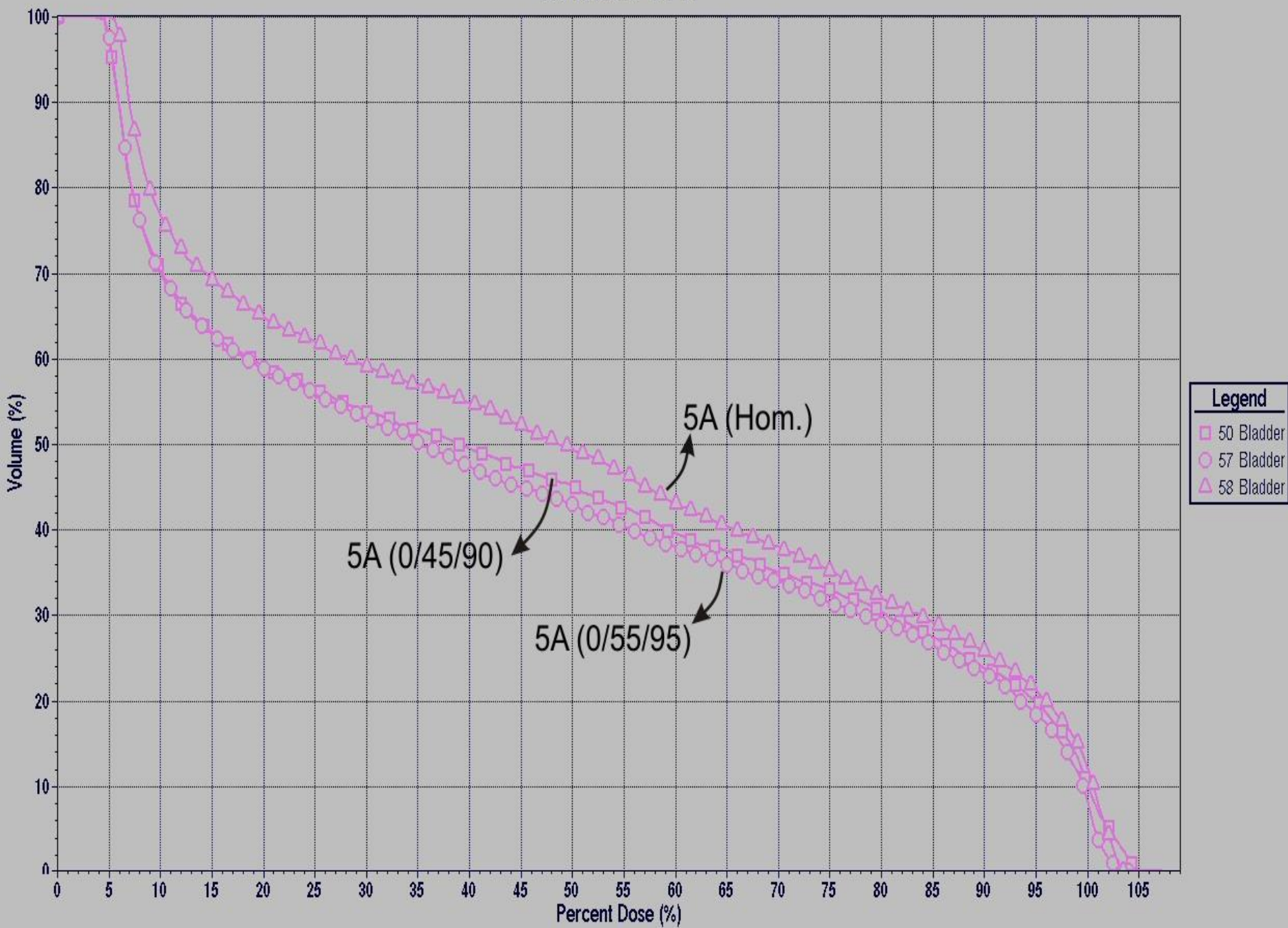
Cumulative DVH



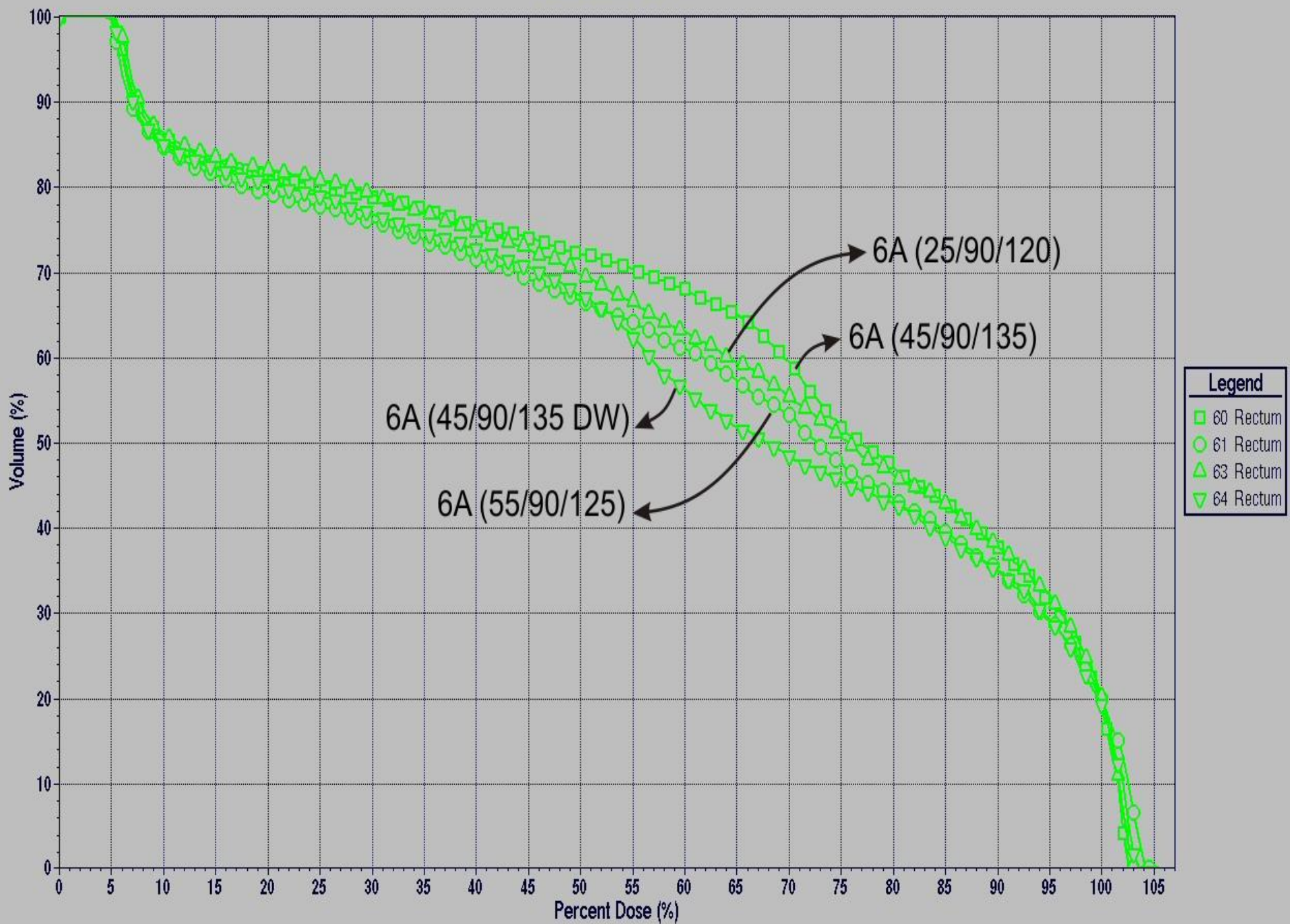
Cumulative DVH



