EUROν
Beta Beams

Elena Wildner, CERN

Outline

- FP7
  - Background
  - Overview
  - Contributions from participants
- Timeline
  - Deliverables/Milestones

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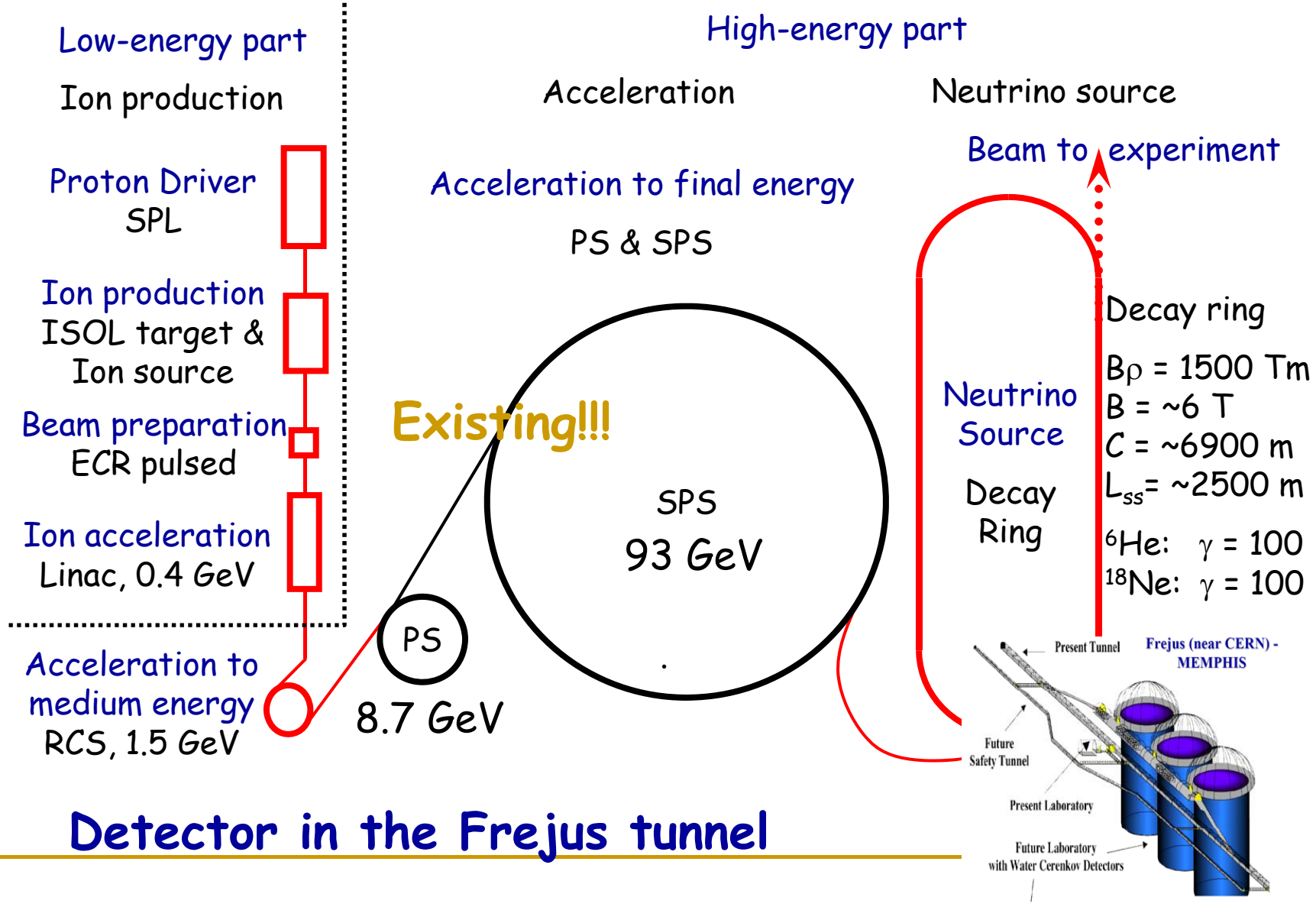
GENERAL INFORMATION			
Project title 3	A High Intensity Neutrino Oscillation Facility in Europe		
Starting date 4	The first day of the month after the signature by the Commission		
Duration in months 5	48		
Call (part) identifier 6	FP7-INFRASTRUCTURES-2007-1		
Activity code(s) most relevant to your topic 7	INFRA-2007-2.1-01: Design studies for research infrastructures in all S&T fields		
Free keywords 8		Neutrino Factory, Super-Beam, Beta Beam	

Abstract 9 (max. 2000 char.)

