Status and program of SLHC 7.1

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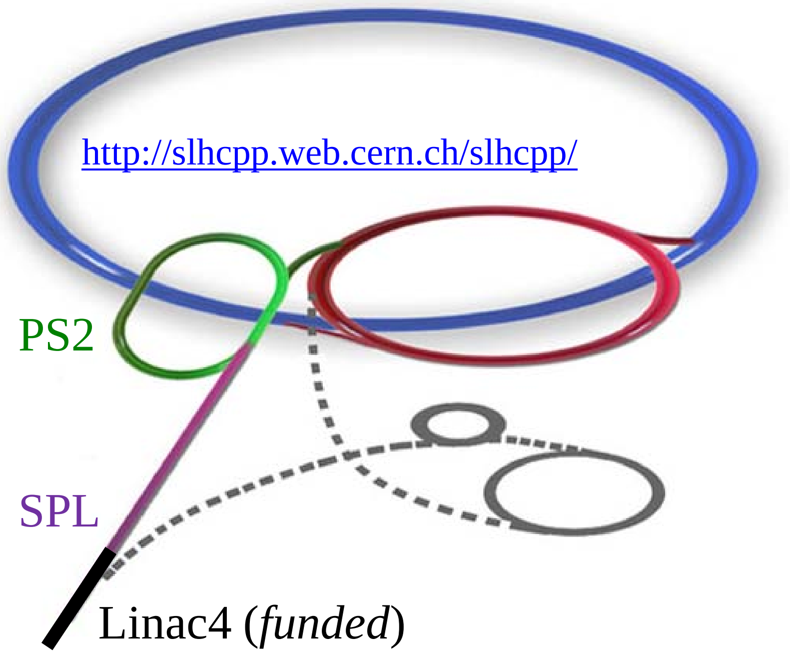
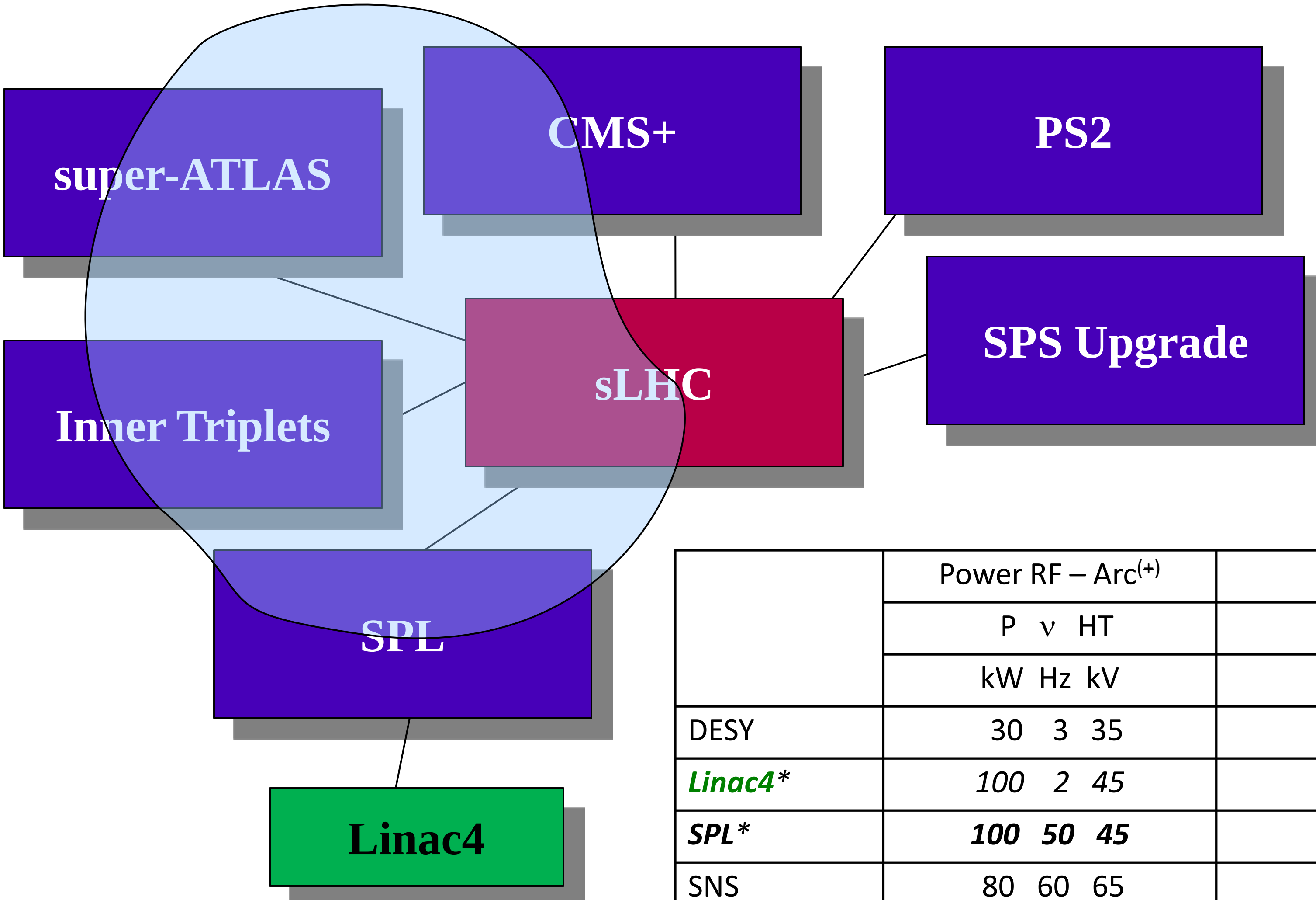