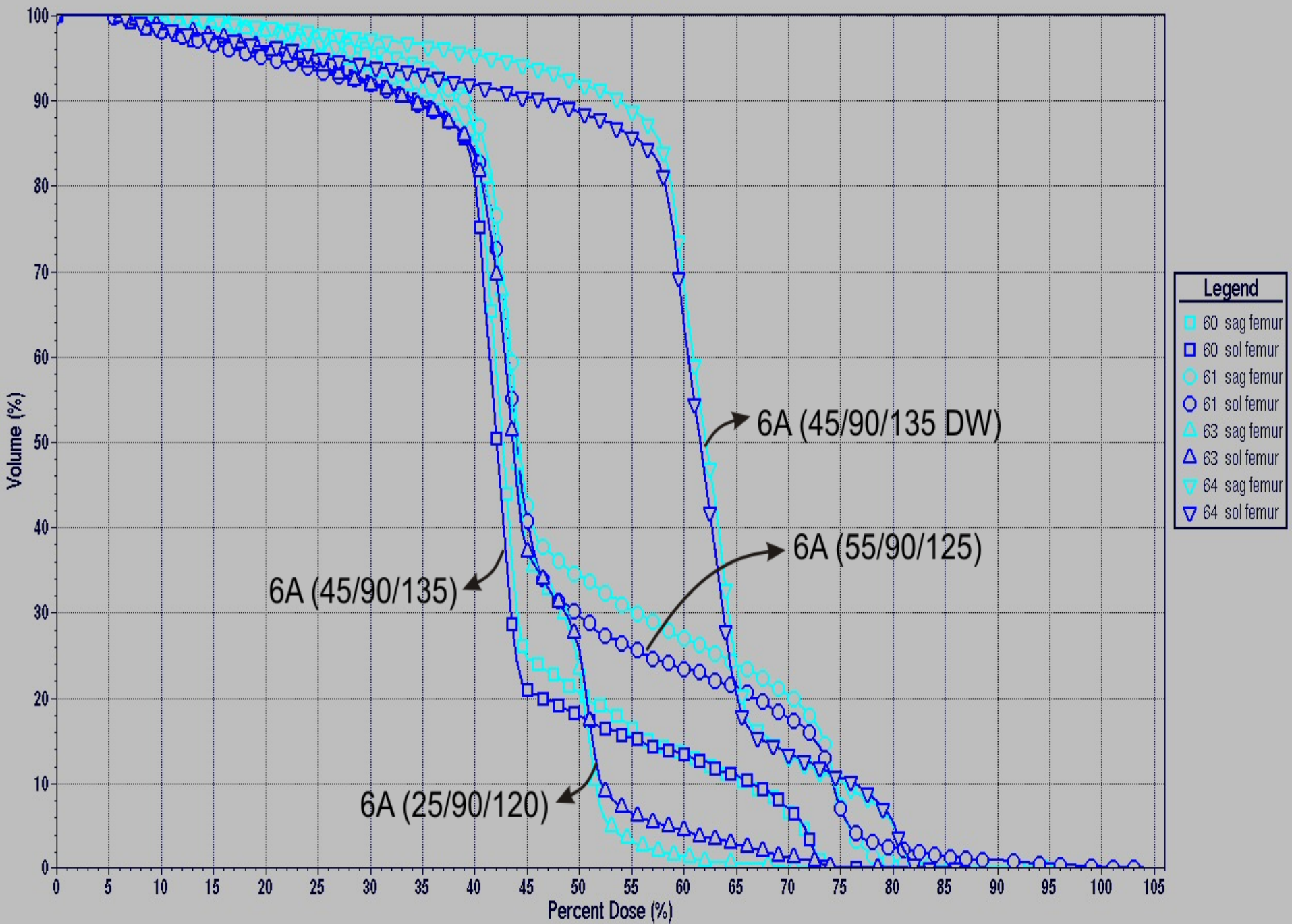
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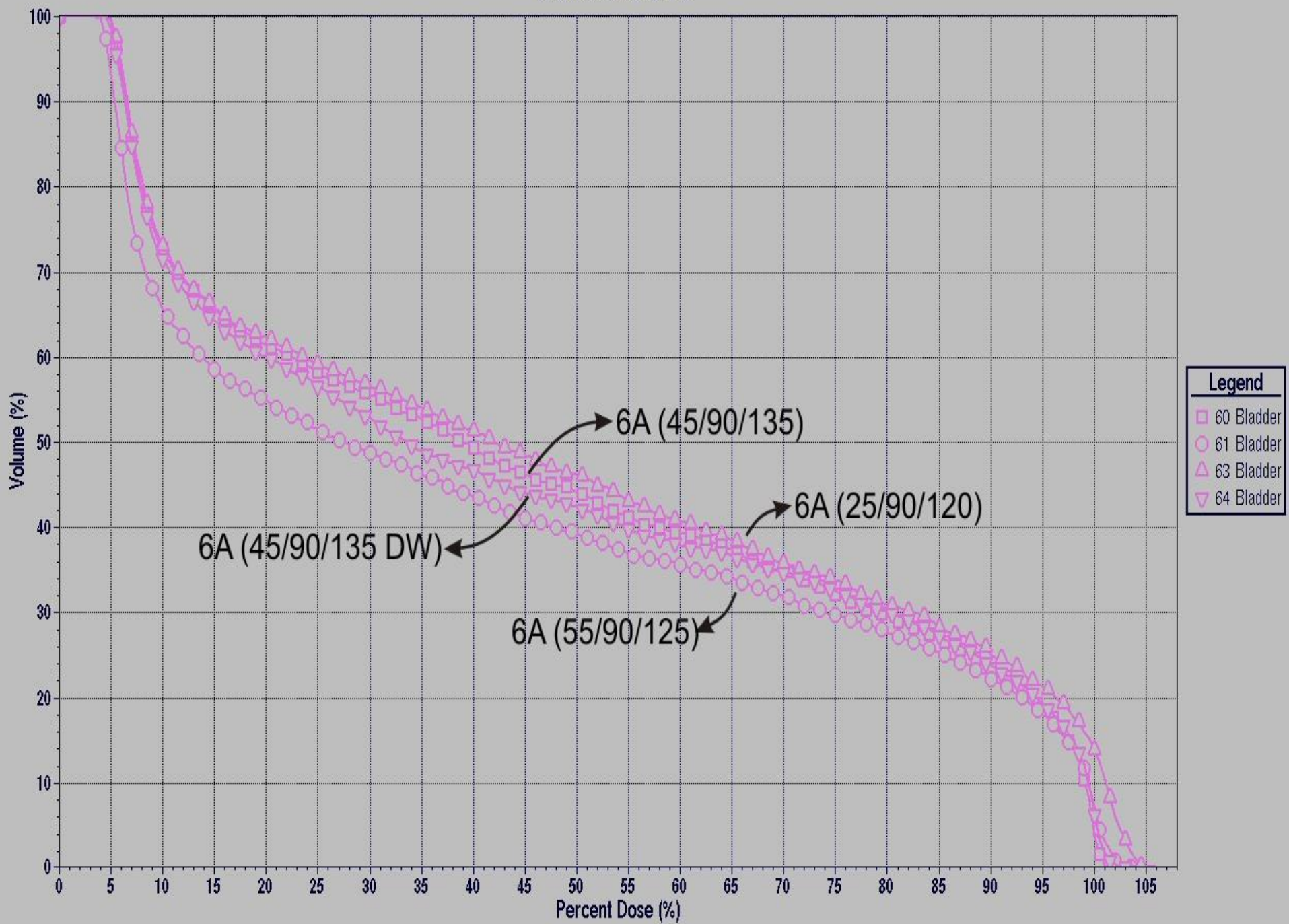
