
2005 HIPPI Activities

Maurizio Vretenar, CERN

- HIPPI Structure
- 2005 Highlights
- ESAC Report
- Planning and deliverables

HIPPI: High Intensity Pulsed Proton Injectors



Main objective:

Research and development of the technology for high intensity pulsed proton linear accelerators up to an energy of 200 MeV.

Applications of the HIPPI results:

Upgrade of the linac injectors for GSI, CERN and RAL.

9 participating laboratories:

RAL, CEA, CERN, FZJ, GSI, IAP-FU, INFN-MI, LPSC, IPNO

Expected budget:

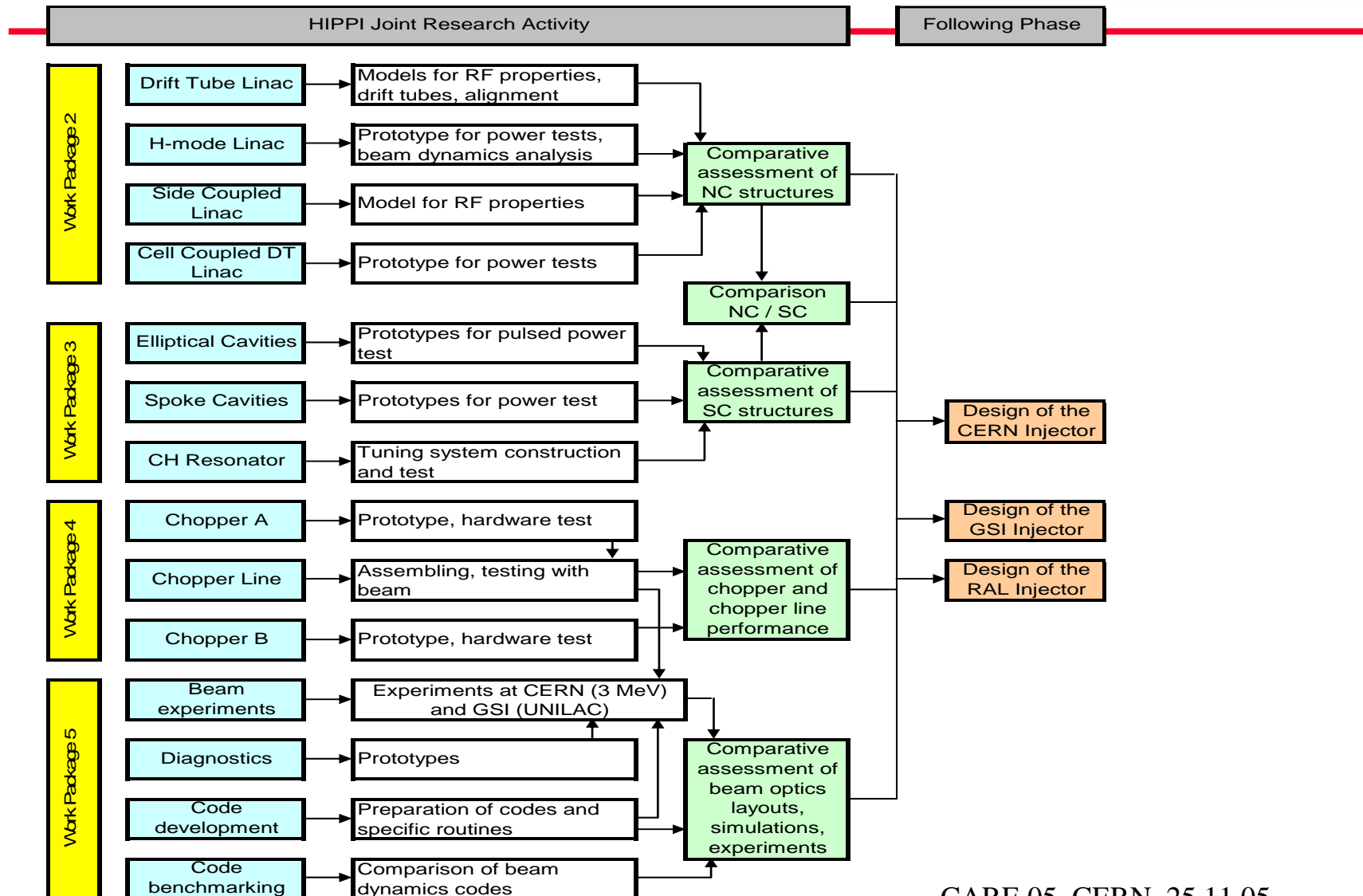
14.7 M€ (FC-equivalent), EU contribution 3.6 M€

Hot topics for HIPPI R&D



- ◆ **High shunt impedance normal conducting cavities**
 - Focusing elements integrated/separated in the structure
- ◆ **Low beta superconducting cavities**
 - Pulsed operation
- ◆ **Lossless injection in a ring**
 - Fast chopping
- ◆ **Control of the halo**
 - Beam dynamics code development

HIPPI Structure



HIPPI Management



From 1st July, 2005:

Coordinator: **M. Vretenar** replaced **R. Garoby**

Deputy Coordinator: **A. Lombardi** replaced **M. Vretenar**

WP Coordinators:

WP2: J.M. De Conto (IN2P3)

WP3: S. Chel (CEA)

WP4: A. Lombardi (CERN, confirmed)

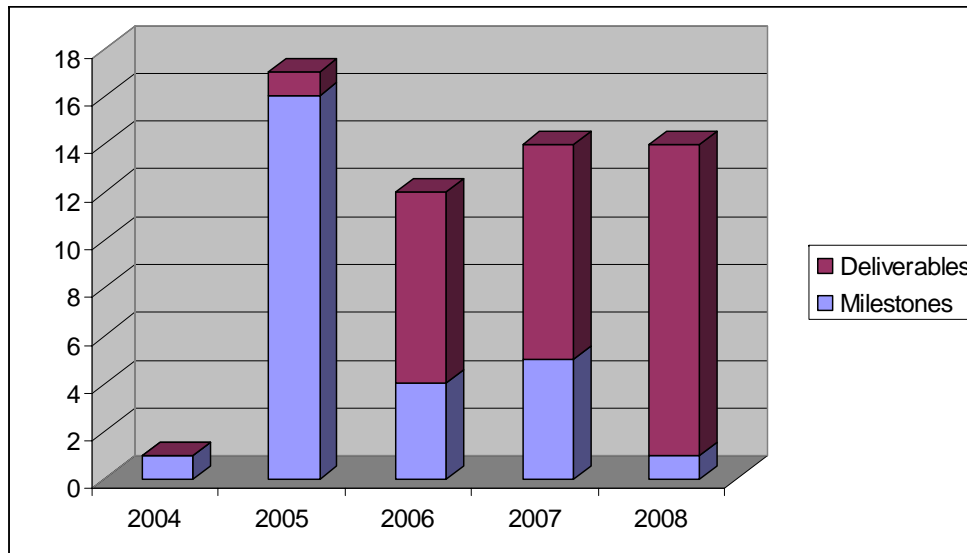
WP5: I. Hofmann (GSI)

Reason for change purely CERN-related (R. Garoby took charge of the AB-BDI Group at CERN, and was forced to reduce his other activities).
Continuity in the HIPPI Management, coordinator and deputy from CERN - allows sharing of tasks and more effective work.

