Surging Energy Absorption Through Increasing Thrust And efficieNcy

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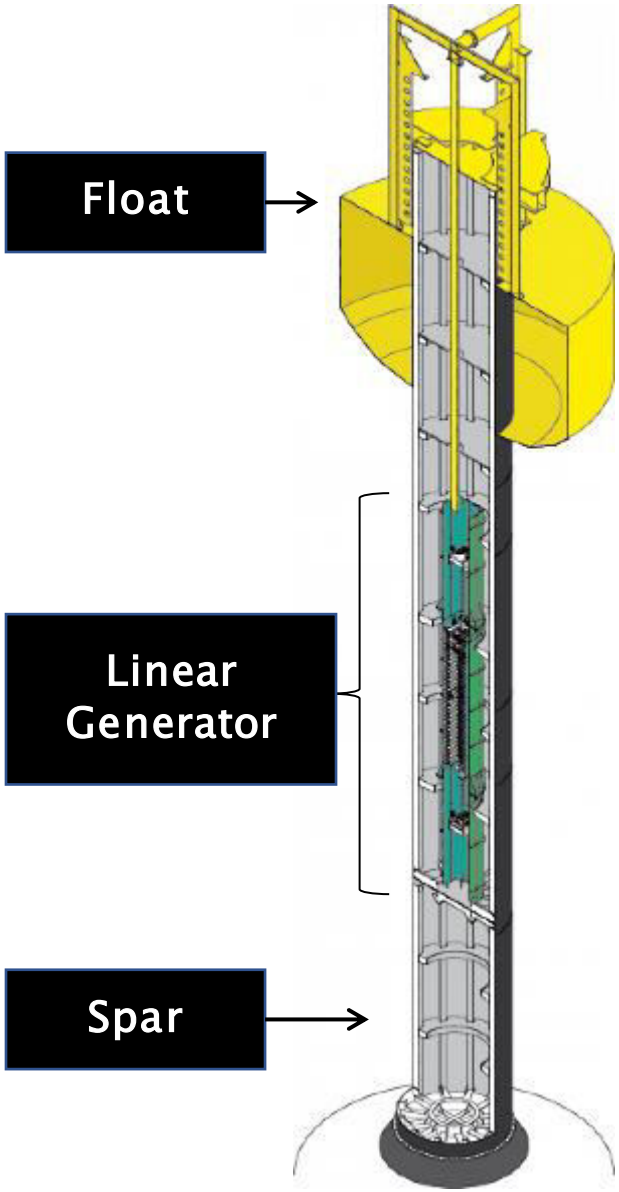
WEDGE GLOBAL

On behalf of the Sea Titan Project

Webinar: Demonstration of wave energy devices and PTO June 11th 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 764014

The Heaving Point Absorber Type WEC



Energy is produced from the relative displacement between the two bodies in the Power Take-Off. A Point Absorber has a small dimension compared to wave length and is able to harvest energy from any wave direction.

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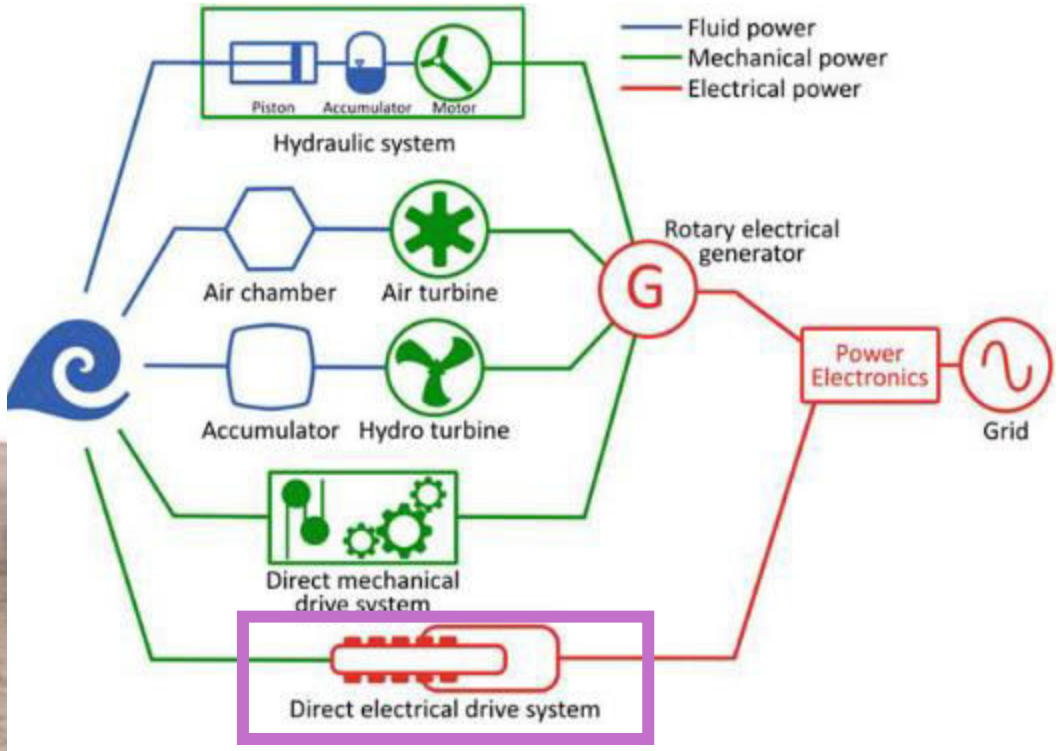
SEA TITAN Background

