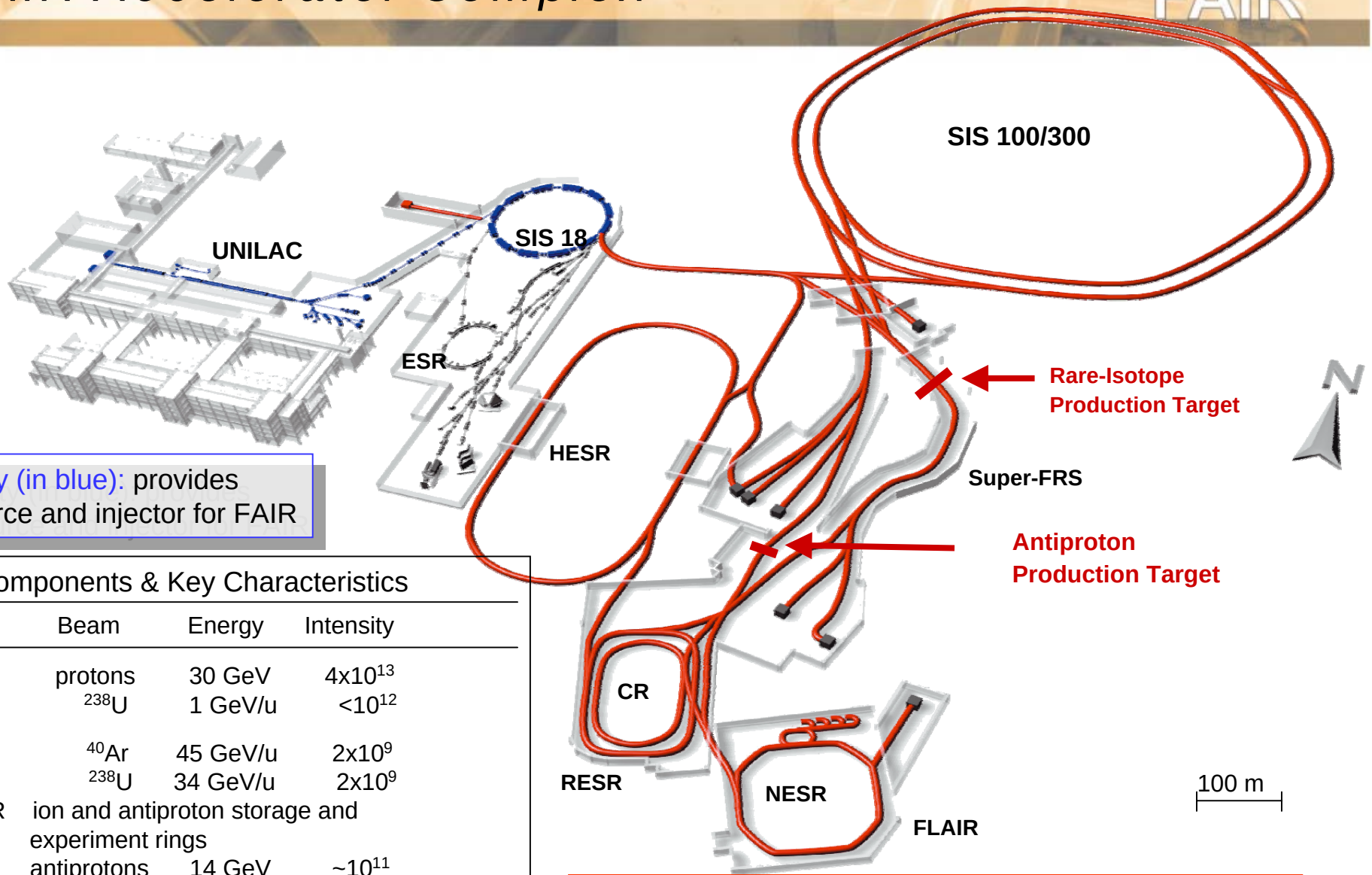
Workpackages and In-Kind Contributions to FAIR

- The FAIR Project
- Preparatory Phase - R&D for FAIR
- Workpackages and In-Kind Constribution

The FAIR Accelerator Complex



Existing facility (in blue): provides ion-beam source and injector for FAIR

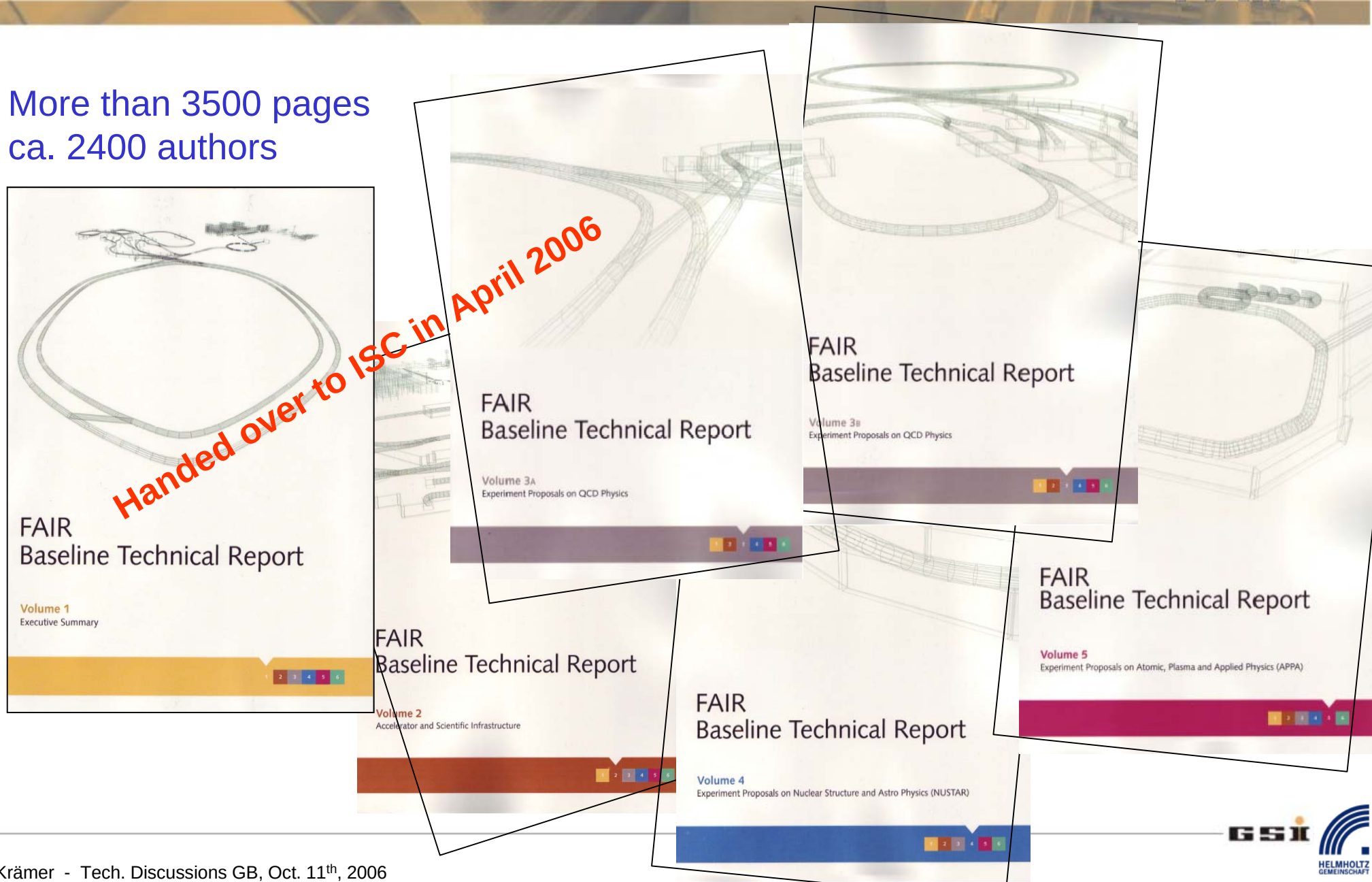
Accelerator Components & Key Characteristics

