H^- source and LEBT

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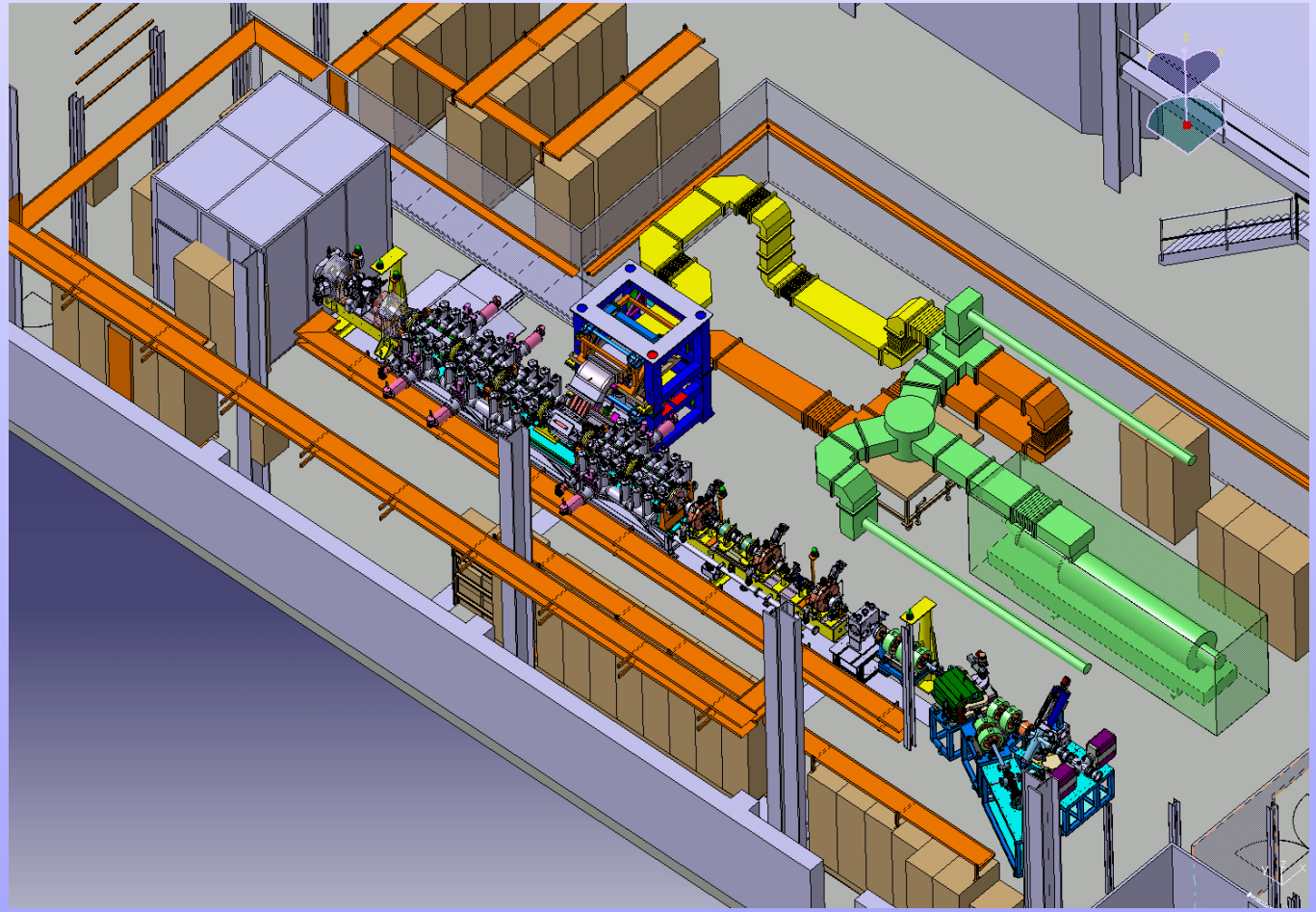
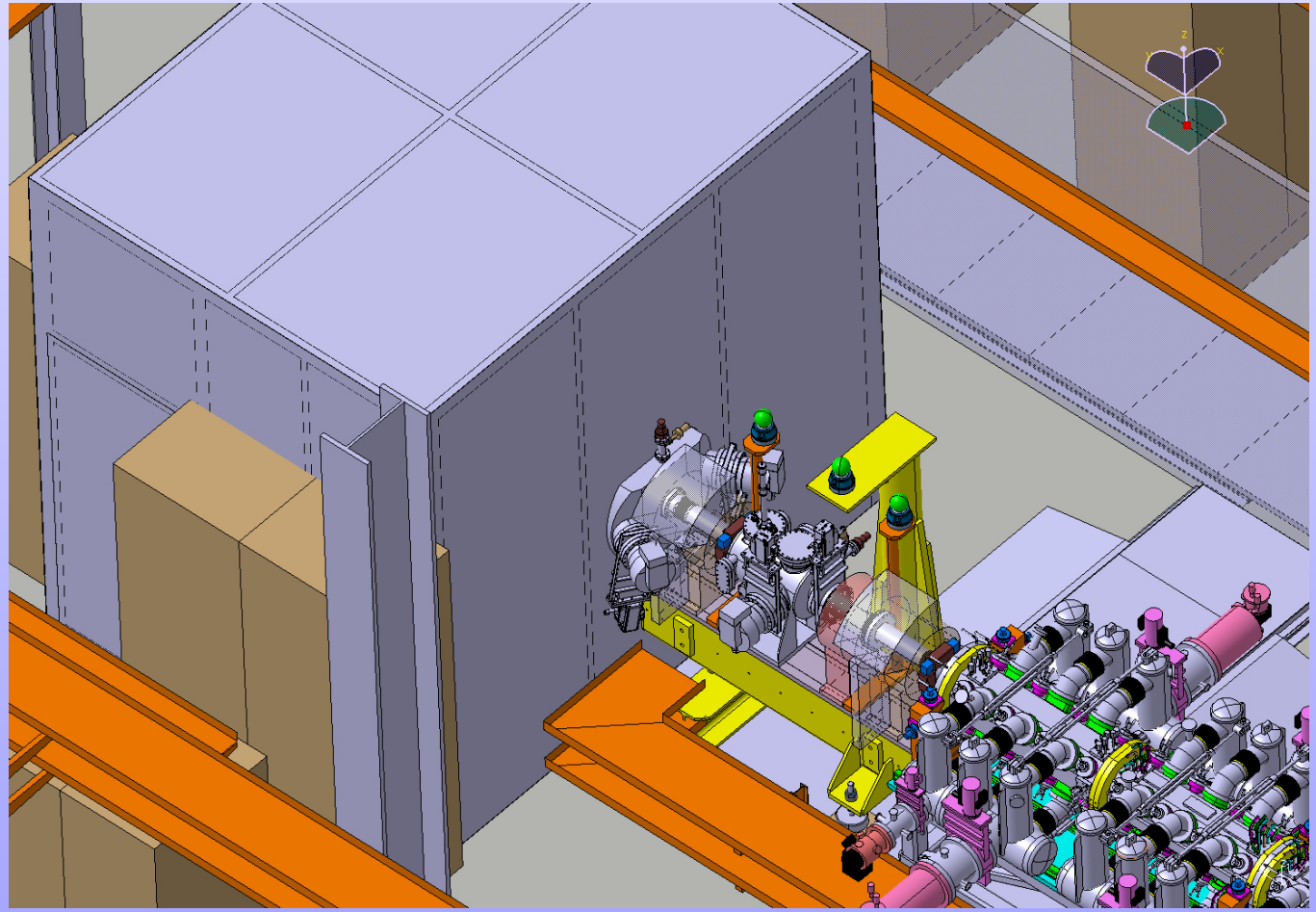
Outline