HIPPI in 2005



- Critical year: highest number of milestones in the entire project !



	Milestones	Deliverables	Total
2004	1	0	1
2005	16	1	17
2006	4	8	12
2007	5	9	14
2008	1	13	14
			58

- Constant exchange of information, more integration inside work packages and between work packages (see ESAC report).
- Internal and External (collaboration) meetings with good attendance and good quality of presentations.

2005 Meetings



	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
CARE & HIPPI												
CSC meetings				5 CERN					5 & 6 Paris			
Workshop WP2						2 & 3 CERN						
Workshop WP3			13 & 14 INFN-Mi									
Workshop WP4				13 & 14 RAL								
Workshop WP5				14 & 15 RAL								
<i>HIPPI yearly meeting</i>									28 - 30 RAL			
CARE yearly meeting											23 - 25 CERN	
Other workshops												
High Power SC Linac					23 - 25 FNAL							
Other collaborations												
IPHI-SPL	27 & 28 CERN										17 - 18 IPNO	
Russia (ISTC)				13 - 19 Russia				17 - 19 CERN (DTL)		10 - 13 CERN (CCDTL)		
Miscellaneous												
INTC										10 - 14 CERN		
PAC05					16 - 20 Knoxville							
ICIS05									12 - 16 Caen			

Dissemination & Recruitment



- Publications of **26** HIPPI papers January-November 2005: 11 Conference papers, 7 CARE Notes, 8 HIPPI Documents (average of 2.4 per month).
- Recruitment: **5** new positions in 2005 (relatively long term: 3 for 3 years, 2 for 2 years), which add to the **4** positions opened in 2004 (for 3 years).
- HIPPI is recruiting talented and motivated young people and is training them in field of accelerators.

Attracting a new partner



- Proposition for an additional member:

INFN-Naples has experience in Side Coupled NC Structures for medical applications. The SCL team (Prof. Vaccaro &C.) is ready to participate to the HIPPI WP2 activity from 2006.

A common programme has been defined with the laboratories working on this subject inside HIPPI and with the WP Coordinator.

2005 Annual Meeting



The Cosener's House
Abbey Close
Abingdon, UK
(organised by RAL)

- 43 participants from all the participating laboratories (38 for HIPPI04).
- 30 technical presentations covering all aspects of HIPPI work.
- 25% of time devoted to questions and discussion.
- 2 members of the External Scientific Advisory Committee (ESAC) present, a 3rd contributed to the report.

HIPPI 05 Programme - 1



Wednesday 28, September, morning		
9h00	Welcoming address	C. Prior
9h15	Status of HIPPI and introduction to the meeting	M. Vretenar
	<u>WORK PACKAGE 4 (Chopper)</u>	
9h45	Introduction (10'+5')	A. Lombardi
10h00	Status of the CERN chopper (25'+5')	M. Paoluzzi
10h30	<i>Coffee Break</i>	
11h00	Status of the RAL 'Fast-Slow' beam chopper development programme (25'+5')	M. Clarke-Gayther
11h30	The FETS: Front End Test Stand (15'+5')	A. Letchford
11h50	Beam dynamics studies and design options for the RAL FETS chopper line (10'+5')	G. Bellodi
12h05	Status of the CERN Chopper line (10'+5')	A. Lombardi
12h20	Design of a rebunching cavity for the RAL FETS chopper line (10')	C. Plostinar
12h30	<i>End of session</i>	
Wednesday 28, September, afternoon		
	<u>WORK PACKAGE 2 (Normal Conducting RF struct.)</u>	
14h00	Introduction (10')	J.M. De Conto
14h10	Progress on DTL design for CERN (30'+10')	F. Gerigk
14h50	Waveguide RF coupler for NC structures (20'+10')	Bernaudin /Deconto
15h20	Preliminary DTL studies at RAL (15'+5')	C. Plostinar
15h40	<i>Coffee Break</i>	
16h10	Status of the RT CH-DTL development and beam dynamics layout of the GSI Proton Linac	G. Clemente
16h50	CCDTL design and prototype measurements (20'+10')	M. Pasini
17h20	Side Coupled Linac design at CERN (15'+5')	M. Pasini
17h40	Side Coupled Linac analysis at LPSC (15'+5')	J.M. De Conto
18h00	<i>Adjourn</i>	

HIPPI 05 Programme - 2



Thursday 29, September, morning		
WORK PACKAGE 3 (<i>Superconducting RF structures</i>)		
Introduction (10')		S. Chel
Status report of coaxial tuner design (25'+5')		P. Pierini
Status of HIPPI activities at CEA-Saclay (35'+5')		G. Devanz
Measurements with the 760 MHz Triple Spoke Cavity (15'+5')		R. Eichhorn
<i>Coffee break</i>		
Final Mechanical Design of the 352 MHz Cavity and Options for Tuning (15'+5')		E. Zaplatine
Status of spoke cavities activities at IN2P3-IPNO (25'+5')		G. Olry
Status of the superconducting CH-Structure at IAP-FU (25'+5')		H. Podlech
Super-conducting slot-finger structure with RF focusing (10'+10')		Y. Senichev
<i>End of session</i>		
Thursday 29, September, afternoon		
WORK PACKAGE 5 (<i>Beam Dynamics</i>)		
Introduction (10'+5')		I. Hofmann
Development of non-intercepting longitudinal and transverse beam profile monitors (15'+5')		P. Fork
High Intensity beam dynamics in the slot-finger structure (15'+5')		N. Vasyukhin
Status of diagnostics development at FZJ (10'+5')		R. Tölle
Progress in HIPPI code benchmarking (15'+5')		A. Franchi
<i>Coffee break</i>		
Status report on the beam shape and halo monitor (15'+5')		M. Hori
Beam dynamics in the Linac4 (10'+5')		A. Lombardi
Measurements & simulations on emittance growth due to space charge along the DTL of the GSI UNILAC (20'+5')		L. Groening / W. Bayer
Status of LORASR Code Development and Recent Benchmarking Results (20'+5')		R. Tiede

