NOVEL ACCELERATION SYSTEMS
Preparation of FP7 bids

CARE06
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Group members,
invited at the Preparation meeting of October 30, at CERN:

Brigitte Cros, Erk Jensen (chair), Terry Garvey, Gilbert Guignard, Alban Mosnier, Vittorio Palladino, François Richard;

The European strategy for particle physics

Scientific activities

3. The LHC will be the energy frontier machine for the foreseeable future, maintaining European leadership in the field; *the highest priority is to fully exploit the physics potential of the LHC, resources for completion of the initial programme have to be secured such that machine and experiments can operate optimally at their design performance.* A subsequent major luminosity upgrade (SLHC), motivated by physics results and operation experience, will be enabled by focussed R&D; *to this end, R&D for machine and detectors has to be vigorously pursued now and centrally organized towards a luminosity upgrade by around 2015.*

4. In order to be in the position to push the energy and luminosity frontier even further it is vital to strengthen the advanced accelerator R&D programme; *a coordinated programme should be intensified, to develop the CLIC technology and high performance magnets for future accelerators, and to play a significant role in the study and development of a high-intensity neutrino facility.*

5. It is fundamental to complement the results of the LHC with measurements at a linear collider. In the energy range of 0.5 to 1 TeV, the ILC, based on superconducting technology, will provide a unique scientific opportunity at the precision frontier; *there should be a strong well-coordinated European activity, including CERN, through the Global Design Effort, for its design and technical preparation towards the construction decision, to be ready for a new assessment by Council around 2010.*

6. Studies of the scientific case for future neutrino facilities and the R&D into associated technologies are required to be in a position to define the optimal neutrino programme based on the information available in around 2012; *Council will play an active role in promoting a coordinated European participation in a global neutrino programme.*

Group "Novel accelerating systems"

Subject	Specific	Title	Acronym	Priority	Years	Cost [M€]	Comments	Contact
CLIC	JRA	High-Gradient RF structures		2	5	5.5		W. Wuensch (CERN)
CLIC	JRA	Drive Beam Issues	EUROdrive	2	3	5		D. Schulte (CERN)
CLIC	JRA	Luminosity Ensuring Design	LED	2	5	5.4		D. Schulte (CERN)
CLIC	JRA	Generation and Diagnostics Gear for tiny emittance	GADGET	2	4	5.9		H. Braun (CERN)
Neutrino	JRA	Development of FFAG Accelerators in Europe	EUROFFAG	2	5	15	?	F. Meot (LPSC)
Neutrino	JRA	MICE VI		3		2		P. Kyberd (Brunel U)
CLIC/ILC	JRA	Positron Polarized Sources	POSIPOL	3	4	10	Including LASCA	A. Variola (LAL)
CLIC	JRA	L-band, High Power and High Efficiency Multi-Beam RF amplifier	HEMBA	3	6	7		I. Syratchev (CERN)
CLIC	JRA	Ka-Band Stand-Alone Power Source	SAPS	3	4	7		E. Jensen (CERN)
Laser-plasma	JRA	Laser Plasma Technology	LAPTECH		4	20	PHIN/EuroLEAP	V. Malka (CNRS)
						82.8		

High Gradient RF Structures, 5.5 M€:

Fundamental Research, development, test with power and beam (CTF3, JINR Dubna, U Lancaster)

Uses the CTF3 facilities: Mid-linac power station and Two-beam test stand (TBTS):

- Structure tests under high power RF @ 30 GHz (and possibly a 2^{nd} frequency)
- Surface topology/chemistry alteration (Auger & AFM)
- Breakdown theory
- DC spark tests
- RF pulsed heating tests (also involved: BINP Dubna)
- Laser fatigue tests
- Ultrasonic fatigue tests
- High power RF interaction with beam
- Module testing

Infrastructures that will benefit: CTF3, AFM, AES and other facilities at Lancaster U.