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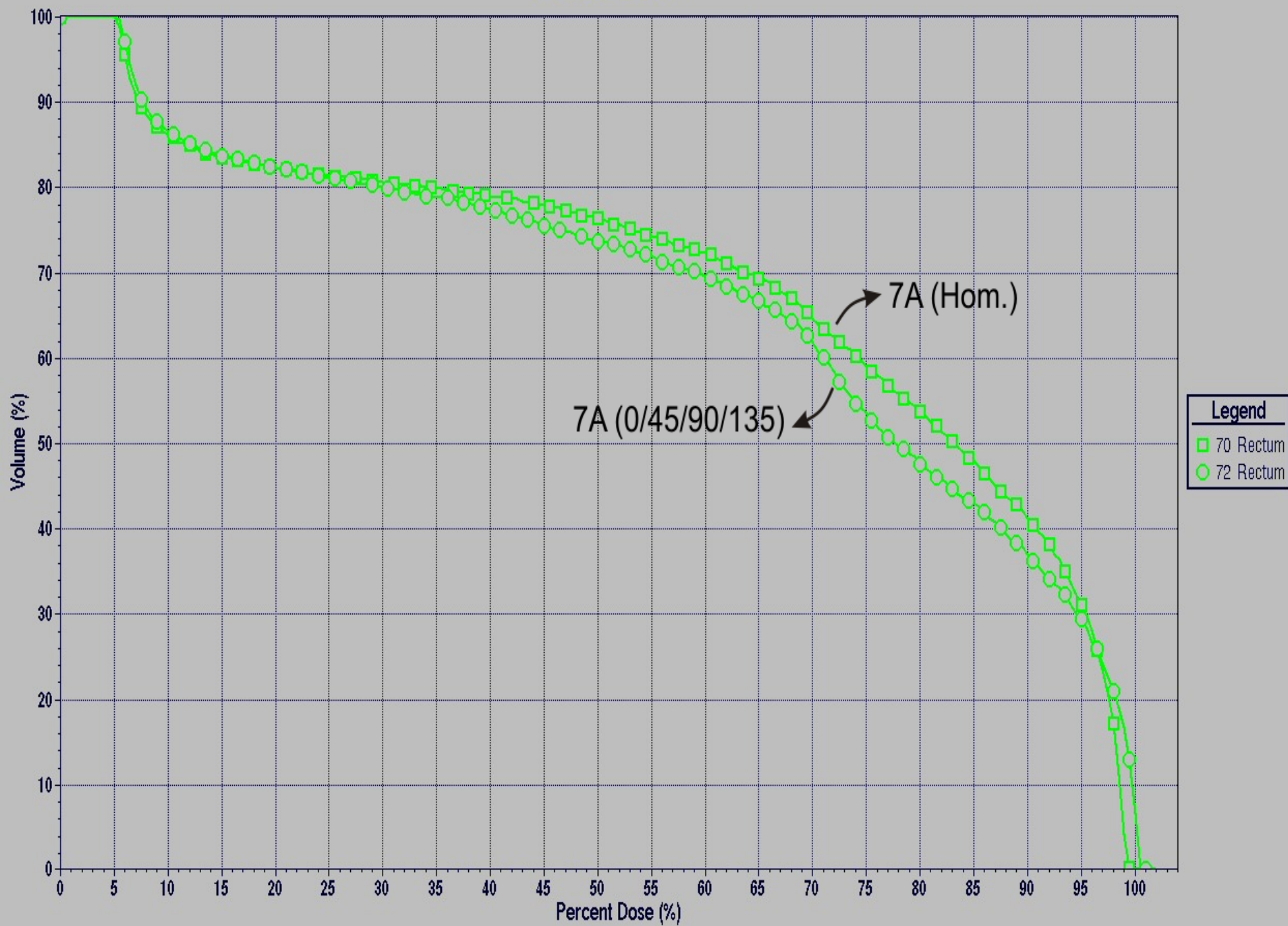
Cumulative DVH