HIPPI 05 Programme - 3



Friday 30, September, morning	
Meeting on HIPPI administrative matters and planning for 2006 (<i>in parallel with ESAC deliberations</i>) ESAC preliminary assessment Concluding talk	
Friday 30, September, afternoon: <i>Visit to Rutherford Laboratory</i>	

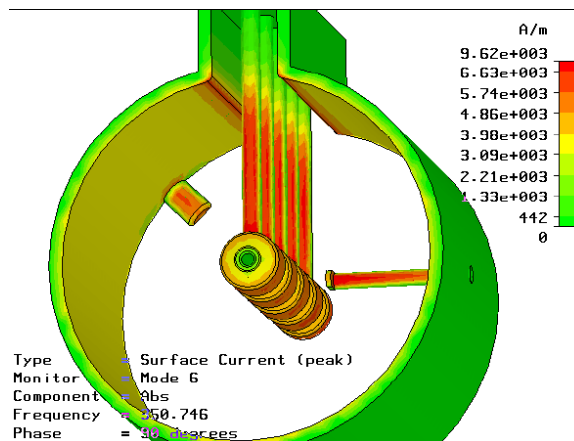
Friday morning:

- Dissemination.
- 2006 planning.
- Budget status.
- CARE05, HIPPI06.

Highlights WP 2 – Normal Conducting Structures

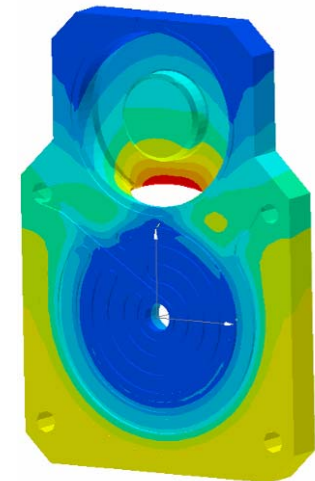
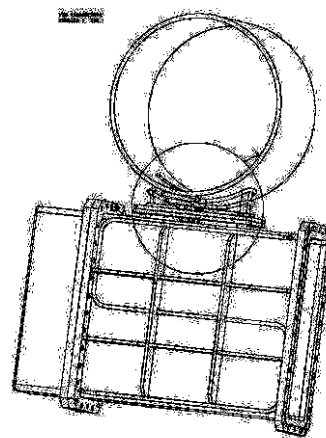


Investigation and comparison of 4 different types of NC structures:
2 standard: Drift Tube Linac (DTL) and Side Coupled Linac (SCL),
2 new: Cell-Coupled DTL (CCDTL) and CH-DTL.



DTL design (here 3D RF simulation showing B-field distribution) developed by CERN, LPSC and CEA.

RF coupler for DTL structures, developed by CEA and LPSC for CERN DTL prototype. Design completed, will be built at LPSC.



Design of SCL cells (here thermal study by LPSC) jointly by LPSC and CERN.

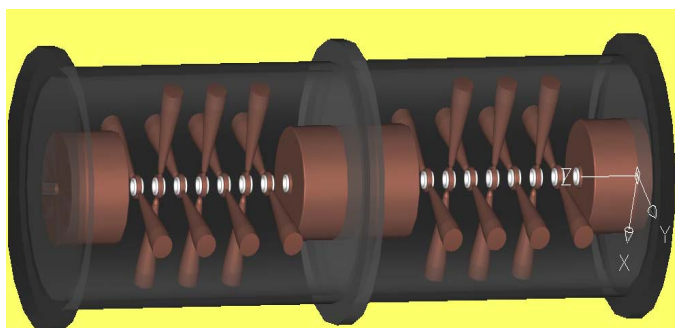
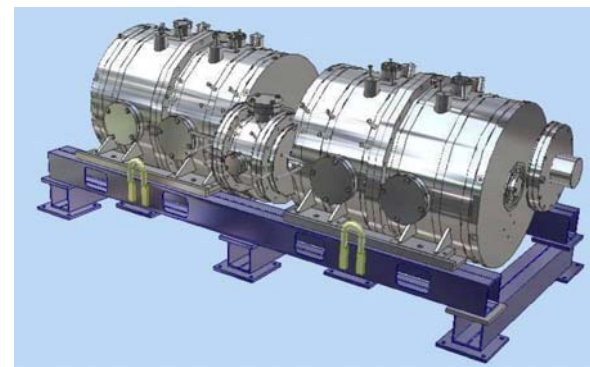
WP2 Normal Conducting



Engineering and prototyping of 2 novel accelerating structures:



CCDTL pre-prototype finished at CERN, ready for power tests (left). Prototype design finished (right), will be built in Russia (agreement with ISTC).



CH-DTL design completed (left, CH-DTL tanks with new end cells) and components for cold model built (press-fitted drift tubes, right).



Concerns for WP2: delays from CERN workshops, difficulties in recruitment (LPSC).

Highlights WP 3 – Superconducting Structures



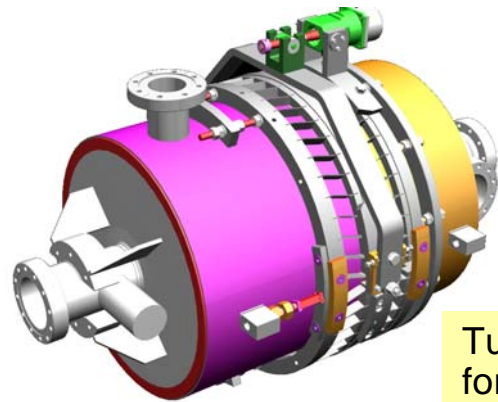
Focused on SC cavities for pulsed mode operation in the range 350-700 MHz

RF & mechanical design of elliptical (CEA) and spoke cavities (FZJ).