EURODrive, 5 M€:

Handling of the high current drive beam
simulations and experiments on alignment and tuning:

- Develop beam based alignment and tuning methods adapted to the drive beam decelerator
- Develop a conceptual machine protection system
- Develop a method to correct the drive beam phase jitter (synergy with X-FEL's)
    1. Study the drive beam phase jitter
    2. Develop the pickups (BW 100 MHz, 20 fs resolution) and correctors
    3. Develop a longitudinal feedback to reduce drive beam phase jitter
- Benchmarking of simulation codes with CTF3 experiments including TBL, CR & TBTS (Test-Beam Line, Combiner Ring and Two-Beam Test-Stand)

LED (Luminosity Ensuring Design), 5.4 M€:

Handling, measurement and conservation of ultra-small beams for future LC
Feasibility of final focus components and stability in sub-nm range

1. Stabilization of final focus magnets, located inside the detector, to 0.2 nm @ 4 Hz. Develop elements that allow this stabilization:
   - Develop sensors to the required resolution and stability
   - Develop a support that can be integrated into the detector
   - Develop the correctors (conceptually)

2. To allow beam-beam scans within a single pulse: Develop intra-pulse tuning concept (kickers)
   - Study the feasibility of kickers (10 ps) and their integration
   - Assess detector technologies and required improvements
   - Integration of instrumentation into the post-collision line

GADGET, 5.9 M€:

Generation and Diagnostic Gear for tiny Emittance

Develop elements and diagnostic necessary to create and control ultra-small emittances, synergy with SR facilities:

- Development and test of high field SC wigglers
- Development of necessary instrumentation to measure, control and tune low emittance beams
- Improve IBS theory, test on existing SR facilities

Uses the SLS and new low-emittance injector for FEL at PSI, Magnet-measurement facility in Budker Institute and ANKA ring at Karlsruhe.

EUROFFAG, 15? M€ (without “models” 5 M€):

Design and prototyping work, including the construction of accelerator models.
Study challenges and potentials of the FFAG method, design concepts and best methods**:**

- ***Lattice design, beam dynamics studies*** – proton acceleration, fast acceleration of muons, electron model (one could focus on the two latter points)
- ***Component design studies*** – non-linear and linear magnets; modulated RF systems; fixed frequency RF systems; injection and extraction kicker systems; beam diagnostics ; vacuum
- ***Prototyping and experimental tests*** - linear and non-linear magnets; broad band modulated RF systems; injection and extraction kicker systems
- ***Proof-of-principle accelerator prototypes*** – launch the construction of two prototypes: the linear electron model (EMMA) and a spiral non-linear proton accelerator of 70 MeV (?)
- ***Comparison of the FFAG methods*** – scaling, semi-scaling and non-scaling: undertake costing studies and assess advantages and drawbacks;

Construction of full-scale accelerator models may look beyond JRA scope

MICE phase VI, 2 M€ (?):

Muon cooling as the essential components of neutrino factory and muon collider

- Completion and exploitation of MICE (Does this is apply to R&D in JRA?)
- Accelerator physics aspects of cooling & new optics
  - Helicoidal dipole (with FNAL)
  - Lithium lens (with Novosibirsk)
- Warm RF technology (incorporated now in "High Gradient RF Structures" above)
- High power RF sources at 200 MHz (R&D really needed here?)

POSIPOL, 10 M€:

Compton-back-scattering polarized positron generation
(alternative scheme to the ILC main option and main scheme for CLIC):

- Design Study (Parameters, Compton ring, collection system) (focus on photon part?)
- Laser & laser cavity development (LASCA): high-power and high rep frequency lasers, cavity in pulsed regime, polarimetry (of photons?)
- Test facility experiments (DAΦNE, at INFN, and ATF, at KEK) (re-scale the effort?)

