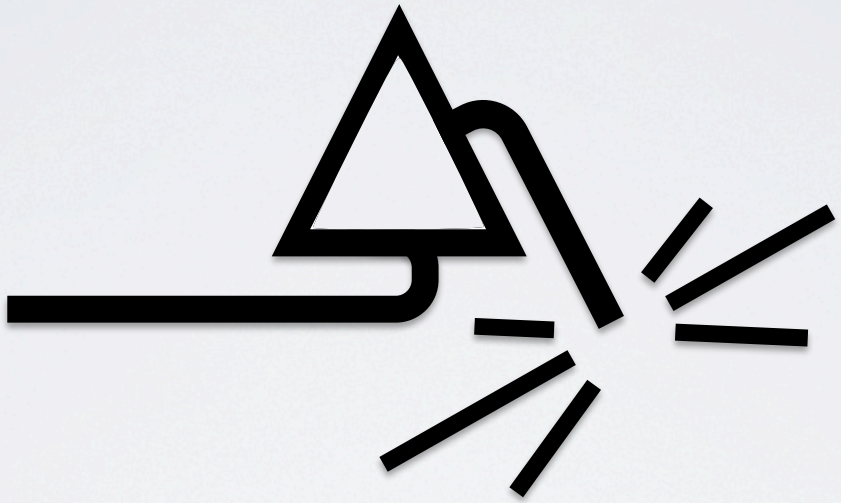
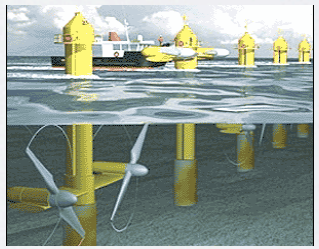


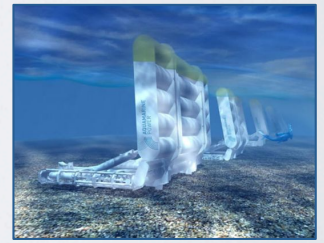
PLANS FOR A **SH**ORT **I**NTENSE **NE**UTRON **S**OURCE (SHINES)

Abel, Cesare, Josu, Mamad

WHY A NEUTRON SOURCE?
AND WHERE?

- To promote science in the developing countries.
- Focus world funding for a science lab in a developing country
- Where to built it?
  - Attractive for the scientists in developed countries
  - Ecologically and economically sustainable
  - Close to Green energy sources
  - Easy to travel to, specially for scientists from developing countries





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REQUIREMENTS

- Power: 1.5 MW
- Energy: 1-8 GeV
- Repetition rate: 50-60 Hz
- Particle: p or H^-
- Pulse length at target: 1 μs

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DESIGN

Optimal Energy: Neutron production is best between 0.5-3GeV.
Use lowest possible energy to decrease costs for LINAC, ring and target

Currents: $P = E \times I_{ave}$:
1.5MW = 1.5mA x 1 GeV *(after LINAC/on Target)*
(1.5 mA = 50 mA x 50 Hz x 0.6 ms)

$N = I_{ave}/q = 1.5mA/1.6x10^{-19} \sim 10^{16}$ / sec
$N_t = N / f = 2 \times 10^{14}$ particles in the RCS stored, it is achievable!

Multi-turn injection (>100 turns) $\Rightarrow H^-$

Parameters	Value
Beam power on target	1.5 MW
Beam energy on target	1 GeV
proton pulse length on target	900 ns
LINAC peak current	60 mA
Pulse rep. rate	600 μs
Beam availability	>98%
LINAC length	236 m
RCS circumference	260 m

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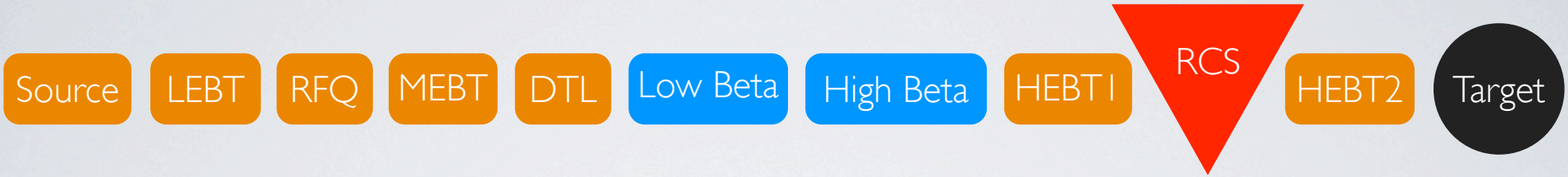
ACCELERATOR