Mechanical behavior in pulsed mode (CEA, INFN, FZJ, IPNO, IAP-FU)

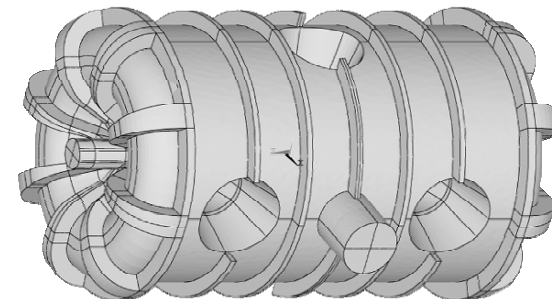
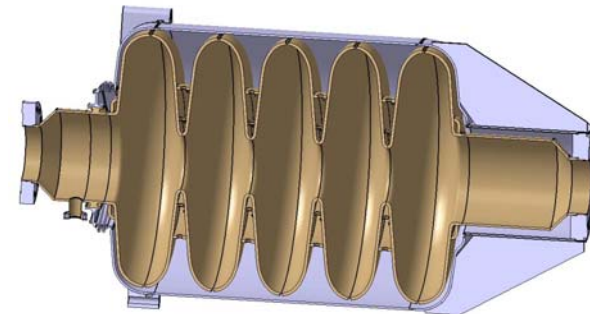
Tuner design for elliptical (INFN, CEA) and CH (IAP) cavities.

Coupler design for multigap spoke (IPNO) and elliptical (CEA) cavities.



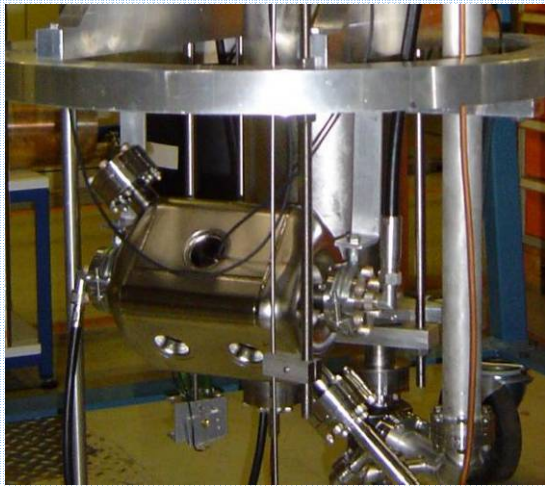
Tuning system
for elliptical
cavity (INFN).

Stiffening rings
for elliptical
cavity (CEA,
top) and for
triple-spoke
cavity (FZJ,
bottom).



Preparation of test stand in Saclay is progressing
(klystron ordered, modulator in preparation).

Progress of the work : cavity tests



Cool-down and 1st test
sc 700 MHz spoke

FZ- Juelich
March 2005



Cool-down and 1st test
sc 352 MHz spoke

IPN- Orsay
April 2005



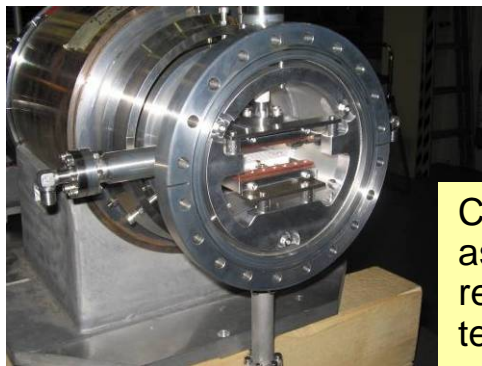
Cool-down and 1st test
sc CH cavity

Frankfurt University
July 2005

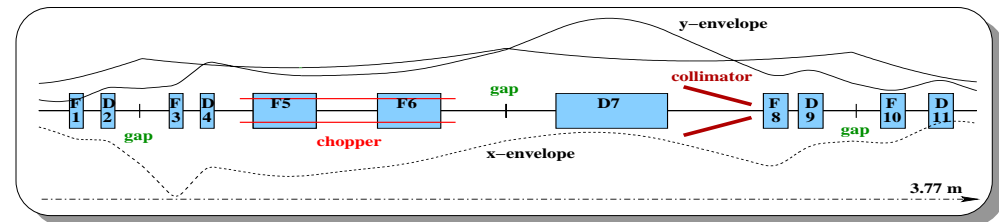
WP 4 – Beam chopping



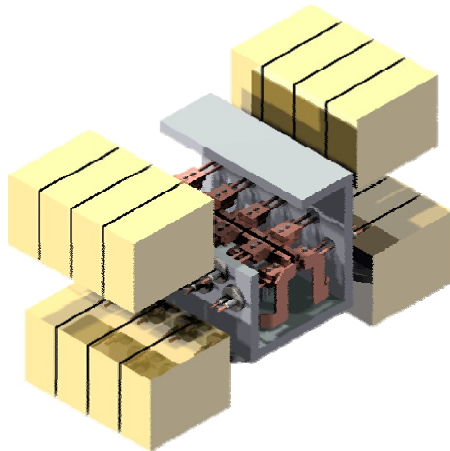
Design of fast choppers (2 ns rise and fall time electrostatic kickers to prepare the beam for lossless injection into a ring) with appropriate drivers, dump and beam line.



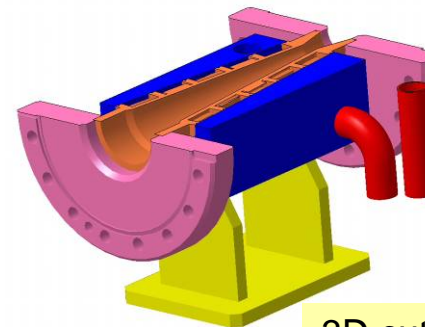
CERN chopper assembled, ready for testing.



Beam dynamics design (envelopes) of CERN chopper line.



RAL chopper design. Driver components ordered and received, line redesigned.



3D cut of CERN dump (design finished, construction started).

Concerns: delays from CERN workshops, need revision to the schedule.

WP 5 – Beam dynamics



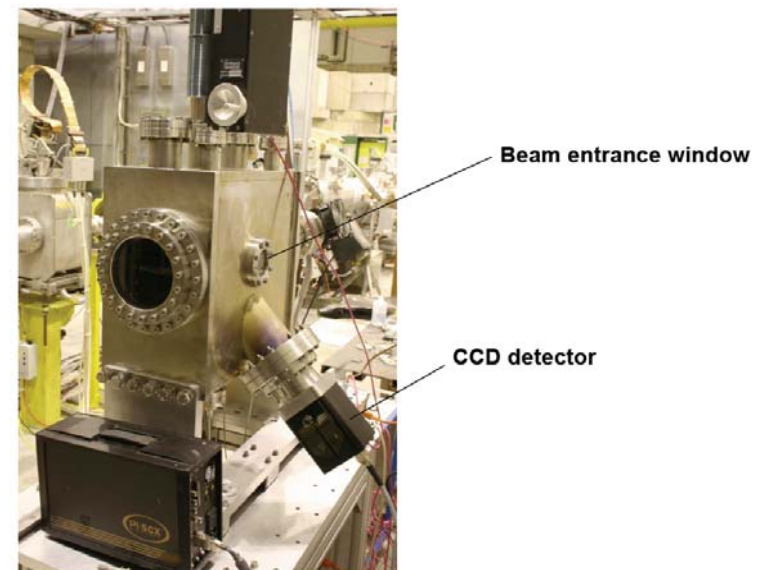
Preparation of appropriate tools for the analysis of high-intensity linear accelerators: **beam dynamics codes** and **detectors**.