The recent discovery that the neutrino changes type (or flavour) as it travels through space, a phenomenon referred to as neutrino oscillations, implies that neutrinos have a tiny, but non-zero mass. This implies that the Standard Model of particle physics is incomplete. The implications are far reaching: e.g neutrino interactions may be responsible for the removal of all the anti-matter created in the Big Bang from the early Universe and that the neutrino may have played a crucial role in the birth of the Universe itself. Knowledge of the contribution of neutrinos in these areas requires precise measurements of parameters governing neutrino oscillations, which will require new high intensity neutrino oscillation facilities in which neutrino beams are generated using new and highly challenging concepts. The construction of such a facility in Europe would reassert Europe's position as the lead region for high energy particle physics and it would be in line with the strategy for the future of European particle physics, as recommended by the CERN Scientific Policy Committee. The design study will review the three currently accepted methods to realize such a neutrino facility (the so-called neutrino Superbeams, Beta Beams and Neutrino Factories) and do detailed studies of potential show stoppers, it will define the detector options necessary to measure the neutrino oscillation parameters and it will perform a critical physics evaluation of these facilities. The design study will also perform a cost assessment, that coupled with the physics performance, will permit the European research authorities to make a timely decision on the lay-out and construction of the future European neutrino oscillation facility. Doing this work now will enable Europe to secure the lead in this field. The study gathers some of the top specialists in the field, working at some of the leading institutes in European high energy physics, to assure results within the given time and cost framework.

