Linac4 Status

M. Vretenar, CERN

BINP Novosibirsk 09.03.2010

Revision of CERN Strategy

Aymar's strategy ("White Paper, 2007): give highest priority to the **LHC luminosity upgrade.**

- **Phase 1**: construction of Linac4, replacement of LHC inner triplets (approved in June 2007)
- **Phase 2**: construction of LP ("Low-Power") SPL + new 50 GeV synchrotron (PS2) (approved for the design phase, construction foreseen for 2016-20).

New facts since 2007:

1. Considerable resources (budget and manpower) were used for LHC repair and will be now needed for LHC splice replacement.
2. The LHC will start up slowly (full energy only in 2013-14) and will saturate in luminosity only ~2025.
3. The LHC old injectors (PS Booster, PS) have to run >15 years → need some consolidation.
4. There are concerns that the SPS accelerator can cope with the higher beam intensity provided by LP-SPL+PS2 (bottleneck...)

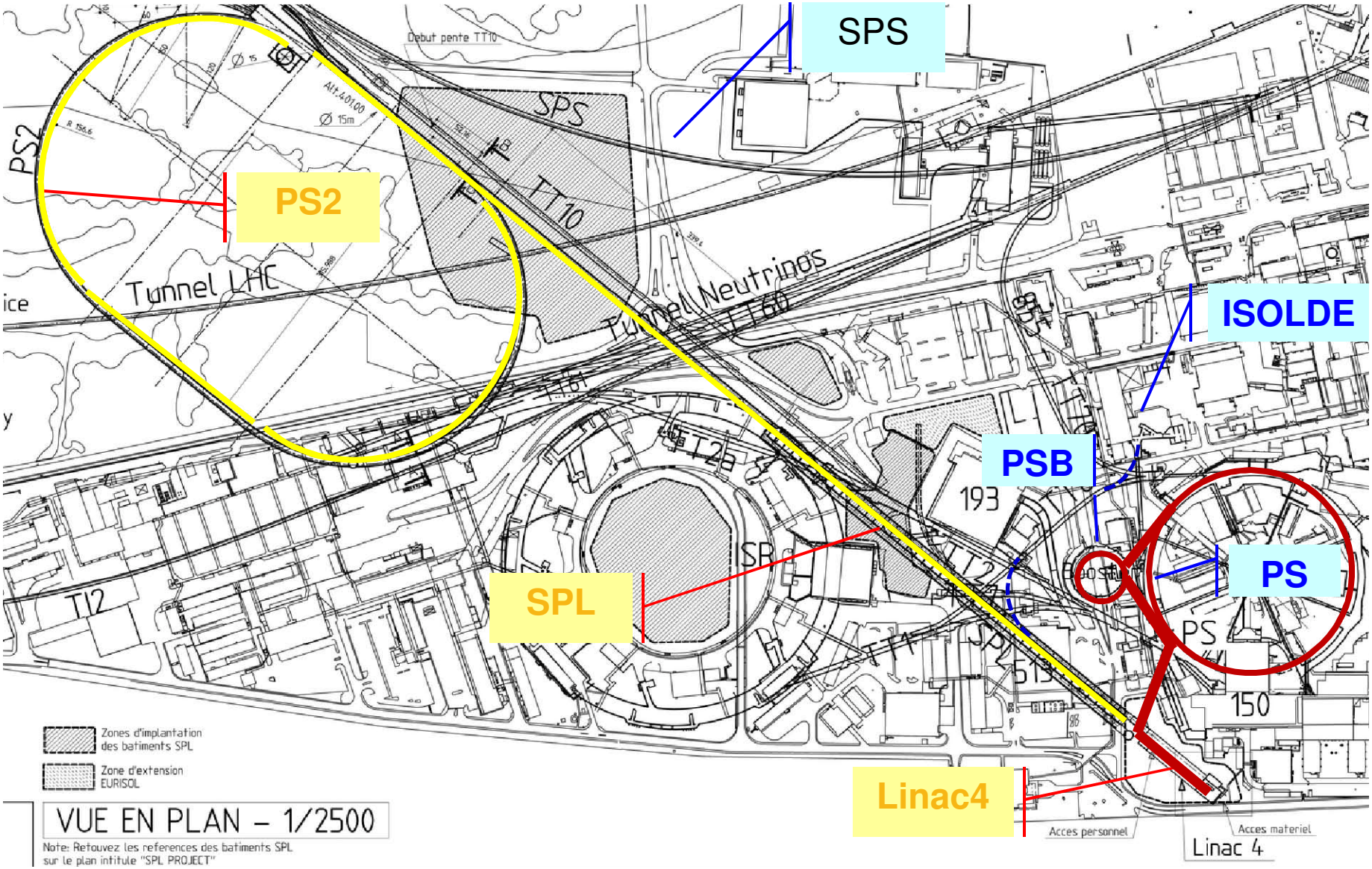
New CERN accelerator plans

New strategy (S. Myers with the support of R. Heuer, Chamonix Workshop 2010):

1. LP-SPL and PS2 will not be built. The design study has to stop at end of 2010.
2. Only Linac4 remains of Phase1 upgrade, injecting into the old machines.
3. The booster (PSB) will be (probably) upgraded from 1.4 to 2 GeV and the PS will be consolidated.
4. SPL (full power version, 5MW) will continue as a study aimed at a neutrino driver.
5. The SPS will be upgraded for higher beam intensity and LHC luminosity.

