

# Офтальмологический комплекс OPTIS2 PSI Switzerland



# From OPTIS to PROSCAN



OPTIS-injector1  
Philips cyclotron  
Maximum energy 72 MeV (protons)  
Beam at OPTIS entrance  
Beam energy 63 MeV  
Beam intensity 60 nA

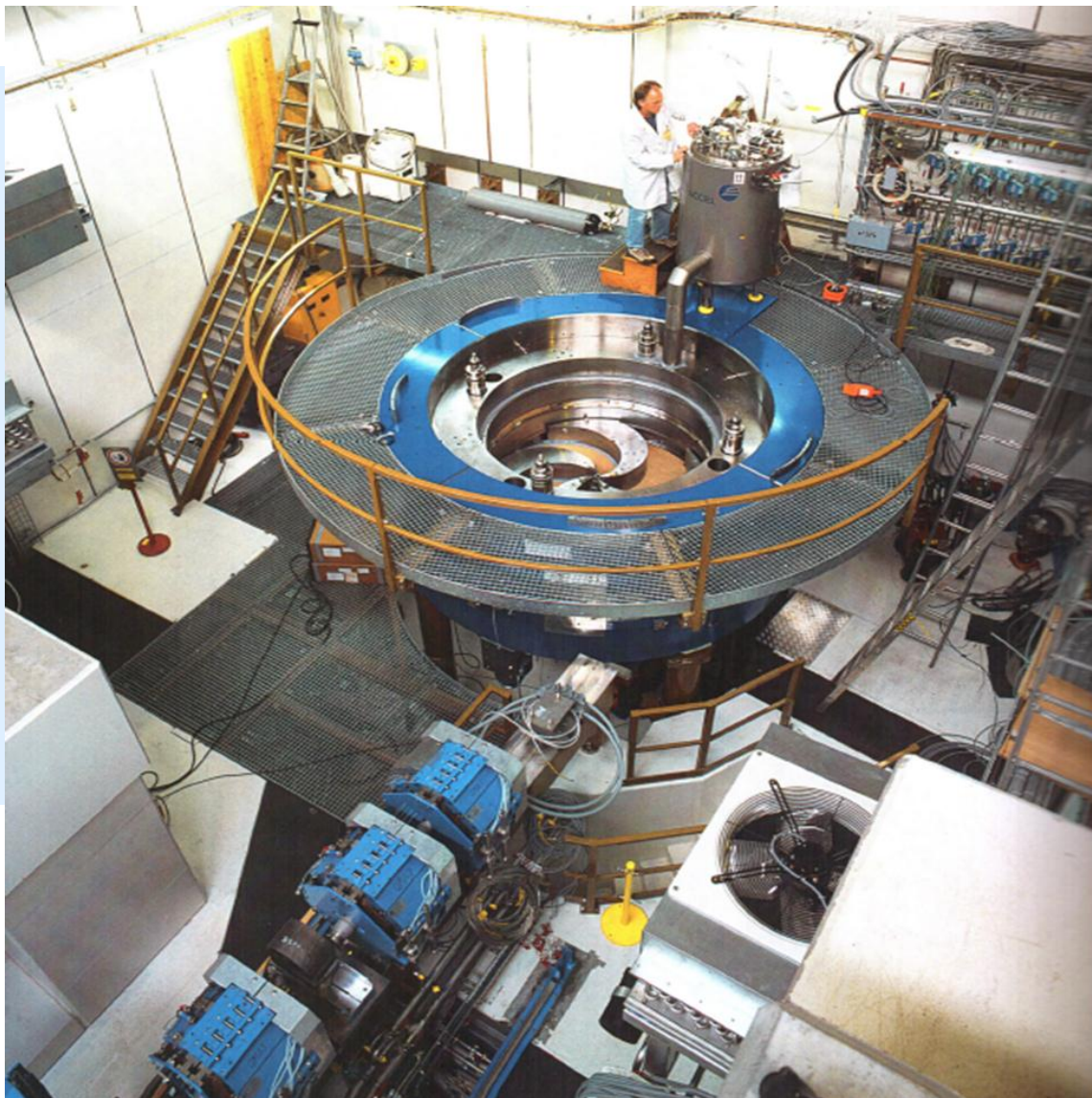
Single scatter foil  
Overall efficiency of OPTIS nozzle  $\sim 2\%$   
Dose rate in treatment volume: 0.5-1 Gy/s  
Treatment time (15 Gy) 10-30 s