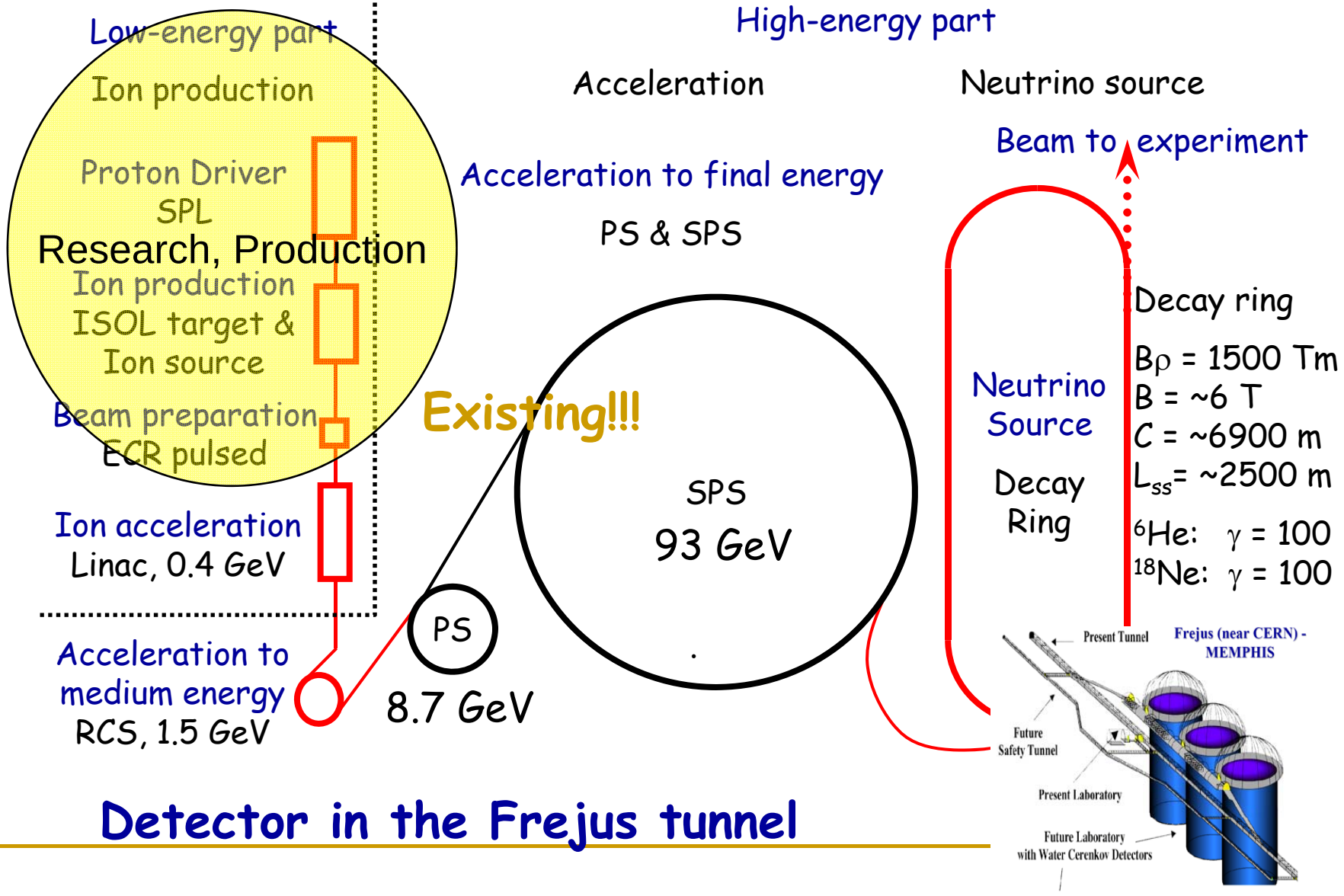
M. Benedikt, A. Fabich, M. Lindroos

CERN Beta Beam scenario



Detector in the Frejus tunnel

CERN Beta Beam scenario



Detector in the Frejus tunnel

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The beta-beam in EURONU DS (I)

- The study will focus on production issues (^{8}B and ^{8}Li)
  - ^{8}B is highly reactive and has never been produced as an ISOL beam
  - Production ring, enhanced direct production
    - **Ring lattice design**
    - **Cooling**
    - **Collection of the produced ions´ release efficiencies and cross sections for the reactions**
    - **Sources ECR**
    - **Supersonic Gas injector**
- Parallel studies
  - Multiple Charge State Linacs
  - Intensity limitations
  - Production methods for 6He and 18Ne
  - Important to recall: Nuclear Physics has not put great interest in ions for beta beams up to now

