

The Abdus Salam International Centre for Theoretical Physics



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Workshop on Biomedical Applications of High Energy Ion Beams

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Venue: Adriatico Guest House Giambiagi Lecture Hall ICTP, Trieste, Italy

Dosimetry & Medical Physics

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Contents Medical physics and dosimetry aspects · Introduction: physical and clinical rationale of charged-particle radiotherapy Physical parameters of clinical beams • · Passive and active scattering beam delivery systems Gantry Stanislav Vatnitsky · Proton and ion beam facilities **Dosimetry and Medical Radiation Physics Section** · Dosimetry of charged-particle beams Division of Human Health Department of Nuclear Applications International Atomic Energy Agency s.vatnitsky@iaea.org S. Vatnitsky ICTP Workshop on Biomedical application of high-energy ion beams Trieste12-16 February 2007









































WHO, WHERE	COUNTRY	PARTICLE	MAX. CLINICAL ENERGY (MeV)	BEAM	START OF	TOTAL PATIENTS TREATED	DATE OF TOTAL
Harvard, Boston	MA.,USA	р	160	horiz.	1961	9116	Apr-02***
ITEP, Moscow	Russia	р	200	horiz.	1969	3858	5-Dec
St.Petersburg	Russia	р	1000	horiz.	1975	1320	6-Oct
Chiba	Japan	р	70	vertical	1979	145	Apr-02***
PMRC (1), Tsukuba	Japan	Р	230	horiz., vertical	1983	700	July-00***
PSI, Villigen	Switzerland	р	72	horiz.	1984	4604	6-Nov
Dubna	Russia	Р	200*	horiz.	1999	318	6-Jul
Uppsala	Sweden	р	200	horiz.	1989	520	4-Dec
Clatterbridge	England	р	62	horiz.	1989	1584	6-Dec
Loma Linda	CA,USA	р	250	gantry,horiz.	1990	11414	6-Nov
Nice	France	р	65	horiz.	1991	3129	6-Sep
Orsay	France	р	200	horiz.	1991	3766	6-Dec
iThemba Labs	South Africa	р	200	horiz.	1993	486	6-Dec
MPRI(2)	IN.,USA	р	200	horiz.	1993	220	6-Sep
UCSF	CA,USA	р	60	horiz.	1994	632	4-Jun

WHO, WHERE	COUNTRY	PARTICLE	MAX. CLINICAL ENERGY (MeV)	BEAM	START OF	TOTAL PATIENTS TREATED
HIMAC, Chiba	Japan	ion	800/u	horiz.,vertical	1994	2867
TRIUMF, Vancouver	Canada	р	72	horiz.	1995	111
PSI, Villigen	Switzerland	p**	230*	gantry	1996	262
G.S.I. Darmstadt	Germany	ion**	430/u	horiz.	1997	316
HMI, Berlin	Germany	р	72	horiz.	1998	829
NCC, Kashiwa	Japan	р	235	gantry	1998	462
HIBMC, Hyogo	Japan	р	230	gantry	2001	1099
HIBMC, Hyogo	Japan	ion	320	horiz.,vertical	2002	131
PMRC(2), Tsukuba	Japan	р	250*	gantry	2001	930
NPTC, MGH Boston	USA	р	235	gantry,horiz.	2001	2080
INFN-LNS, Catania	Italy	р	60	horiz.	2002	114
Shizuoka	Japan	р	235	gantry, horiz.	2003	410
Wakasa WERC, Tsuruga	Japan	р	200	horiz.,vertical	2002	33
WPTC, Zibo	China	р	230	gantry, horiz.	2004	270
MD Anderson , Houston, TX	USA	р	250	gantry, horiz.	2006	114
FPTI, Jacksonville, FL	USA	р	230	gantry, horiz.	2006	15



















































































	Energy, MeV	(W _{air}) _p	1 STD
Larsson, 1958	1.83	35.2	0.2
Palmans et al, 1996	55	34.3	0.4
Denis et al, 1990	65	35.6	0.6
Hiraoka et al, 1988	68	35.3	0.7
Petti et al, 1986	150	34.2	0.4
Siebers et al, 1995	180	34.4	0.4
Delacroix et al, 1997	186	34.3	0.4
Medin et al, 2006	142	33.6	0.6
AAPM TG 20		34.3	4.0
ECHED		35.2	4.0
ICRU 59		34.8	2.0
TRS 398		34.2	0.4
Upcoming ICRU 200	7	34.2	0.4































Standard uncertainties in D _w						
$u(N_{D,w}^{SSDL}) = 0.6$	k _Q calc					
Co-60 gamma-rays High-energy photons High-energy electrons	0.9 1.5 1.4-2.1					
Proton beams Heavy ions	2.0-2.3 3.0-3.4					
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WHO, WHERE	COUNTRY	PARTICLE	MAX. CLINICAL ENERGY (MeV)	BEAM DIRECTION	NO. OF TREATMENT ROOMS	START OF TREATMENT PLANNED
RPTC, Munich*	Germany	р	250 SC cyclotron	4 gantries, 1 hor.	5	2007
PSI, Villigen*	Switzerland	р	250 SC cyclotron	Additional gantry, 2D parallel scanning, 1 hor.	3	2007/08 (OPTIS2/ Gantry2)
NCC, Seoul*	Korea	р	230 cyclotron	2 gantries 1 hor.	3	2007
UPenn	USA	р	230 cyclotron	4 gantries 1 hor.	5	2009
Med-AUSTRON	Austria	p, ion	synchrotron	2 gantries 1-2 hor.	3-4	2011?
Trento	Italy	р	? cyclotron	1 gantry 1 hor.	2	2010?
CNAO, Pavia*	Italy	p, ion	430/u synchrotron	1 gantry? 3 hor. 1 vert	3-4	2009?
Heidelberg/GSI Darmstadt*	Germany	p, ion	430/u synchrotron	1 gantry, raster scanning, 2 fixed	3	2007
iThemba Labs	South Africa	р	230 cyclotron	1 gantry 2 hor.	3	2009?
RPTC, Koeln	Germany	р	250 SC cyclotron	4 gantries 1 hor.	5	2009?
WPE, Essen*	Germany	р	230 cyclotron	3 gantries 1 hor.	4	2009
CPO, Orsay	France	р	230 cyclotron	1 gantry, 4 fixed beams	3	2010?
PTC, Marburg	Germany	p, ion	430/u synchrotron	3 hor. fixed beams, 45 degrees fixed	4	2010?
Northern Illinois PT R.I, W. Chicago, IL	USA	р	250 accelerator	2-3 gantries, 1-2 horiz.	4	2011
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