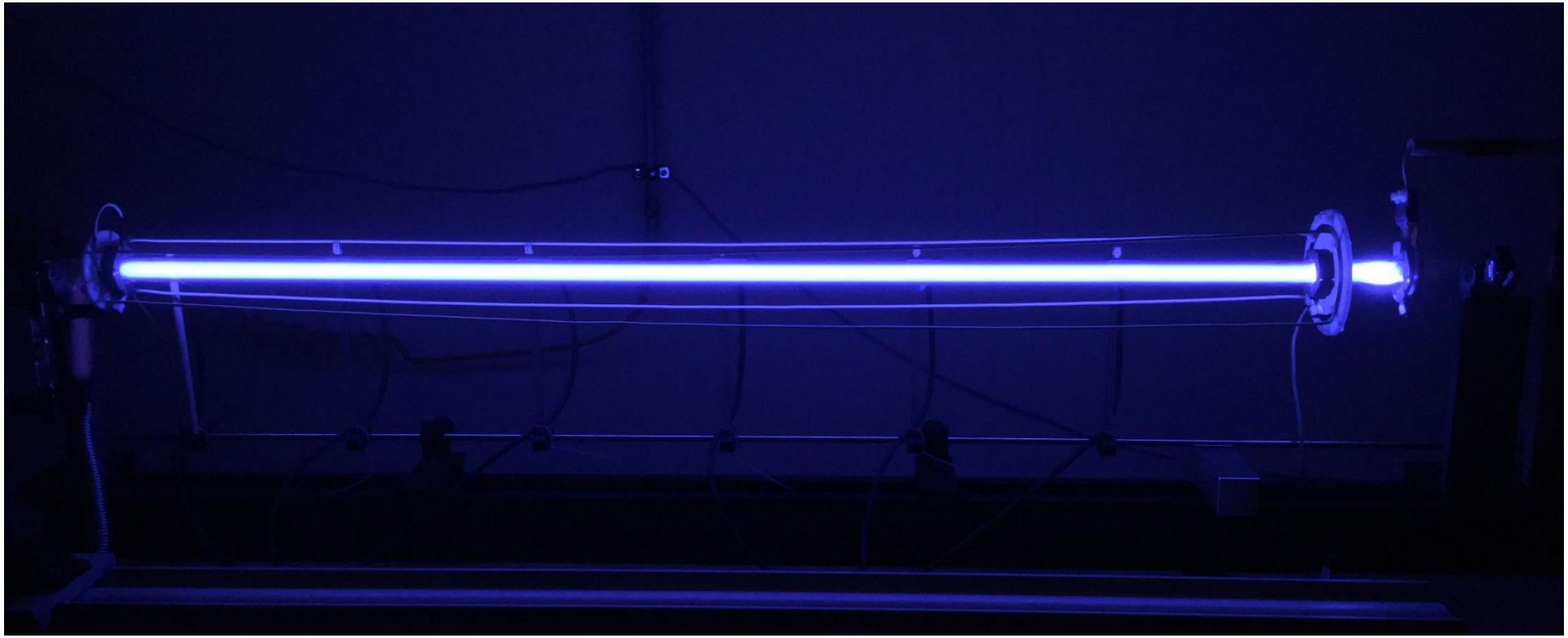
Feasibility of a Discharge plasma source test during YETS2022



A. Sublet, on behalf of TE/VSC and AWAKE project

Zoom meeting 08.12.2021

https://indico.cern.ch/event/1102387/

Today's meeting

Discussion on the feasibility of a DPS test in AWAKE tunnel during YETS-2022

Goal:

- go through the technical and physics objectives → presentations by Patric and Nelson
- assess the preparation work and resources needed for such a test → presentation by Alban + discussion
- highlight open points and limitations → during the discussion
- evaluate its feasibility → based on the discussion outcomes
- define a decision point limit (go/no go date) within the AWAKE project plan. → tbd with project stakeholders

→ No decision today, the idea is to discuss the feasibility and launch the build of a 10 m cell in the lab as close as possible to a possible tunnel configuration.

→ This approach remains within the baseline R&D program on the DPS, irrespective to the test feasibility, with same resources/budget as detailed during the AWAKE CSR from 18th November.

Tunnel test, what do we need?

- **Limited scope project** → “simple” source compared to vapour source, not demanding in terms of facilities (no cooling, no high power, etc.)

- **Needs**:
  1. Risk assessment and safety → DPS team + AWAKE + HSE
  2. Planning/Program → AWAKE experiment and DPS team
  3. Technical preparation, qualification and operation of a 10 m cell in the lab → DPS team (CERN + IST)
  4. Integration, Infrastructure and Installation (AWAKE):
     - Design/fabrication for cell supports, up/down stream interfaces and gas injection/pumping scheme (vacuum, civil engineering, alignment)
     - Transport from lab to tunnel (glass tubes, interfaces, power supplies, etc.)
     - Control and interfaces to operate the system, log data, read diagnostics (electrical, IT, vacuum, etc.)