EU project – FP7: ***sLHC-PP***

super-ATLAS and CMS2
Radiation Safety
Inner Triplet Upgrade
Injectors (SPL) – low level RF and H- Ion Source (7.1)

budget (P+M): 15.5 M€, 5.2 M€ from the EU
18 collaborating institutes (10 countries)

SLHC & CERN's accelerators



	Power RF – Arc$^{(+)}$	H^- pulse
	P ν HT	I τ ε
	kW Hz kV	mA ms πμm
DESY	30 3 35	40 0.15 0.25
*Linac4**	*100 2 45*	*80 0.4 0.25*
SPL*	***100 50 45***	***80 1.2 0.25***
SNS	80 60 65	65 0.5 0.25
ISIS	4^{+} 50 35	70 0.25 0.5

SPL H- plasma generator (no HT !)

SLHC-7.1 Schedule and deliverables:

a. 1 April 2008 : Project start

b. 31 March 2009: Report - *Finite element thermal study of the Linac 4 design source at the final duty factor* – Complete

c. 31 May 2009: Report - *List of required improvements for the design of the high duty factor plasma generator to function at a high duty factor* – Complete

d. 30 September 2009: Report - *Design of a high duty factor plasma generator* – Complete, presented at ICIS-09

e. 30 September 2010: Demonstrator - *Construction of the plasma generator and sub-systems* (e.g. 2Hz RF generator, hydrogen gas injection and pumping)

f. 31 March 2011: Report - *Plasma generation and study of the thermal and vacuum conditions*