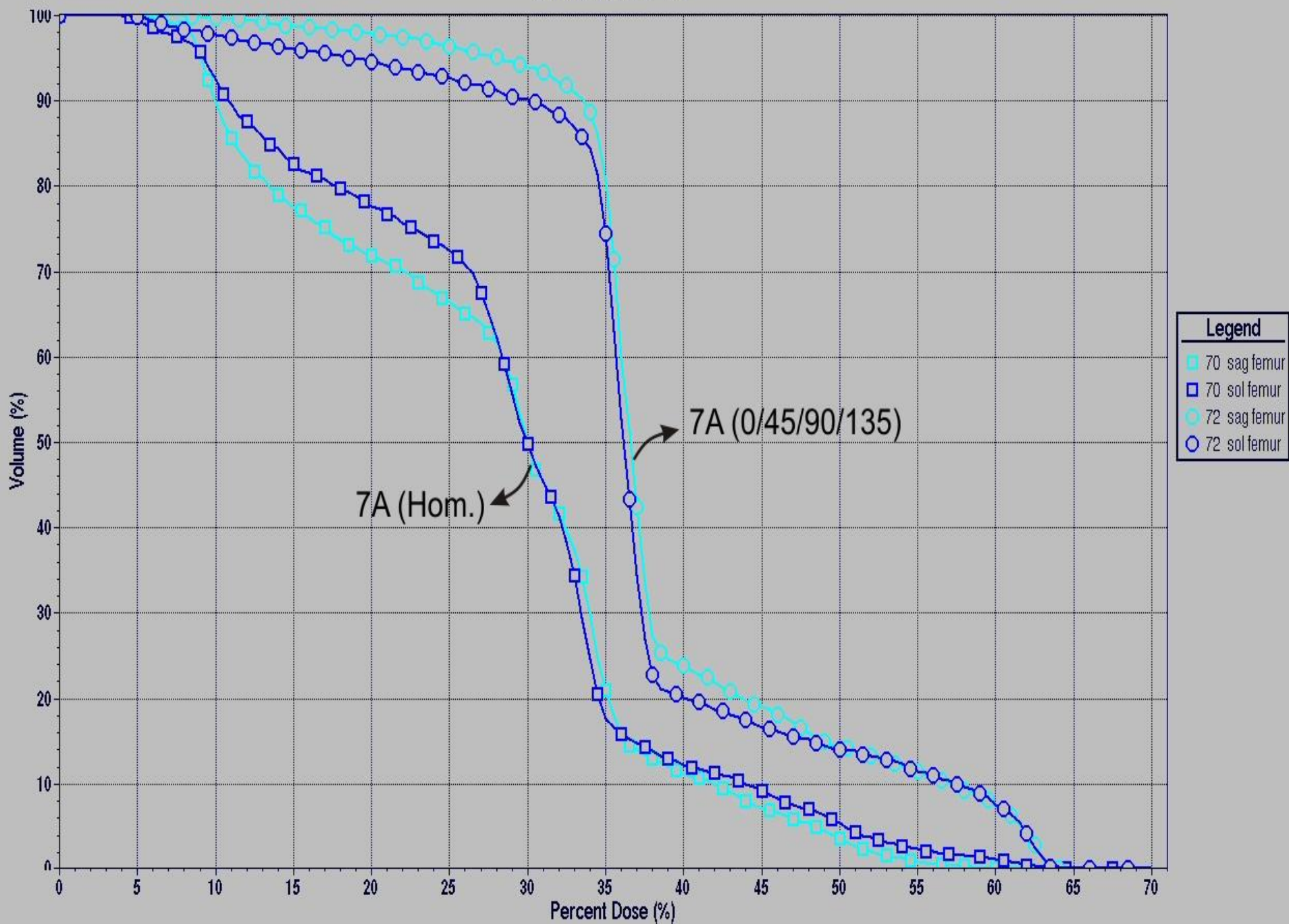
Cumulative DVH



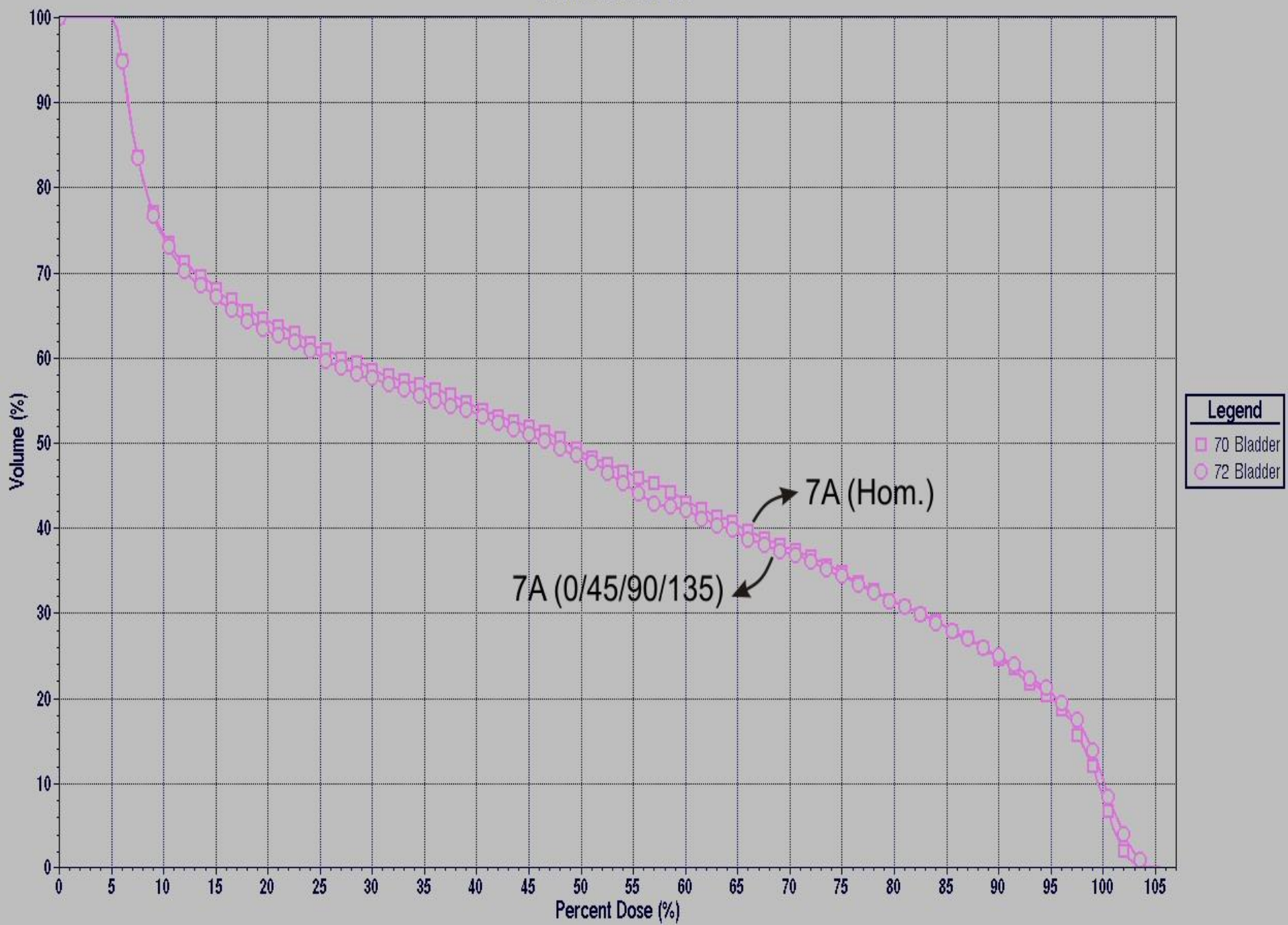