Ring/Device	Beam	Energy	Intensity
SIS100 (100Tm)	protons	30 GeV	4×10^{13}
	^{238}U	1 GeV/u	$<10^{12}$
SIS300 (300Tm)	^{40}Ar	45 GeV/u	2×10^{9}
	^{238}U	34 GeV/u	2×10^{9}
CR/RESR/NESR	ion and antiproton storage and experiment rings		
HESR	antiprotons	14 GeV	$\sim10^{11}$
SuperFRS	rare-isotope beams	1 GeV/u	$<10^{9}$

New future facility (in red): provides ion and anti-matter beams of highest-intensity and up to high energies

The FAIR Baseline Technical Report

More than 3500 pages
ca. 2400 authors



Technical Advisory Committee
CORE-A
CORE-E
Locked for more than 5000 individual items, costed them,
Intensive search for forgotten items …

Sept 7 – 8, 2005	beam diagnostics
Oct 26	p-linac
Oct 27/28	power supplies
Oct 31 – Nov 1	cryogenics
Nov 3	warm magnets
Nov 15 – 16	cold magnets
May 2006	civil construction

The Costbook Rev. 3.0

Investment Cost:

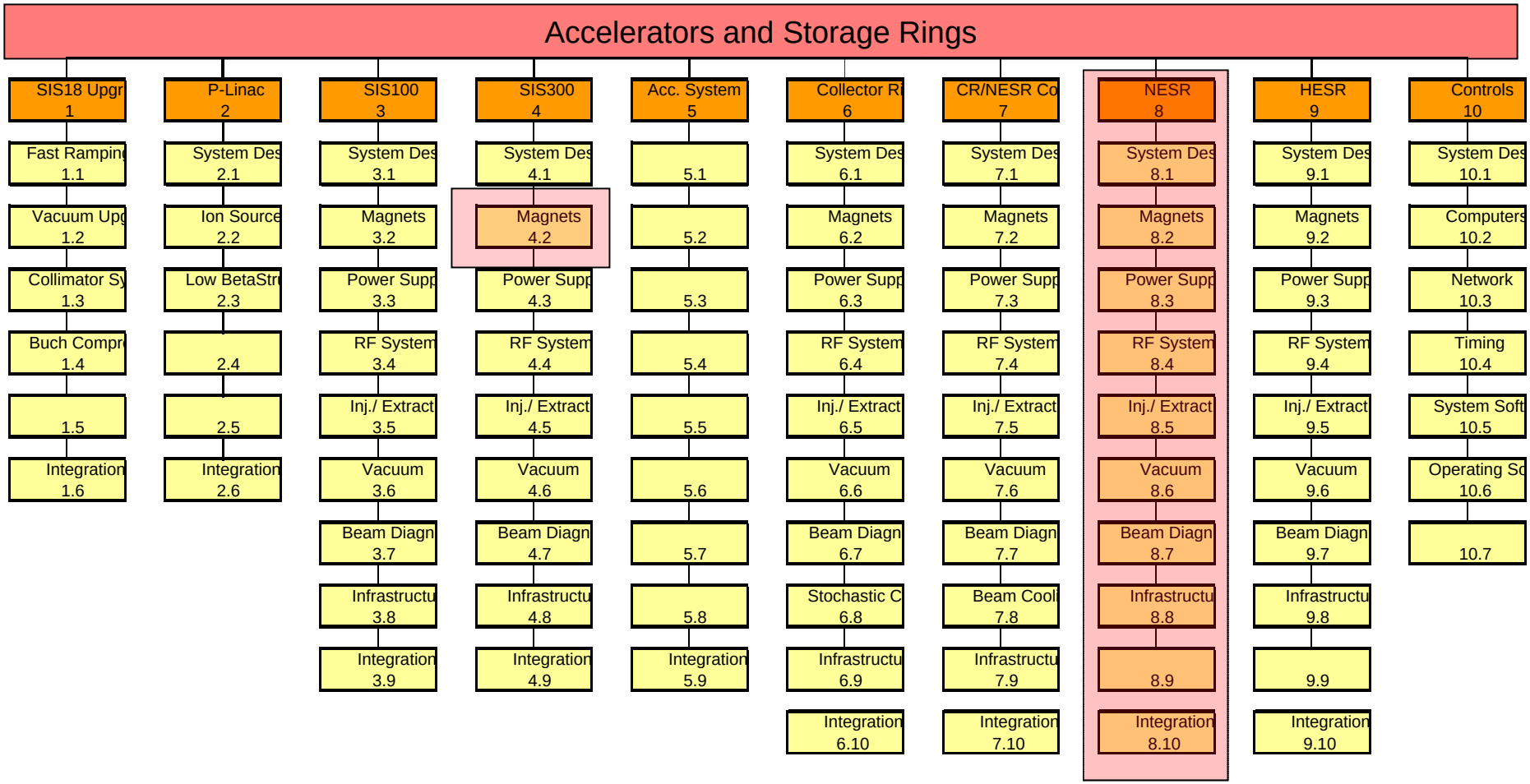
• Accelerators w/o sFRS*	593 M€
• Civil Construction	322 M€
• Experiments incl. sFRS	200 M€
• Manpower	2400 FTE
according to FCI (1 FTE=77k€/y)	185 M€

"The *Costbook* reflects the present status of the estimate. The facility costs are evaluated on a component basis and then aggregated for the sub-systems and finally for the total facility.

This adds up to a total of 1114 M€ in investment cost."