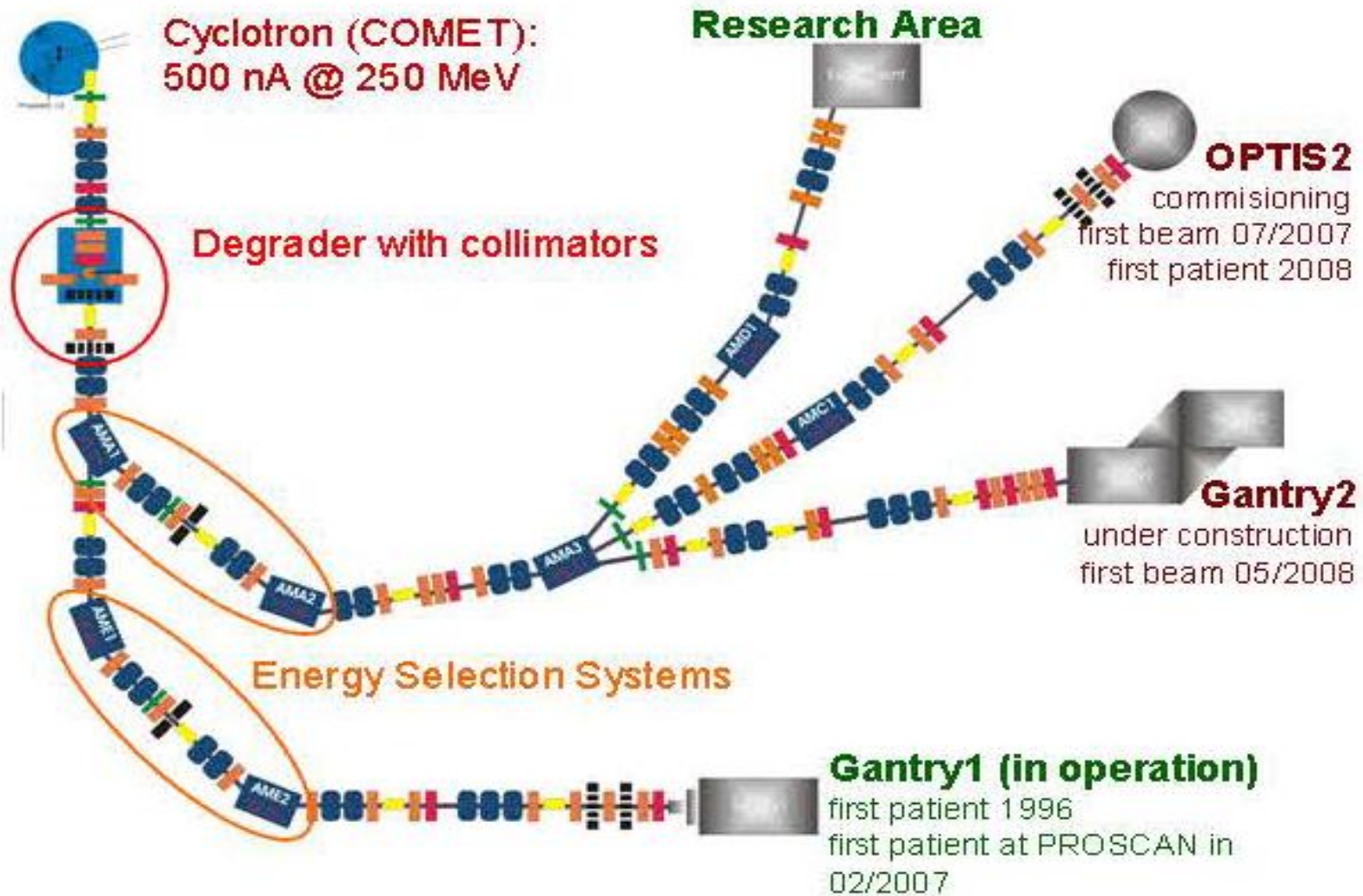
# От модели к реальности за 3 года

Реальная установка в зале PSI в 2006 году

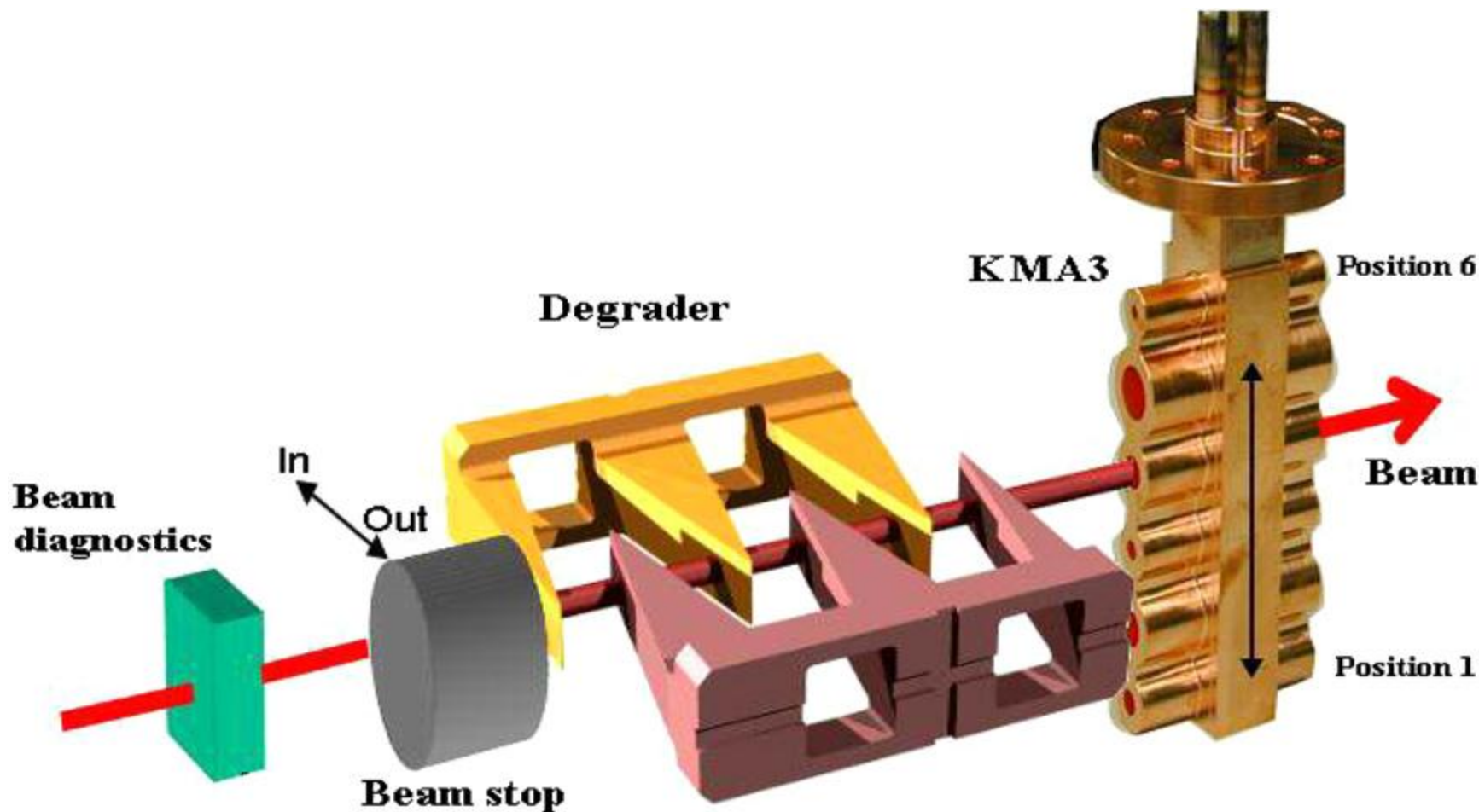
Computer generated (2003)



# Схема протонных пучков PROSCAN



# Изменение энергии протонов 250→75 МэВ



# Degrader properties

Material	Carbon
Minimum overlap	10 mm
Variation of degrader length	30 – 200 mm
Proton energy range output	70- 238 MeV
Advantage of multiplewedge degrader	Compactness Reduced weight
Very fast change in the beam energy (essential for Gantry2)	(2% in 50 ms)

# Сравнение параметров протонного поля OPTIS и OPTIS2

	OPTIS2	OPTIS
Однородность	$\pm 1.5-1.8\%$	$\pm 4\%$
Полутень:		
боковая	1.8mm	1.4mm
передняя	1.5mm	1.1mm
Время облучения	30-60 s	15-30s
Эффективность	~50% (double scattering)	~2% (single scattering foil)
Число пациентов	~1500	~3500