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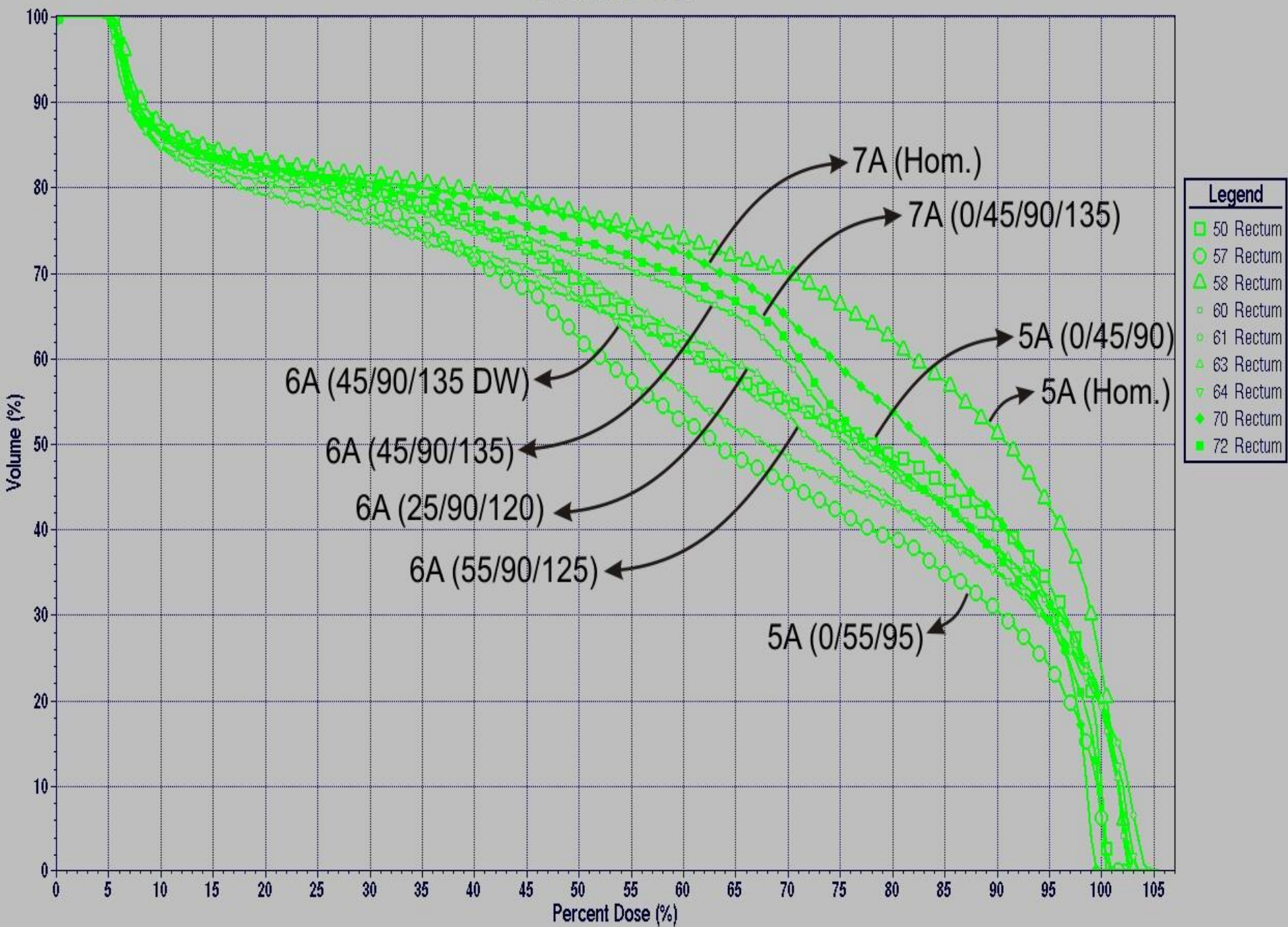
Cumulative DVH