The project builds upon Wedge Global W200 linear generator power take-off

- Crosscutting technology
- Improved efficiency
- Affordable and reliable



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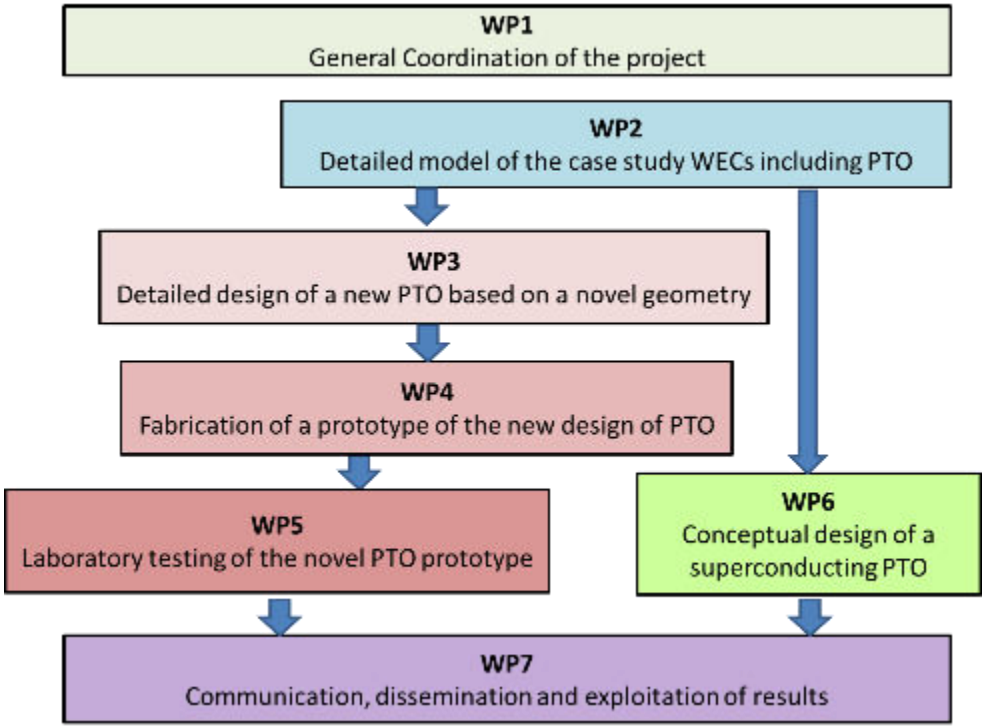
The SEA TITAN Project

GOALS:

- **Development of a new type of PTO based on SRM**
  - Force Density x 2
  - IPCR x2
  - FtWE up to 80%
  - Capex/kW down by 25%
  - LCoE down by 30%

- **Modularity & Crosscuting up to 500 kN & 3m/s**
- **3rd Generation of superconducting PTOs**
- **Bussines models based on "open hardware models"**



	Participant Organization name	Type	Country
1 (C)	Wedge Global S.L.	WEC Developer	Spain
2	CIEMAT	Pubilc R&D Center	Spain
3	WavEC - Offshore Renewables	R6D Center	Portugal
4	CorPower Ocean	WEC Developer	Sweden
5	Centipod LTD	WEC Developer	UK
6	Hydrocap Energy SAS	WEC Developer	France
7	OCEM Energy Technology srl	Power Electronics	Italy
8	ASG	Superconductors	Italy
9	Engie Fabricom	Installation & Services	Belgium
10	EDP Center New Energy Technologies	R&D Center	Portugal
11	Asociación Española de Normalización	Regulatory Body	Spain