# Система мониторинга пучка на входе в OPTIS2

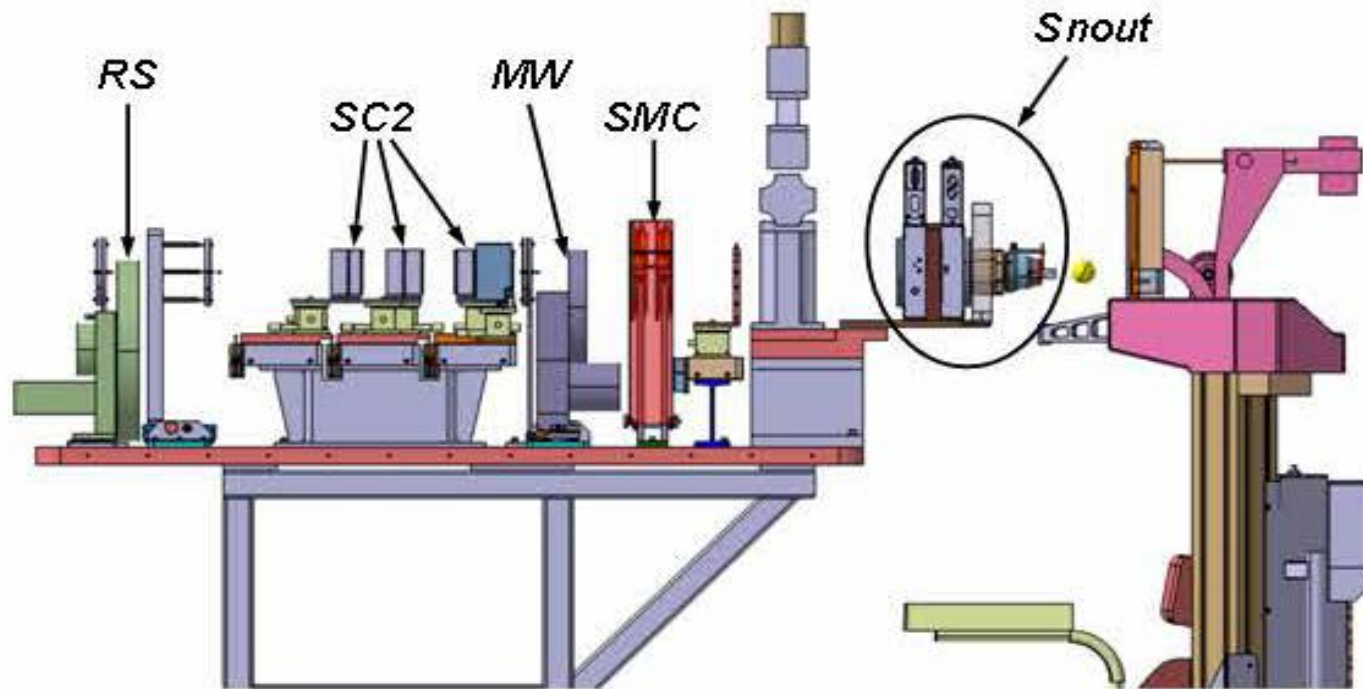




# Установка облучения в зале OPTIS2



# OPTIS2 Nozzle scheme

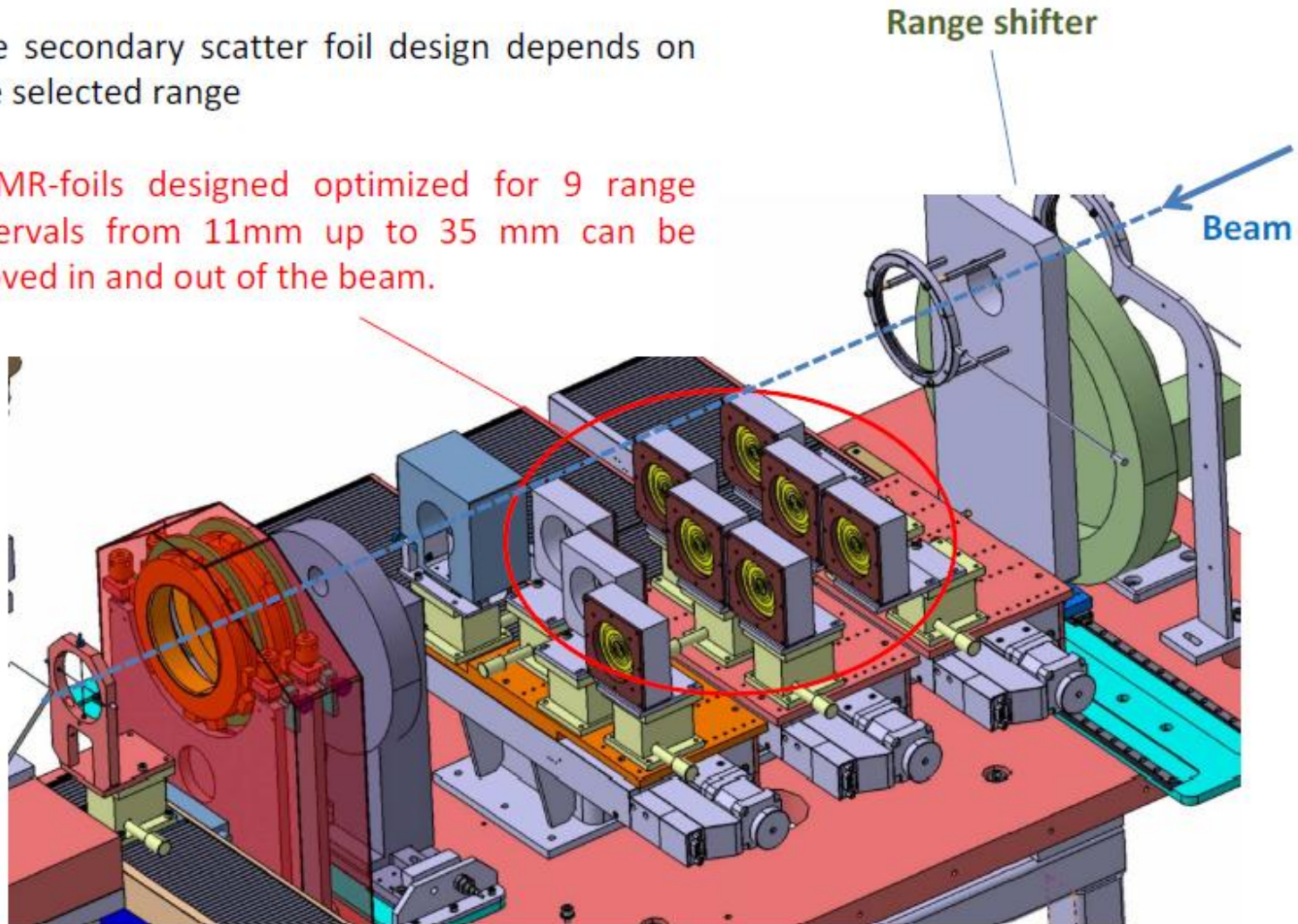


*Figure 2: Drawing of the OPTIS2 Nozzle, consisting of range shifter (RS), second scatterers (SC2), modulator wheel (MW), segmented dose monitors (SMC), snout with patient collimator and eye surveillance system.*