Benchmarking of 7 codes (some old, some new, some updated) started, to be compared with measurements to be done at the UNILAC DTL linac at GSI (March and October 06).

Progress in the understanding of beam neutralization phenomena.

Different detectors developed at GSI, FZJ and CERN

Beam Shape and Halo Monitor assembled and tested at CERN : provides high sensitivity and dynamic range of 10^6 to identify halo from main beam.
(only deliverable in 2005).



ESAC Assessment



2 ESAC members present at Abingdon (J. Stovall, A. Pisent), 1 contributed via e-mail (Y. Yamazaki), ESAC report received on Nov. 16th.

8 page document, quite complete analysis of all HIPPI activities, will be annexed to the HIPPI Annual Report.

“The HIPPI activities represent the **bulk of R&D activities addressing high-current linac technology** under way worldwide.”

“We find the work to be of **high quality** and are encouraged to see HIPPI being used as a **vehicle for recruiting new members** to the fraternity of accelerator designers. It is very encouraging to see that some of the funding has been directed towards facility **improvements aimed at advancing the art.**”

“The committee is pleased to observe no reluctance among the participants to collaborate with their colleagues and in some cases to note strong inter-lab collaborations.”

WP4: noticed “stronger collaboration” from last year, still to improve collaboration with WP5.

WP2: “very pleased” for response to last year remarks on DTL, check post-couplers length and cost CCDTL.

WP3: better synthesis of activities and collaboration with WP5. “The collaboration among members of this work package is very strong, with many examples of common design choices and common use of existing infrastructures and instrumentation. Such continued collaboration will assure optimum use of the high-power RF test stand presently under development.”

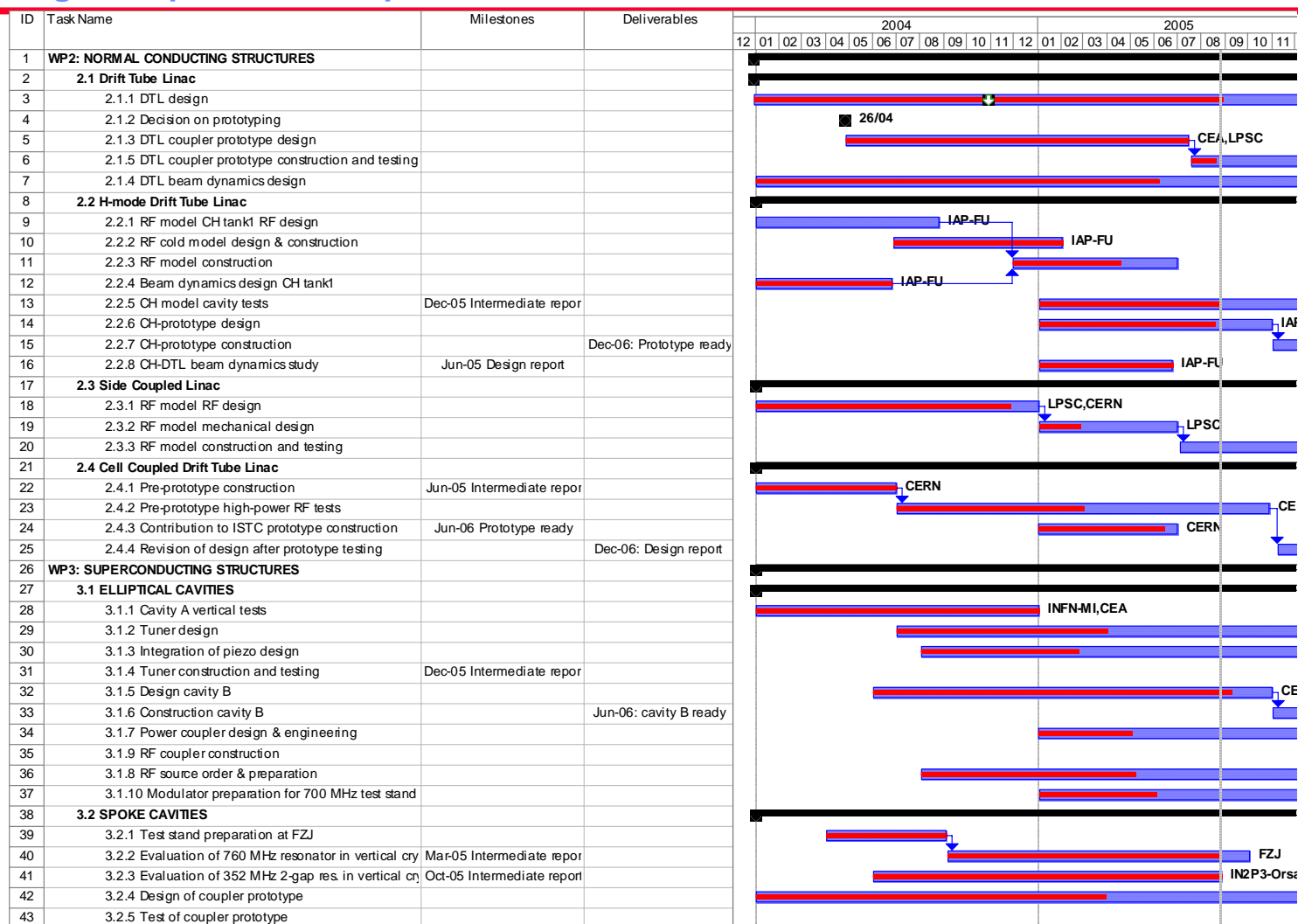
WP5: stress importance of dynamics for ring injection, strengthen code benchmarking and coordination for detectors, test promising halo monitor.

General comment: define a common set of HIPPI objectives, use to compare structures across WP's.