Only a more limited LHC luminosity upgrade foreseen, at a much lower cost.

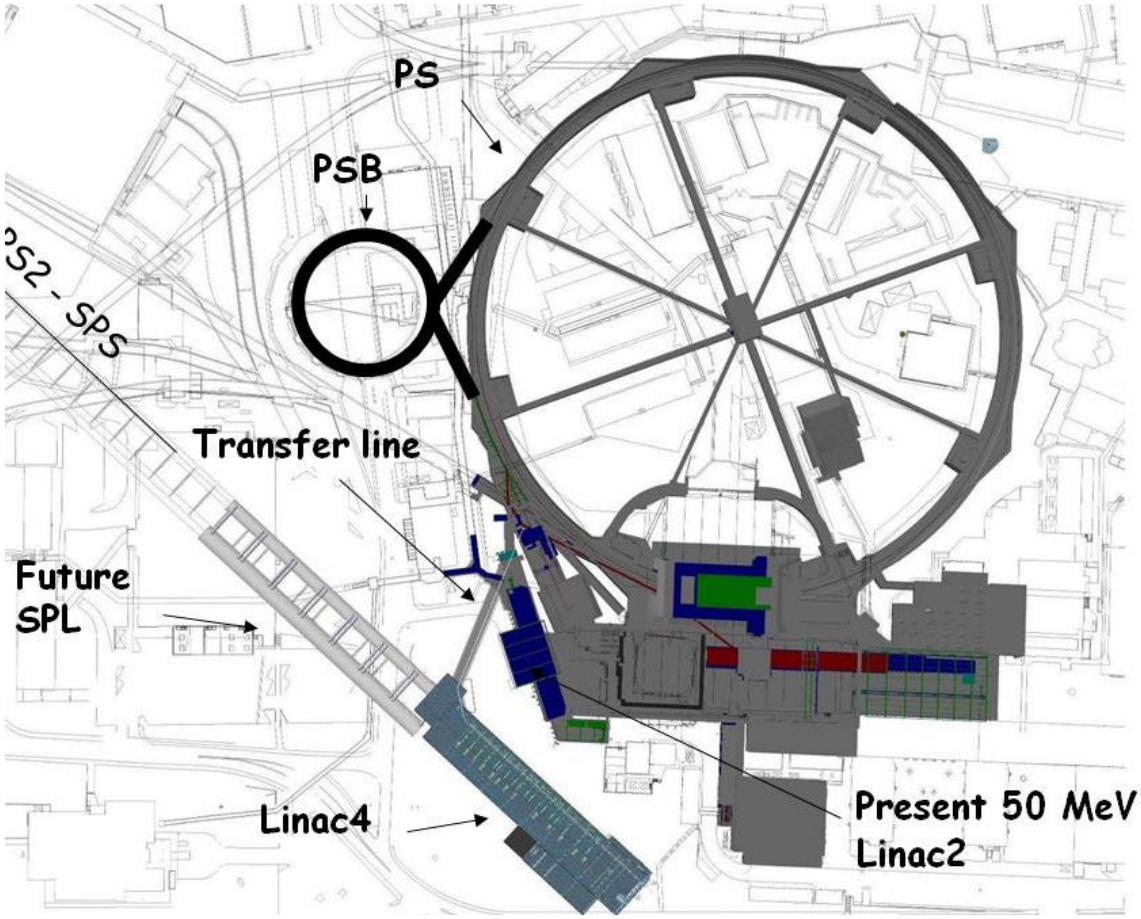
Layout on the CERN site



Consequences on Linac4

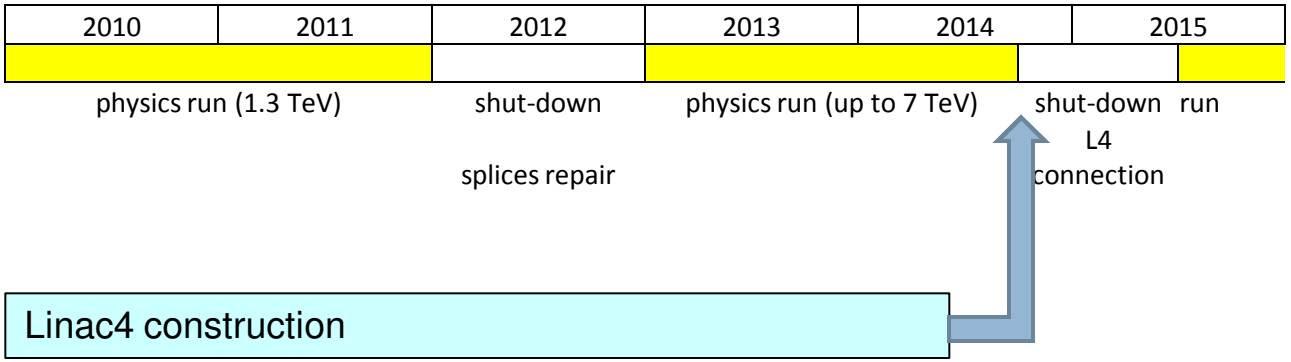
Linac4 is fully justified for:

1. Increase of the LHC luminosity, up to the maximum allowed by the upgrade of the present injectors.
2. Replacing the aging Linac2.
3. As possible future injector for a 50 Hz SPL as neutrino driver (after 2020…).