	E (MeV)	F(MHz)	Temp (K)	# Modules	Cavities	L (m)	I (mA)
Source	0.045	--	300	1	-	2.5	60
LEBT	0.045	--	300	1	-	1.5	60
RFQ	3	352.21	300	1	1	3	56.65
MEBT	3	352.21	300	1	3	2.5	56.65
DTL	100	352.21	300	6	6	40	51.5
Low Beta	288	704.42	2	19	38 (0.51)	77	51.5
High Beta	1000	704.42	2	12	72 (0.78)	114	51.5
RCS	1000	1 & 2 & 4	300	1	2	260	eq. 50

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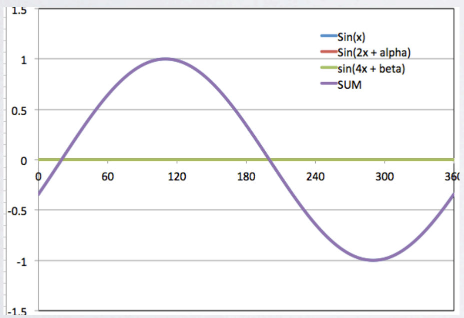
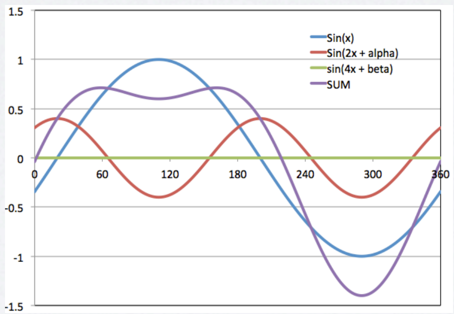
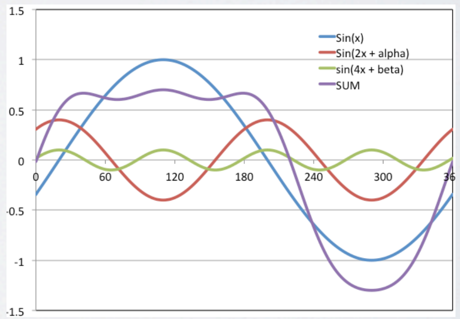
MEBT & CHOPPER

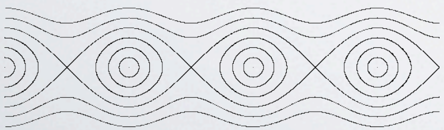
- To match the beam out of RFQ to DTL a Medium Energy Beam Transport is designed.

- MEBT is equipped with a Chopper to remove 36 bunches out of 352 bunches (10%)









