HEHIHB - WP1
Accelerator Magnet Technology

Status at kick-off

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Scope of the WP1

- 5 critical study and R&D tasks identified based on present state-of-the-art in magnet and accelerator technology :
  - AMT-1 - Stability and Quench Limit of LHC at Ultimate Field and for LHC Upgrades (L+E)
  - AMT-2 - Magnets for an SPS Upgrade (L)
  - AMT-3 - Magnets for a Booster Ring in the LHC Tunnel (E)
  - AMT-4 - High Field Magnet Design (L+E)
  - AMT-5 - Optimisation of the overall Cost of the Magnet System for a High Energy-High Intensity Hadron Collider

Contributors to WP1

- 11 contributing associations:
  - CEA (Saclay, France)
  - CERN (Geneva, Switzerland)
  - EPFL/CRPP (Villigen, Switzerland)
  - GSI (Darmstadt, Germany)
  - ENEA (Frascati, Italy)
  - FZK (Karlsruhe, Germany)
  - INFN-GE (Genova, Italy)
  - INFN-MI (Milano, Italy)
  - RAL (Chilton, UK)
  - UT (Enschede, The Netherlands)
  - WUT (Wroclaw, Poland)
- 5 associated international laboratories:
  - LBNL (Berkeley, CA, USA)
  - FNAL (Chicago, IL,USA)
  - BNL (Upton, NY, USA)
  - JINR (Dubna, Russia)
  - KEK (Tsukuba, Japan)

The World after AMT

- contributing labs/universities
- associated labs/universities

Work Matrix: Contributing Labs

Contributing laboratory			AMT-1 Stability and Quench Limit of the LHC at Ultimate Performance and for Future Upgrades	AMT-2 Magnets for an SPS Upgrade	AMT-3 Magnets for an LHC Booster in the Ring Tunnel	AMT-4 High-Field Magnet Design	AMT-5 Optimisation of the Overall Cost of a High Energy Hadron Collider
CEA	Commissariat a l'Energie Atomique, Saclay, FRANCE	A. Devred, J.M. Rifflet, C. Meuris	X	X	X	X	X
CERN	Organisation Europeene pour la Recherche Nucleaire, Geneve, SWITZERLAND	L. Rossi, L. Bottura	X	X	X	X	X
EPFL/CRPP	Centre de Recherche en Phyisique des Plasmas, Villigen-PSI, SWITZERLAND	P. Bruzzone	X	X	X		
GSI	Gesellschaft fuer Schwerionenforschung, Darmstadt, GERMANY	G. Moritz		X	X	X	
ENEA	Enter per le Nuove Tecnologie, l'Energia e l'Ambiente, Frascati, ITALIA	L. Petrizzi	X				
FZK	Forschungszentrum Karlsruhe, GmbH, Karlsruhe, GERMANY	R. Heller	X			X	
INFN-GE	Istituto Nazionale di Fisica Nucleare, Genova, ITALIA	P. Fabbricatore	X	X	X	X	
INFN-MI	Istituto Nazionale di Fisica Nucleare, Milano ITALIA	G. Volpini	X	X	X	X	
RAL	Rutherford Appleton Laboratory, UK	E. Baynham	X			X	
UT	University of Twente, Enschede, THE NETHERLANDS	A. den Ouden	X			X	
WUT	Wroclaw University of Technology, Wroclaw, Poland	M. Chorowski	X	X		X	

Work Matrix: Associated Labs

	Associated laboratory		AMT-1 Stability and Quench Limit of the LHC at Ultimate Performance and for Future Upgrades	AMT-2 Magnets for an SPS Upgrade	AMT-3 Magnets for an LHC Booster in the Ring Tunnel	AMT-4 High-Field Magnet Design	AMT-5 Optimisation of the Overall Cost of a High Energy Hadron Collider
LBNL	Lawrence Berkeley National Laboratory, Berkeley, CA, Usa	S. Gourlay		X		X	X
FNAL	Fermi National Accelerator Laboratory, Chicago, IL, USA	J. Strait			X	X	X
BNL	Brookhaven National Laboratory, Upton, NY, USA	P. Wanderer, R. Gupta, A. Gosh	X	X		X	
JINR	Joint Institute for Nuclear Research, Dubna, Russia	A. Kovalenko		X	X		X
KEK	High Energy Accelerator Research Organization, Tsukuba, Japan	A. Yamamoto	X	X	X	X	X