HEMBA, 7 M€:

Develop, build and test high efficiency L-band power source, synergy with ILC
High-power, high-efficiency multi-beam RF amplifier (based on multi-beams driven by over-moded RF cavities and suppression of unwanted spurious oscillations)

- Develop it from the existing 10 MW, 65% efficiency to the needed 50 MW, 80%.

SAPS, 7 M€:

Develop build and test high-power stand-alone RF power source for structure tests (30 GHz or another frequency)
Ka-band power source, gyro-klystrons in 18-30 GHz for structure R&D and conditioning,160 MW, 100 ns, 100 Hz RF. Fabricate

- a number of identical gyro-klystrons with their SC solenoid, with tests
- the modulators driving these tubes
- the necessary power combiner and pulse compressor
- the required diagnostic equipment

LAPTECH, 20 M€:

Develop laser plasma technology for staged accelerators that will constitute the basis for future high energy accelerators

Aiming a stable, reproducible e- beam of a few GeV.

- Laser development increase stability, reproducibility. Reliability and efficiency (mainly concerns the FEL and SR community as ELI – not available before 2015)
- Injector development (based on EuroLEAP results – 3 years starting mid-2006)
- Electron beam dynamics, beam transport and shaping between stages
- Plasma target studies, optimization of plasma parameters, stability and reliability (L)
- Beam-beam interaction studies for ultra-short bunches, polarisation studies, positron generation (modelling)

Look at a possible reduction of total cost

Facilities candidates for TA :

ANKA ring, CTF3, TBTS, TBL, JINR Dubna, Cockroft Inst., PSI new injector, Magnet meast BINP, EMMA, MICE, Daphne INFN, … ATF (KEK)…

Interested Institutes:

BINP, CERN, CCLRC, CIEMAT, DAPNIA, DESY, INFN, IN2P3, KEK, LAL,LOA, LLR, LPGP, LULI, LAPP, PSI

HELSINKI Institute,	ANKA Karlsruhe,	Babcock Noell Germany,
Cockcroft Institute,	NSC KIPT Karkov	Oxford University
Paris University	VALENCIA University	UPPSALA University
BERLIN University	RH University,	Bedford College
John Adams Institute	Savoy University	Twente University
Pisa University	Strathclyde University	Dusseldorf University
Imperial College	Max Plank, Germany	Iena, Germany
Lud, Maximilian Univ.	Lundt Laser Center (S)	Inst.Sup.Tech. GoLP (P)

Waseda and Kyoto Universities
KURRI Institute (Japan)
BNL, FermiLab

Industrial Partners interested to develop Klystrons and Modulators

For the klystron development: International Linear Collider GDE (Int.), Thales Electron Device (F), E2V, TMD, Lancaster University. (UK), DESY-XFL (G), Tory,Svetlana, Istok(Russia), CPI, SLAC(USA),Toshiba (Japan).
For the modulator Development: E2V (UK), Thales Electron Device, PULSE MC², Physique & industrie, EUROMEV (F), North Star Research Corporation, Diversified Technologies, Inc., Applied Pulsed Power, Inc. (USA), FUG Elektronik, Puls-Plasmatechnik GmbH (DE).OCEM (IT),ScandiNova Systems AB (SE), JEMA (ES)

For the Gyroklystron development: Universität Karlsruhe (D), Forschungszentrum Karlsruhe (D), Thales Electron Devices (F), IAP and Gycom (Nizhniy Novgorod, RUS), TU Hamburg-Harburg (D), TU Berlin (D), EPFL Lausanne (CH).
For the tube technology: Thales Electron Devices (F), Gycom (Nizhniy Novgorod, RUS), E2V (GB)
For the superconducting solenoid: Ansaldo (I), ACCEL (D), Alstom (F), Gycom (RUS).
For the HV modulator: Puls-Plasmatechnik GmbH (D), DTI (USA), ABB (CH), Physique&Industrie (F), ScandiNova (S), Ocem (I), F.u.G. Elektronik GmbH (D), E2V (GB), Heinzinger (D), DESY (D)