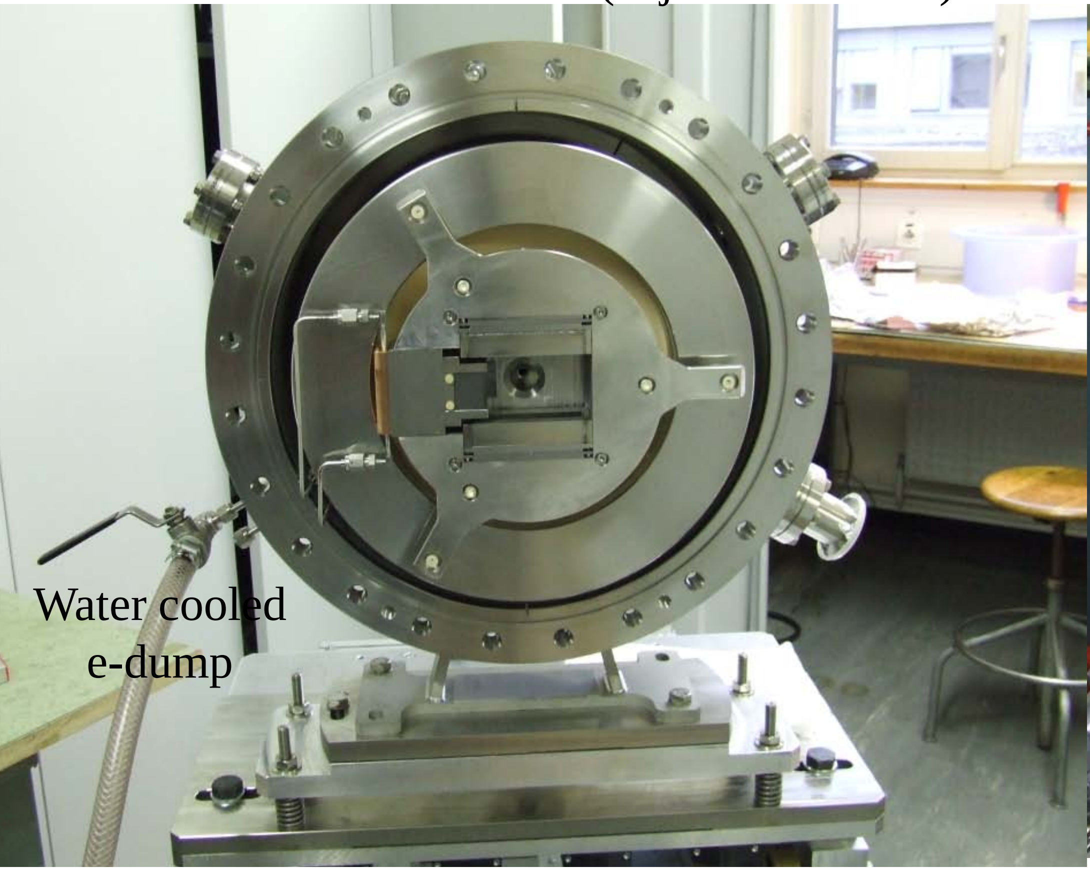
Linac 4 - DESY 2 MHz H^- ion source

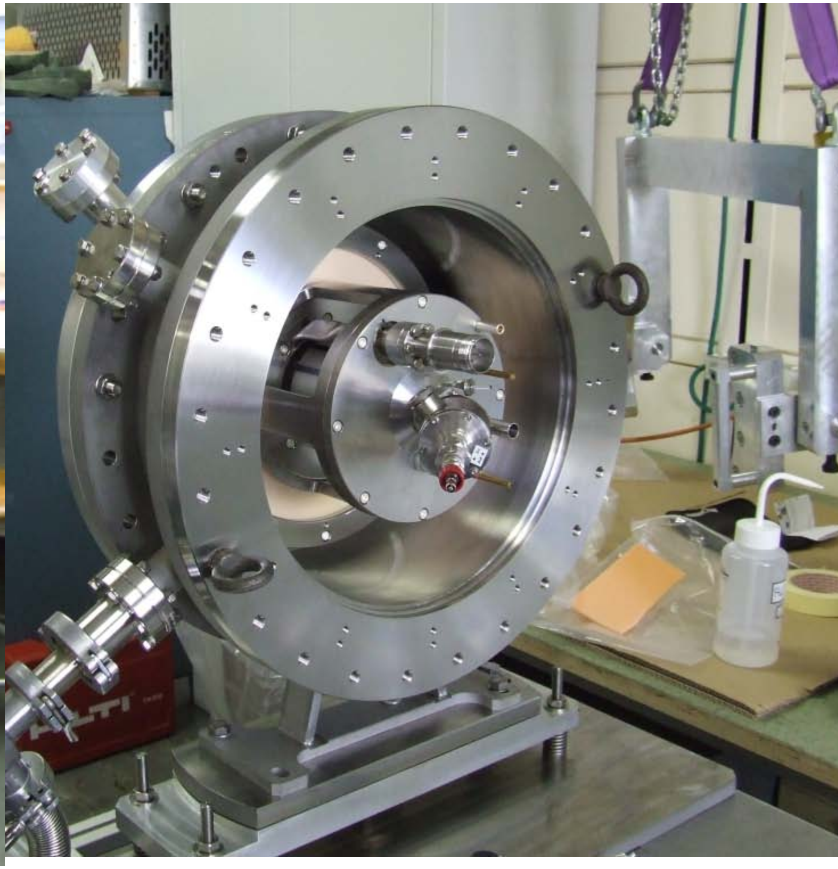
Comissioning at 35 kV, 45 kV by end of the year.