Connection of Linac4 to PSB

New LHC schedule (from Chamonix Workshop 2010):



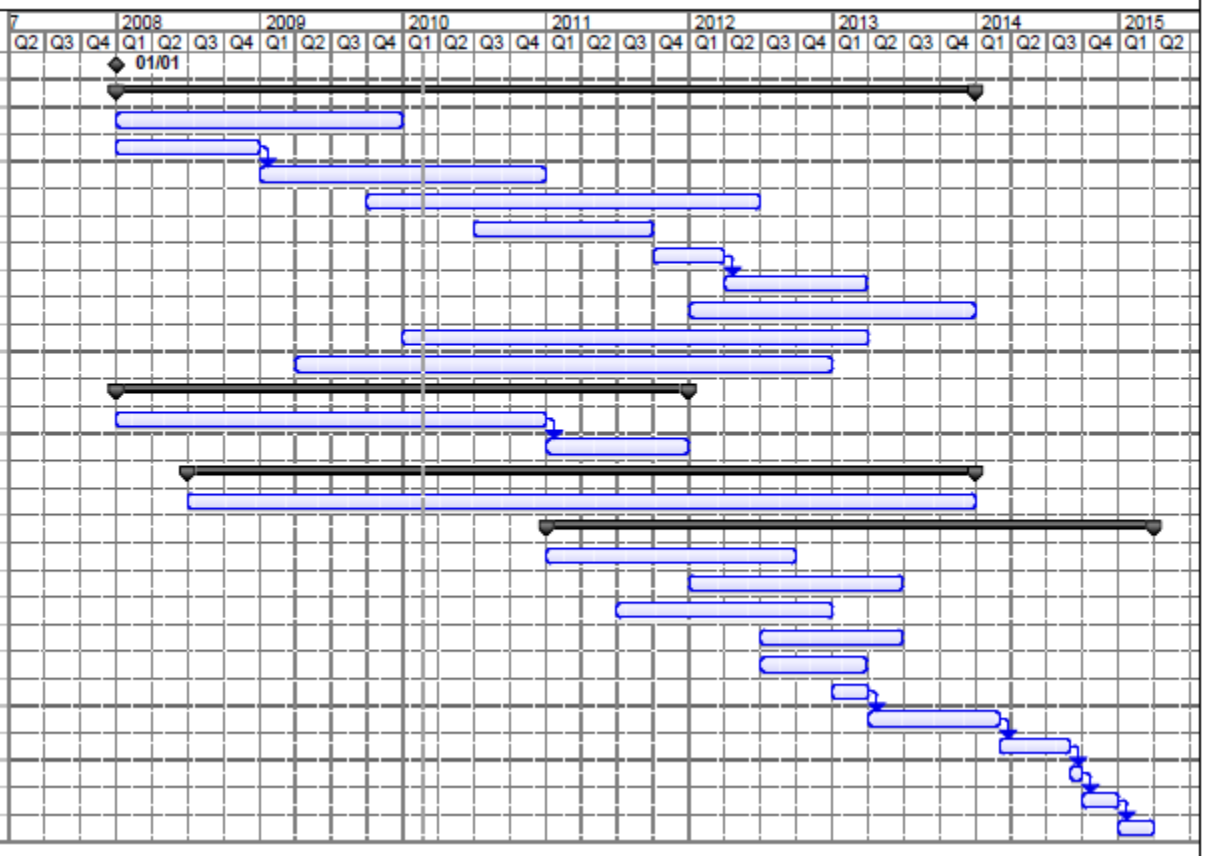
New Linac4 schedule

Project Leader: M. Vretenar

Fri 19/02/10

LINAC4 MASTER PLAN

ID	Task Name
1	**Linac4 project start**
2	**Linac systems**
3	Source and LEBT construction, test
4	Drawings, material procurement
5	RFQ construction and commissioning
6	Accelerating structures construction
7	LEP klystrons testing
8	Klystron prototype testing
9	Klystrons delivery and installation
10	Transfer line construction and installation
11	Magnets construction and installation
12	Power converters construction, installation
13	**Building and infrastructure**
14	Building design and construction
15	Infrastructure installation
16	**PS Booster systems**
17	PSB injection elements construction
18	**Installation and commissioning**
19	Test stand operation (3 MeV)
20	Cavities testing, conditioning
21	Cabling, waveguides installation
22	Accelerator installation
23	Hardware tests
24	Front-end commissioning
25	Linac accelerator commissioning
26	Reliability run
27	Transfer line commissioning
28	PSB modifications
29	PSB commissioning with Linac4