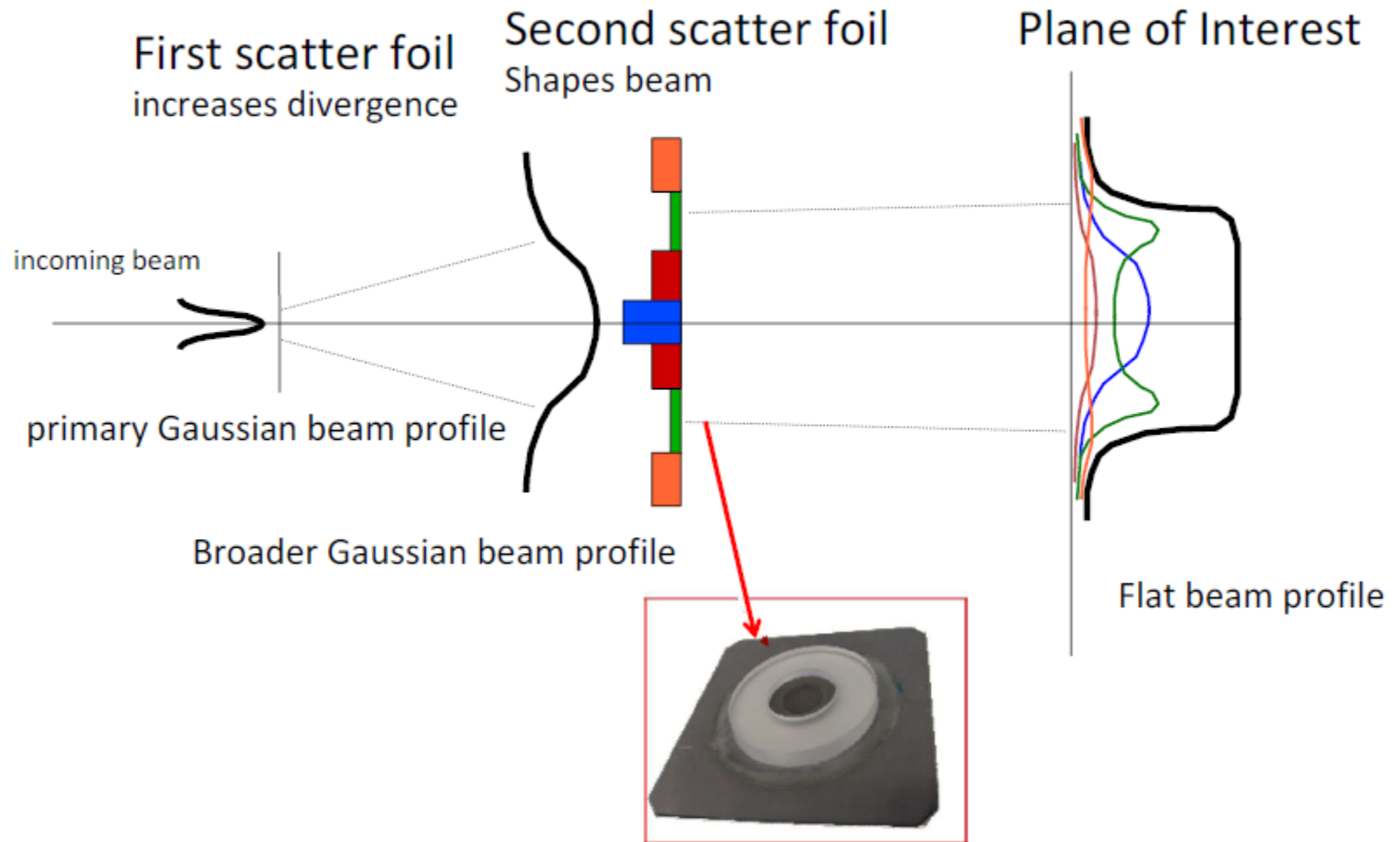
# OPTIS2 Field forming elements: Range Shifter

The secondary scatter foil design depends on the selected range

9 MR-foils designed optimized for 9 range intervals from 11mm up to 35 mm can be moved in and out of the beam.



# Double Scattering Multiple Ring technique



A software tool was developed to find the optimal foil design

# OPTIS2 : Manufacturing Scatter Foils

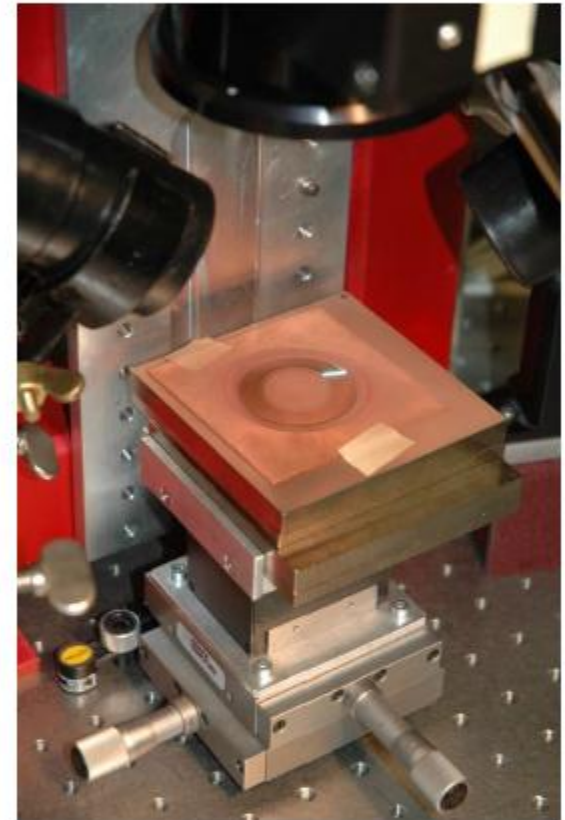
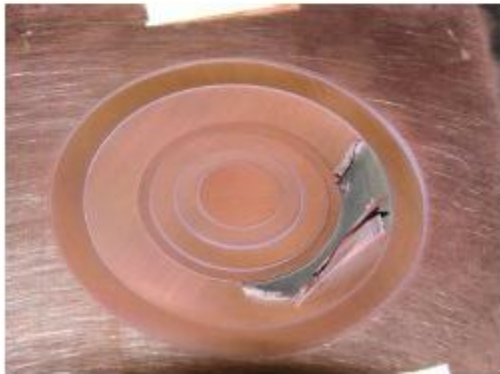
Manufacturing 2nd scatter foil was a cooperation between Fach Hochschule Nord West Schweiz (Brugg AG) (dr. Gabriel Dumitru).

Using a laser ablation process the rings were created in Tantalum plates provided by the PSI

Processing time laser ablation machine ~ 1-2 Days

Compensator is produced at PSI Machine shop (U. Bugmann).

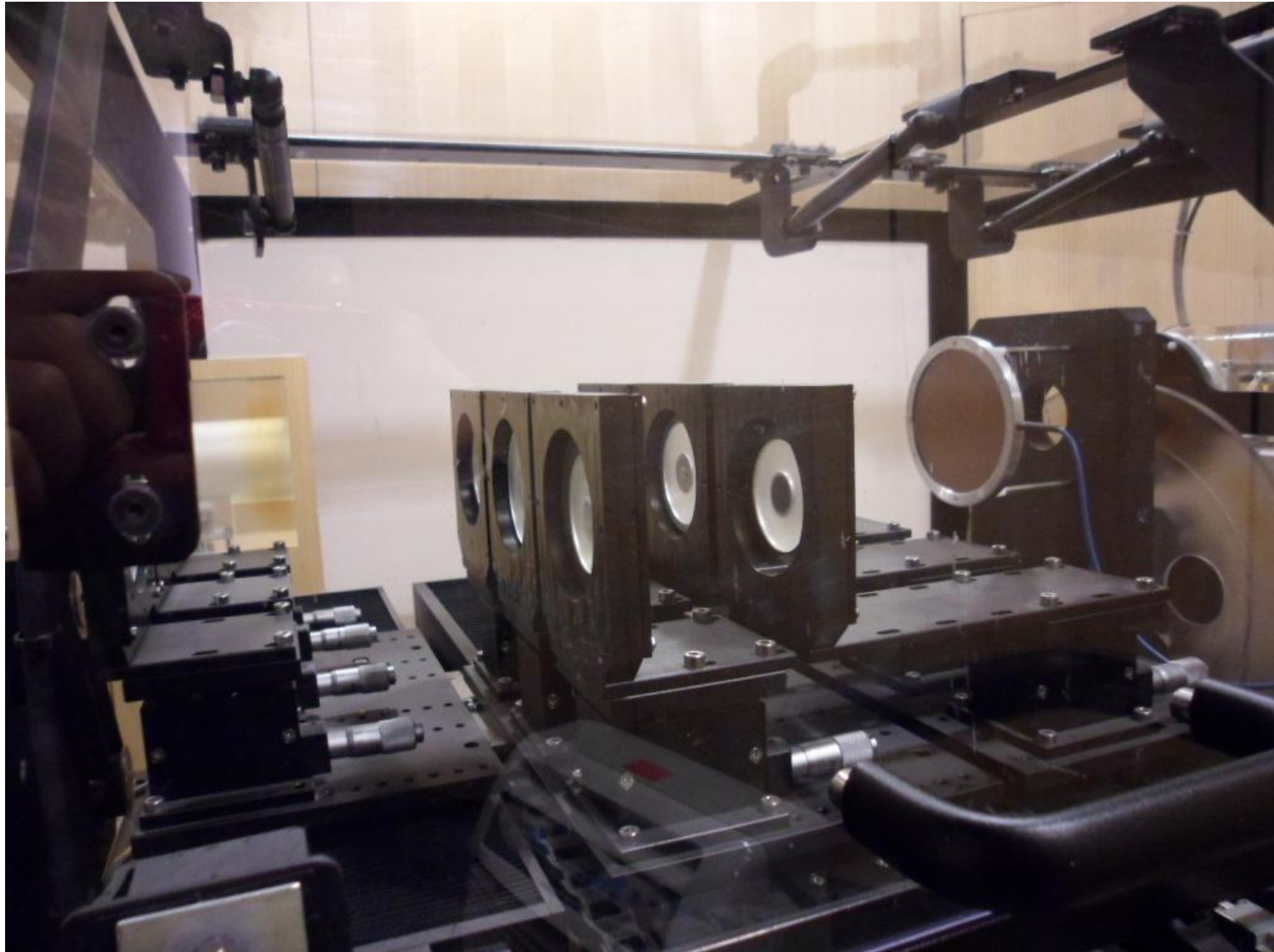
We needed to learn how to apply the laser ablation technique