Linac4 front end



(design status August 2007)

Linac4 front end



(design status August 2007)

Introduction

- requested source parameters:
  - H^- current of 80 mA
  - 45 kV extraction
  - pulse length 0.4 ms
  - 2 Hz repetition rate
  - horizontal/vertical emittance of 0.25 π mm mrad (normalized)
  - high reliability

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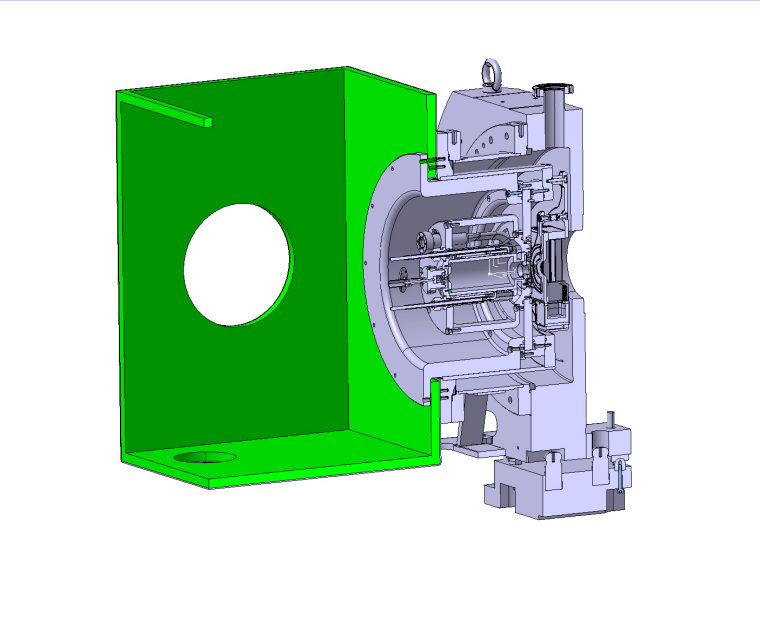
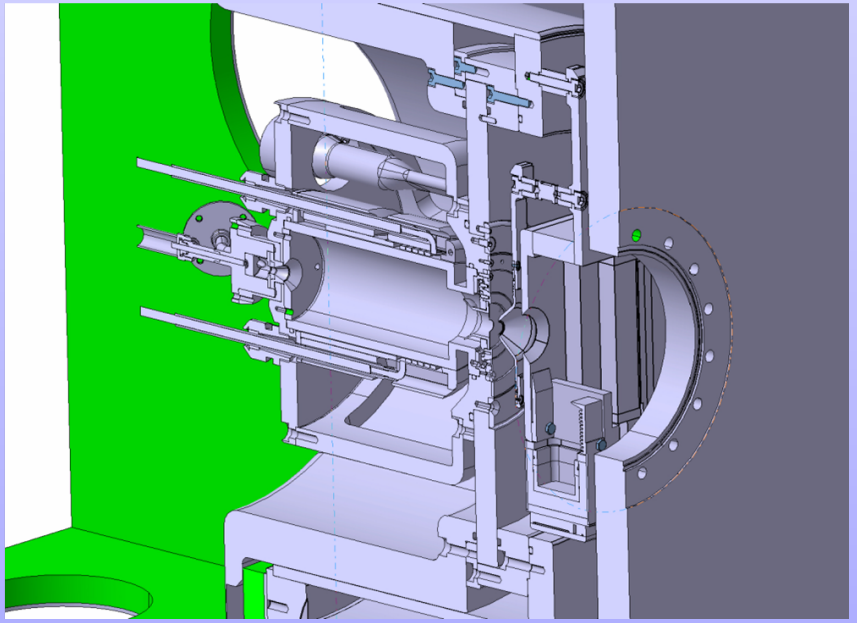
  - high reliability
- base of the source design: RF driven H^- from DESY
  - very long life-time (more than 25000 hours)
  - cesium free
  - peak currents up to 70 mA
  - test with long pulses successful (several ms)
- the source core has minor modifications,
  the integration to Linac4 required a redesign

Source characteristics

- plasma heating with RF of 2 MHz ($\leq$ 100 kW),
  antenna outside the plasma chamber
- the RF generator, isolating transformer and matching system are all designed and built by AB-RF
- extraction voltage of 45 kV (DESY: 35 kV)
- passive beam load compensation with $\Delta E/E<700$ V,
  dynamic compensation in a later stage
- modified vacuum system (higher conductance)
- dump of extracted electron beam at full extraction voltage
- controls based on a PLC system