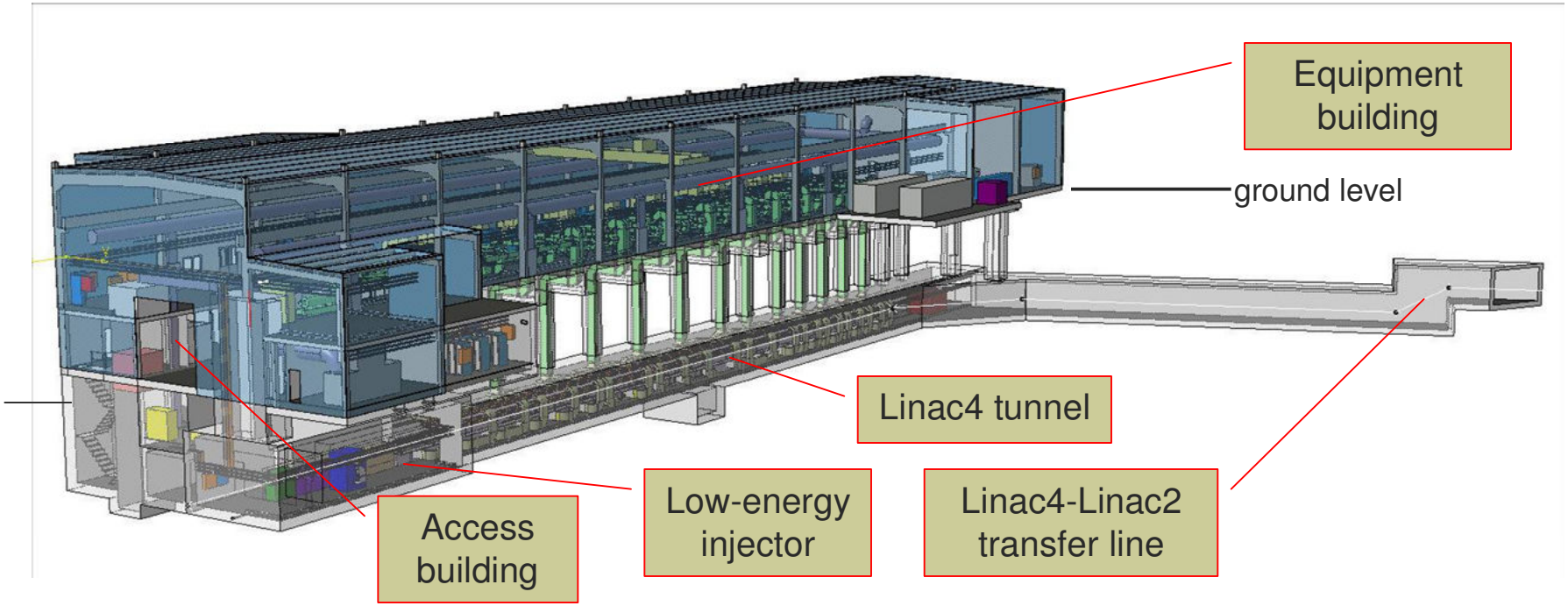


Differences with old masterplan

1. Connection to PSB will take place one year later (synchronised with LHC long shut-down).
2. Added 6 months of “reliability run” to assess remaining reliability issues before connection to the PSB (aim for 98% machine availability!).
3. Machine commissioning moved forward by 6 months.
4. Added 6 months of hardware commissioning (infrastructure, power supplies, RF) before machine commissioning.

Goals:
-Keep the old schedule for building, infrastructure, RF and power supplies.
-Give 6 months more to accelerating structures to catch up delays (…) and reduce pressure (and risks…).
-Be sure that Linac4 has the required reliability before connecting to the injectors.

Linac4 Civil Engineering



Main requirements:

Length ~100m

• Simple connection with the PSB

• Possible extension to the future SPL

Selected location ("Mount Citron"):

- Size ~100m x 30m.
- Easy connection to existing Linac2-PSB line.
- Orientation towards SPL – PS2.
- Natural shielding: underground, but at PSB level.
- No interference with Linac2 and PSB operation during construction and commissioning.