Budget

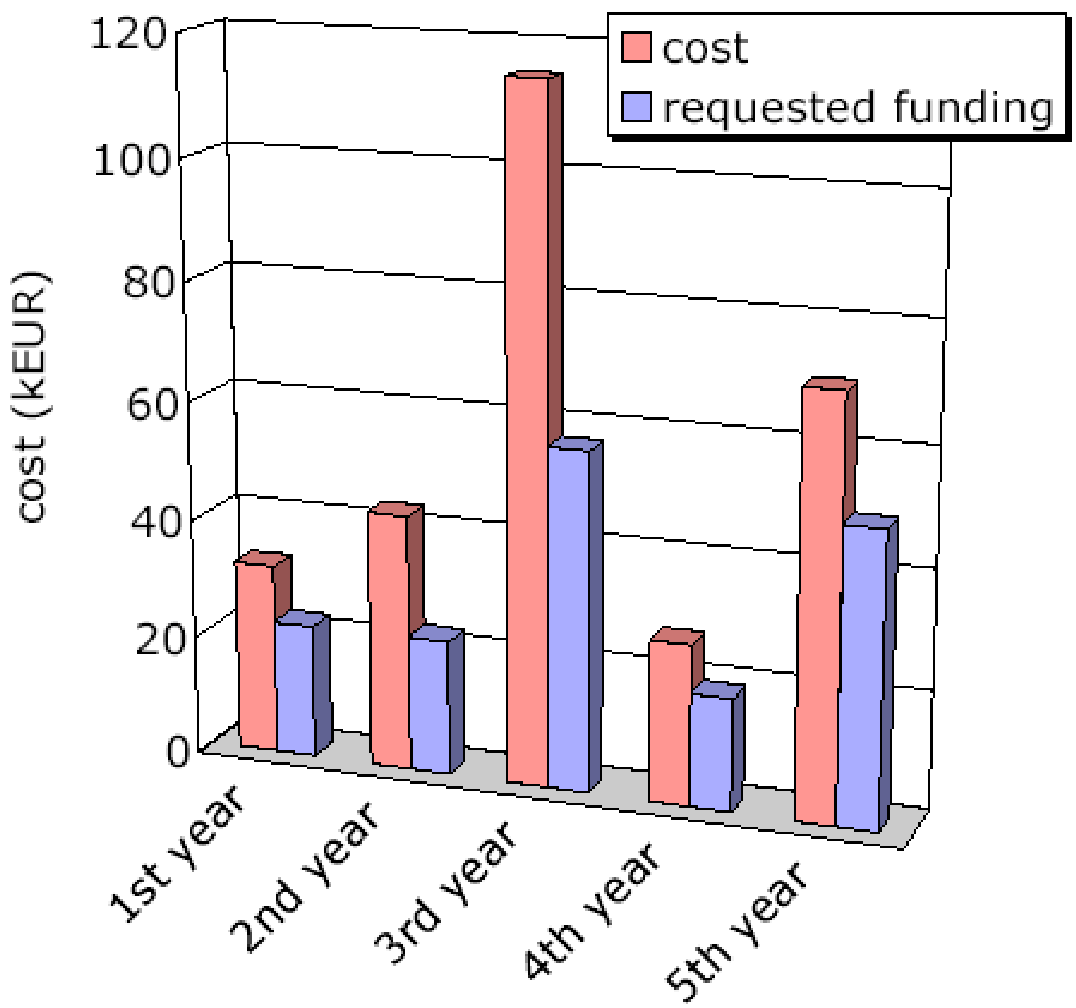
cost

N4-AMT COST STRUCTURE **costs in k€**

			General Meetings	Workshops	Exchange Travels	student-stagist	Fellow DB	Low-B option (specialist)	**TOTAL/ year**
Gen Meeting	Workshop								
Kick-off	SC materials	1st year	11.1	17.7	3.4	0	0	0	**32.2**
Refining objectives		2nd year	7.4	0	5.8	0	30	0	**43.2**
Mid-term report	HFM-LFM design	3rd year	7.4	29.5	8.2	0	30	40	**115.1**
Design validations		4th year	14.8	0	12.3	0	0	0	**27.1**
Final Report	S-LHC options	5th year	14.8	34.4	21.2	0	0	0	**70.4**
		TOTAL	**55.5**	**81.6**	**50.9**	**0**	**60**	**40**	**288**
	FUND REQUEST	percent	70%	70%	70%	100%	45%	30%	**59.24%**
		1st year	7.77	12.39	2.38	0	0	**0**	**22.54**
		2nd year	5.18	0	4.06	0	13.5	0	**22.74**
		3rd year	5.18	20.65	5.74	0	13.5	12	**57.07**
		4th year	10.36	0	8.61	0	0	0	**18.97**
		5th year	10.36	24.08	14.84	0	0	0	**49.28**
		TOTAL	**38.85**	**57.12**	**35.63**	**0**	**27**	**12**	**170.6**

funding requested

Budget - profile



- topics by year:

  1. HF SC materials
  2. HF magnet design
  3. HF and LF magnet design
  4. collider issues
  5. S-LHC options

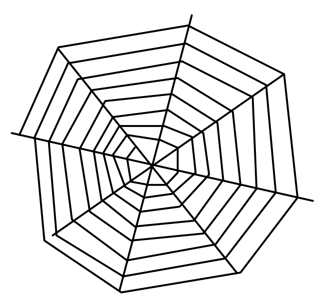
Budget - comments

- The projected budget is for coordination, networking and promoting activities, and is clearly not sufficient to cover the work to be performed in the AMT tasks
- Approximately 60 % of above costs are covered in the proposal
- The system will work if and only if the contributing labs/universities will honor their engagement in terms of manpower and resources (computer/travel) invested (e.g. CERN fellow for database design and construction)

monitoring work is essential !

Activity start-up - general

- for the next 18 months the main focus is on:
  - superconducting materials for high-field accelerator magnets
    - mainly Nb3Sn…
    - … but also Nb3Al,
    - High-Tc materials (BSSCO, YBCO),
    - and MgB2
  - R&D and design activities in support of the NED development (accelerator-quality 15 T dipole magnet)
  - start spinning the net !



Activity start-up - Q3 2003

- kick-off meeting
  - December 9th, 2003, at CERN (1/2 day)
  - aims of the meeting
    - presentation of the latest status of the proposed AMT activities to the contributing laboratories (scope, time schedule, budget)
    - contribution of laboratories/universities in terms of study and experimental activity. review of the general capabilities (test facilities)
    - preparation of the first workshop on superconductors for high-field, high-intensity hadron beams
    - finalize the plan for the first 18 months of activity of the network

Activity start-up - Q1 2004

- Workshop on Superconductors for High-Field, High-Intensity Hadron Beams
  - 3 days workshop
  - organised by CERN (Archamps ?)
  - to take place during the last two weeks in March 2004
  - attendance by invitation
    - major European firms for both LTc and HTc superconducting materials
    - leading European laboratories and universities
    - representatives from US (LARP program) and Japan

Activity start-up - Q1 2004

- Aim of the workshop:
  - Review the status of the world R&D on superconducting materials and cables for high field magnets ($B > 10$ T), with particular focus on needs on the NED program (Nb_3Sn)
  - Review the capabilities of European industries and European laboratories in support of the superconductor R&D
  - Identify needs and define directions of development for industry and laboratories