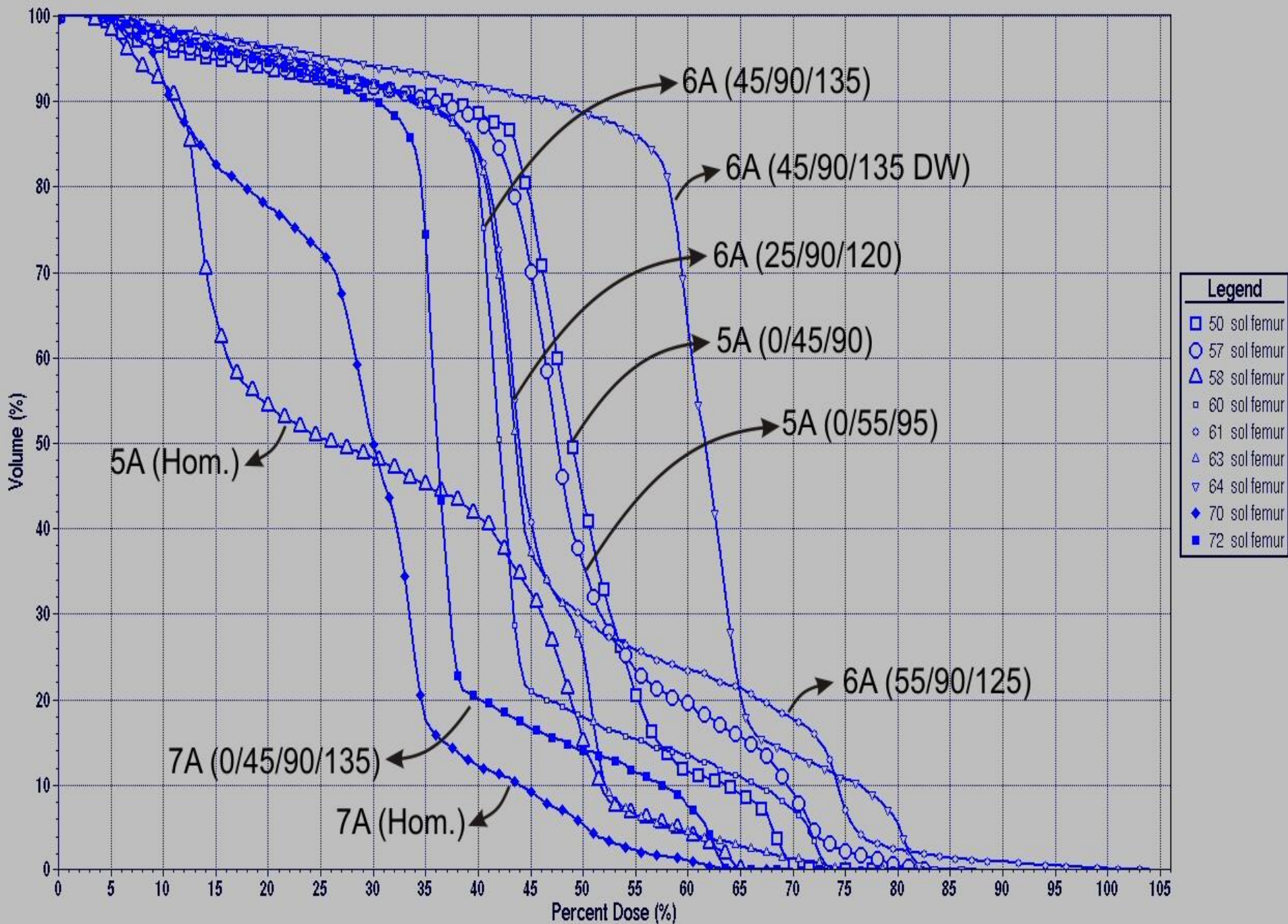
Cumulative DVH



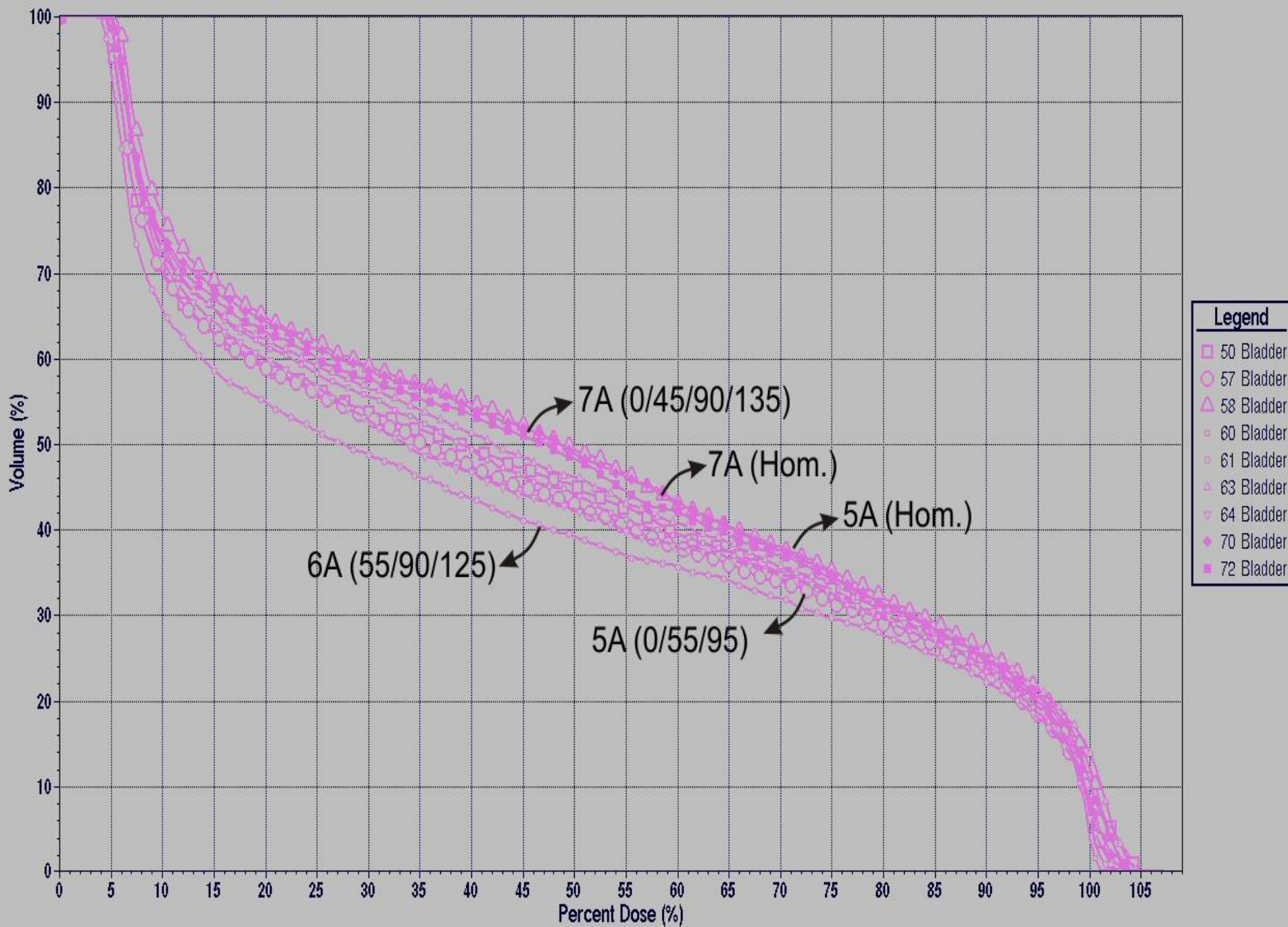
Cumulative DVH



Cumulative DVH



Cumulative DVH



INOPERE		Rektum						Femur		Mesane			
		V90		V80		V50		V70		V90		V70	
3A	0/90	50.25	11.30	56.36	11.18	68.79	12.40	76.03	14.52	43.73	11.66	51.51	12.41
	0/105	56.11	11.51	62.82	11.95	76.97	11.17	27.38	15.85	44.98	11.32	57.25	12.46
	0/115	66.98	9.07	75.14	11.36	85.68	8.25	4.35	5.06	47.54	10.71	64.70	13.45
	0/120	72.16	9.66	77.05	9.44	87.96	7.46	5.27	6.02	50.65	10.53	70.12	13.36
4A	BOX	50.36	12.24	57.13	12.36	91.76	7.73	0.01	0.03	44.56	11.41	53.83	12.26
	55/90	51.09	9.76	57.20	10.19	73.97	10.54	36.51	9.88	42.52	10.67	51.17	11.90
	45/90	51.63	10.55	58.10	10.79	76.52	9.99	20.43	7.26	42.86	11.25	51.78	12.06
	35/90	50.91	10.58	57.67	10.92	77.48	10.61	9.01	4.21	43.83	11.00	54.14	12.13
	45/135	80.89	6.55	85.30	6.58	92.32	6.81	1.94	2.21	55.76	11.62	66.89	12.93
5A	0/45/90	34.24	10.18	41.84	10.84	72.97	9.63	2.71	3.43	30.95	8.65	43.52	11.32
	0/55/95	32.28	9.93	40.23	10.41	67.16	10.48	8.89	5.23	30.88	8.81	42.50	10.69
	HOM.G.	50.47	11.82	62.65	11.10	83.70	9.46	0.02	0.05	33.39	9.01	48.02	11.49
6A	45/90/135	36.25	11.09	45.31	12.10	78.00	6.79	3.60	2.77	29.04	8.01	41.36	10.11
	55/90/125	37.53	9.76	45.58	10.57	71.41	8.34	14.13	6.87	28.27	7.87	38.89	9.61
	25/90/120	36.80	15.89	44.81	16.01	70.98	11.84	4.03	6.26	30.46	8.69	41.81	10.56
	DW	32.72	10.80	39.39	11.17	71.33	8.73	8.36	4.57	28.06	8.02	37.63	9.89
7A	HOM.G.	41.24	11.00	53.38	11.90	85.83	8.75	0.16	0.48	32.60	9.10	48.44	12.08
	0/45/90/135	35.23	10.88	45.79	11.71	80.07	6.75	0.25	0.44	31.29	8.53	47.07	11.01