Photos

November – December 2008

Earthworks and piling works

Photos

January – February 2009

Photos

March 2009

Photos

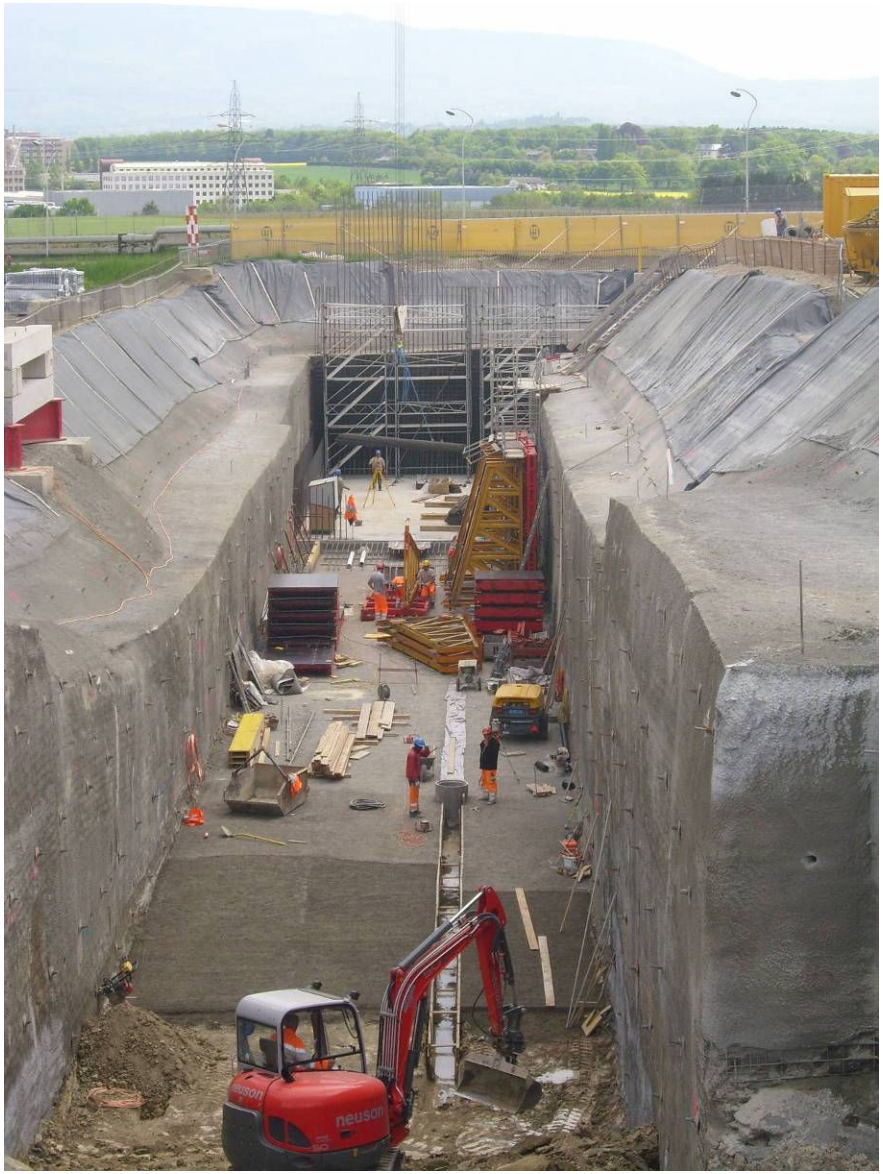
April 2009

Low energy structure concrete works

Photos

May 2009

Low energy structure and tunnel concrete works



Photos

May 2009

Transfer line under TP9

Photos

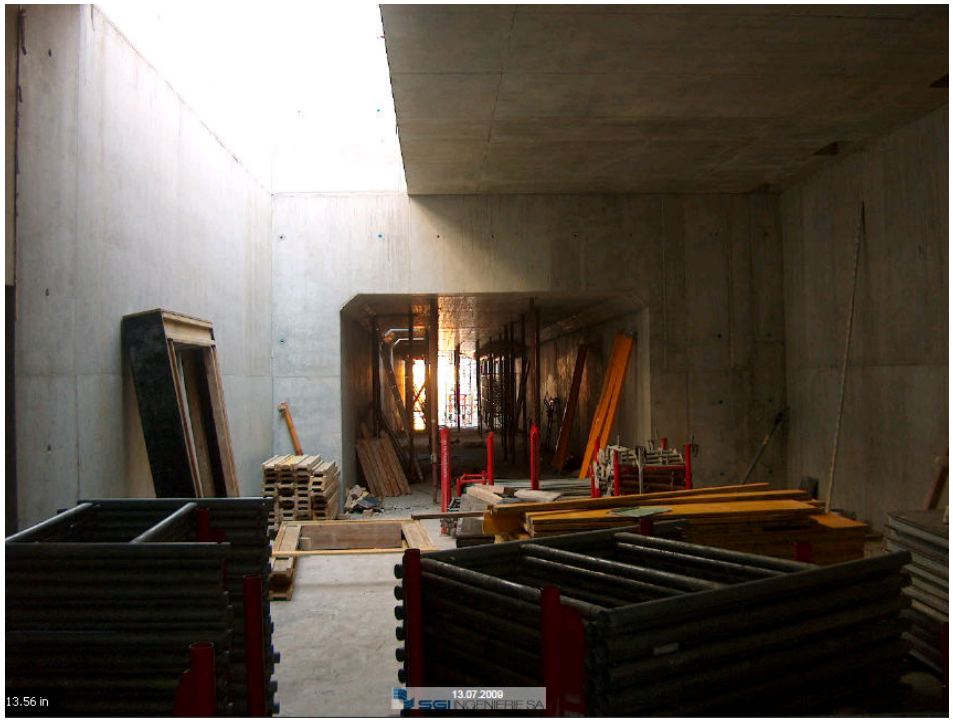
June 2009

Concrete works of Linac 4 tunnel

Transfer line under TP9

Photos

July 2009



Low energy structure

Concrete works of Linac 4 tunnel

Photos

August2009

Concrete works of wave guides and backfilling

Photos

September 2009

Low energy structure

Transfer line

Photos

November 2009

Transfer line concrete works