Detailed planning and progress



Progress up to end of September



Detailed planning and progress



Milestones and deliverables 2005



WBS #	Title	Due date in Annex 1	Status	Revised delivery date
2.2.5	Test of CH model cavity: intermediate report	December 2005	On time	
2.2.8	Design report on beam dynamics in the CH-DTL	June 2005	Delayed	September 2005
2.4.1	Construction of CCDTL pre-prototype: intermediate report	June 2005	Delayed	December 2005
3.1.4	Cavity A tuner: intermediate report	December 2005	On time	
3.2.2	Report on evaluation of 760 MHz prototype	March 2005	Delivered	
3.2.3	Report on evaluation of 352 MHz 2gaps-proto	October 2005	On time	
3.2.6	Design report on 352 MHz n-gaps resonator	May 2005	Results available	August 2005
3.3.1	Report on CH tuners	June 2005	Delayed	September 2005
4.1.1	Chopper A design report	June 2005	delayed	December 2005
4.1.2	Intermediate test report	March 2005	Waiting for task 4.1.5	March 2006
4.2.2	Dump design report	June 2005	pending	October 2005
4.3.1	Chopper B intermediate report	June 2005	Delivered July 2005	
5.1.2	LORASR development: intermediate report	December 2005	On time	
5.3.1	Profile measurement by fluorescence prototype	March 2005	Ready	
5.3.3	Non-interceptive meas. preparation	June 2005	80% Ready	October 2005
5.3.5	Halo measurement device prototype ready	June 2005	Ready	
5.3.5	Final report on Halo measurement device	June 2005	Done (CARE/HIPPI Document-05-005)	

HIPP

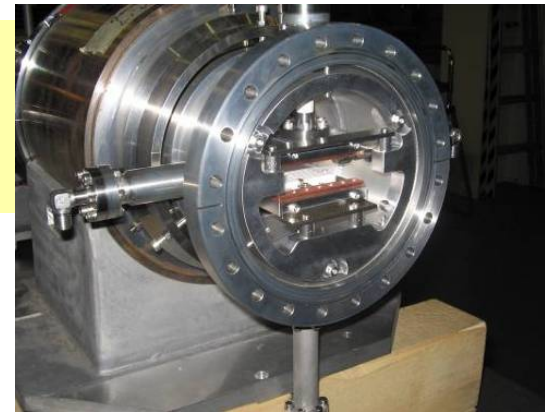
WP 4 – Beam chopping



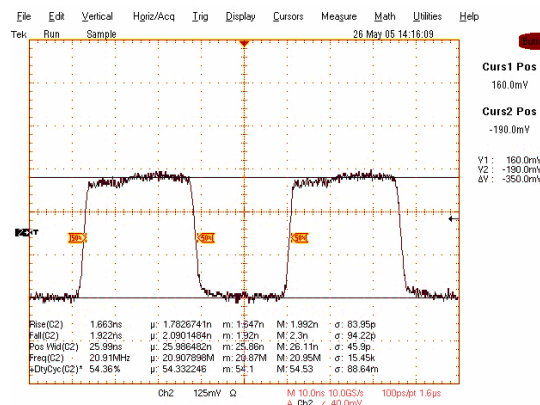
Design of choppers (fast - 2 ns - kickers to prepare the beam for lossless injection into a ring) with appropriate drivers, dump and beam line.



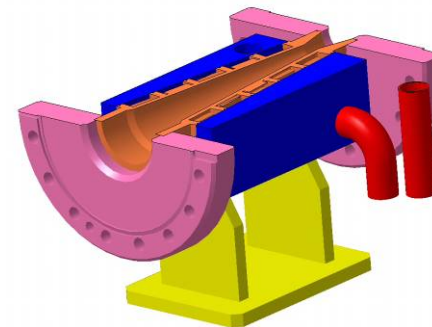
Meander line of the CERN chopper structure



CERN chopper assembled in a quadrupole, ready for testing



CERN prototype driver pulse : $\frac{1}{4}$ nominal voltage, 1.6nsec rise time, 3% ripple.



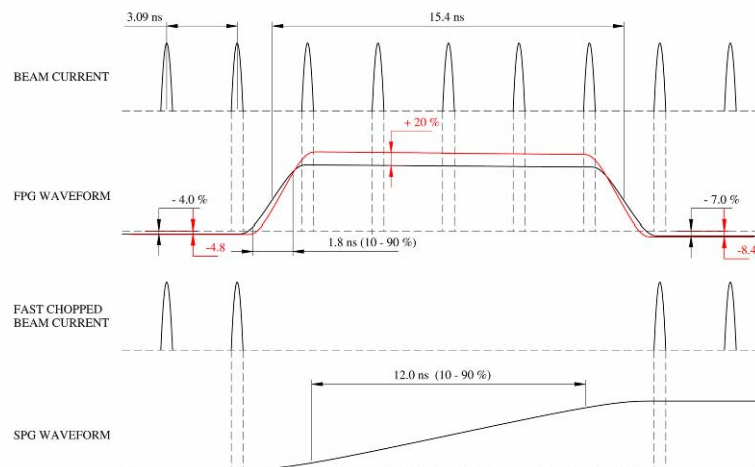
3D cut of CERN dump (construction started).

Concerns: delays from CERN workshops, need revision to the schedule.

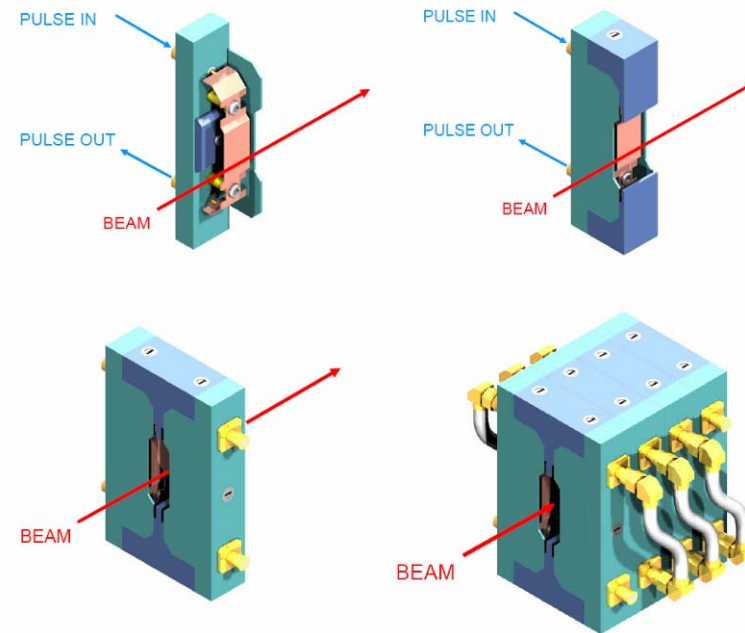
WP 4 – Beam chopping



Design of choppers (fast - 2 ns - kickers to prepare the beam for lossless injection into a ring) with appropriate drivers, dump and beam line.