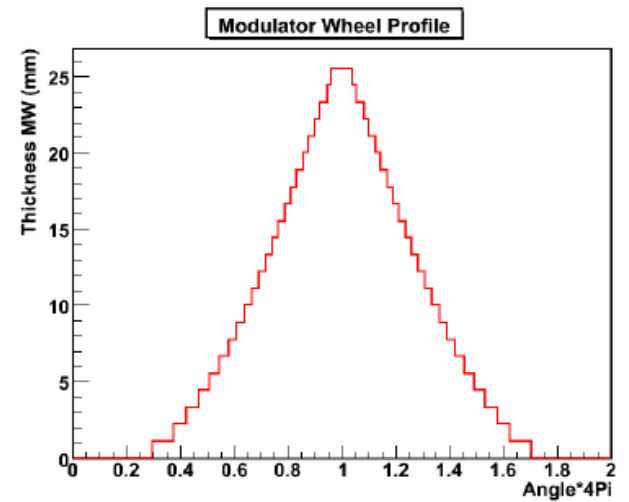
Laser ablation in action

Laser ablation works down to thicknesses of about 100  $\mu\text{m}$

# Double scattering multiple rings



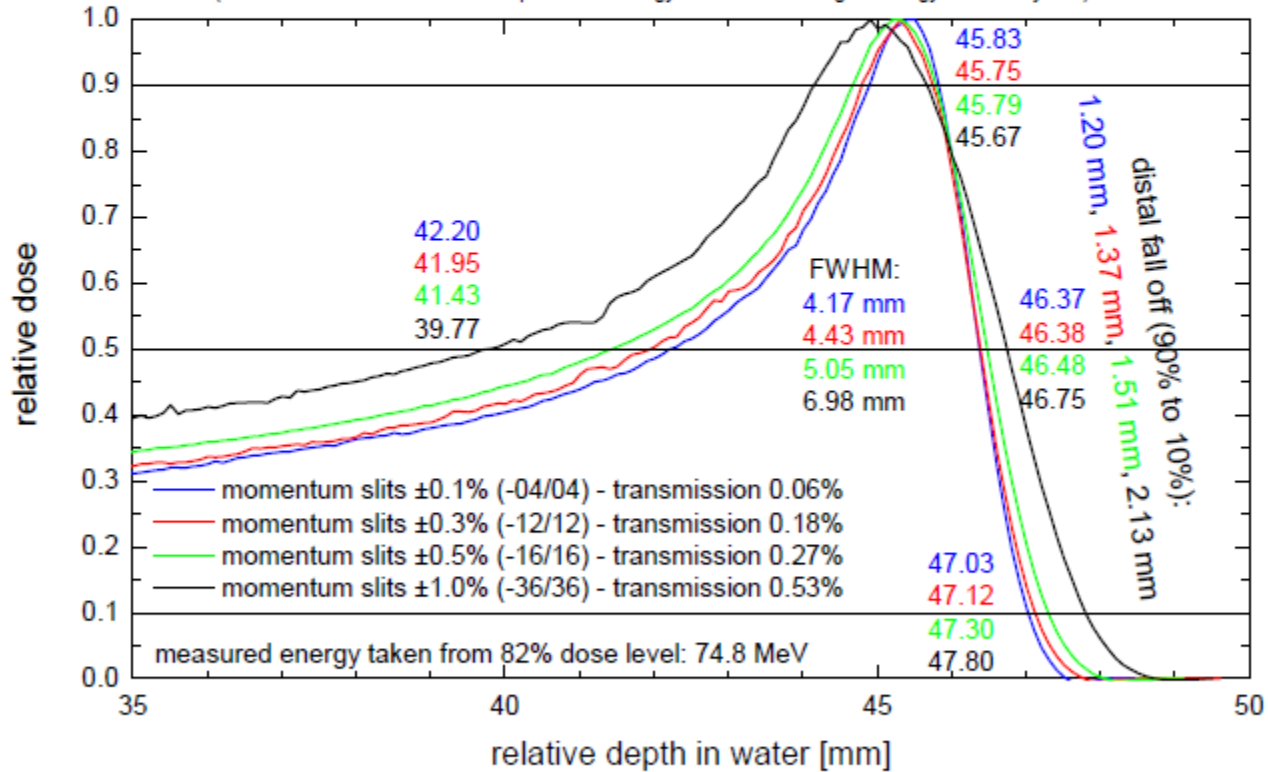
# Модулятор пика Брэгга



# Effect energy selection on distal fall-off

Single Bragg peaks of ca.75.6 MeV protons in OPTIS2 on 22.08.2007  
with different momentum selection

(Markus chamber with 300V in waterphantom - \*energy derived from settings of energy selection system)





# Меланома

- наиболее часто встречающаяся (80 – 87% всех внутриглазных опухолей)
- самая злокачественная опухоль органа зрения
- быстро прогрессирующее течение
- высокий риск метастазирования (до 50% после лечения на протяжении 15 лет)
- высокая летальность за 5 лет после хирургического лечения (50-60%)