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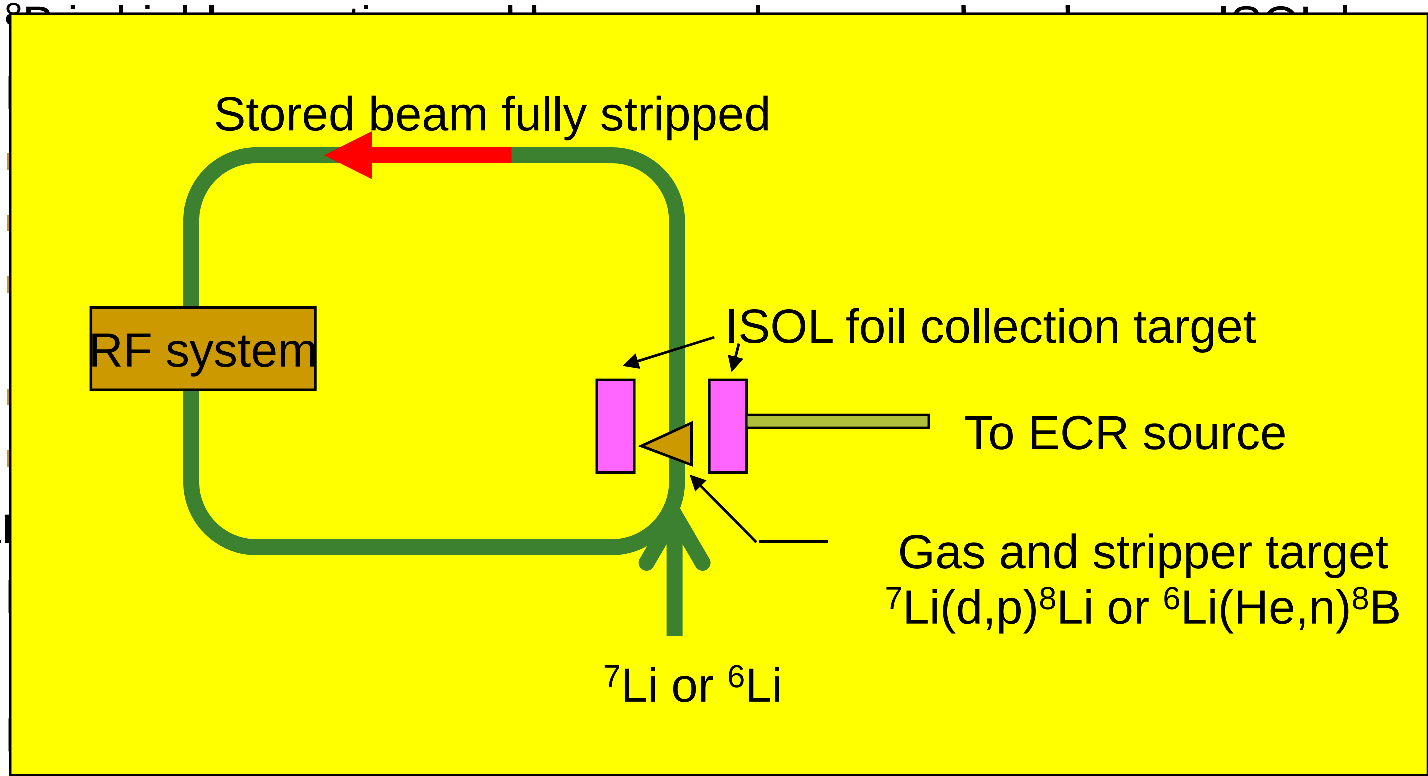

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The beta-beam in EURONU DS (II)

- Optimization of the Decay Ring
  - Lattice design for new ions
  - Open midplane superconducting magnets
  - R&D superconductors, higher field magnets
  - Field quality, beam dynamics
  - Injection process revised (merging, collimation)
  - Duty cycle revised
- A new PS?
  - Magnet protection system
  - Intensity limitations?
- Overall radiation & radioprotection studies

Options for production

- ISOL method at 1-2 GeV (200 kW)
  - >1 10^{13} ^{6}He per second
  - <8 10^{11} ^{18}Ne per second
  - ^{8}Li and ^{8}B not studied
  - Studied within EURISOL
- Direct production
  - >1 10^{13} (?) ^{6}He per second
  - 1 10^{13} ^{18}Ne per second
  - ^{8}Li and ^{8}B not studied
  - Studied at LLN, Soreq, WI and GANIL
- Production ring
  - 10^{14} (?) ^{8}Li
  - >10^{13} (?) ^{8}B
  - ^{6}He and ^{18}Ne not studied
  - Will be studied in FP7

Aimed:

He 2.9 10^{18} (2.0 10^{13}/s)

Ne 1.1 10^{18} (2.0 10^{13}/s)

Courtesy: Mats Lindroos

EUROν

- DS to EC FP7:

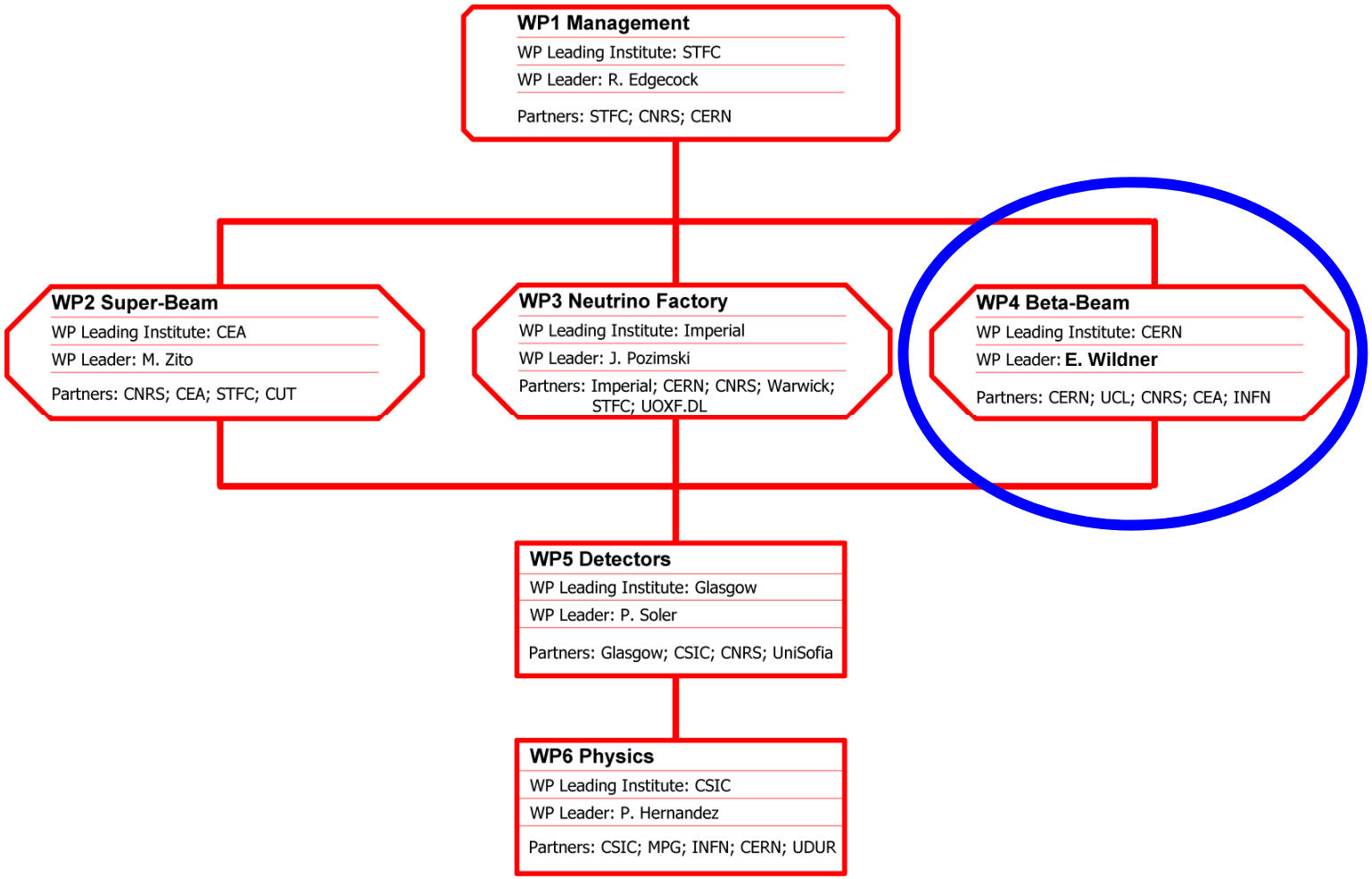
"A High Intensity Neutrino Oscillation Facility in Europe"

- Includes CERN to Frejus SB, NF and BB
- Main objectives:
  - CDRs for each facility
  - Physics and cost comparison
  - Provide information for next step
- Project coordinator: Rob Edgecock

Work Packages (1)

Work package No	Work package title	Type of activity	Lead participant No	Person-months	Start month	End month
1	Management and Knowledge Dissemination	MGT	1	92	1	48
2	Super-Beam	RTD	2	333	1	48
3	Neutrino Factory	RTD	5	282	1	48
4	Beta Beam	RTD	3	295	1	48
5	Detector Performance	RTD	4	178	1	48
6	Physics Reach	RTD	6	217	1	48
	TOTAL			1397		

