

# MILESTONES OF THE HITRAP PROJECT

- March 1994:** Start of the g-factor experiment (precision trap) in Mainz
- November 1997:** Demonstration of single-ion detection efficiency
- January 1998:** Start of the EUROTRAPS EU Research Network (until end of 2001)
- November 1998:** Submission of the HITRAP project proposal as mid-term GSI project
- December 1998:** Workshop on Deceleration of Highly Charged Ions
- January 1999:** Approval of HITRAP as a mid-term project by the GSI Directorate
- July 2000:** Measurement of the g factor in  $C^{5+}$  to ten digits in the precision trap
- August 2000:** Demonstration of deceleration in the ESR down to 9 MeV/u
- August 2001:** Improved value for the electron mass from the g-factor measurements
- November 2001:** Start of the HITRAP EU-RTD network (duration: until October 2005)
- October 2001:** Wissenschaftlicher Rat of GSI: “fascinating opportunities”
- December 2002:** HITRAP Workshop

# COSTS OF THE HITRAP PROJECT AND SPENDING PROFILE

Components	Costs [k€]				
	first year	second year	third year	fourth year	sum
<b><u>Decelerator linac for highly charged ions:</u></b>					
First IH decelerator cavity (without quadrupole lens, 108 MHz)	45	105	105	45	300
Second IH decelerator cavity (with quadrupole lens inside, 108 MHz)	60	140	140	60	400
RFQ decelerator cavity (108 MHz)	15	35	35	15	100
3 quadrupole lenses (before each decelerator cavity, triplet / triplet / doublet)	37	88	88	37	250
RF transmitter 108 MHz, 240 kW*	0	0	0	0	0
Beam line from ESR to decelerator linac: buncher, steerer, quadrupole triplet, deflection magnets, diagnostics	45	105	105	45	300
Installation of the RF transmitters and commissioning in building BG1/16	0	0	50	50	100
Integration of decelerator into infrastructure of GSI accelerator facility (10 % of total costs)	0	50	100	100	250
<b><u>Total decelerator</u></b>	<b>202</b>	<b>523</b>	<b>623</b>	<b>352</b>	<b>1600</b>
<b><u>Cooler Penning trap:</u></b>					
Superconducting magnet	52	78	0	0	130
Mechanical parts, vacuum equipment	10	25	0	0	35
Voltage power supplies	0	20	0		20
<b><u>Total cooler trap</u></b>	<b>62</b>	<b>123</b>	<b>0</b>	<b>0</b>	<b>185</b>
<b><u>Transfer line between cooler trap / precision trap:</u></b>					
Mechanical parts, vacuum equipment, diagnostics	0	25	0	0	25
<b><u>Total transfer line</u></b>	<b>0</b>	<b>25</b>	<b>0</b>	<b>0</b>	<b>25</b>
<b><u>Precision trap</u></b>					
Precision trap (incl. superconducting magnet)*	0	0	0	0	0
Material for trap modifications, electronics and computers	0	10	35	0	45
<b><u>Total precision trap</u></b>	<b>0</b>	<b>10</b>	<b>35</b>	<b>0</b>	<b>45</b>
<b><u>Transfer line between IH structure and cooling trap</u></b>					
Mechanical parts, vacuum equipment, diagnostics	0	0	25	0	25
<b>Sum for each years and total sum:</b>	<b>264</b>	<b>681</b>	<b>683</b>	<b>352</b>	<b>1980</b>

\* The following existing equipment will be used:

Precision trap, incl. superconducting magnet, RF electronics etc., total value 350 k€

RF transmitter 108 MHz, total value approx. 1000 k€

The costs of the move to the NESR and preparations for antiproton deceleration are estimated to 250 k€

**Contribution by the EU (HITRAP RTD Network, essentially manpower): 1900 k€**

# Development of Costs of the HITRAP Project

November 1998: 1.53 M€

HITRAP Project Proposal:  
based on a deceleration starting from 3 MeV/u  
2 IH-cavities  
and existing RF transmitters (240 kW)