Goal 80 mA H^-

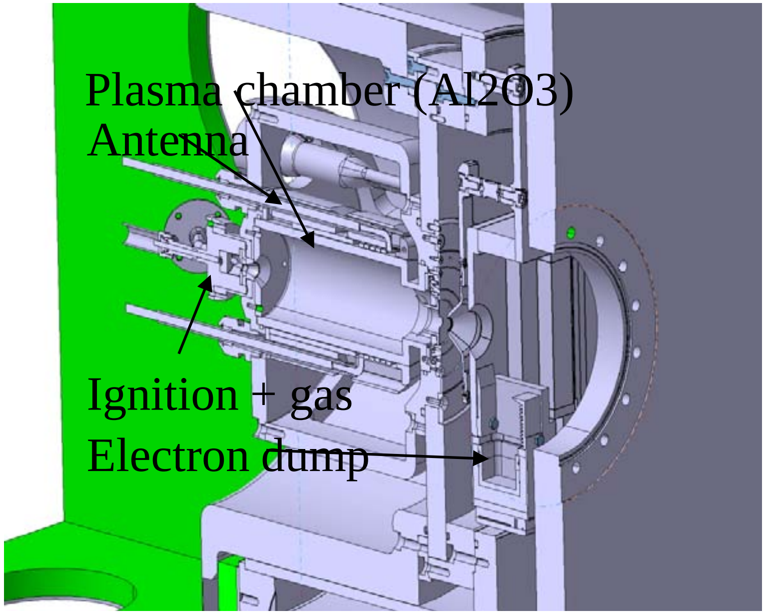
Extraction (adjustable center)

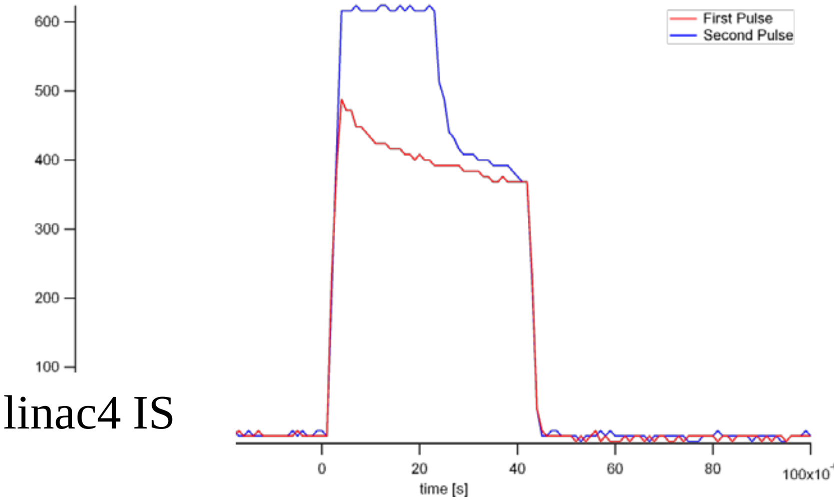
Quartz view of plasma and ignition
Pulsed H2 gas inlet piezo valve
Antenna