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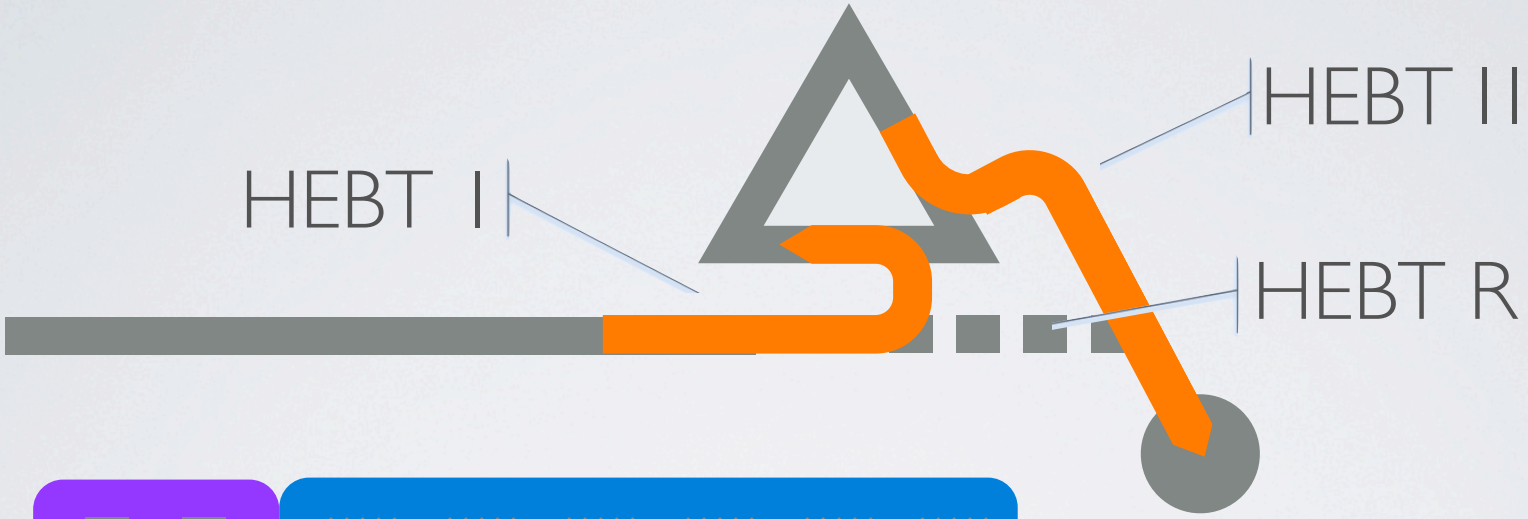
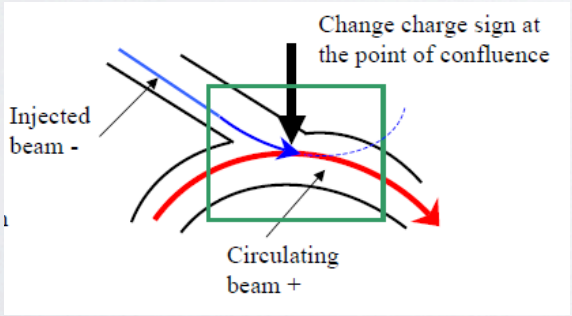
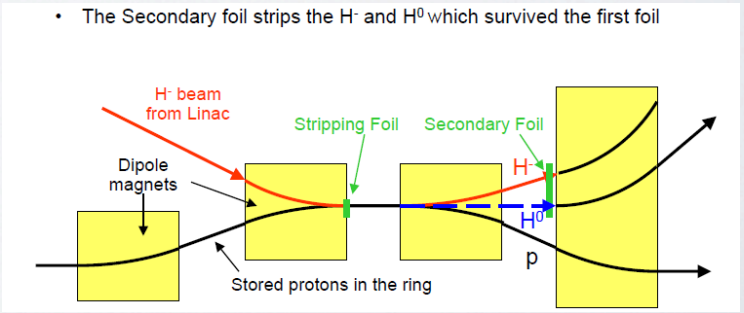
LAYOUT







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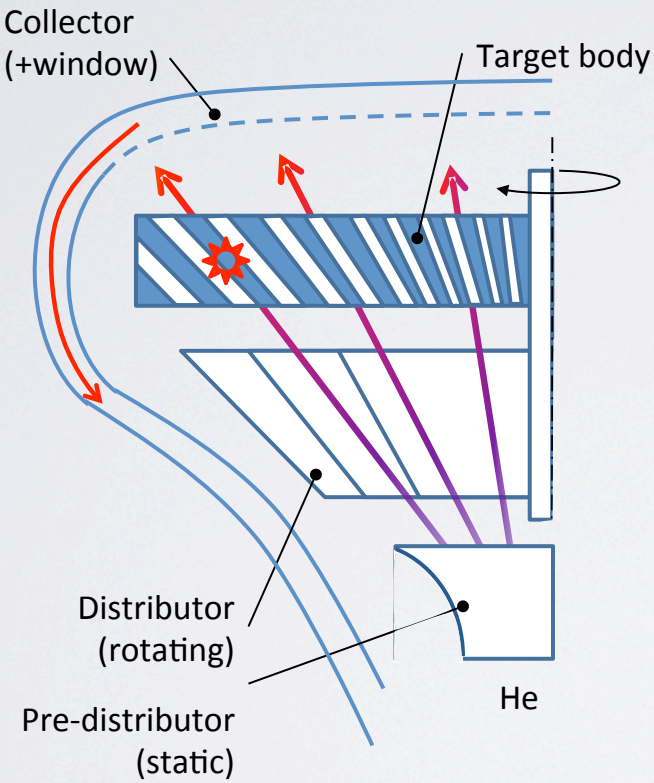
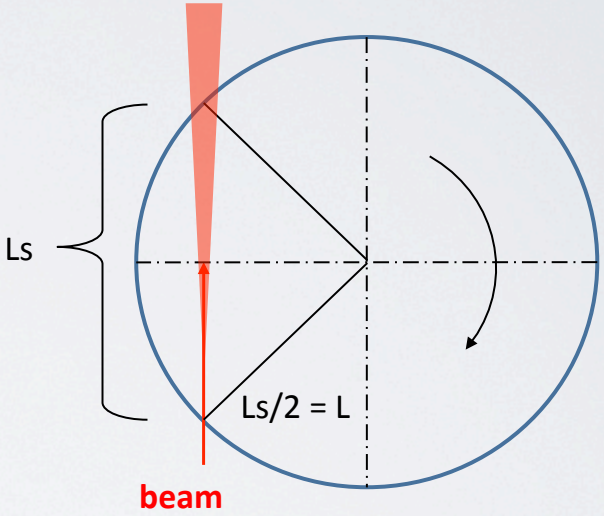
TARGET STATION