Scheme of the H^- source





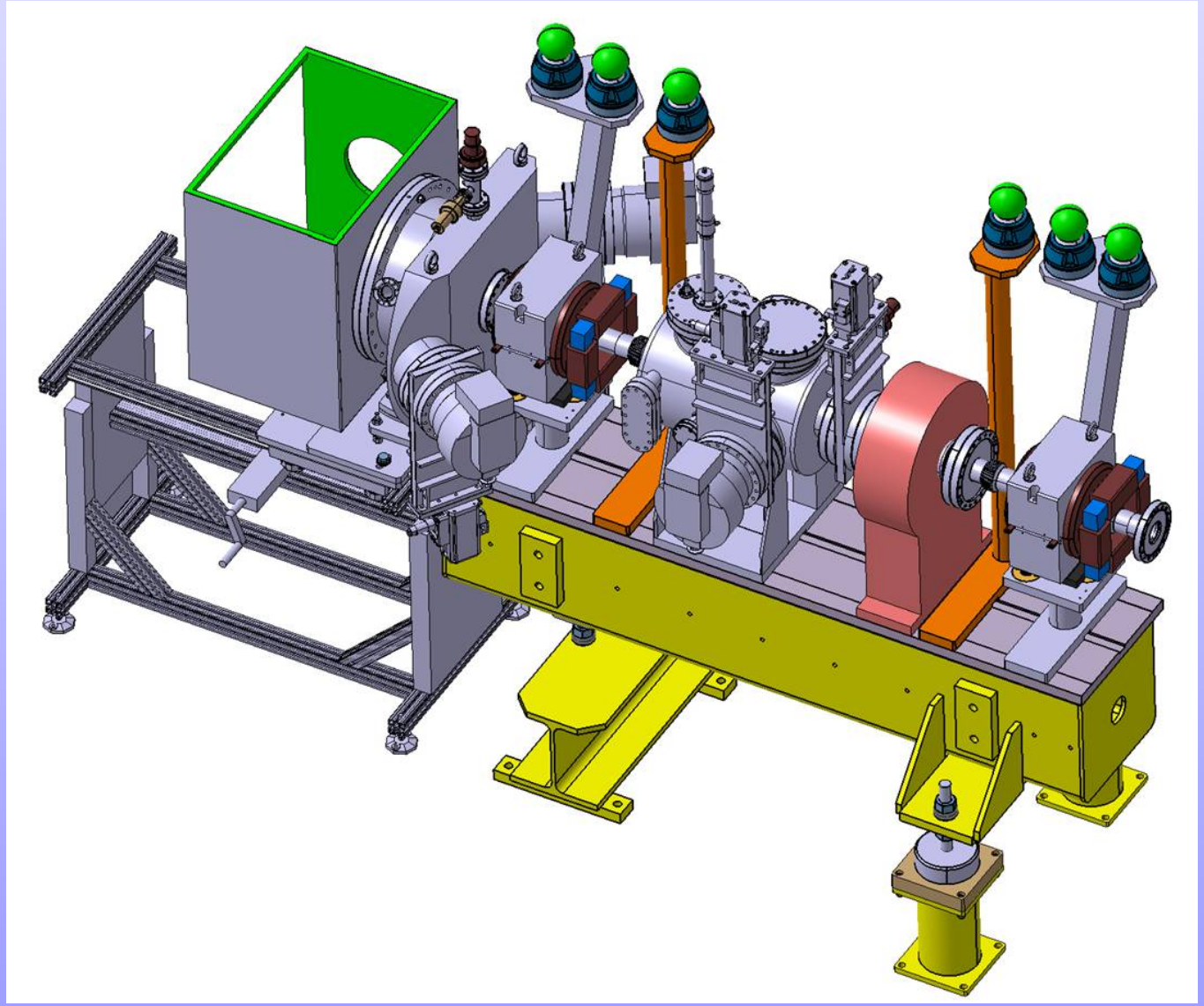
Low Energy Beam Transport (LEBT)

- magnetic two-solenoid LEBT
- modular to allow step-wise beam characterization
- space charge compensation with gas injection
- two sets of steerers
- beam diagnostics: beam current transformer, Faraday cup
- emittance meter and energy spectrometer to be installed during source/LEBT commissioning
- in the case if it is necessary a pre-chopper is foreseen

LEBT beam dynamics

- beam characteristics out of the source extrapolated from measurements
- beam compensation of 90% used (simple linear compensation model used 8/80 mA)
- simulations give emittance growth $<25\%$ in the LEBT (with small aperture solenoids)
- for Linac4 it is proposed to use larger aperture solenoids, but the cooling is not compatible with the 3MeV test stand; the solenoid design will be done after beam measurements

Scheme of the LEBT



Schedule

- finishing of the drawings and production of the source parts during the second quarter 2008
- assembly of the source should be finished until the end of the second quarter
- test of the sub-systems and start of source commissioning in the third quarter 2008
- source and single solenoid characterization in the fourth quarter of 2008
- the second solenoid is proposed for the middle of 2009

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- 2009 onwards: study and optimization of source parameters, providing beam for down-stream machine parts

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- source should have sufficient potential to meet the design goals
- end of 2008 source is available, first beam parameters will be measured
- 2009 onwards: study and optimization of source parameters, providing beam for down-stream machine parts
- the complete LEBT will not be available at the end of 2008, but single solenoid measurements to understand LEBT beam dynamics
- LEBT upgrade to larger aperture solenoids in 2009-2010
- higher intensities from the source will probably increase the source emittance, we need a brighter beam, not a more intense one, this will require development on the source and extraction