17 hastaya ait 2142 adet verinin ortalama ve standart sapmaları hesaplanıp istatistiksel olarak değerlendirildi (T-testi).

3A PLANLAMA TEKNİKLERİ

- Tüm rektum ve mesane değerlerinde en düşük, fakat femur başı değerlerinde en yüksek plan 0/90 ($p<0.001$).
- Mesane ve rektum açısından en yüksek değerler plan 0/120.
- Femur açısından en düşük değerler plan 0/115 ($p<0.001$).

4A PLANLAMA TEKNİKLERİ

- Rektum ve mesane için en yüksek değerleri veren plan 45/135 ($p < 0.001$).
- Femur için en düşük doz değerlerini veren planlama tekniği Box ($p < 0.001$), en yüksek değerleri veren 55/90 ve 45/90 ($p < 0.001$).
- Box ile 35/90 kıyaslandığında; rektum V_{90} , V_{80} ve mesane V_{70} , V_{90} değerleri açısından anlamlı bir fark yoktur ($p > 0.05$). Ancak rektum V_{50} değeri 35/90'da daha iyi ($p < 0.005$), femur ise Box'ta en iyidir ($p < 0.001$).

- 3A 0/90 ile 4A Box tekniklerini kıyaslandığında; femur değerlerinde Box tekniği anlamlı derecede daha iyi ($p < 0,0005$), rektum V_{90} , V_{80} ve mesane V_{90} da anlamlı bir fark yoktur ($p > 0.05$)

5A PLANLAMA TEKNİKLERİ

- Rektum ve mesane açısından en düşük değerler 0/55/95 en yüksek değerler ise Homojen gentri.
- Rektum V_{90} , V_{80} ve mesane V_{90} , V_{70} değerleri için, 0/45/90 ile 0/55/95 planlar arasında anlamlı fark yoktur ($p>0.05$). Rektum V_{50} 'de 0/55/95 daha iyi ($p<0.01$), femur V_{70} 'de 0/45/90 ($p<0.001$) daha iyidir.

6A PLANLAMA TEKNİKLERİ

- Rektum ve mesanede en düşük değer 45/90/135 DW ($p<0.001$)
- Femurda en yüksek değer 55/90/125 ($p<0.001$)
- 45/90/135 ile 25/90/120 arasında rektum V_{90} , V_{80} , femur V_{70} ve mesane V_{70} açısından anlamlı bir fark yoktur ($p>0.05$).