Timing schematic for the 324 MHz RAL FETS chopping scheme with an 8 kV (12 ns) SPG



RAL helical slow-wave structure B / Conceptual design

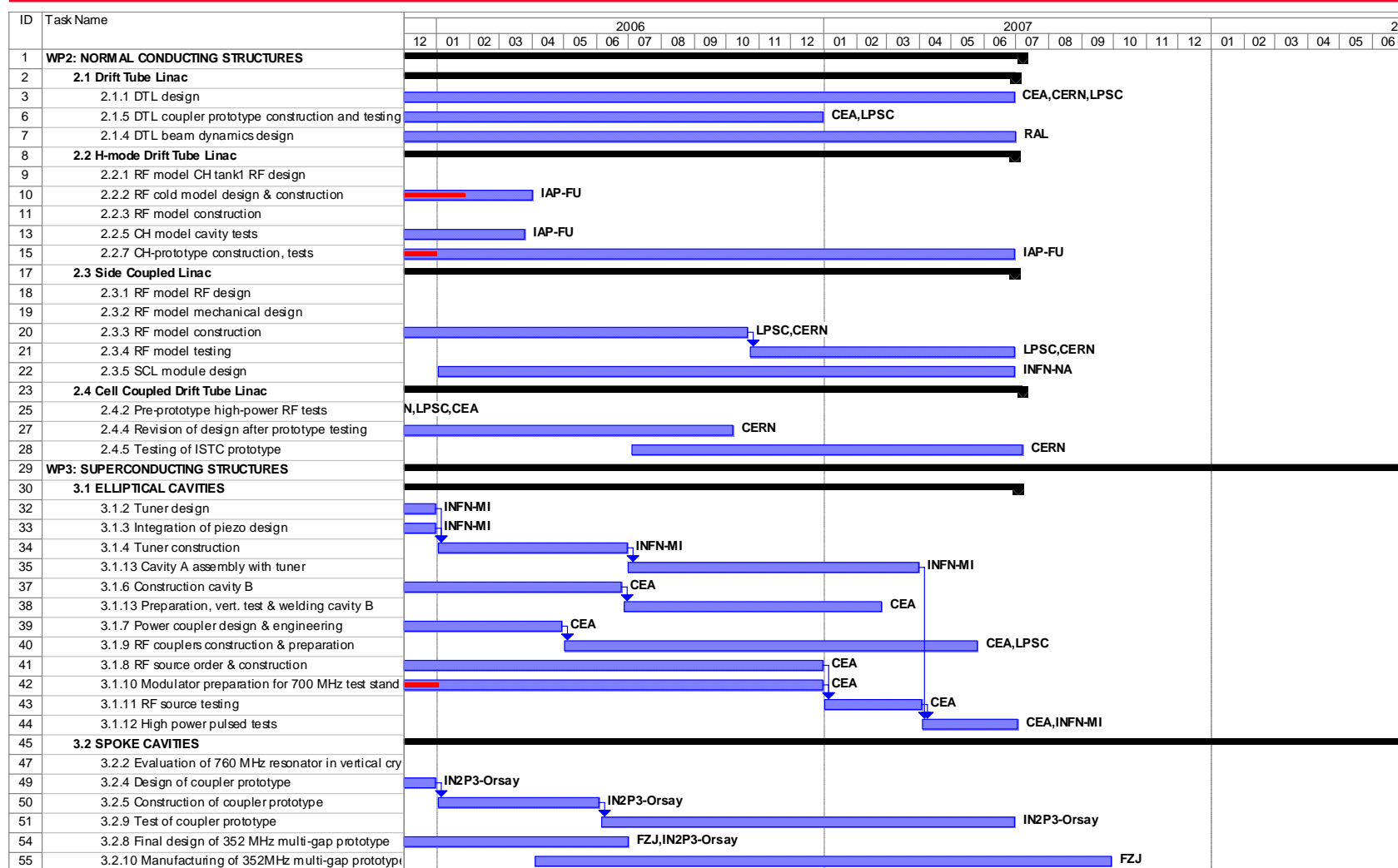
Financial Table for Annual Report



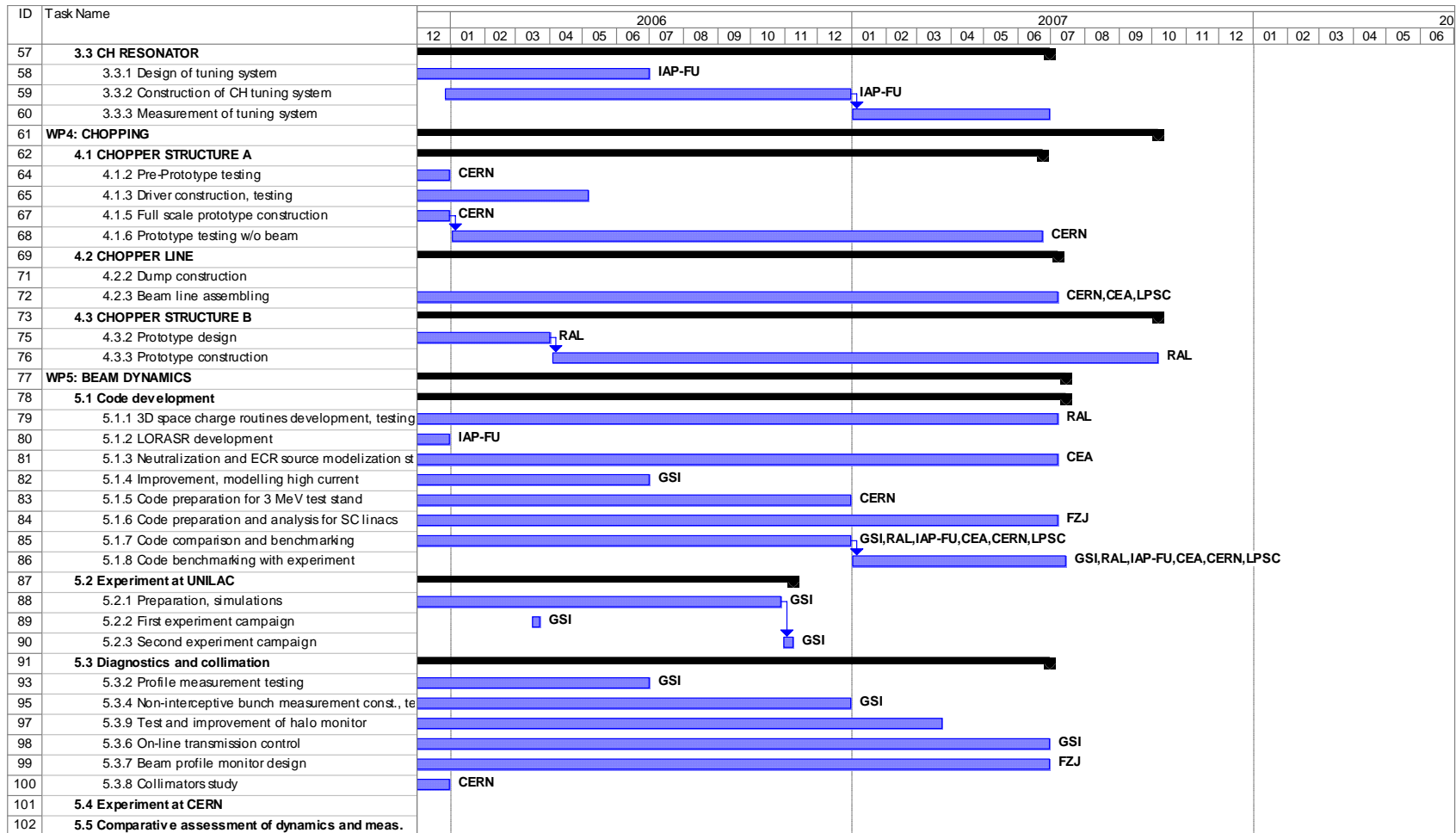
JRA3	Participant (cost model)	Permanent staff including indirect cost (Euros)	Additional Staff including indirect cost (Euros)	Durable Equipment including indirect cost (Euros)	Consumables and Prototyping including indirect cost (Euros)	Travel including indirect cost (Euros)	Real costs including indirect cost (Euros)	Direct cost	Sub- contract	Indirect cost	First received payment (Euros)
1	CEA (FC)	249,620			44,144	6,625	300,389	191,566	0	108,822	239,960
3	CNRS-IN2P3	30,610	0	0	0	0	30,610	25,509	0	5,102	7,500
	CNRS-LPSC	53,414	0	0	0	1,685	55,099	45,916	0	9,183	9,000
	CNRS(FCF)	84,024	0	0	0	1,685	85,710	71,425	0	14,285	16,500
4	GSi(FC)	156,567	33,588	159	0	2,875	193,189	140,740	0	52,449	127,500
5	IAP-FU(AC)	0	74,286	0	0	3,552	77,838	64,865	0	12,973	108,750
7	FZJ(FC)	381,027	0	0	25,189	3,249	409,465	238,319	0	171,146	112,405
10	INFN- Mi(AC)	0	13,592	0	0	1,560	15,151	12,626	0	2,525	22,500
17	CERN (AC)	0	130,015	0	306,865	13,046	449,927	374,939	0	74,988	97,500
20	CCLRC (FC)	238,668	0	0	20,272	7,119	266,059	126,836	0	139,223	96,000
	Grand total	1,109,906	251,481	159	396,470	39,711	1,797,728	1,221,317	0	576,411	821,115

HIPP

HIPPI Planning 2006/07 - 1



HIPPI Planning 2006/07 - 2



Deliverables & Milestones



HIPPI MILESTONES AND DELIVERABLES 2006

WBS #	WP	Title	Due date in Annex 1	Type
2.4.3	2	CCDTL Prototype ready	June 06	M
2.2.7	2	H-DTL Prototype ready	December 06	D
2.4.4	2	CCDTL prototype design report	December 06	D
3.1.6	3	Cavity B ready	June 06	D
4.3.2	4	Chopper B design report	June 06	M
4.1.5	4	Chopper A Prototype ready	August 06	D
5.1.5	5	Intermediate report on codes for 3 MeV tests	June 06	M