## Статистика заболеваемости увеальной меланомой

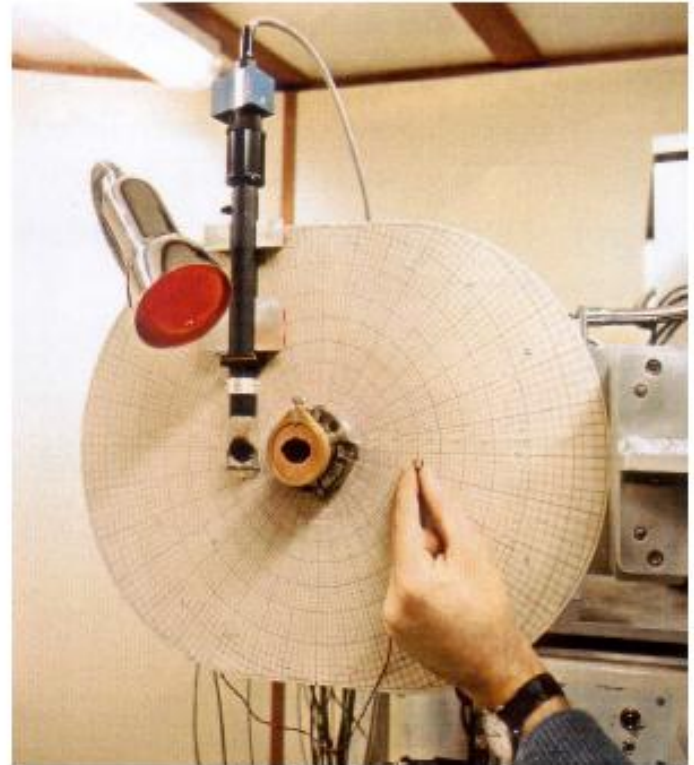
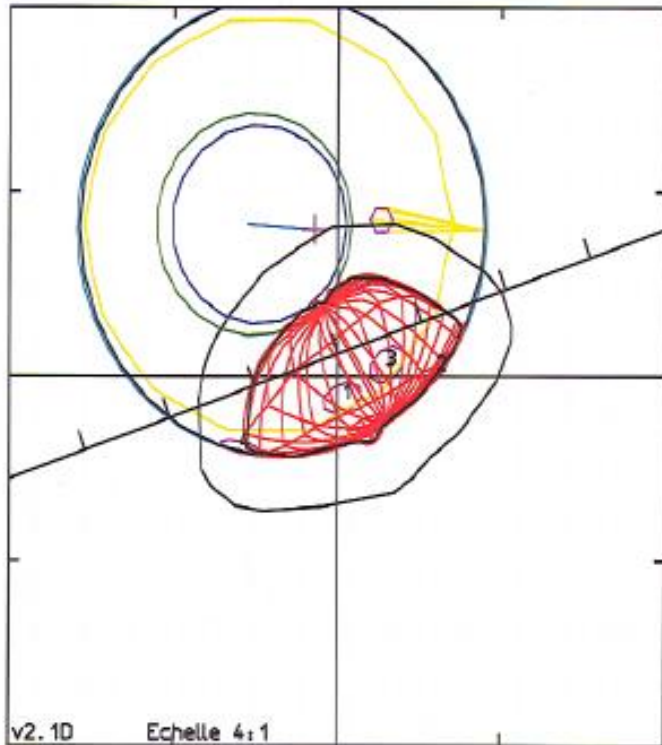
- 6-7 человек (12-22 ) на 1 млн. населения
- пик заболеваемости приходится на 5 – 6 десятилетие жизни
- превалирует женский пол