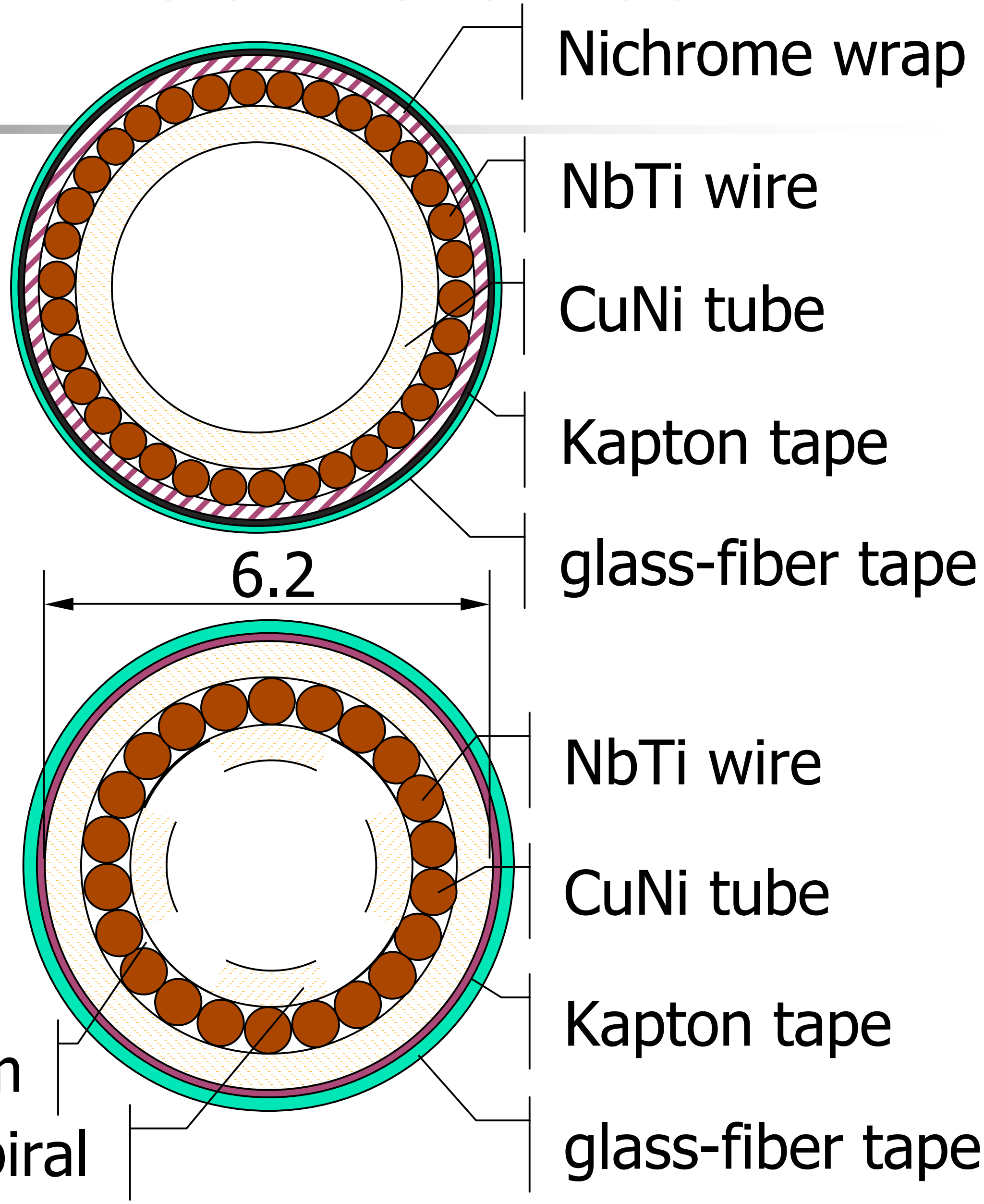
Pulsed cable for GSI - SIS-100

bring strands close to He

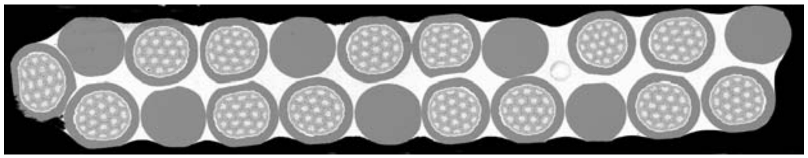
provide a low-impedance cooling path

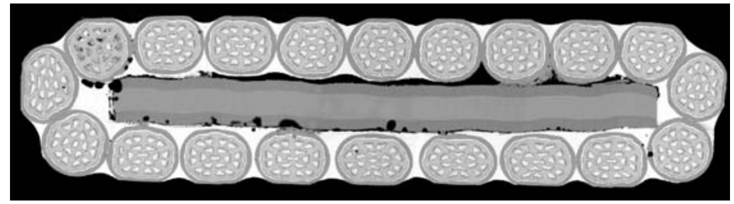
use realistic strand data J_c=5200 A/mm^2

maintain operating conditions



Study of cost effective cables





- Mixed strands Cable
  - Less sc strands = reduced cost
  - Smaller copper fraction co-processed with sc = reduced cost
  - Smaller power losses (dB/dt)
- Copper cored Cable
  - Smaller copper fraction co-processed with sc = reduced cost
  - Less winding turns = reduced winding cost + smaller inductance
- Common Quench Performance
  - ~10 times faster quench (avoid quench heaters) = reduced cost
  - Reduced temperature in the superconductor during quench
  - Potentially better Radiation Hardness

courtesy of M. Coccoli

cables from LBNL, quench simulations M. Coccoli and M. Calvi