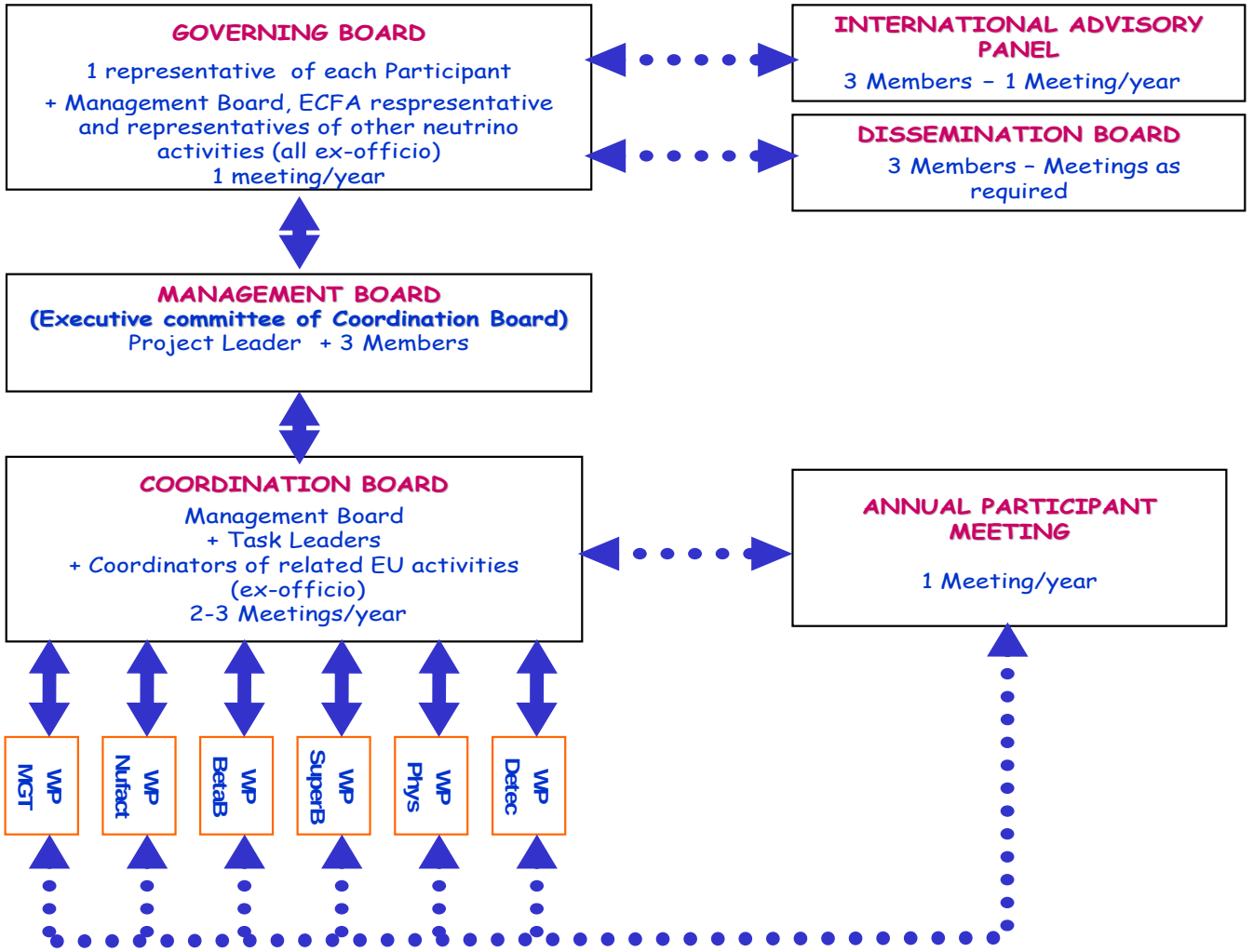
Work Packages (2)



Staff Effort

Participant no./short name	WP1	WP2	WP3	WP4	WP5	WP6	Total person months
1 STFC	**68**	137	78	0	0	0	283
2 CEA	0	**46**	0	34	0	0	80
3 CERN	12	0	74	**80**	0	1	167
4 Glasgow	0	0	0	0	**36**	0	36
5 Imperial	0	0	**84**	0	0	0	84
6 CSIC	0	0	0	0	47	**60**	107
7 CNRS	12	102	12	78	44	0	248
8 CUT	0	48	0	0	0	0	48
9 UDUR	0	0	0	0	0	43	43
10 INFN	0	0	0	18	0	56	74
11 MPG	0	0	0	0	0	57	57
12 UOXF.DL	0	0	6	0	0	0	6
13 UniSofia	0	0	0	0	51	0	51
14 Warwick	0	0	28	0	0	0	28
15 UCL	0	0	0	85	0	0	85
Total	92	333	282	295	178	217	1397