# Предварительная подготовка пациента



A

## Optimal Treatment Position Found in TPS (EyePlan)



EyePlan uses a geometrical (ellipsoidal) model of the eye

# Head Fixation Achieved with Mask & Bite-block

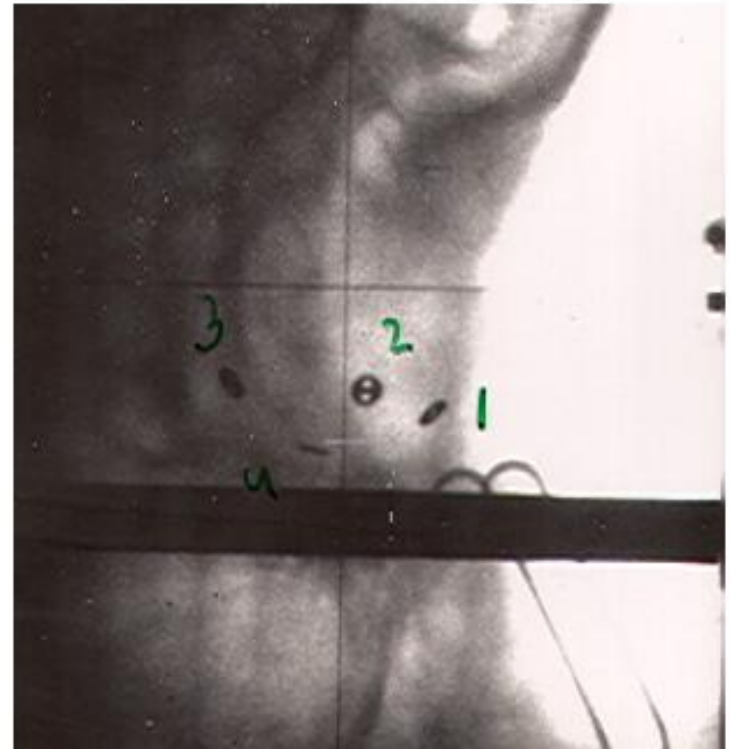


Gazing angle determined with LED on disk with polar coordinate system



# Tumor base is delineated with tantalum clips

Tumor position assessed using stereo-tactic x-ray imaging

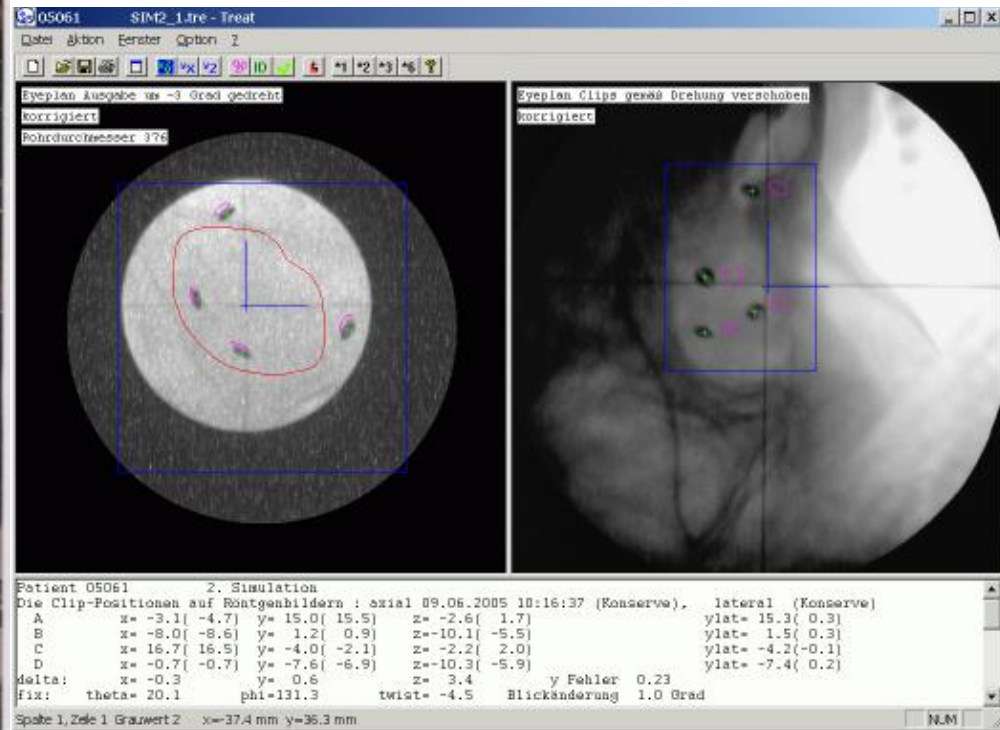
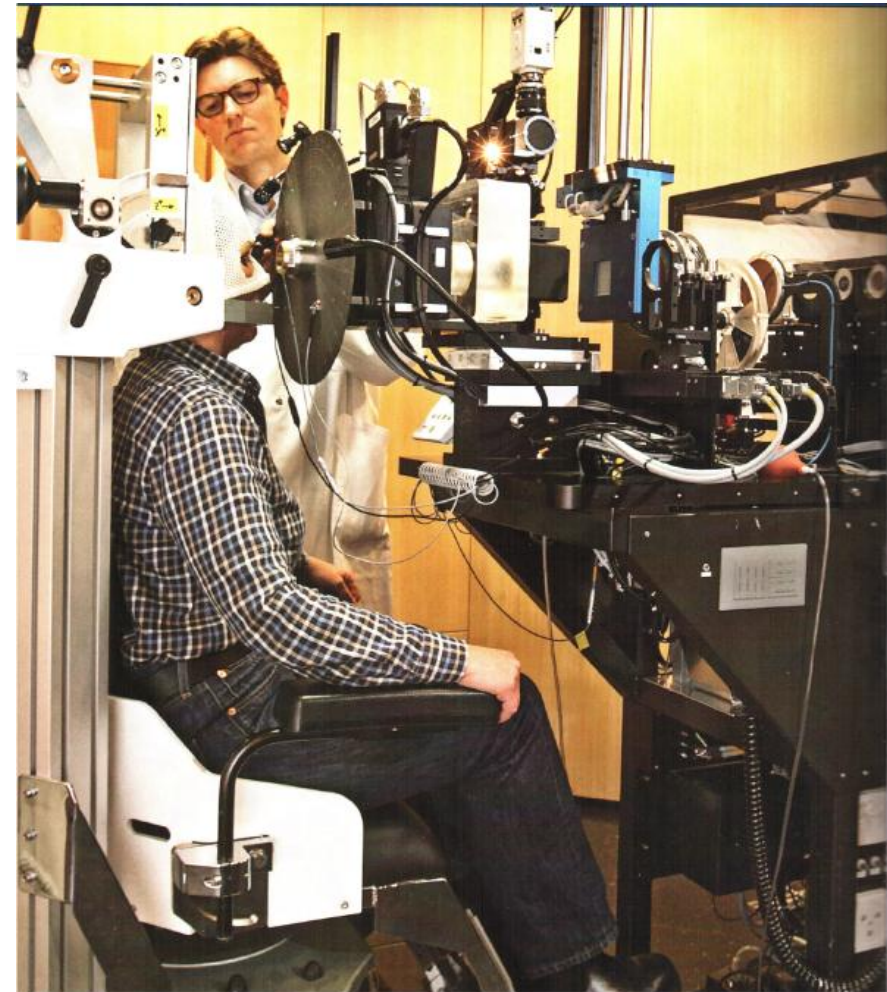


# Система визуализации места облучения

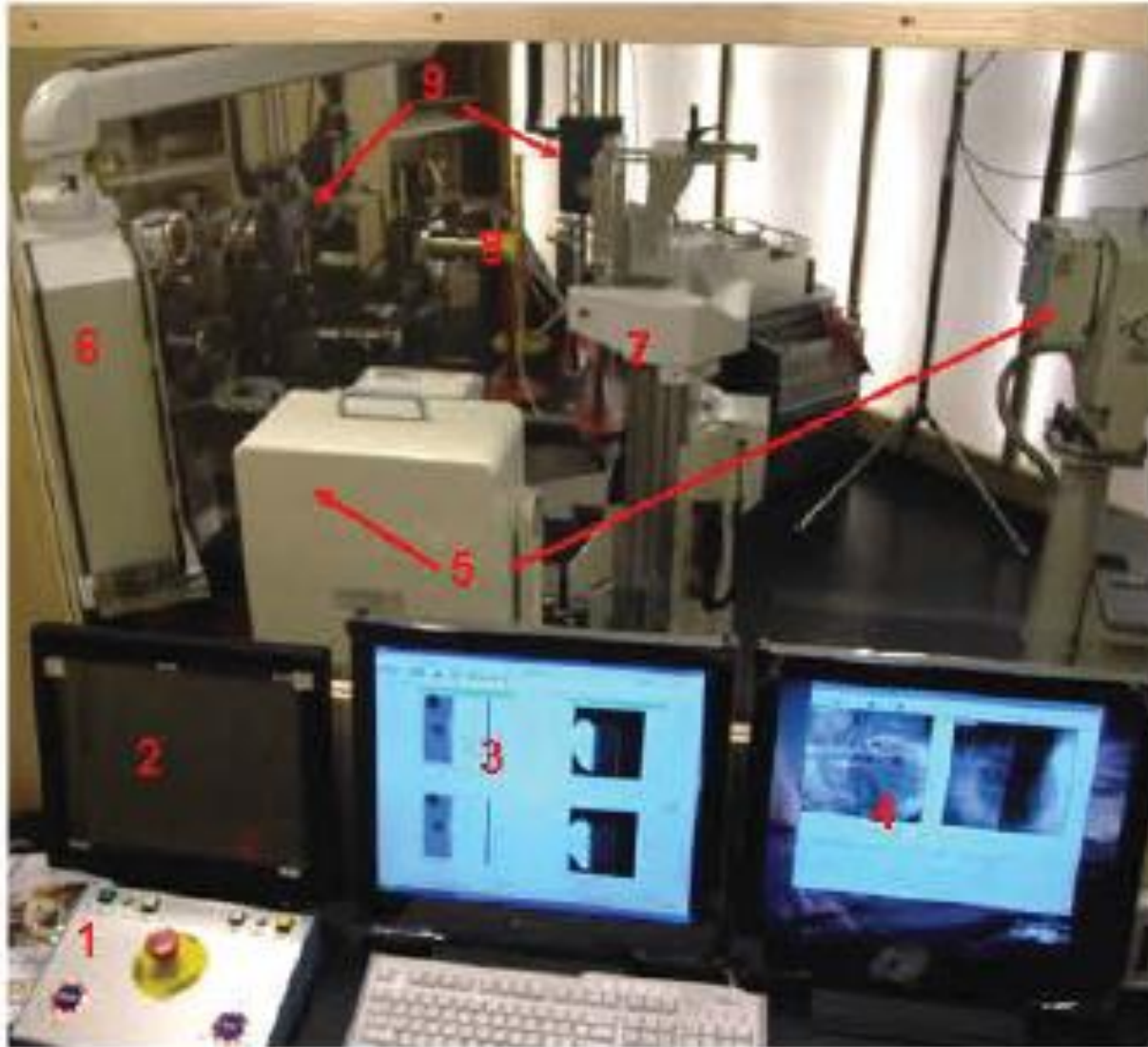


# Подготовка пациента к облучению

- Operator identifies clips on digital images
- Software calculates transformation matrix
- Determines new LED position and patient translation
- Patient translation performed by robotchair