October 2002: 1.98 M€

HITRAP Project Description:  
based on a deceleration starting from 7 MeV/u  
3 IH-cavities and one RFQ-structure  
and existing RF transmitters (240 kW)

December 2002: 2.08 M€

based on a deceleration starting from 7 MeV/u  
4 IH-cavities and one RFQ-structure  
and existing RF transmitters (200 kW)

# HITRAP GSI-Project: Personnel Plan 2003 – 2010

Personnel	2003	2004	2005	2006	2007	2008	2009	2010
<b>HITRAP technical coordinator (W. Quint)<sup>1</sup></b>	█	█						
<b>HITRAP cooler trap and precision trap:</b>								
1 postdoc (M. Vogel, Mainz team) <sup>2,§</sup>	█	█	█	█				
1 PhD student (S. Djekic, Mainz team) <sup>3,#</sup>	█	█	█	█				
1 PhD student (T. Valenzuela, Mainz)	█	█	█	█				
<b>HITRAP decelerator linac:</b>								
1 postdoc <sup>4</sup> (F. Herfurth, GSI team)		█	█	█				
1 PhD student <sup>5,#</sup> (C.Kitegi, GSI/Frankfurt)	█	█	█	█				
<b>1 Scientific coordinator (T. Beier)<sup>6</sup></b>	█	█	█	█				
<b>Development of exp. set-ups for HITRAP:</b> Postdocs and PhD's equivalent to 7 postdoc positions (EU RTD Network HITRAP) <sup>4</sup>	█	█	█	█				
<b>Operation of the HITRAP facility at ESR:</b>								
1 postdoc				█	█	█	█	█
1 PhD student				█	█	█	█	█
1 technician				█	█	█	█	█
<b>Move of HITRAP facility to NESR<sup>&amp;</sup>:</b>								
2 postdocs							█	█
1 PhD student							█	█
1 technician							█	█
<b>Operation of HITRAP at NESR:</b>								
1 postdoc								█
1 PhD students								█
1 technician								█

- █ External funding, approved
- █ Funding requested or open
- █ GSI-AP staff

- <sup>1</sup> Heisenberg-Fellow of Deutsche Forschungsgemeinschaft (until spring 2004)
- <sup>2</sup> financed by BMBF
- <sup>3</sup> financed by GSI Hochschulprogramm
- <sup>4</sup> financed by EU HITRAP RTD Network
- <sup>5</sup> financed by Marie Curie Fellowship
- <sup>6</sup> financed by GSI
- § proposal for the next funding period has been submitted
- # proposal for the next funding period will be submitted
- & it is assumed that the move to the NESR takes place in 2009

In addition, the following support of GSI infrastructure is requested:  
 installation of the decelerator at the ESR: 18 personmonths  
 installation of RF equipment: 24 person months  
 integration of decelerator into GSI accelerator control system: 12 personmonths

## TIME SCHEDULE OF THE HITRAP GSI PROJECT

Planned time schedule in months from the start of the design of the HITRAP decelerator.

Tasks	1-12			13-24			25-36			37-48		
Deceleration of highly charged ions to 7 MeV/u: machine tests and optimisation												
Specification and purchase of super-conducting magnet for HITRAP cooler trap												
Design, simulations, construction and assembly of cooler trap												
Construction of test ion source and transfer line to cooler trap												
Test experiments of cooler trap with off-line test ion source												
Construction of cryogenic transfer line between cooler trap and precision trap, simulations												
Modification of the beamline in the re-injection channel between ESR and SIS (together with PHELIX project)												
Design, construction and assembly of HITRAP decelerator												
Installation and commissioning of decelerator in the re-injection channel between ESR and SIS												
Test of cooler trap with decelerated HCI												
Development of experimental set-ups for the experimental program of HITRAP												
Start of the experimental program at the HITRAP facility												