Supplement to FBTR

WBS Structure

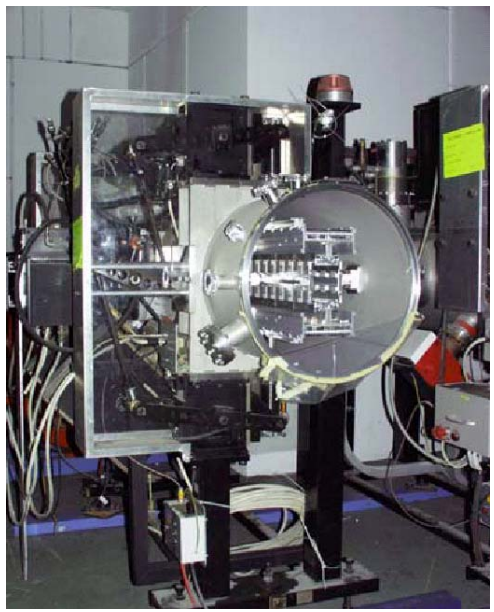


Complete R&D of Critical Items within the Prepartory Phase

- Rapidly-cycling superconducting magnet technology for synchrotrons
- Superconducting magnets for large aperture devices
- Beam phase-space compression by electron-beam and stochastic cooling
- Cryogenics …

Superconducting magnet (prototype) for FAIR

Electron Cooler at GSI



Stochastic Cooling Structure

Main R&D Activities During Preparatory Phase

BNL – SIS 300 superconducting ramped dipole
JINR – SIS100 s.c. ramped dipole & quadrupole
IHEP – SIS300 s.c ramped dipole
BINP – SIS100 curved dipole
BNN – SIS100 straight dipole
Toshiba – Super FRS mulitpole triplet
Spain consortium – NESR magnets, vacuum, power converter
Chinese consortium – CR superconducting dipole
BINP – RF cavity
BINP – fast ramped power converter for ECOOL
BINP – Feasibility studies/ Design studies on
Septa, ER-Electron Ring, Electroncooling, Electron-Target at NESR
ACCEL – Feasibility study on injection/extraction at SIS100/300

Preparatory Phase R&D by GSI & Partner Institutes

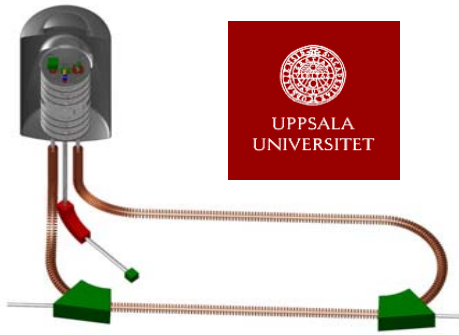
INFN Istituto Nazionale di Fisica Nucleare

SIS300 magnets

BROOKHAVEN NATIONAL LABORATORY

IHEP Protvino

NESR Electron Cooling



UPPSALA UNIVERSITET

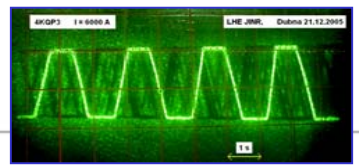
Forschungszentrum Jülich
in der Helmholtz-Gemeinschaft

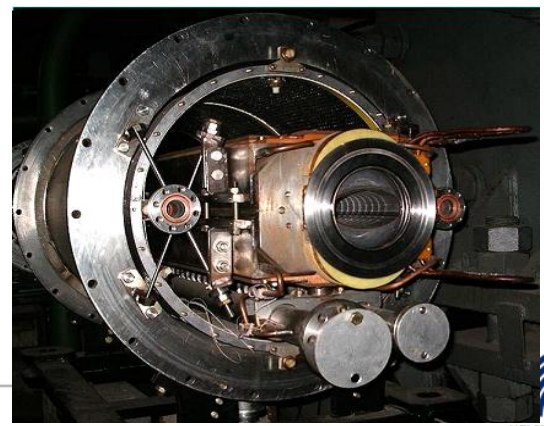
CNA / CNRS

Variable Frequency Cavities

SIS100 rapidly cycling sc magnets

Joint Institute for Nuclear Research



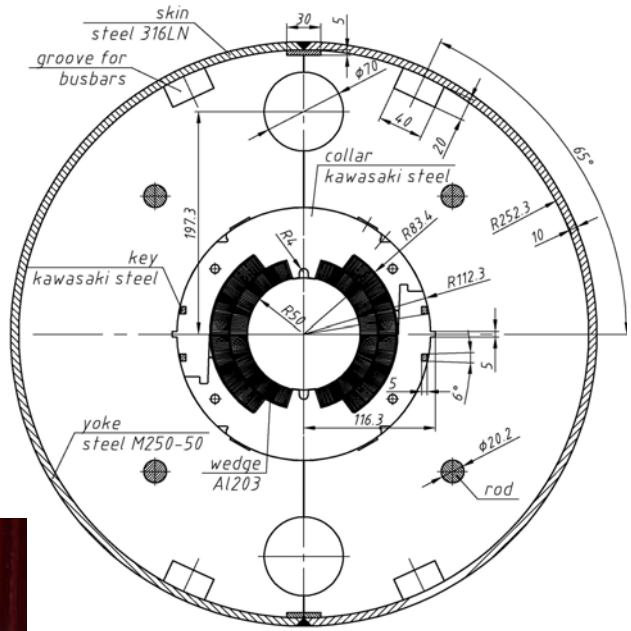


BINP Novosibirsk

HELMHOLTZ GEMEINSCHAFT

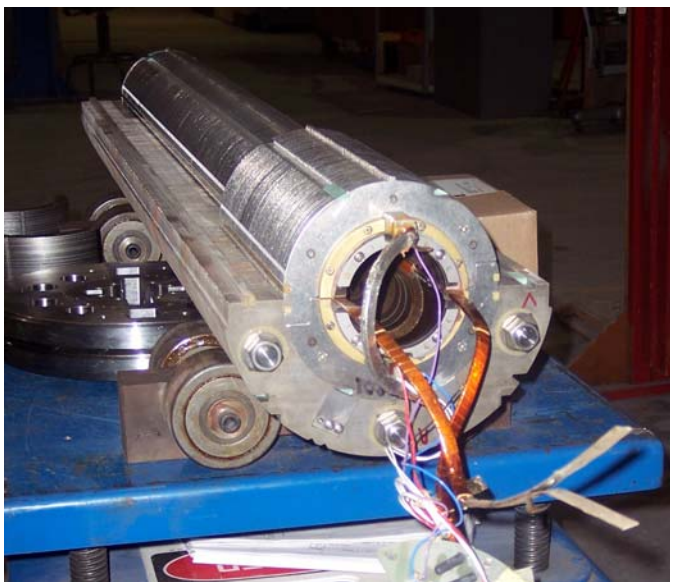
SIS300 R&D: Dipole Magnet

Coil ID, mm	100
Good field diameter, mm	80
Central field, T	6
Field ramp rate, T/s	1
Temperature margin, K	~1
Magnetic length, mm	2909
Field cycle, T	1.6 – 6 – 1.6
Time cycle, s	4.4 – 11 – 4.4