7A PLANLAMA TEKNİKLERİ

- Rektum ve mesane açısından en düşük değer plan 0/45/90/135 ($p < 0,001$). Femur açısından anlamlı bir fark yoktur ($p > 0.05$).

En uygun 5A 0/55/95 ve 6A 45/90/135 DW planlar kıyaslandığında, rektum ve femur değerlerinde anlamlı bir fark yoktur ($p > 0.05$).

Mesane açısından 6A 45/90/135 DW daha iyi ($p < 0.01$).

OPERE		Rektum						Femur		Mesane			
		V90		V80		V50		V80		V90		V70	
3A	0/90	52.95	10.83	57.14	11.36	67.48	12.28	38.99	7.10	38.19	9.81	45.65	10.83
	0/105	59.12	12.29	64.70	13.37	77.19	12.52	2.06	2.55	41.75	9.43	52.99	10.60
	0/115	71.15	14.82	75.74	14.15	86.93	9.74	0.11	0.31	47.62	9.66	65.28	12.27
	0/120	75.96	14.77	79.88	13.63	89.95	8.30	0.29	0.81	52.03	11.87	70.73	14.39
4A	BOX	50.52	11.65	56.13	12.72	93.55	8.76	0.00	0.00	39.05	9.66	47.30	10.39
	55/90	53.66	11.08	58.58	11.70	74.20	11.05	22.50	15.48	37.94	9.33	46.10	11.14
	45/90	54.59	10.88	59.15	11.84	75.88	10.97	9.92	8.70	38.22	9.60	47.18	10.84
	35/90	54.38	11.01	59.28	11.58	75.65	10.26	3.62	3.65	39.12	10.19	48.49	11.58
	45/135	83.37	15.30	86.94	13.38	94.15	7.74	0.23	0.62	56.33	13.24	67.58	13.84
5A	0/45/90	40.55	7.17	47.19	7.90	79.40	12.26	0.03	0.08	27.39	7.16	40.25	8.66
	0/55/95	39.84	6.83	46.05	8.04	73.17	14.03	0.63	1.49	27.84	7.70	38.21	8.84
	HOM.G.	55.86	17.85	68.24	18.22	90.34	9.58	0.00	0.00	32.07	8.21	46.27	10.71
6A	45/90/135	40.03	9.22	47.84	11.76	83.55	12.83	0.08	0.21	27.78	7.32	39.74	9.14
	55/90/125	42.77	7.58	49.75	9.70	76.66	14.66	1.30	2.65	26.97	7.19	37.29	8.46
	25/90/120	40.04	10.05	46.80	11.57	75.45	14.46	0.01	0.03	27.92	7.19	40.29	9.10
	DW	36.57	8.33	42.14	9.84	76.38	15.06	1.27	2.53	26.33	7.21	33.95	8.27
7A	HOM.G.	46.07	12.83	56.96	15.70	91.22	10.20	0.00	0.00	32.07	7.85	48.30	10.37
	0/45/90/135	39.71	8.34	48.46	11.09	84.94	12.24	0.01	0.03	29.78	6.92	46.74	11.27

3A PLANLAMA TEKNİKLERİ

- Tüm rektum ve mesane değerlerinde en düşük, fakat femur başı değerlerinde en yüksek plan 0/90 ($p<0.001$).
- Mesane ve rektum açısından en yüksek değerler plan 0/120.
- Femur açısından en düşük değerler plan 0/115 ($p<0.001$).

4A PLANLAMA TEKNİKLERİ

- Rektum ve mesane için en yüksek değerleri veren plan 45/135 ($p < 0.001$).
- Femur için en düşük doz değerlerini veren planlama tekniği Box ($p < 0.001$), en yüksek değerleri veren 55/90 ve 45/90 ($p < 0.001$).
- Box ile 35/90 kıyaslandığında; rektum V_{90} , V_{80} ve mesane V_{70} , V_{90} değerleri açısından anlamlı bir fark yoktur ($p > 0.05$). Ancak rektum V_{50} değeri 35/90'da daha iyi ($p < 0.001$), femur ise Box'ta en iyidir ($p < 0.05$).

- 3A 0/90 ile 4A Box tekniklerini kıyaslandığında; femur değerlerinde Box tekniği anlamlı derecede daha iyi ($p < 0,001$), rektum V_{90} , V_{80} da anlamlı bir fark yoktur ($p > 0.05$).

5A PLANLAMA TEKNİKLERİ

- Rektum ve mesane açısından en düşük değerler 0/55/95 en yüksek değerler ise Homojen gentri.
- Rektum V_{90} , V_{80} ve mesane V_{90} , V_{70} değerleri için, 0/45/90 ile 0/55/95 planlar arasında anlamlı fark yoktur ($p>0.05$). Rektum V_{50} 'de 0/55/95 daha iyi ($p<0.01$), femur V_{80} 'de anlamlı fark yoktur ($p>0.05$).

6A PLANLAMA TEKNİKLERİ

- Rektum ve mesanede en düşük değer 45/90/135 DW ($p < 0.001$)
- Femurda en yüksek değer 55/90/125
- 45/90/135 ile 25/90/120 arasında rektum V_{90} , V_{80} , femur V_{80} ve mesane açısından anlamlı bir fark yoktur ($p > 0.05$).

7A PLANLAMA TEKNİKLERİ

- Rektum ve mesane açısından en düşük değer plan 0/45/90/135 ($p < 0.05$). Femur açısından anlamlı bir fark yoktur ($p > 0.05$).

En uygun 5A 0/55/95 ve 6A 45/90/135 DW planlar kıyaslandığında, rektum V_{90} , V_{50} ve femur değerlerinde anlamlı bir fark yoktur ($p > 0.05$).

Mesane ve rektum V_{80} açısından 6A 45/90/135 DW daha iyi ($p < 0.05$).

SONUÇ

- Tüm risk altındaki organlar birlikte göz önüne alındığı zaman birbirinden üstün tekniğinin olmadığı belirlendi. Ancak rektum ve mesanenin yan etkilerinin daha sık görüldüğü düşünülerek tedavinin ilk 50 Gy'i için 4A (Box) tekniğinin, boost tedavileri için ise 5A (0/55/95) veya 6A (45/90/135 DW) planlama tekniklerinin daha uygun olduğu sonucuna varıldı.