Photos

November 2009

Klystrons building slab

Low energy structure

Photos

December 2009

Klystrons building slab concreted

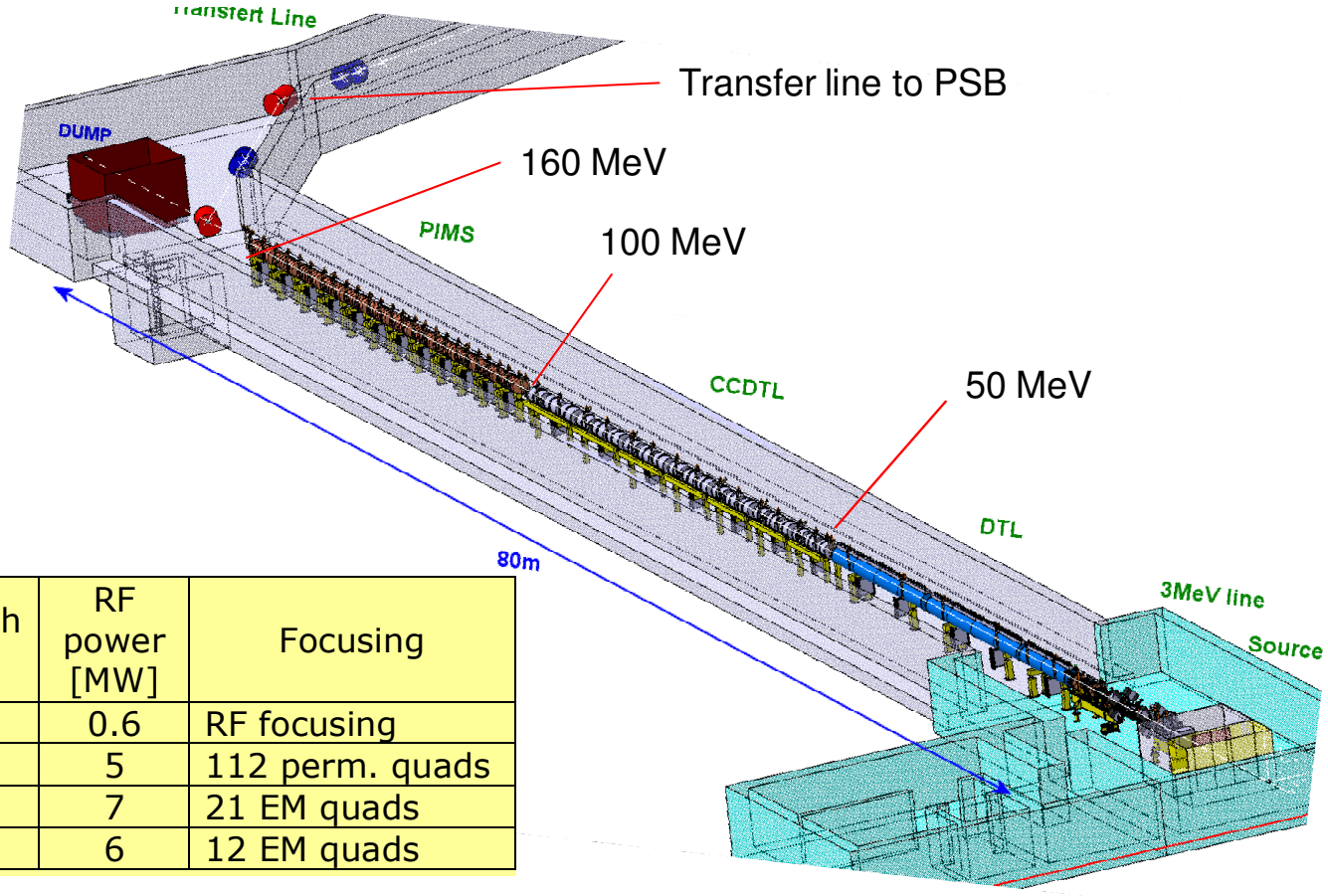
Photos

March 2010

Start construction equipment building (klystron hall)

Linac4 layout

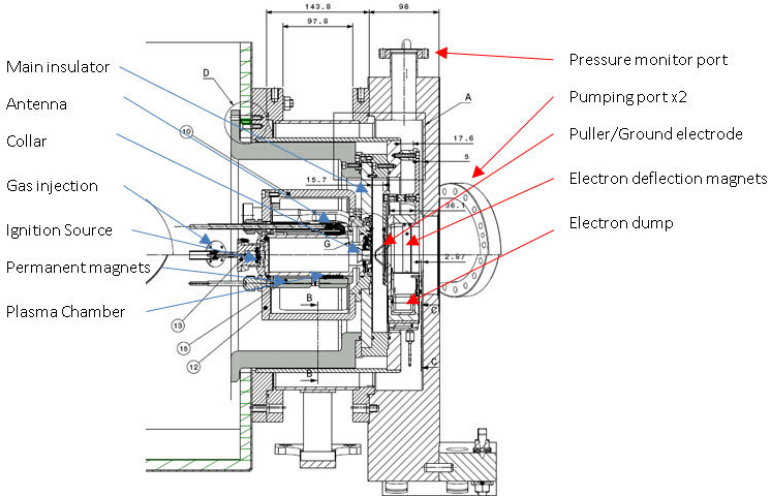
- Linac4 is made of 4 types of normal-conducting accelerating structures at 352 MHz, each matched to the increasing beam energy. The linac is terminated in a beam dump for beam setting-up, and a switching magnet sends the beam to the present Linac2 to PSB line.
- The Linac4 project includes important modifications to the PSB injection region (higher injection energy, H- stripping).