„GSI001“

BROOKHAVEN NATIONAL LABORATORY



B = 4 T, dB/dt = 1 T/s

INFN Istituto Nazionale di Fisica Nucleare

Bend prototype dipole
3.7 M€ & ~40 FTE

IHEP Protvino

RF-Stations for SIS100 (10th Harmonic)

BINP Novosibirsk

Frequency range	1.1-2.7 MHz
RF voltage	20 kV
Ferrite type	400 NN-2
Number of ferrite for unit	68
Number of unit	29

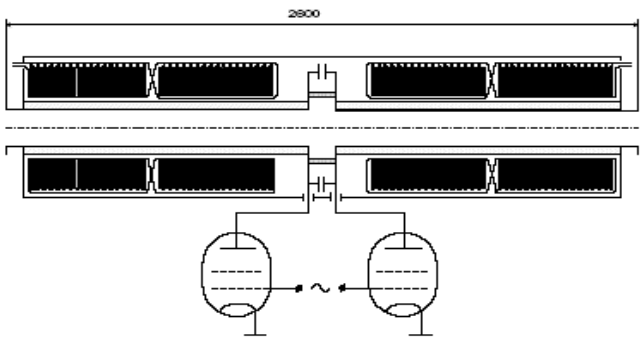
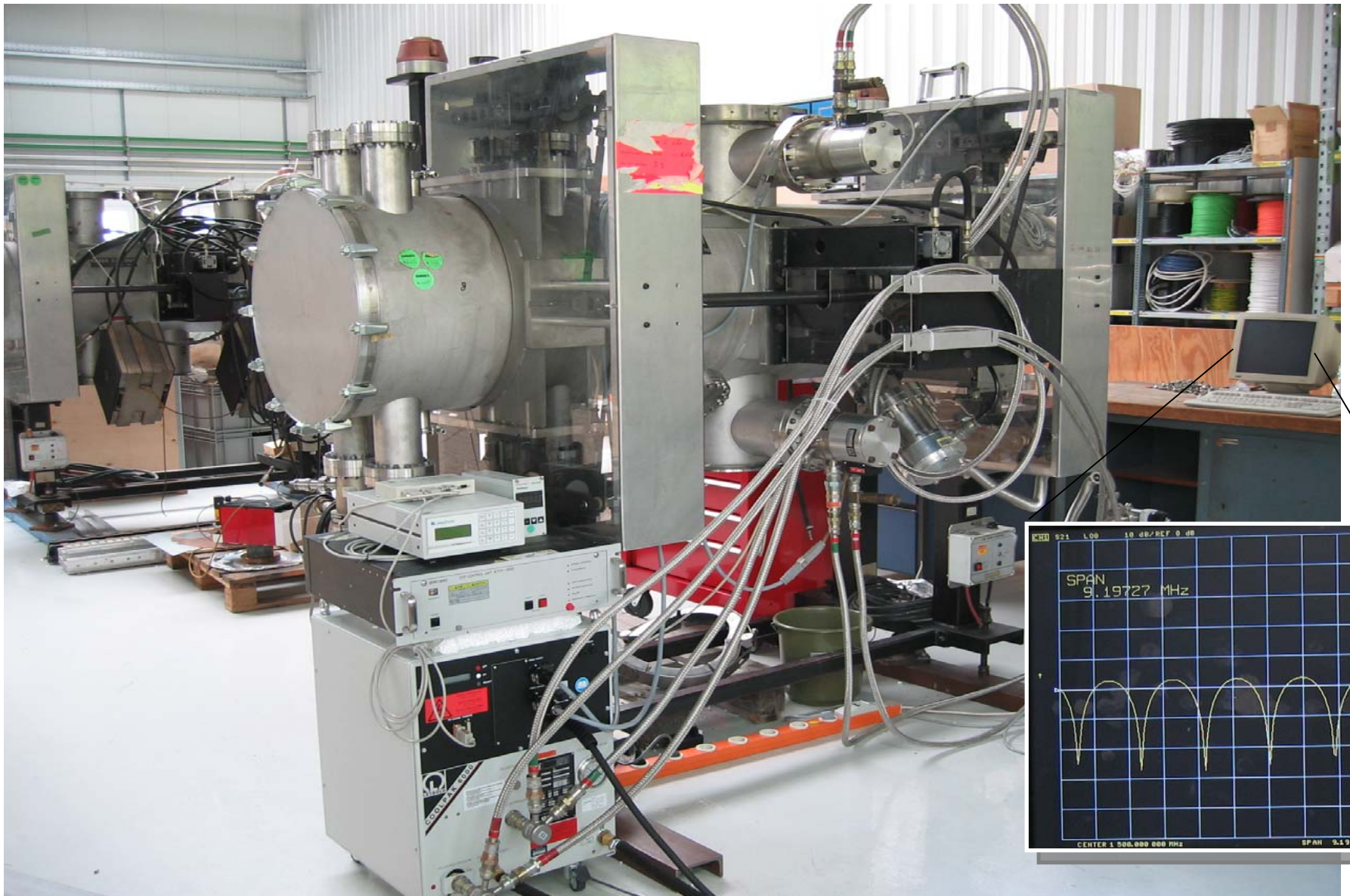


Fig.2.1 Schematic drawing of RF station.

BINP Cavity built for IHEP (Lanshou)

R&D on Stochastic Cooling:
Test tank for cryogenic measurements



Technical negotiations between GSI/FAIR and partner institutes

China	-	CR superferric bending magnets	Oct. 2004
India	-	VECC on sc magnets	Dec. 2005
Italy	-	INFN on SIS300 bending magnets	Jan. 2006
France	-	CNRS-CEA on SIS300 multipole magnets and ECR for p-Linac	Feb. 2006
UK	-	RAL on cryogenics	Feb. 2005
Russia	-	JINP, IHEP, ITEP, BINP	May 2006
Spain	-	CIEMAT on NESR magnets, vacuum etc.	May 2006

Definition of Workpackages

Non of these activities of the preparatory phase imply a decision who finally will procure the components!

All partners will be free to propose their in-kind contribution.