5.3.2	5	Final report on profile measurements by fluor.	July 06	D
5.2.3	5	Final report on simulations and exper. at Unilac	December 06	D
5.3.4	5	Final report on non-interceptive bunch meas.	December 06	D
5.3.8	5	Collimator prototype ready	December 06	M
5.3.8	5	Final report on collimator design	December 06	D

HIPPI MILESTONE MOVED FROM 2005 TO 2006

WBS #	WP	Title	Due date in Annex 1	Revised date	Type
4.1.2	4	Chopper A Intermediate test report	June 05	March 06	M
3.3.1	3	CH tuning intermediate report	June 05	March 06	M

HIPPI Budget 18 months 2006-07



Budget for the next 18 months (January 1st 2006 to June 30 2007)

JRA3	Participant (cost model)	Permanent Staff direct cost ONLY (Euros)	Additional Staff direct cost ONLY (Euros)	Durable Equipment direct cost ONLY (Euros)	Consumable s and Prototyping direct cost ONLY (Euros)	Travel direct cost ONLY (Euros)	All Direct Cost	Subcontract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
1	CEA (FC)	384,637	100,000	450,000	280,000	4,000	1,218,637	0	357,853	1,576,490	504,000
3	CNRS-IN2P3	80,000	18,000	0	35,000	4,000	137,000	0	27,400	164,400	30,000
	CNRS-LPSC	96,000	0	0	40,000	3,000	139,000	0	27,800	166,800	24,000
	CNRS(FCF)	176,000	18,000	0	75,000	7,000	276,000	0	55,200	331,200	54,000
4	GSI(FC)	147,570	174,258	10,000	2,900	7,800	342,528	0	78,000	420,528	236,550
5	IAP-FU(AC)	0	185,000	0	310,000	13,333	508,333	0	101,667	610,000	245,000
7	FZJ(FC)	204,000	110,000	0	75,000	9,000	398,000	0	0	398,000	194,000
10	INFN-Mi(AC)	0	0	0	20,000	5,000	25,000	0	5,000	30,000	15,000
17	CERN (AC)	0	280,000	100,000	40,000	12,000	432,000	0	86,400	518,400	127,860
20	CCLRC (FC)	202,252	125,470	0	220,650	5,000	553,372	0	458,811	1,012,183	140,795
	Grand total	1,114,459	992,728	560,000	1,023,550	63,133	3,753,870	0	1,142,931	4,896,801	1,517,205

1.5 M€ from preliminary spending profile in HIPPI proposal for the same period