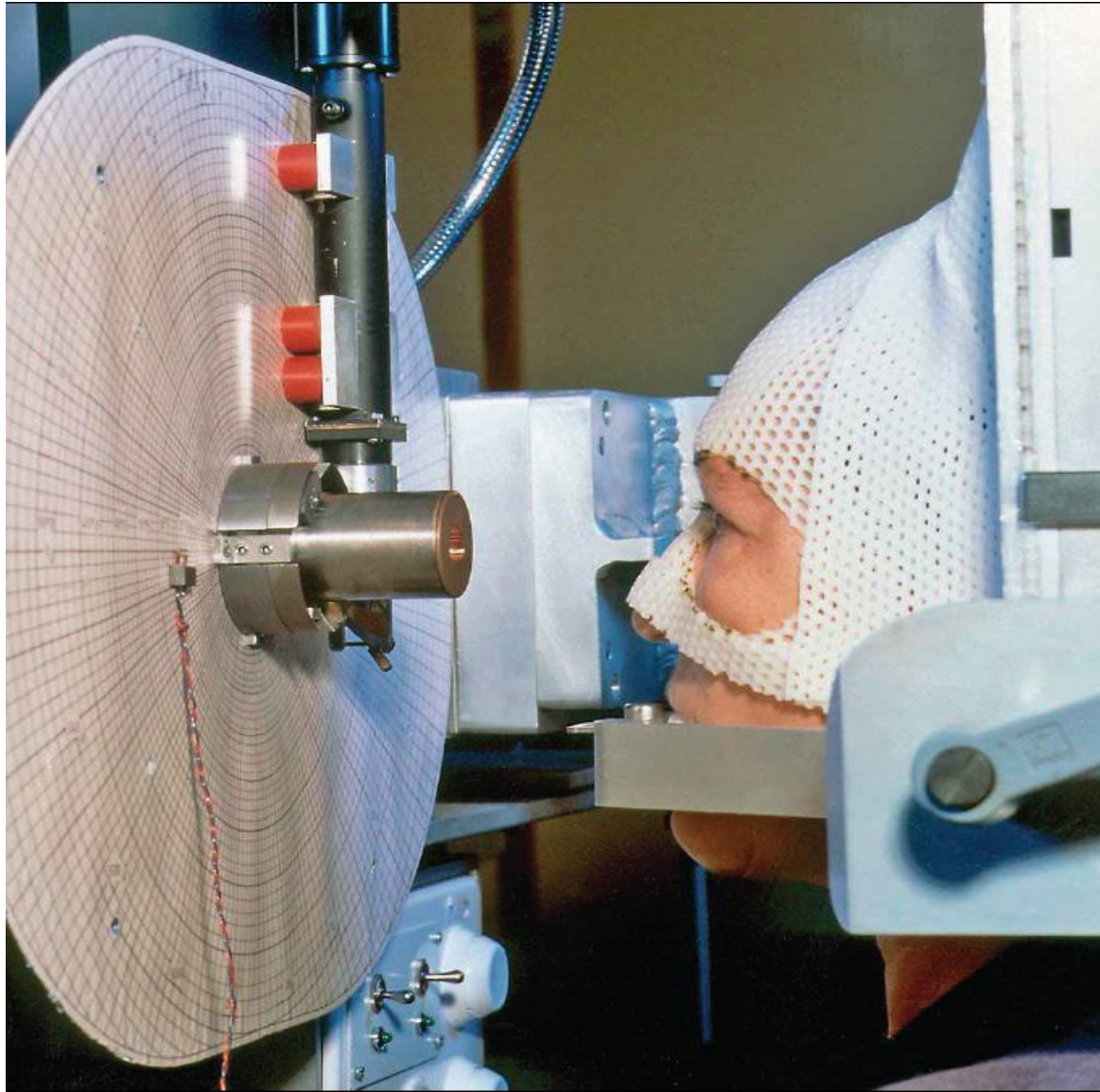


# Визуальное и СТ мониторинг зоны облучения

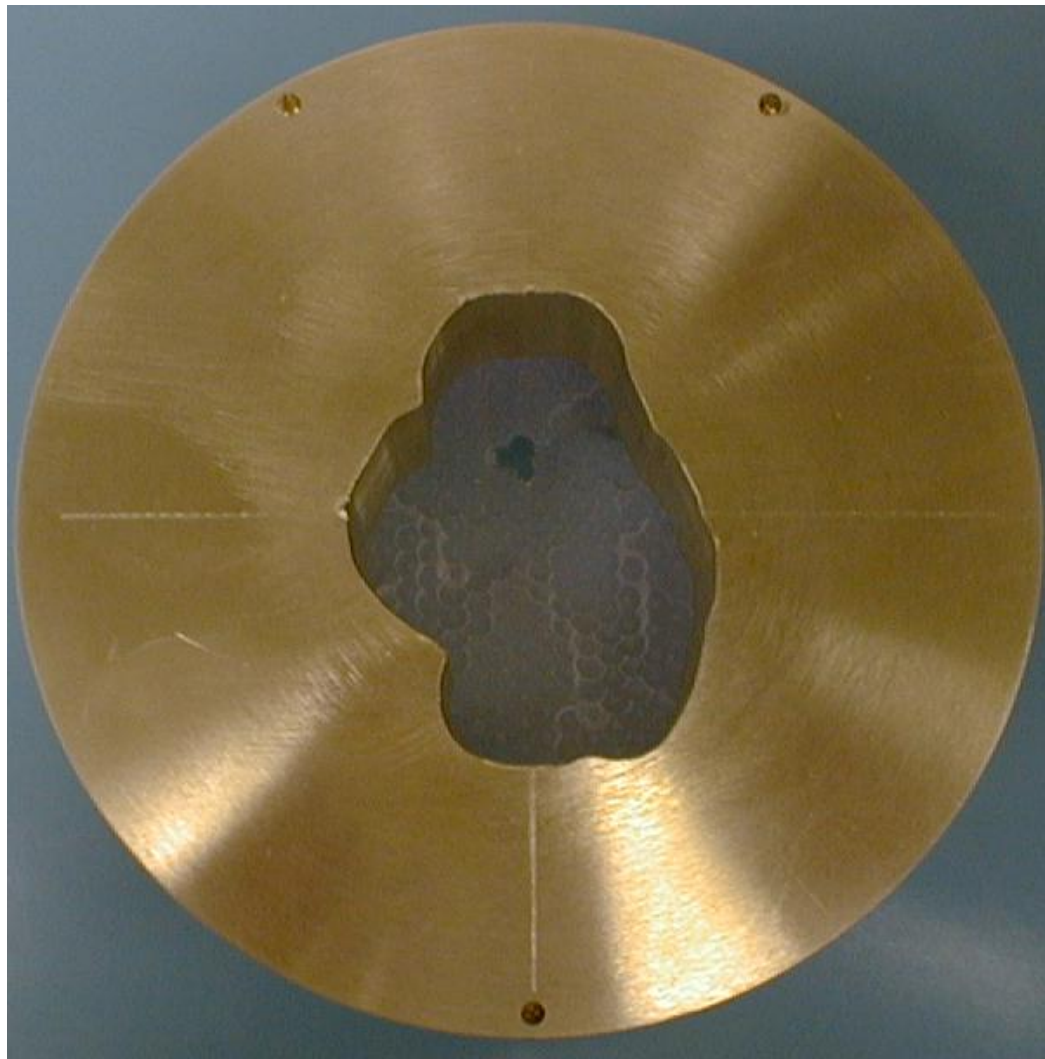




# Индивидуальная коллимация пучка



# Внешний вид индивидуального коллиматора пациента



# Improved radiation therapy means:



- More precise match between the radiation dose and the shape of the tumor
- Higher radiation dose in the target volumes (tumor plus safety zone)
- Lower radiation stress for healthy structures in the body
- Better, more sustainable odds on recovery
- Fewer side effects
- Better quality of life
- Justifiable treatment costs

**Спасибо за внимание**