Decision points:

1. Decision point by AWAKE to endorse this project → AWAKE project go/no go, TEB+PEB 20th January 2022
2. Yes, global resources are available for this plan → CERN to decide by February 2022
3. 10 m cell ready for tunnel test? → go/no go October 2022

1. Risk assessment and safety in the tunnel

- Main risks, based on current lab (169/R-026) risk assessment and experience:
  - Electrical = up to 120 kV microsecond scale short voltage/current pulse + EMI
  - X-ray emission (still to be assessed) = Bremsstrahlung from high energy (up to 120 keV) electron impact on the anode
  - Non ionising radiation (UV, light) = plasma light emission from UV-visible in short intense flashes
  - Others = uses of low pressure noble gases and vacuum in long glass tubes

- Define
  - Safety and Access control during installation/dismantling
  - Safety and Access control during DPS tests without p-beam
  - Safety and Access control during DPS tests with p-beam

→ Need support form HSE + AWAKE safety team to prepare the safety framework of the test

2. Planning/Program

- Main ideas:
  - YETS 2022 (dates to be agreed)
  - During upgrade of the Rb plasma cell to the new density step Rb cell
  - Possibly 3-5 weeks: 1 week installation 1 week operation and data collection, 1 week dismounting

+ see details in Patric’s presentation

3. Technical preparation, qualification and operation of a 10 m cell **in the lab**

→ Get a setup fully functional and tested prior to tunnel test, masteries assembly and operation, remote interface and control.

- Tasks split between CERN and IST: + see detailed presentation by Nelson
  - IST:
    - Development + production of generation 2 pulsed power supplies, specification defined together with CERN → by June 2022
    - Development of double plasma scheme with the possibility to safely operate a 5 m and a 10 m discharge remotely
    - Development of interface and control together with CERN control standard schemes compatible with tunnel infrastructures
  - CERN:
    - Prepare the new lab facilities, get them ready by June 2022 and move the 1.6 m and start assembly of the 10 m setup
    - Order all the components for a 10 m cell (tubes, electrodes, O-rings and clamps, pumps, injection, gas bottles, NEG cartridges, etc.)
    - Design together with TE/VSC and EN/MME the supports and interface schemes
    - Setup of a tunnel grade 10 m cell with design and construction of supports and vacuum interfaces
    - Test long HV cable routing and setup with IST pulsed power supplies
    - Test of pumping/injection scheme (including static pressure operation with NEG pump)
    - Measure plasma density and uniformity as far as possible sharing diagnostics from the HPS

4. Integration, Infrastructure and Installation

- Design/fabrication of the cell supports → EN/MME + TE/VSC
- up/down stream interfaces → TE/VSC
- gas injection/pumping scheme → TE/VSC
- Transport from lab to tunnel (glass tubes, interfaces, power supplies, etc.) → EN/HE
- Cabling, control and interfaces to operate the system, log data, read diagnostics (electrical, IT, vacuum, etc.)
- EMI

→ Need support form AWAKE CP4: Integration, Infrastructure and Installation

CERN/AWAKE Work Packages list

WP	WP Name	WP Leader	Group
WP1	SPS Beam	Heiko Damerau	SY-RF
WP2	Synchronous Clock Distribution and Fast Timing	Ben Woolley	SY-RF
WP3	Laser Synchronisation	Ben Woolley	SY-RF
WP4	Electron LLRF	Ben Woolley	SY-RF
WP5	Proton Line	Francesco Velotti	SY-ABT
WP6	Electron Line	Francesco Velotti	SY-ABT
WP7	Electron Source and High Power System	Steffen Doebert	SY-RF
WP8	Shielding, Dumps	Ans Pardons	EN-ACE
WP9	Supports	Ans Pardons	EN-ACE
WP10	Laser Beam Line	Valentin Fedosseev	SY-STI
WP11	UV laser for e-source	Valentin Fedosseev	SY-STI
WP12	DAQ	Edda Gschwendtner	BE-ABP
WP13	Beam instrumentation	Stefano Mazzoni	SY-BI
WP14	Helicon Plasma Cell @ CERN	Alban Sublet	TE-VSC
WP15	Discharge Plasma Cell @ CERN	Alban Sublet	TE-VSC
WP16	Simulations	John Farmer	BE-ABP
WP17	Magnets	Philippe Schwartz	TE-MSC
WP18	Power Converteres	Gilles Le Godec	SY-EPC
WP19	Vacuum	Chiara Pasquino	TE-VSC
WP20	Interlock	Richard Mompo	TE-MPE
WP21	Mechanical Design	Nicolas Chritin	EN-MME
WP22	Civil Engineering	John Osborne	SCE-DOD
WP23	Cooling and Ventilation	Michele Battistin	EN-CV
WP23.1	Cooling and Ventilation: Design	Alejandro Rodriguez	EN-CV
WP23.1	Cooling and Ventilation: Operation	Jani Lehtinen	EN-CV
WP24	Electrical Services	Mickael Lonjon	EN-EL
WP24.1	Electrical Services: Electrical Systems	Mickael Lonjon	EN-EL
WP24.2	Electrical Services: Cabling	Guillaume Gros	EN-EL
WP25	Transport and Handling	Caterina Bertone, Jean-Louis Grenard	EN-HE
WP26	Access	Vitor Rios	EN-AA
WP27	Fire and Gas	Silvia Grau, Denis Raffourt	EN-AA
WP28	Survey	Jean-Frederic Fuchs	BE-GM
WP29	Ethernet, Wifi, GSM, TETRA	Maryse da Costa	IT-CS
WP30	Control	Marine Gourber-Pace	BE-CO
WP31	Radiation Protection	Claudia Ahdida	HSE-RP
WP31.1	Radiation Protection: Simulations	Claudia Ahdida, Elzbieta Nowak	HSE-RP
WP31.2	Radiation Protection: RP Monitoring	Christelle Saury, Claudia Ahdida	HSE-RP
WP32	DAQ	Giovanni Zevi Della Porta	BE-ABP