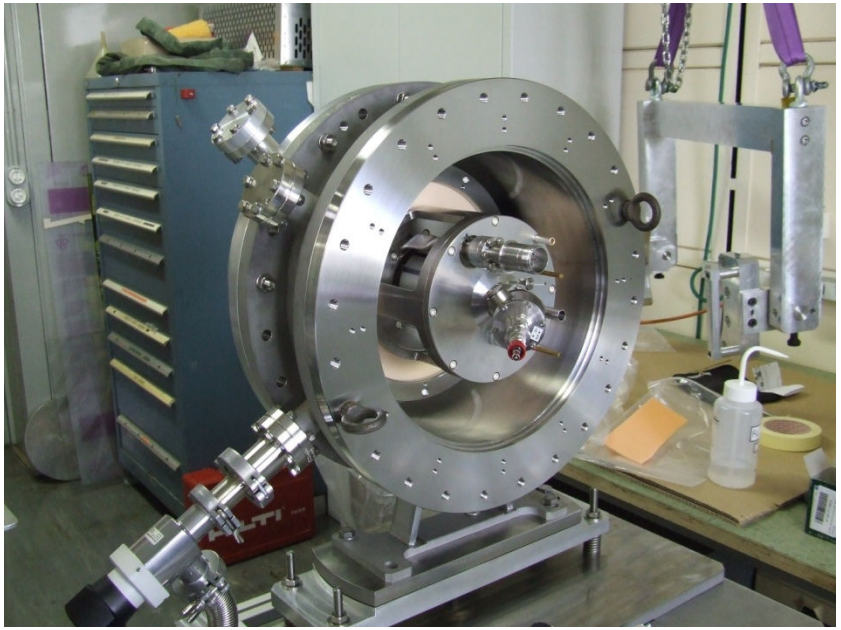


	Energy [MeV]	Length [m]	RF power [MW]	Focusing
RFQ	0.045 – 3	3	0.6	RF focusing
DTL	3 – 50	19	5	112 perm. quads
CCDTL	50 – 102	25	7	21 EM quads
PIMS	102 – 160	22	6	12 EM quads

L4 status – ion source

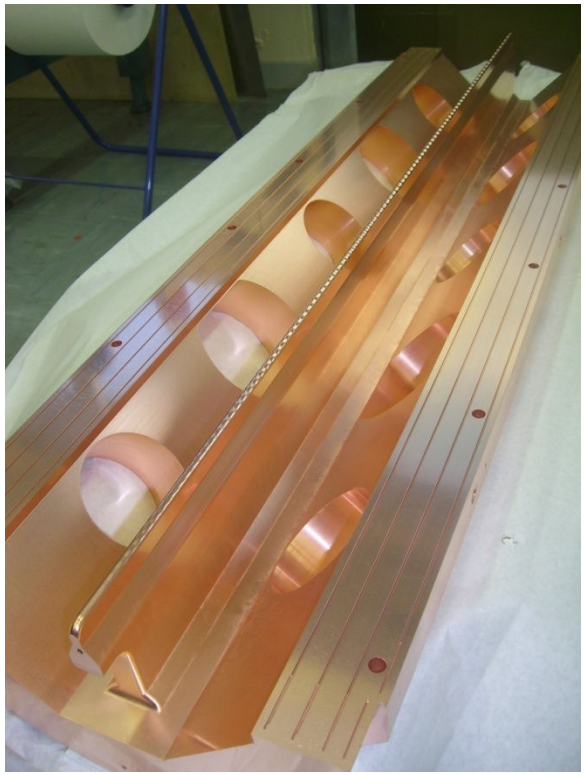
Linac4 H- ion source: installed at the Linac4 test stand, already delivers beams of 25 mA at 30 keV.
Energy will be soon increased to the nominal 45 keV (with increase in current)





L4 status – RFQ

Radio Frequency Quadrupole, 3 MeV:
bunch, focus and accelerate low-energy beam
Three 1-m sections with precisely modulated electrodes