Following the structure of WBS and Costbook
94 Workpackages have been definied

Size of Workpackages

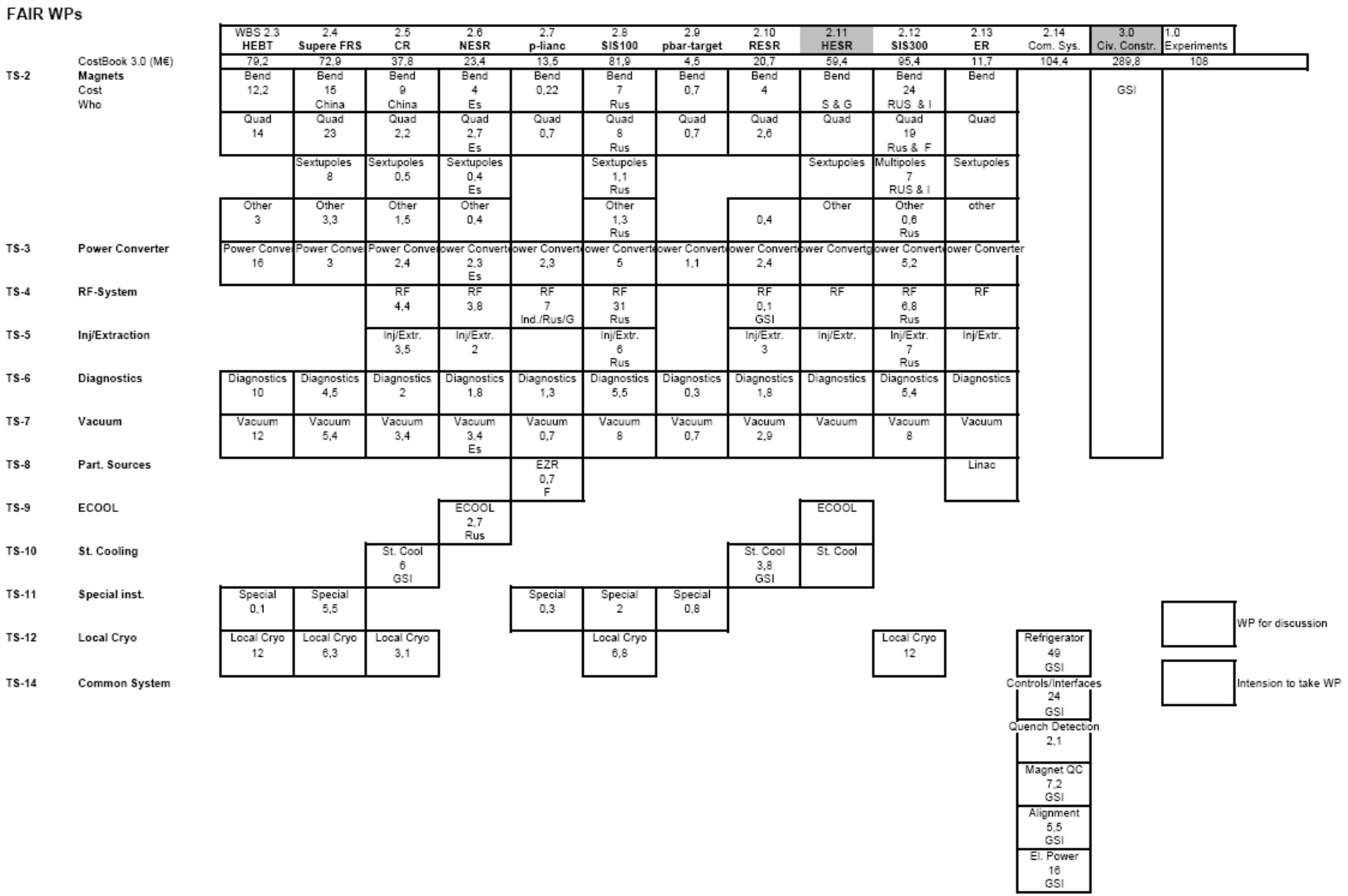
Assumption: due to legal regulation Germany procures all buildings (~300 M€)
~ 186 M€ for man-power (to be financed by GSI)
Consortium KFZ Jülich, TSL and GSI procure HESR (~100 M€)

i.e. ~ 300 M€ for Germany and ~ 300 M€ for the partners
for in-kind contributions

Having ~100 WPs $\Rightarrow$ typical value 6 M€/WP, i.e. 0,5% of total sum

Compatible with 1% as minimum share for FAIR-shareholders.