Management


GOVERNING BOARD
1 representative of each Participant
+ Management Board, ECFA respresentative and representatives of other neutrino activities (all ex-officio)
1 meeting/year
INTERNATIONAL ADVISORY PANEL
3 Members – 1 Meeting/year
DISSEMINATION BOARD
3 Members – Meetings as required
MANAGEMENT BOARD
(Executive committee of Coordination Board)
Project Leader + 3 Members
COORDINATION BOARD
Management Board
+ Task Leaders
+ Coordinators of related EU activities (ex-officio)
2-3 Meetings/year
ANNUAL PARTICIPANT MEETING
1 Meeting/year
WP MGT
WP Nufact
WP BetaB
WP SuperB
WP Phys
WP Detec

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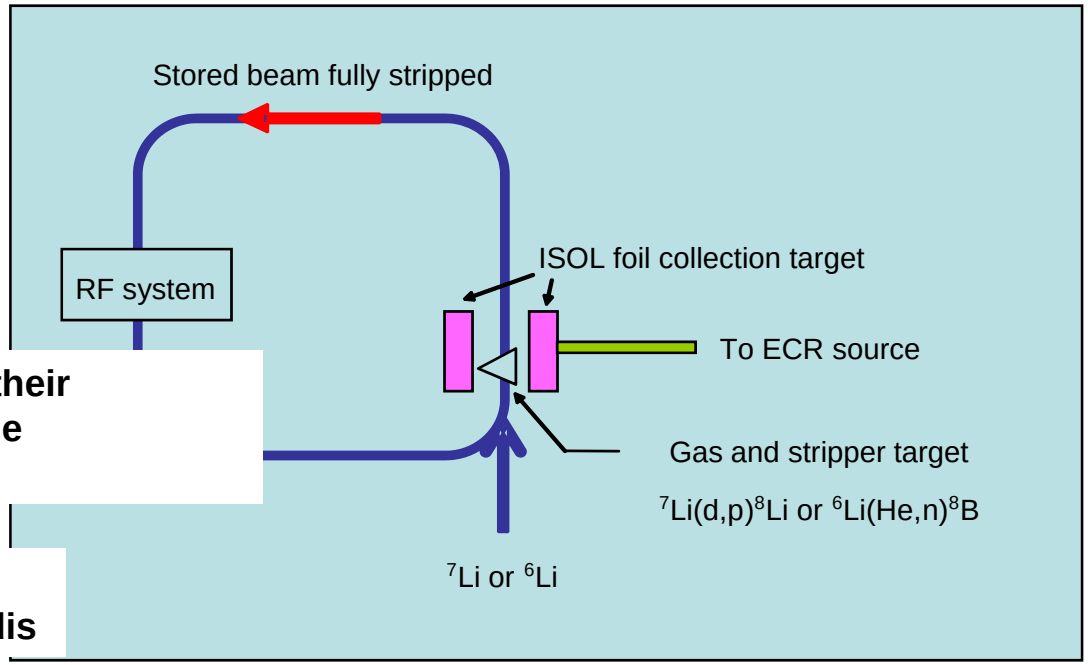
New ions: Production Ring (CERN)

- Gas target or liquid metal film target?
  - Supersonic gas target
  - Argonne National lab. liquid metal film target?
- FFAG or ”classical” ring lattice



“Development of FFAG accelerators and their applications for intense secondary particle production”, Y. Mori

“Beam Cooling with ionisation losses”
C. Rubbia, A. Ferrari, Y. Kadi, V. Vlachoudis

ECR (LPSC, GHMFL)