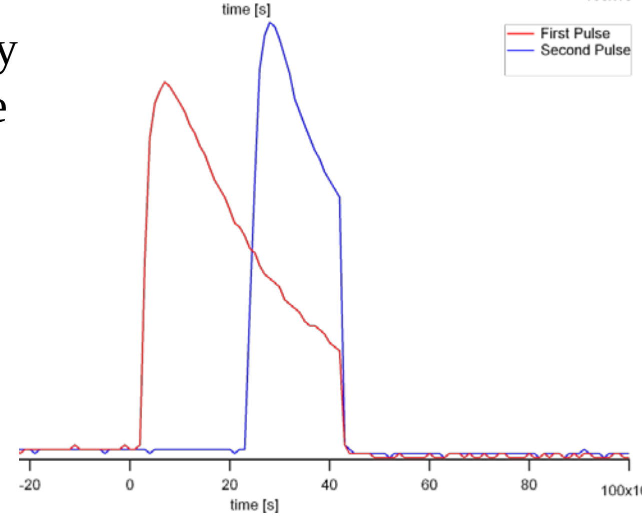


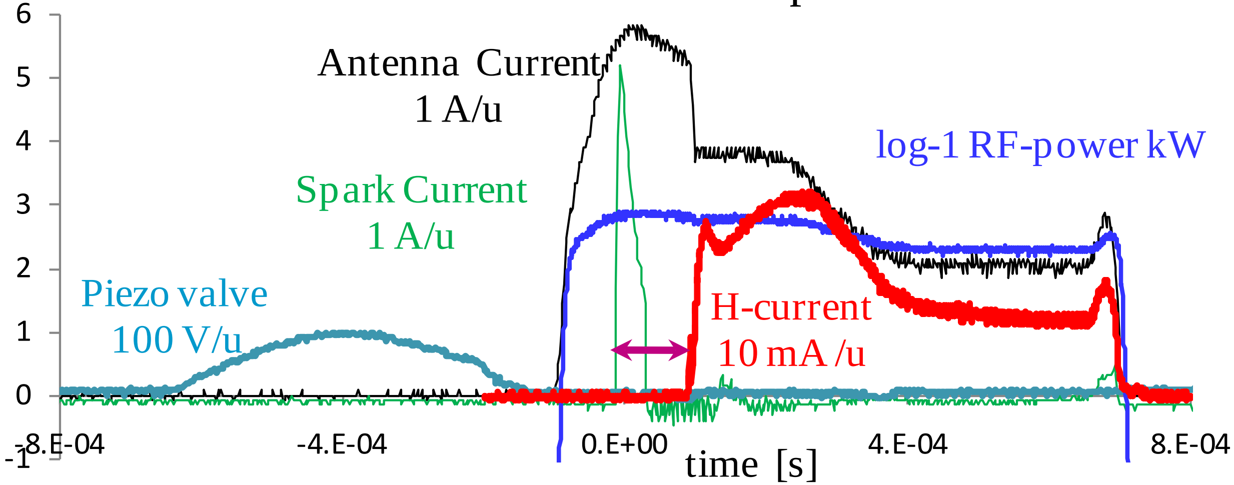
Comissioning of Linac4's ion source





Tests of the linac4 IS @ 50 Hz
"late" ignition was only observed in this double pulse measurement.