Definition of 94 Workpackages



Indication to Take Over WPs

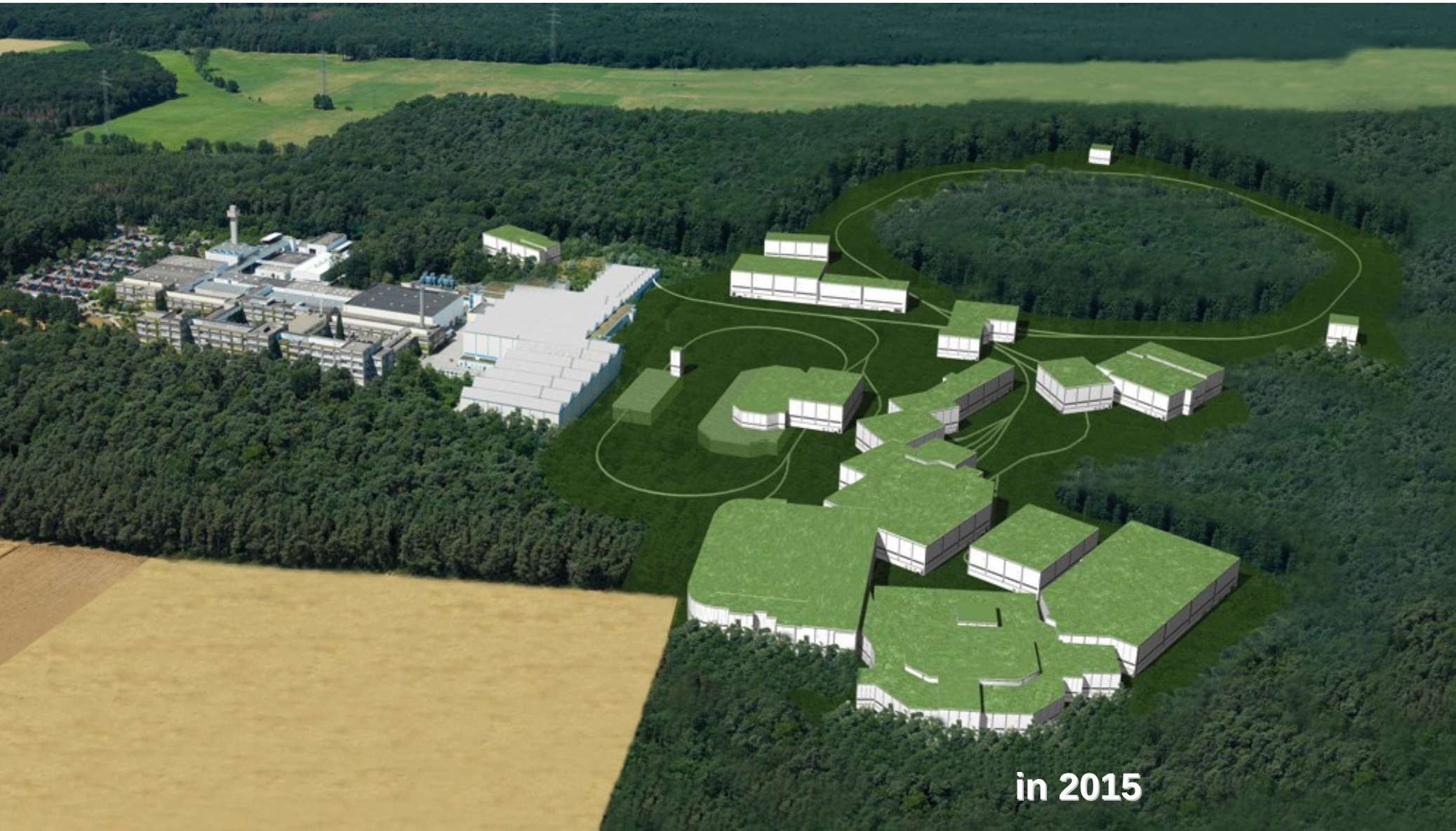
FAIR WPs

		WBS 2.3 HEBT	2.4 Supere FRS	2.5 CR	2.6 NESR	2.7 p-lianc	2.8 SIS100	2.9 pbar-target	2.10 RESR	2.11 HESR	2.12 SIS300	2.13 ER	2.14 Com. Sys.	3.0 Civ. Constr.	1.0 Experiments
	CostBook 3.0 (M€)	88	81	42	26	15	91	5	23	66	106	13	116	322	120
TS-2	Magnets Cost Who	Bend 13,5	Bend 14 China	Bend 10 China	Bend 4,5 Es	Bend 0,25	Bend 7,7 Rus	Bend 0,8	Bend 4,5	Bend S & G	Bend 27 RUS & I	Bend		GSI	
		Quad 15,4	Quad 26	Quad 2,5	Quad 3 Es	Quad 0,8	Quad 8,7 Rus	Quad 0,8	Quad 2,9	Quad Jülich	Quad 21 Rus & F	Quad			
			Sextupoles 9	Sextupoles 0,6	Sextupoles 0,4 Es		Sextupoles 1,2 Rus			Sextupoles	Multipoles 8 RUS & I	Sextupoles			
		Other 3,3	Other 3,6	Other 1,7	Other 0,5		Other 1,4 Rus		0,4	Other	Other 0,7 Rus	other			
TS-3	Power Converter	Power Conve 18	Power Conve 3,4	Power Conve 2,6	ower Convert 2,5 Es	ower Convert 2,7	ower Convert 5,5	ower Convert 1,2	ower Convert 2,6	ower Convert	ower Convert 5,7	ower Converter			
TS-4	RF-System			RF 4,9	RF 4,2	RF 7,8 Ind./Rus/G	RF 34 Rus		RF 0,1 GSI	RF	RF 7,5 Rus	RF			
TS-5	Inj/Extraction			Inj/Extr. 3,8	Inj/Extr. 2,2		Inj/Extr. 7 Rus		Inj/Extr. 3	Inj/Extr.	Inj/Extr. 8 Rus	Inj/Extr.			
TS-6	Diagnostics	Diagnostics 11	Diagnostics 5	Diagnostics 2,2	Diagnostics 2	Diagnostics 1,4	Diagnostics 6	Diagnostics 0,3	Diagnostics 2	Diagnostics	Diagnostics 6	Diagnostics			
TS-7	Vacuum	Vacuum 13	Vacuum 6	Vacuum 3,7	Vacuum 3,7 Es	Vacuum 0,8	Vacuum 9	Vacuum 0,8	Vacuum 3,2	Vacuum	Vacuum 9	Vacuum			
TS-8	Part. Sources					EZR 0,8 F						Linac			
TS-9	ECOOL				ECOOL 3 Rus					ECOOL					
TS-10	St. Cooling			St. Cool 6,6 GSI					St. Cool 4,2 GSI	St. Cool					
TS-11	Special inst.	Special 0,1	Special 6			Special 0,3	Special 2,2	Special 0,9							
TS-12	Local Cryo	Local Cryo 13,5	Local Cryo 7	Local Cryo 3,4			Local Cryo 7,5				Local Cryo 13				
TS-14	Common System												Refrigerator 54 GSI Controls/interfaces 26,5 GSI Quench Detection 2,3 Magnet QC 8,1 GSI Alignment 6 GSI El. Power 18 GSI		