- 60 GHz ECR for bunching studies ^{6}He and ^{18}Ne contunued for reach of high efficiencies.
- Study and first tests on bunching ^{8}Li and ^{8}B
- Ion source technology (magnetic structures)

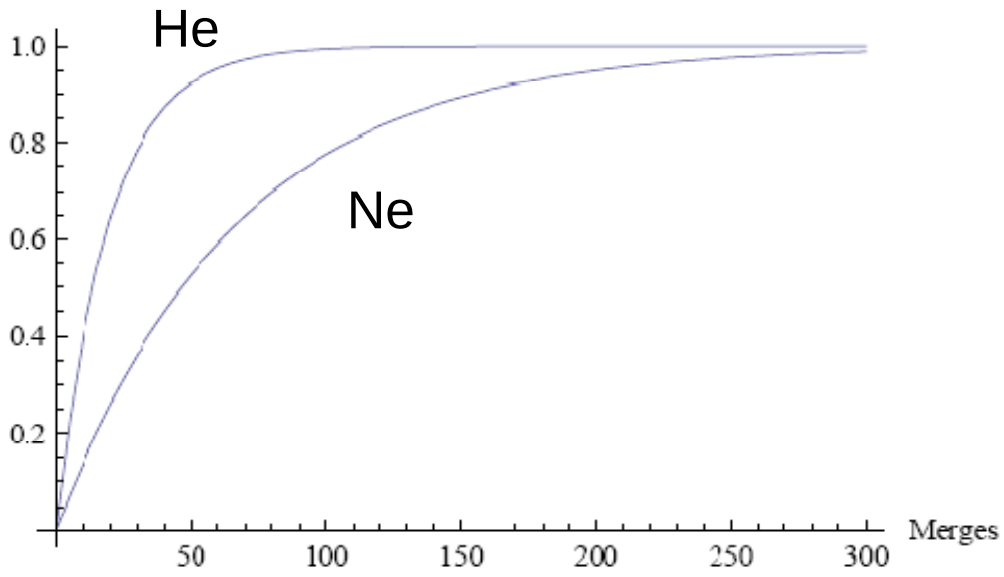
Collection Device (UCL, INFN)

- Prototype of production ring collection device
  - extraction efficiency of ^{8}Li measured
  - ^{8}B extraction tested on-line
- Release efficiencies
- Production cross sections (theory & experiment)

Decay Ring (CERN, CEA)

- New baseline scenario for new beta emmitters
- Superconducting Open Mid Plane Dipoles
- Magnet Protection
- Collimation
- Revise stacking process

Decay Ring, stacking (CERN)



Stacking (dilated life-time) by assymetric merging.

If we can relax on the dutyfactor we can fill the complete Decay Ring and we can use a ”barrier bucket filling scheme” (ref. FNAL anti-protons)”

Other contributions

- Supersonic Gas injector (PPPL)
- Alternative ION collection devices (ANL)
- Beam tracking code ACCIM (TRIUMF)
- Analysis and theoretical work on results at LPSC (The institute of Applied Physics in Nizhny Novgorod)
- Production of 8Li and 6He (Weizmann Institute)
- Beta Beam scenarios at DESY (Phys. Inst. Aachen)

Princeton Plasma Physics Laboratory
Laboratoire de Physique Subatomique et de Cosmologie de Grenoble

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FP7

70	**WP4 Beta-Beam**	**01/01/2008**	**23/12/2011**
71	**Deliverables**	**01/01/2008**	**19/04/2010**
72	Collector device	01/01/2008	19/04/2010
73	**Milestones**	**01/12/2008**	**22/12/2010**
74	Baseline scenario	01/12/2008	22/12/2008
75	Design of collection device	01/04/2009	23/04/2009
76	Lattice frozen for production ring	01/07/2009	29/07/2009
77	New decay ring optics for 8Li and 8B	01/09/2009	25/09/2009
78	Interim report on possible superconducing magnet lay-out	01/12/2009	25/12/2009
79	Full simulation of production ring	01/12/2010	22/12/2010
80	**Staff effort**	**01/01/2008**	**23/12/2011**
86	**Budget request travel**	**01/01/2008**	**23/12/2011**

Conclusion

Ambitious and interesting program !

Thank you for your attention!