Sub assemblies of the SPL plasma Generator

Confinement box
RF-connection
& coupling box

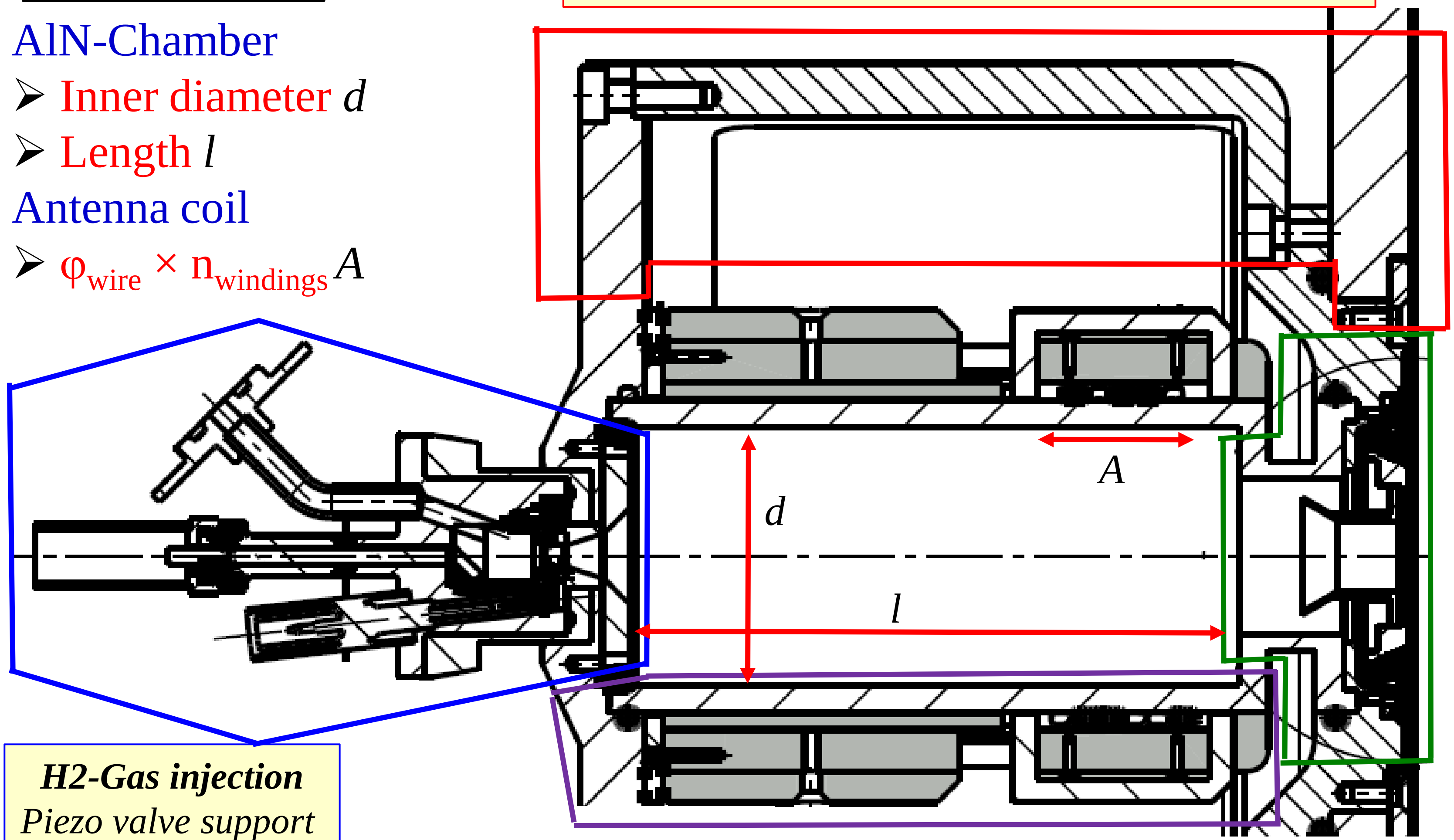
AlN-Chamber

- Inner diameter *d*
- Length *l*

Antenna coil

- $\varphi_{wire} \times n_{windings}$ *A*