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TARGET STATION

- Lead @ E=1.0 GeV L_{min}= 550 mm
- E=1.5 GeV L_{min}=950 mm

Safety factor L_s=L x 2 therefore target radius R_t=Ls/2=L
At 50 Hz revolution frequency of target, $\omega \geq 300\ min^{-1}$
En density peak (at equal material and beam radius)

$e^* \sim E/L$ ==> $e^*_{1.5GeV} \approx 0.75\ e^*_{1.0GeV}$

$\Delta T^* = f(\alpha, e^*, \tau)$ (in 1st approx $\Delta T^* \sim c_p^{-1}, \rho^m, \sigma^4, k^{-1}, \tau^{-1}$)

Stresses/thermal/radiation fatigue
Target material
Liquid to Supercritical He cooling

- A Target designed for short pulse can be used for long pulses

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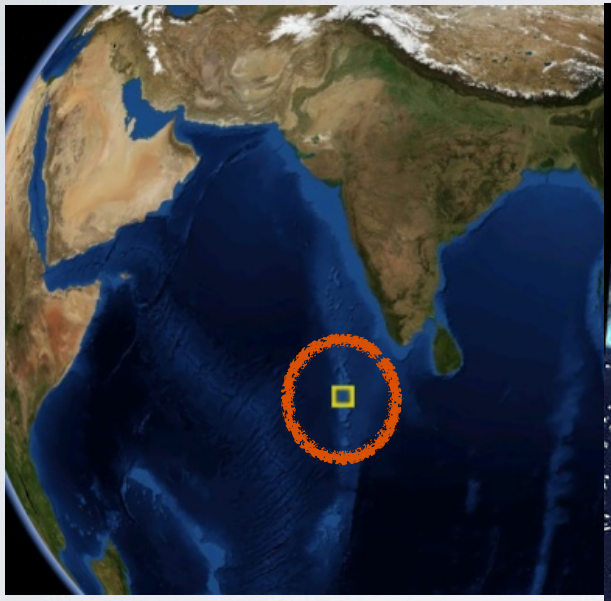
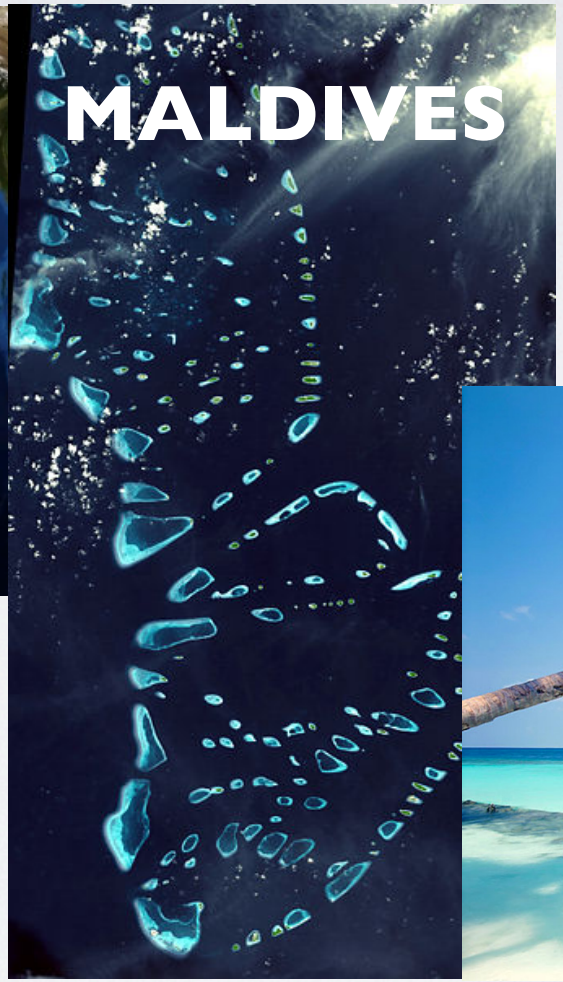
LOCATION?
A POSSIBLE SOLUTION?





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SUMMARY

- A 1.5 MW neutron source using available science/expertise is proposed
- The LINAC is designed to use the energy in the most efficient way
- Proposed lab is based on green energies only

Shines

THANK YOU FOR YOUR ATTENTION