Construction strategy:
- Entirely machined and brazed at CERN

Ready for RF and beam tests at end 2010

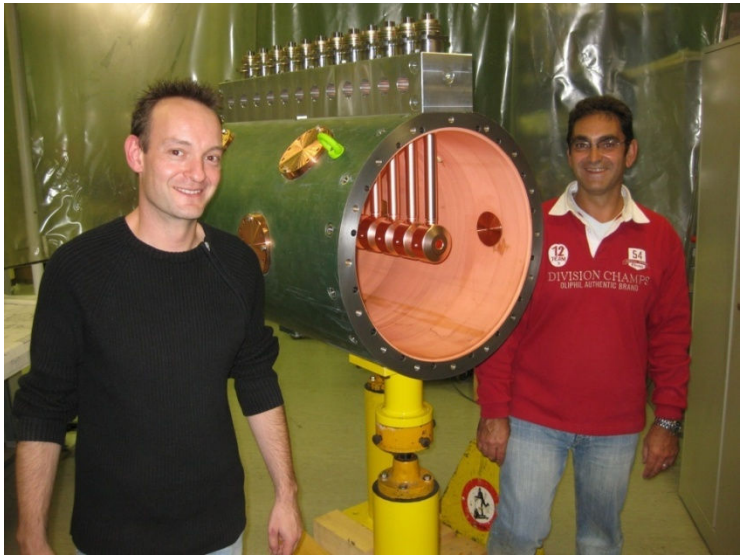
L4 - DTL

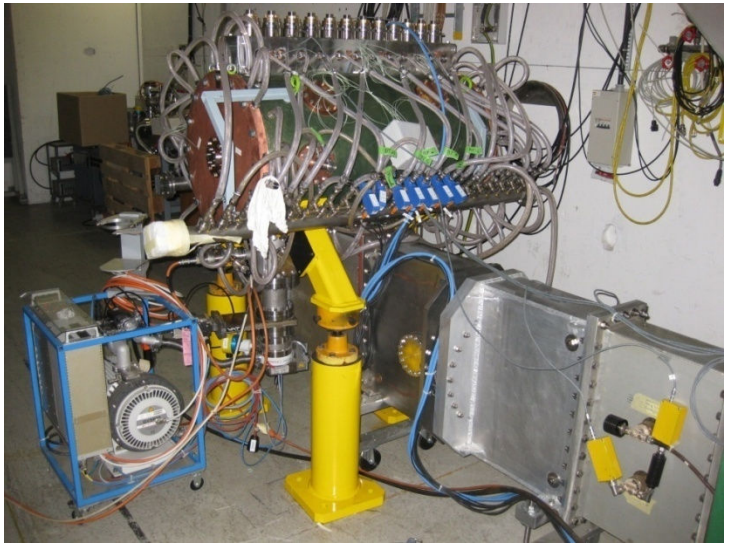
- Drift Tube Linac (DTL):
  - Design completed
  - Prototype (12 drift tubes) tested at SPL duty cycle (7.5%)

Strategy for construction:

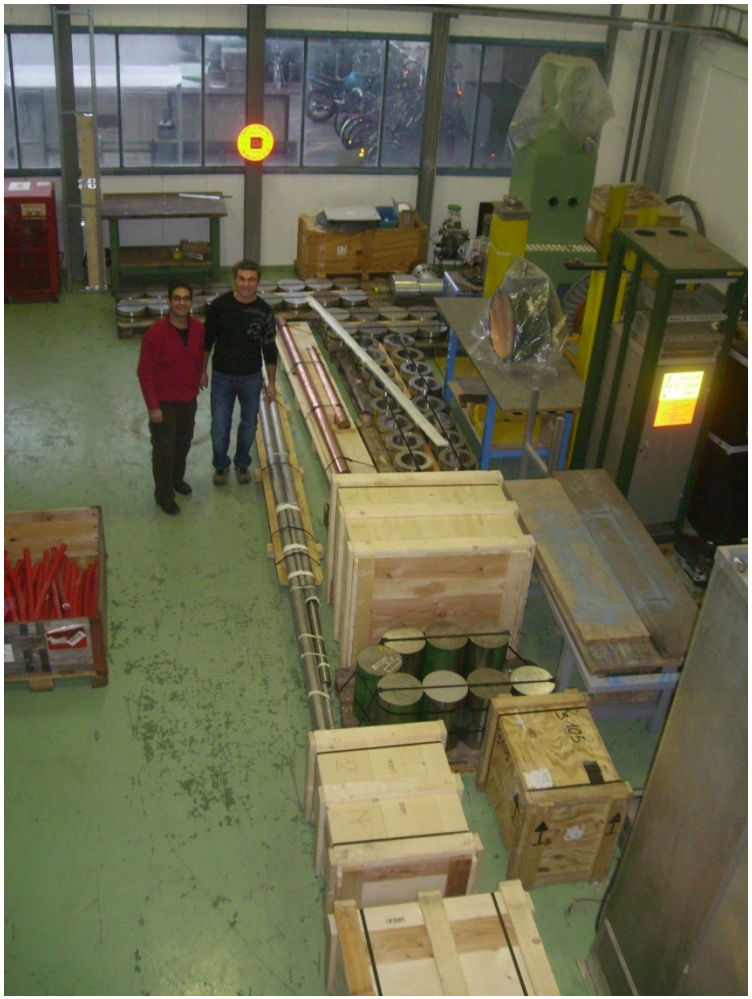
•Steel tanks (8, ~2.5 m long) machined in industry.
•Drift tubes (copper, ~120) provided by ESS-Bilbao (Spain) as in-kind contribution.
•Permanent Quadrupole magnets purchased from industry.

The prototype was provided by INFN Legnaro (Italy) as in-kind contribution





L4- CCDTL



CCDTL material ready for shipment – CERN, 12.2009

L4 – PIMS structure

Preliminary assembly of the PIMS prototype – CERN, 4.3.2010

Strategy for construction:

- Prototype built and EB welded in the CERN workshops.
- Cavity machining (12 cavities, 84 copper cells) and preliminary tuning at Soltan Institute (Poland).
- First EB welding steps at FZ Julich (Germany).
- Final EB welding and tuning at CERN.

Linac4 Virtual Tour