



# LOCMAF

a **L**ow **C**ost **M**ulti-use **A**ccelerator **F**acility  
for medical applications

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**PHYSICS FOR HEALTH IN EUROPE WORKSHOP**  
(Towards a European roadmap for using physics tools in the development  
of diagnostics techniques and new cancer therapies)  
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# Outline



1. Motivation
2. CERN strategy for KTT
3. MS and KTT
4. A novel idea?
5. LOCMAF
6. Call for a consortium
7. The INAAF Area at CERN
8. Epilogue



# 1. Motivation

- ❑ The growing **incidence of cancer**, its high **mortality level** and need for progress in the **therapy of patients** are still among the **dominant problems** in our days.
- ❑ Available **statistics** show, about **50% of cancer patients** are treated by **radiation therapy (RT)** using traditional sources (x-ray, gamma, electron beams).
- ❑ According to estimates of the leading radiation-therapy experts, **hadron therapy (HT)** will significantly complement the radiation-therapy so that the **creation of clinical HT centers** represents the **strategy** of development in this field.
- ❑ In addition, the **correct** and **timely** diagnosis of the cancer in patients can be achieved by the **combination** of the **computed tomography (CT)** and **positron emission tomography (PET)**; so that...



**radio-isotope production (RiP)**, of medical interest is needed in most of the countries trying to upgrade the level of their life-science services.



# 2a. CERN strategy for KTT



CERN-Council-S/049 / September 2009

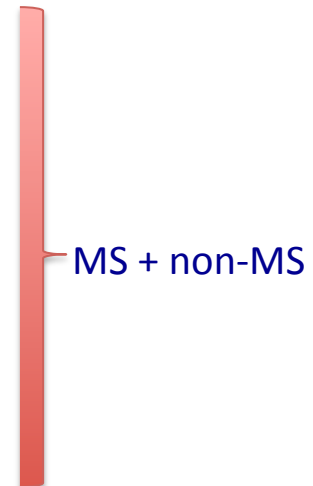
INCREASING EFFICIENCY OF **TECHNOLOGY TRANSFER** ACTIVITIES IN **MEMBER STATES (MS)**  
REPORT ON THE ACTIVITIES OF THE TECHNOLOGY TRANSFER NETWORK WITHIN **THE**  
**FRAMEWORK OF THE EUROPEAN STRATEGY FOR PARTICLE PHYSICS**

The **KTT** has therefore placed a strong focus to promote the **technologies** and **expertise** of the PP community to:

- Society/Industry
- Other research domains

The **KTT** will provide:

- Standardized presentation of technology offers
- Service capabilities
- R&D opportunities currently available



categorized by technology domains with a particular focus on the communication of offers **related to technologies important for the PP community** and for which the expertise is distributed across many organizations.



## 2b. CERN strategy for KTT



- ❖ **Technology offers** will comprise
  - **innovation** features and advantages,
  - possible **applications**,
  - **access conditions** for academic and industry partners.
  
- ❖ **Services** will highlight capabilities specific to PP laboratories that are currently **not provided** by industry and specify the access conditions for academic and industry partners.
  
- ❖ **R&D opportunities** will provide information on:
  - current **developments** of the PP research programmes,
  - organization of the **R&D activities**,
  - possible **participation** of academia and industry to the research programmes
  - **access** conditions to the **results**.
  
- ❖ **Information** on successful **applications** developed by academic partners in other research sectors and on **commercial developments** of industrial partners.



## 3. KTT to Member States (MS)

### CERN COUNCIL : PARTICLE PHYSICS EUROPEAN ROADMAP, LISBON, 2006

The technology transfer from **CERN** to the Member States, not only from the Laboratory's viewpoint but for the benefit of the **Member States** themselves, had led to the establishment of the **Technology Transfer Task Force (TTTF)** after the CERN Council's approval, in **Lisbon, July 2006**, of the **European Strategy for Particle Physics**, which comprised a list of **priority actions** for the field of particle physics in the years to come but a certain number of **complementary issues**, notably **Technology Transfer**.

The **Strategy Statement** which had been produced at the **Lisbon CERN Council Meeting** specifically prescribed a **Technology Transfer Forum** to analyse the keys to success in technology transfer and to make proposals for improving its effectiveness; aiming that the established **TTTF** would achieve those goals, through the sharing of best practice and principles with a view **to the future pooling** of technology transfer resources at CERN and in the **Member States (MS)**.

In addition, the general **KTT strategy** to the MS plays a **key-role** as described in the document CERN/FC/5332, in particular Section 3, presented to the **Council in March 2009** by **C. Parrinello**, creating key tools to implement such a strategy, which are developed in-house at CERN.



## 4. A novel idea?

The proposal: **WE** (Europe or maybe more..) need a **LOW Cost Multi-use Accelerator Facility (LOCMAF)** for medical applications.

An advanced accelerator, possibly **SuperConducting (SC)**, could provide solutions to the medical needs and not only:

- **Hadron Therapy (HT)**
- **Medical Radio-isotopes Production (RiP)**
- **Medical and Biological R&D research (R&D)**
- **Advanced Technological research means (AT)**

**Novelty:** A multi-national effort under the frame of an **Innovative and Advanced Applications Facility (INAAF)** at CERN, can provide TT to the MS and to other cooperating countries!



# 5a. Proposed solution LOCMAF

❖ A **LO**w-**C**ost size advanced **M**ulti-use **A**ccelerator **F**acility (**LOCMAF**) for *protons* or *light ions*, can provide an **ADEQUATE** solution to the cancer therapy and the medical radio-isotopes production.