WP for discussion

Intention to take WP

FAIR – an Unprecedented Research Facility



Staging of the Project

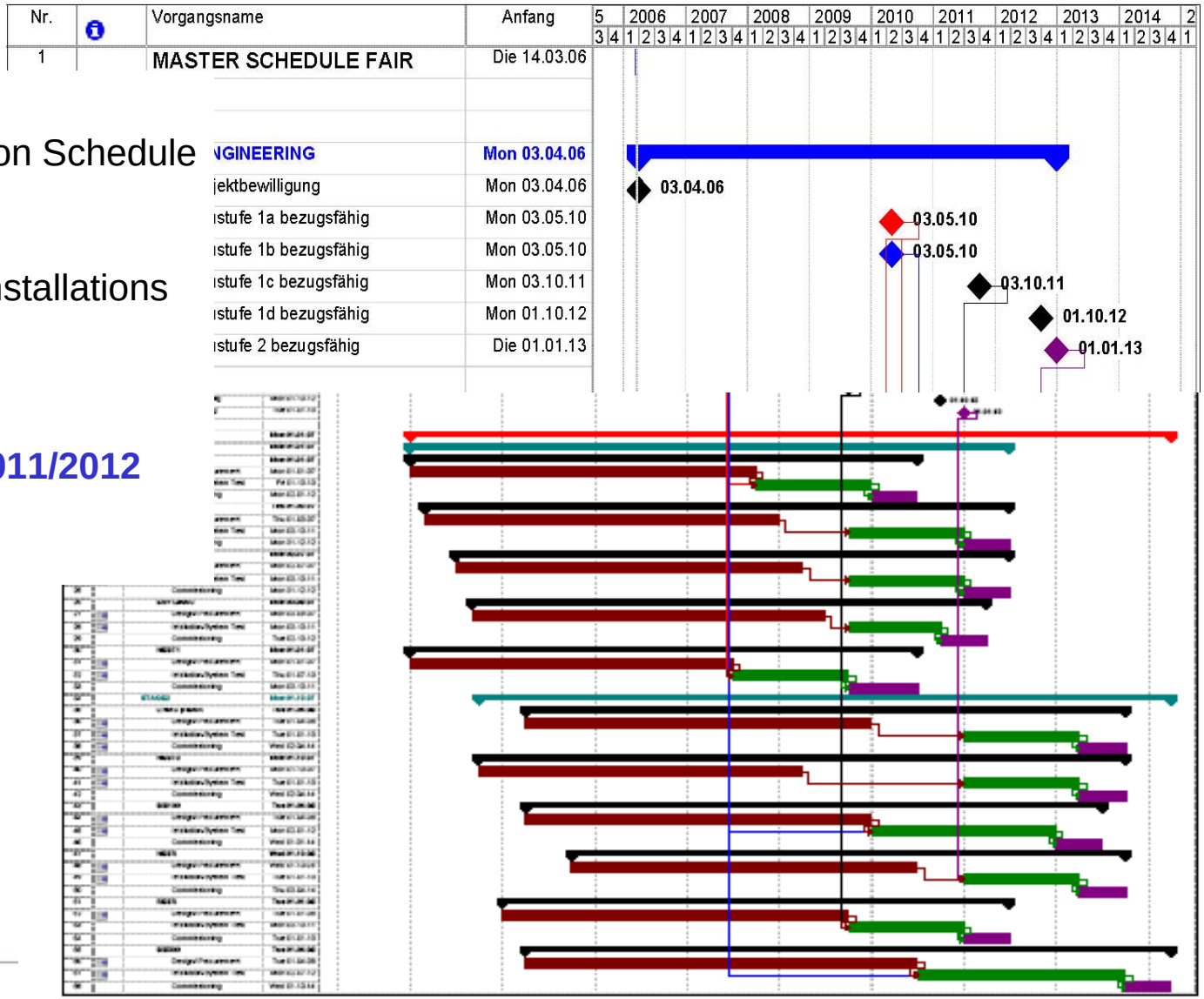
Project Master Schedule

Adapted to Bung Civil Construction Schedule

Critical Path:
Availability of buildings to start installations

Actual planning allows for:

- **First experiments at sFRS 2011/2012**
- **Project end 2014/2015**



The International Committee Structure

China Finnland France Germany Greece India Italy Poland Spain Sweden Russia Great Britain Romania

ISC
International Steering Committee
H. Schunck

STI Working Group
Scientific + Technical Issues
H. Wenninger

- PAC QCD *E. Chiavassa*
- PAC NUSTAR *R. Casten*
- PAC APPA *D. Schwalm*
- TAC *Y. Cho*
- CORE
  Cost Review Groups
  D. Plane, W. Bartel

FAIR Project

Mini-TACs
- Cryogenics
- Warm magnets
- Cold magnets
- Power Supplies
- Beam Instrumentation
- p-Linac

AFI Working Group
Administrative + Funding Issues
Ö. Skeppstedt

- LFI
  Legal Framework Issues
  U.B. Jahn
- FCI
  Full Cost Issues
  B. Brandt

Observers:

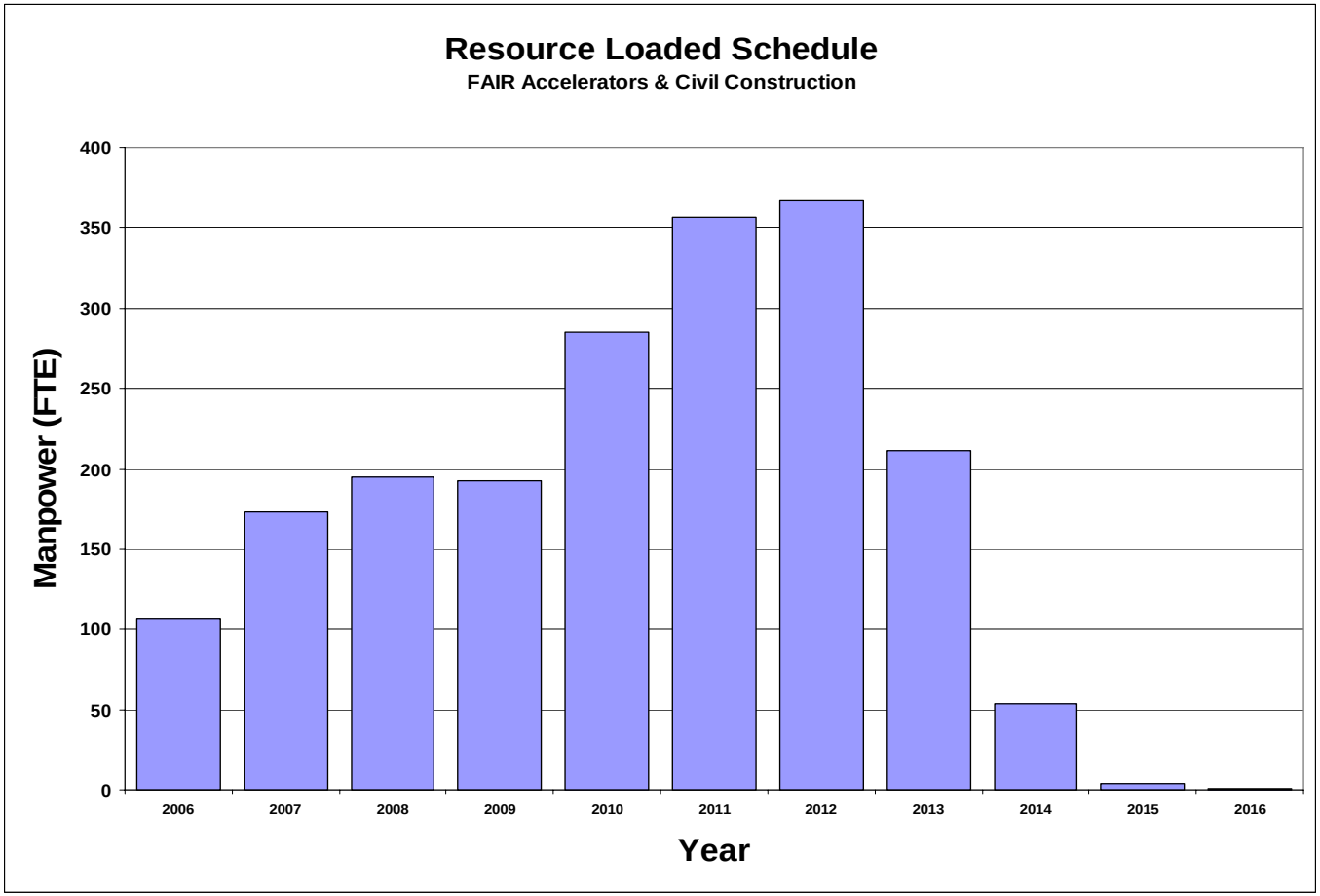
FAIR Accelerator Costbook

Acc-sections

WBS-E2.1	UNILAC Upgrade
WBS-E2.2	SIS18 Upgrade
WBS-E2.3	HEBT
WBS-E2.4	Super FRS
WBS-E2.5	CR
WBS-E2.6	NESR
WBS-E2.7	p-LINAC
WBS-E2.8	SIS100
WBS-E2.9	pBar TARGET
WBS-E2.10	RESR
WBS-E2.11	HESR
WBS-E2.12	SIS300
WBS-E2.13	ER
WBS-E2.14	Common Systems