***Mechanical support** & coupling to a DN-150 flange*

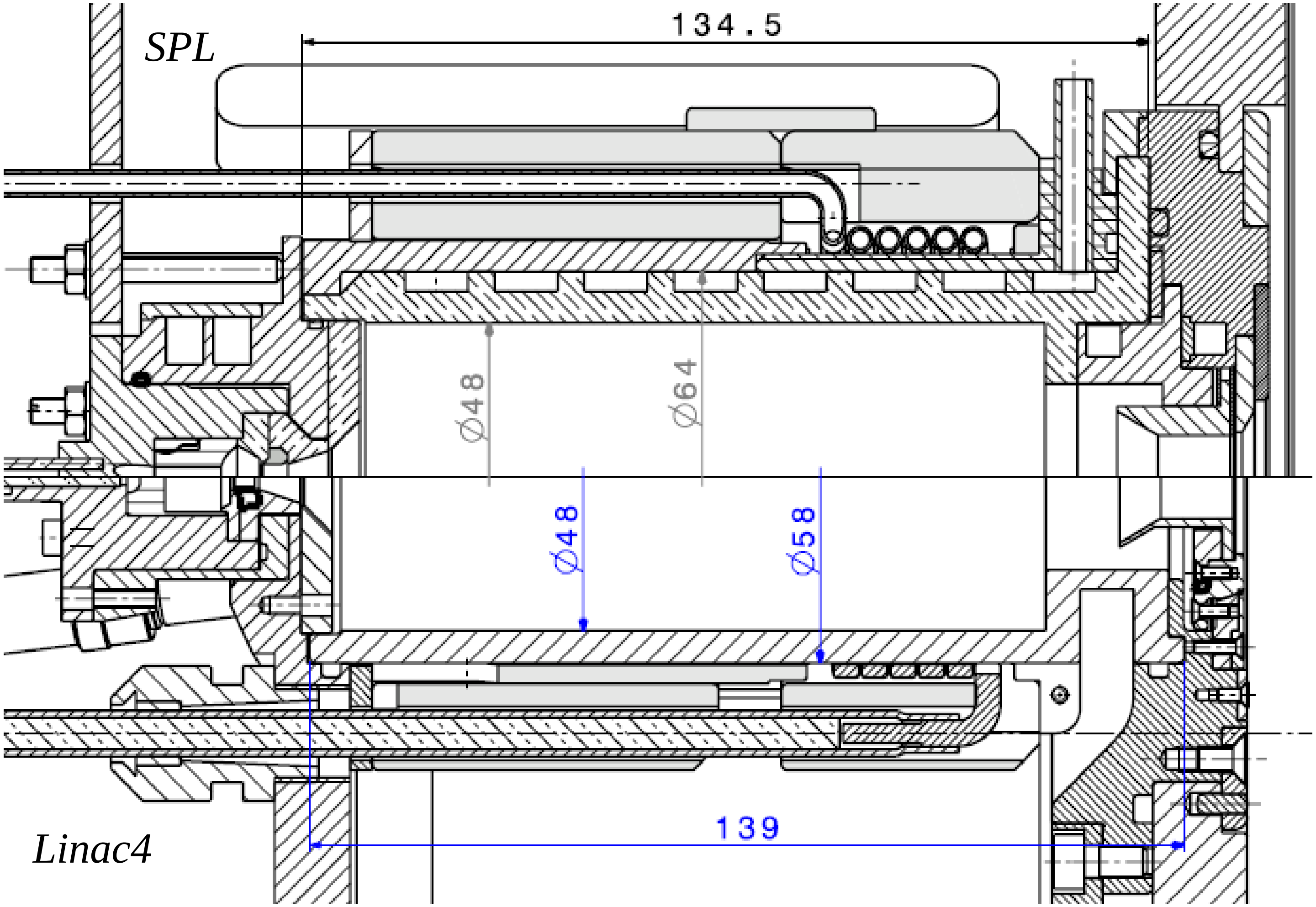


Extraction Region
filter,
collar

H2-Gas injection
Piezo valve support
Quartz light guide
Ignition (e-gun)

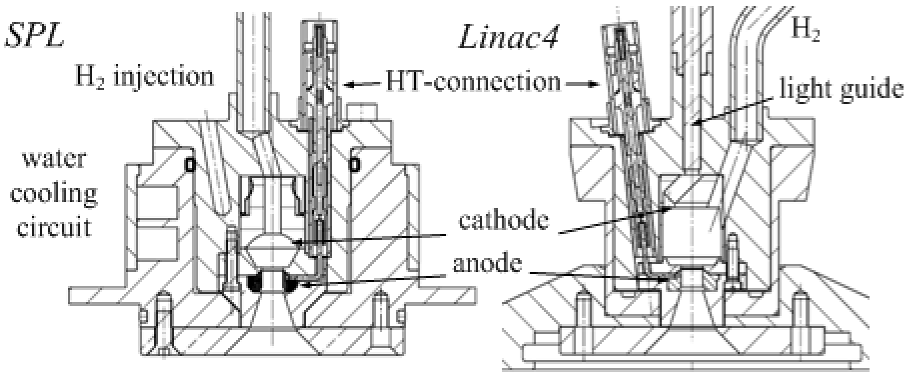
Plasma Chamber
AlN-Chamber, RF-antenna Permanent magnets, ferrite