It can be, also, used for **medical physics research**; upgrading, in parallel the **research facilities** of the host countries useful for other research domains, too, i.e. material science studies, etc.

❖ The **participation** to the **design, construction** and **operation** of a small size advanced multi-use accelerator facility (**LOCMAF**) for protons or light ions and **training** of the personnel during the design, construction and operation, for the **member states (MS)** and **non-MS**; **materializes** the prospected **Knowledge and Technology Transfer (KTT)** concept from CERN to the collaborative partners in an unique, solid and pragmatic way.

❖ It is proposed: the **European Countries**, the **European Commission (EC)** and the **other countries** cooperating with CERN, to efficiently support this kind of organization/project, which can provide them with **the proposed KTT product**, coming exclusively from the **collaborative, fruitful research experience** and the **innovative results, methods and techniques** accumulated over the 55 years of CERN's operation.





## 5b. Proposed solution LOCMAF

Feasibilities studies should be started for the project LOCMAF, which may include innovative techniques and advanced technologies discussed at this workshop for reducing the size of the accelerator:

- ❖ **Electron Cooling** (see abs. No 35 by V. Vostrikov)
- ❖ **Cyclotron-Linac Complex** (see abs. No 65 by A. Degiovanni & U. Amaldi)
- ❖ **FFAG-based Hadron-Therapy Accelerators** (see abs. 8 by D. Trbojevic)

The characteristics of these techniques make them suitable for medical applications, such as Hadron-Therapy. A compact solution would offer significant cost and operation benefits.



## 5c. Proposed solution LOCMAF



A project for a prototype of the “**LOW-COST SIZE MULTI-USE ACCELERATOR FACILITY for PROTONS or LIGHT IONS – LOCMAF**”, describing the design, construction and operation could be proposed for funding to the EU/FP7 and the MS, having proper and tight time schedule for:

- conceptual design report (CDR),
- technical design report (TDR)

The proposed **innovative technologies**, such as **Super-Conductivity**, could be used to reduce the size of the facility and the power consumption (**green energy policy**).



# 5d. Proposed solution LOCMAF



The proposed **fields of training** and **dissemination** :

- Cryogenics
- SC-magnets
- Beam instrumentation
- Beam optics
- Ion-source unit
- FFAG-Gantry (design)
- Radio-Isotope production
- Image processing
- Radio-protection
- Dosimetry
- Clinical applications (HT, RiP)



## 6a. Call for a CONSORTIUM

A **LOCMAF CONSORTIUM** of dedicated group of scientists:

- physicists,
- biologists,
- engineers & technicians

will participate in the project under an agreed **common fund** or **in-kind** contribution framework.



In addition, a group of experts from CERN and MS, will start **training** the personnel that will subsequently maintain and operate a facility in their home country.



## 6b. Call for a CONSORTIUM

### TIME SCHEDULE, COST and Country's POPULATION

❑ The **cost** should be of the order of a similar compatible facility for the same use **HT** and **RiP**, taking into account the additional cost for the necessary cryogenic facility in the case of SC-accelerator.

❑ The **time schedule** should be quite tight, i.e. about **5-7 years** after the financial approval; aiming to:

- complete the facility that is **ready-for-operation**,
- implement the **training** of the local personnel,
- **construct** the LOCMAF building

❑ The **population** for a such facility corresponds to a minimum of **10'000'000** habitants, having in mind various business plans for similar facilities.



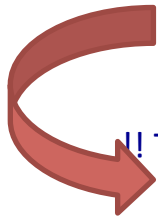
# 7. The INAAF Area at CERN



A **frame** should be established at CERN to host this kind of the proposed activities:

It is proposed the establishment of an **R&D Area** at CERN for **I**nnovation, **A**ccelerator and other **A**pplications **F**acility (**INAAF**), where the studies of:

- SC-magnets
- LINACS for hadrons
- ion-sources
- FFGA tests
- Gas-detectors
- FE-electronics
- Imaging
- Specified S/W
- Gantry design



!! The proposed item by M. Silari's talk, yesterday, is moving in the same line with the present INAAF



## 8a. Epilogue



There are many kinds of acknowledging the Funding Agencies contributing to the CERN budget:

### **A. Acknowledgment of 310 DELPHI publications:**

“... The DELPHI collaboration is indebted to the funding agencies from the many countries participating in this experiment for the generous financial support during the construction of the detector...”

**B.** Acknowledgment of the CERN Council to the MS and the collaborative countries, providing the INAAF area, for innovative products i.e. LOCMAF and NOT ONLY...



## 8b. Epilogue



" ... 'Ὦν ἔστιν γάρ ἡμῖν τοῖσιν τε τῶν φυσίων τοῖσιν τε τῶν τεχνέων ὀργάνοις επικρατέειν, τουτέων ἐστίν ἡμῖν δημιουργοῖς εἶναι, ἄλλων δέ οὐκ ἔστιν. "

Ἱπποκράτης 460-370 π.Χ.

“... there, we can prevail with the help of the physical or the scientific instruments; there we, only, have the possibility to become creators. “

Hippocrates 460-370 BC



*Hippocrates was born around 460 BC on the island of Kos, Greece. He became known as the **founder of medicine** and was regarded as the **greatest physician** of his time.*

*He based his medical practice on **observations** and on the **study** of the **human body**. He held the belief that **illness** had a **physical** and a **rational explanation**.*

*He **rejected** the views of his time that considered **illness** to be caused by superstitions and by possession of evil spirits and disfavor of the gods.*