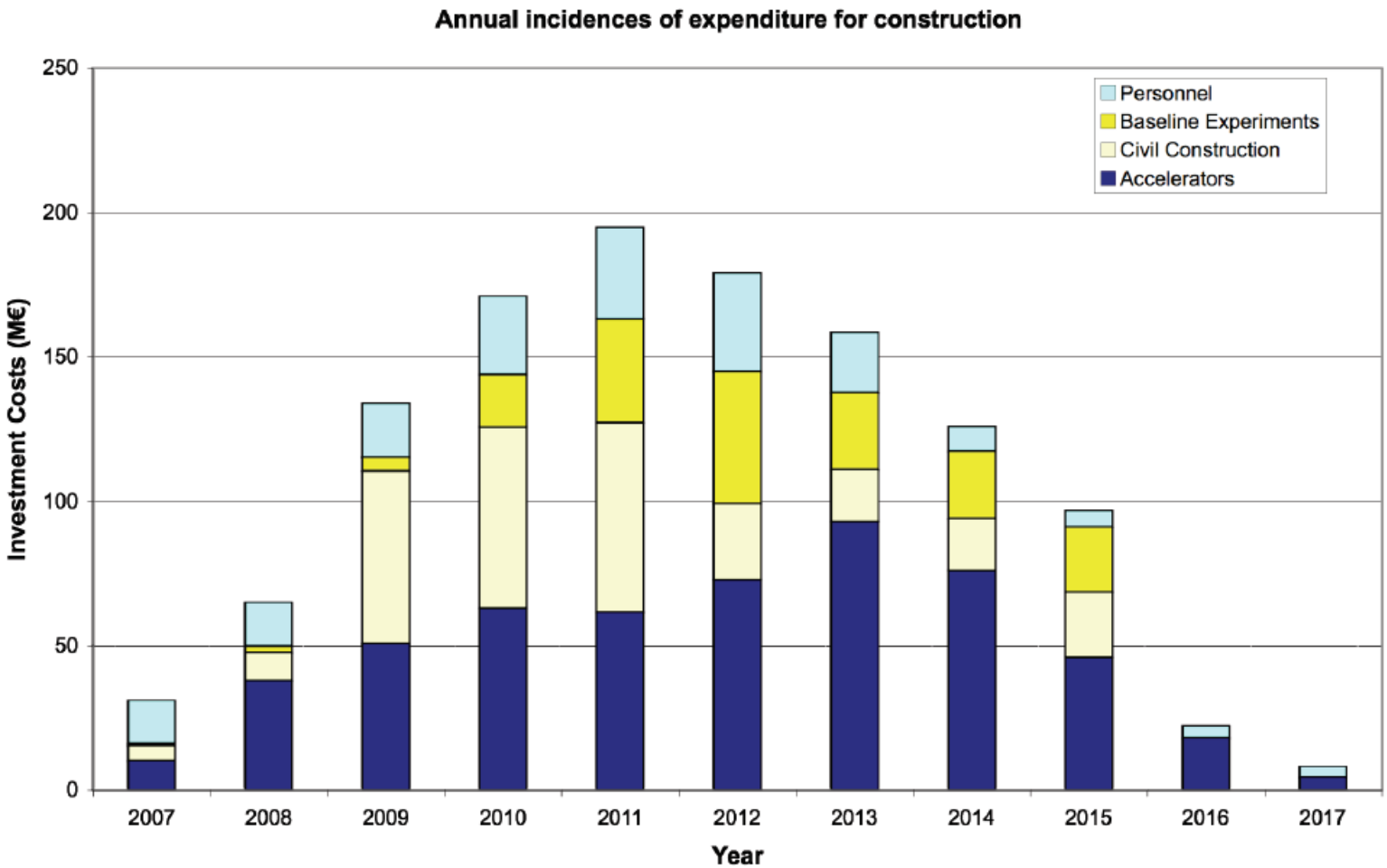
Techn. systems

TS-2	Magnets
TS-3	Power Supplies
TS-4	RF Systems
TS-5	Injection / Extraction
TS-6	Beam Diagnostics
TS-7	Vacuum
TS-8	Particle Sources
TS-9	Electron Cooling
TS-10	Stochastic Cooling
TS-11	Special Installations
TS-12	Local Cryogenics
TS-14	Common Systems



FAIR Accelerators and Civil Construction: 2400 man-years in total incl. FAIR GmbH

Spending Profile



FAIR Baseline Technical Report
Table of Contents

Volume 1 **Executive Summary**

Volume 2 **Accelerator and Scientific Infrastructure**

Volume 3A **Experiment Proposals on QCD Physics**

3.1 CBM

Volume 3B **Experiment Proposals on QCD Physics**

3.2 PANDA
3.3 PAX
3.4 ASSIA

Volume 4 **Experiment Proposals on Nuclear Structure & Astro Physics (NUSTAR)**

4.1 LEB-SuperFRS
4.2 HISPEC/DESPEC
4.3 MATS
4.4 LASPEC
4.5 R3B
4.6 ILIMA
4.7 AIC
4.8 ELISe
4.9 EXL

Volume 5 **Experiment Proposals on Atomic, Plasma & Applied Physics (APPA)**

5.1 SPARC
5.2 HEDgeHOB
5.3 WDM
5.4 FLAIR
5.5 BIOMAT

Volume 6 **Civil Construction and Safety**

The International Committee Structure

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- Cryogenics
- Warm magnets
- Cold magnets
- Power Supplies
- Beam Instrumentation
- p-Linac

FCI
Full Cost Issues
B. Brandt

CORE
Cost Review Groups
D. Plane, W. Bartel

ISC accepted the FBTR as ‚The Project' to perform
ISC took note of the project cost of 1186 Mio. €
ISC asked its members to discuss the legal documents (convention, AoA ..)
Aiming for signature to the legal documents in early 2007
- Creation of FAIR GmbH as the project owner
that will hand over all operataive tasks to GSI.

Observers:

Core Groupe "A" for Accelerators and Infrastructure

•**David Plane, chair (ex CERN)**	experiments, beam lines, project management
•**Y. Cho, Argonne (ex officio, TAC chair)**	accelerators, costing
•**K. Blasche (ex GSI)**	accelerators
•**T. Taylor (ex CERN)**	magnets, sc magnets
•**E. Weisse (ex CERN)**	accelerator systems, safety, infrastructure
•**G. Stevenson (ex CERN)**	safety, infrastructure
•**W. Erdt (ex CERN)**	cryo systems
•**P. Strubin (CERN)**	vacuum
•**I. Gardner (CCLRC)**	accelerators systems
•**L. Miralles (Synchr. Lab Spain)**	accelerators, ATLAS, engineering
•**D. Krämer (BESSY II)**	Accelerators, infrastructure

•**First Meeting on July 26/27th, 2005, last meeting 8-10th November 2005**