Linac4-DESY vs. SPL plasma generators

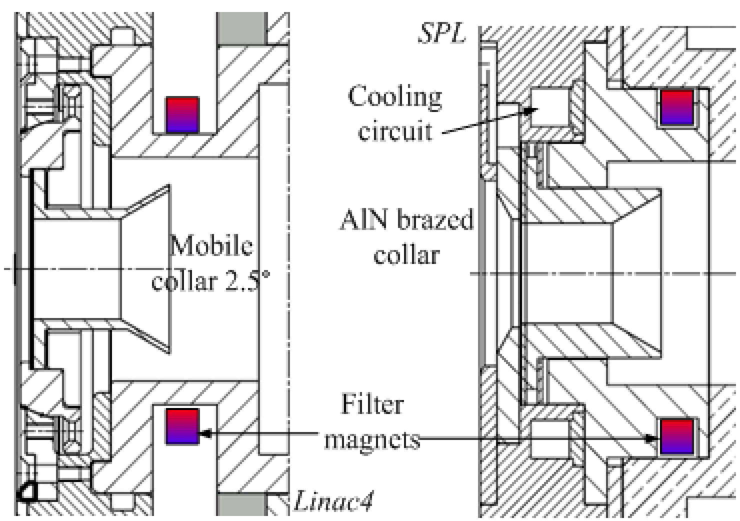


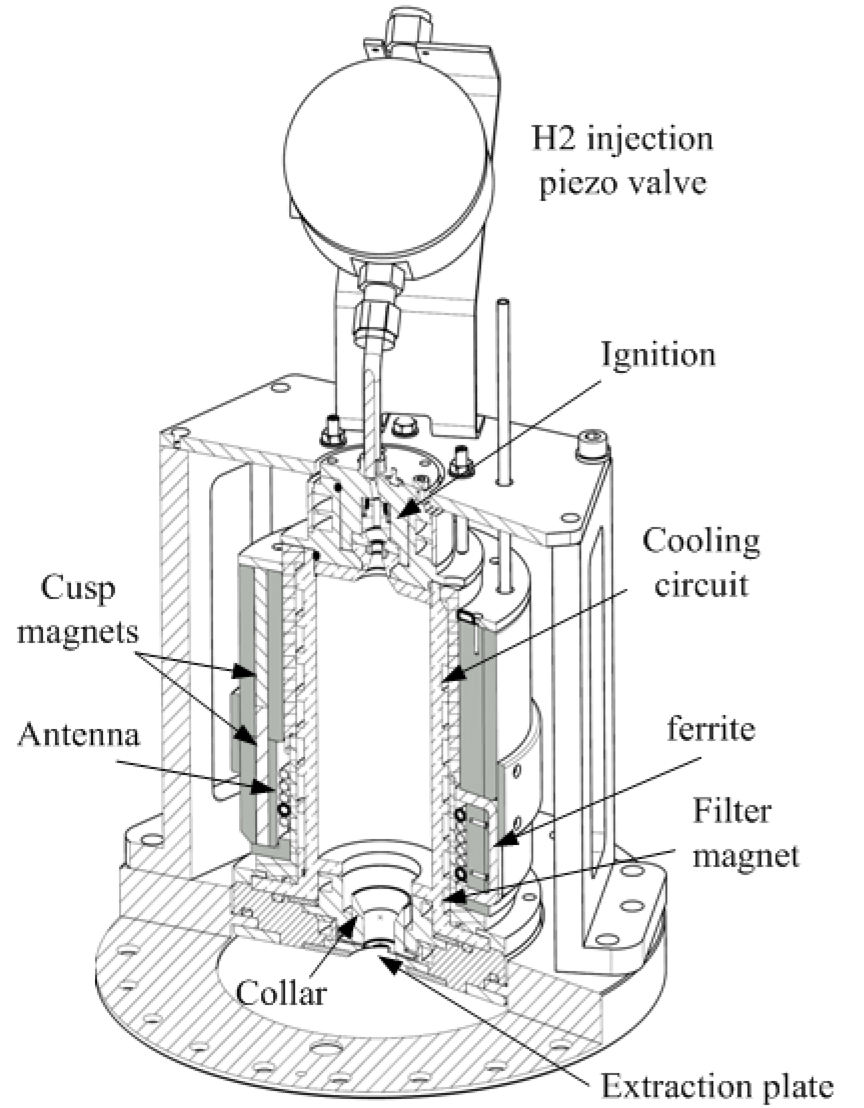
Design of the SPL plasma Chamber

Spark gap ignition



Collar, ion-extraction





Identified challenges

- Narrow ignition parameter space:
  - Gas injection from pulsed to cw
  - e-gun based ignition ?
- Stabilization of the ignition timing
  - Strongly correlated to gas pressure in linac 4
- 2MHz ±10%, heating of the plasma
  - Plasma chamber dimensions
  - Plasma heating antenna # of turns
  - Coupling of 2 ±10%, MHz to the plasma
    - Tunable coupling circuit
  - Measurement technique (flux, current, injected & reflected power)
    - Installed *pearson* current transformer, injected & reflected power
    - Voltage and I-U phase
- Plasma and H^- current stabilization
  - Variable power during the pulse
  - Variable frequency during the pulse
- Effect of the extraction field on the plasma ?
- Insulation of the Antenna
  - Coating with ceramics, plastics
  - Immersed in araldite under vacuum (i.e. magnet)

Summary - Outlook

Start from the DESY/Linac4 concept
Understand the power limitations for high duty factor.
Design and build a plasma generator to accept high duty factor.
This serves as a test bed for further development.

Compile a full energy balance; RF: 80 mA /100 kW $\leftrightarrow$ 1.25 MeV/ H^- ion
efficiency: ratio H^- ion per injected H atom

RF-coupling - I,U,ϕ measurement on the antenna

Plasma: - Measure optical transitions
- Langmuir probe
- H^- density (via laser depletion of H^- & langmuir probe)

? Pos, Neg - Ion and electron densities & Temperature distributions f(t) **?**