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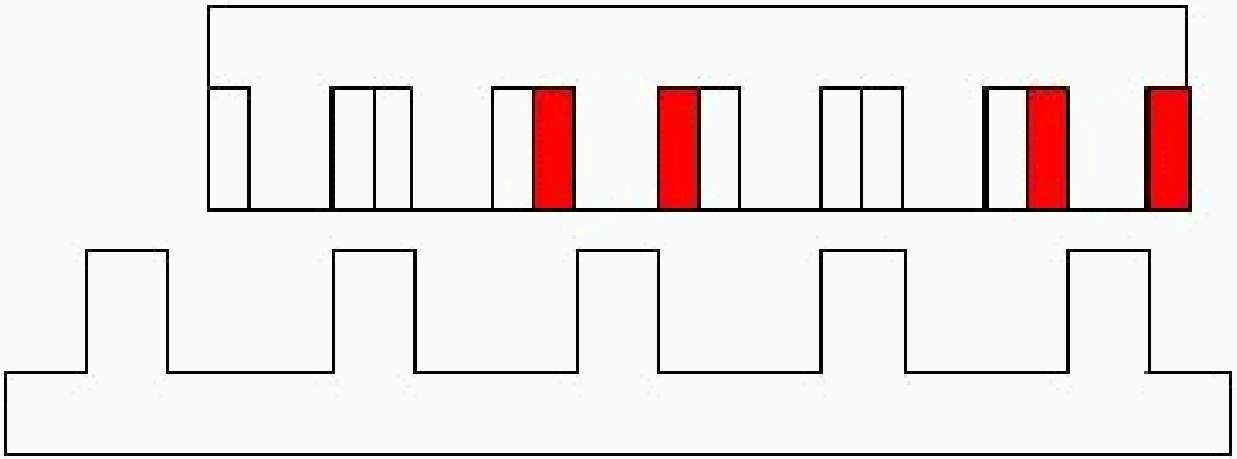
The Principles of the Switched Reluctance Machines

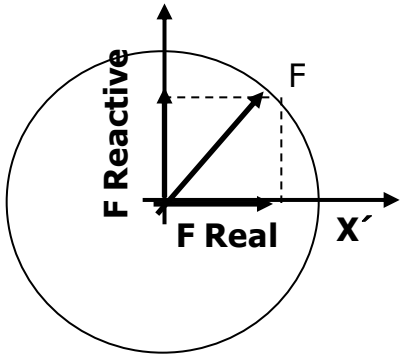
In a A Switched Reluctance Machine (SRM), each phase is activated until the corresponding passive pole is fully aligned, starting from misalignment (motor) or fully misaligned starting from alignment (generator).



$$F = k_s x + k_v \frac{dx}{dt} + k_a \frac{d^2x}{dt^2}$$

SPRING (REACTIVE) VISCOUS (REAL) ADDED MASS (REACTIVE)

$-1 > x > 1 \quad F < 160\ kN$



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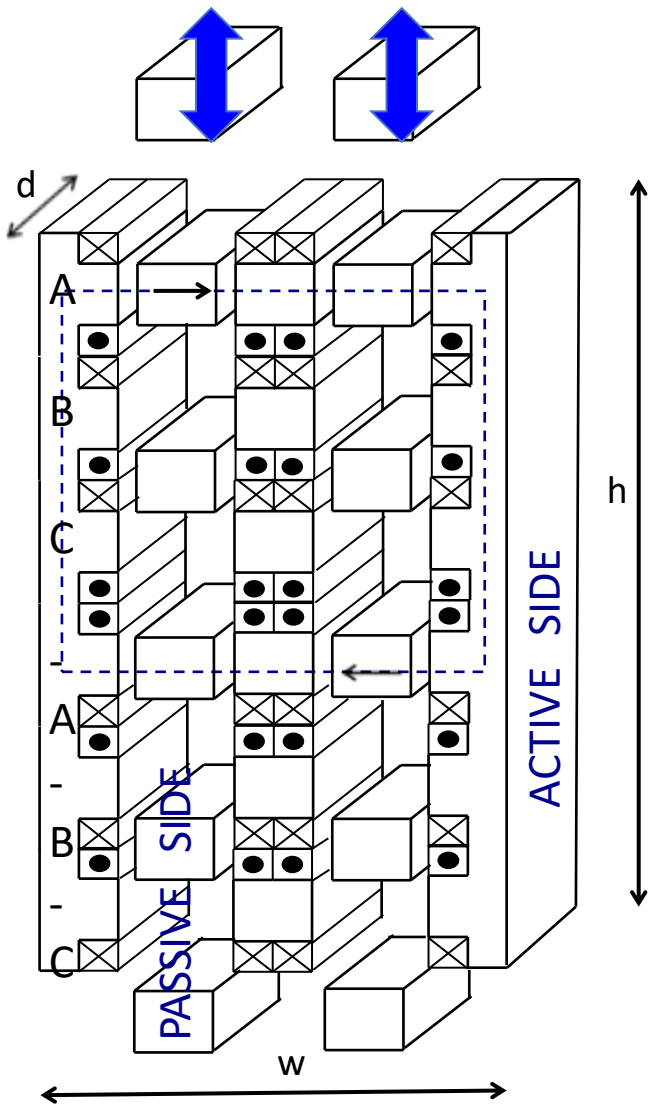
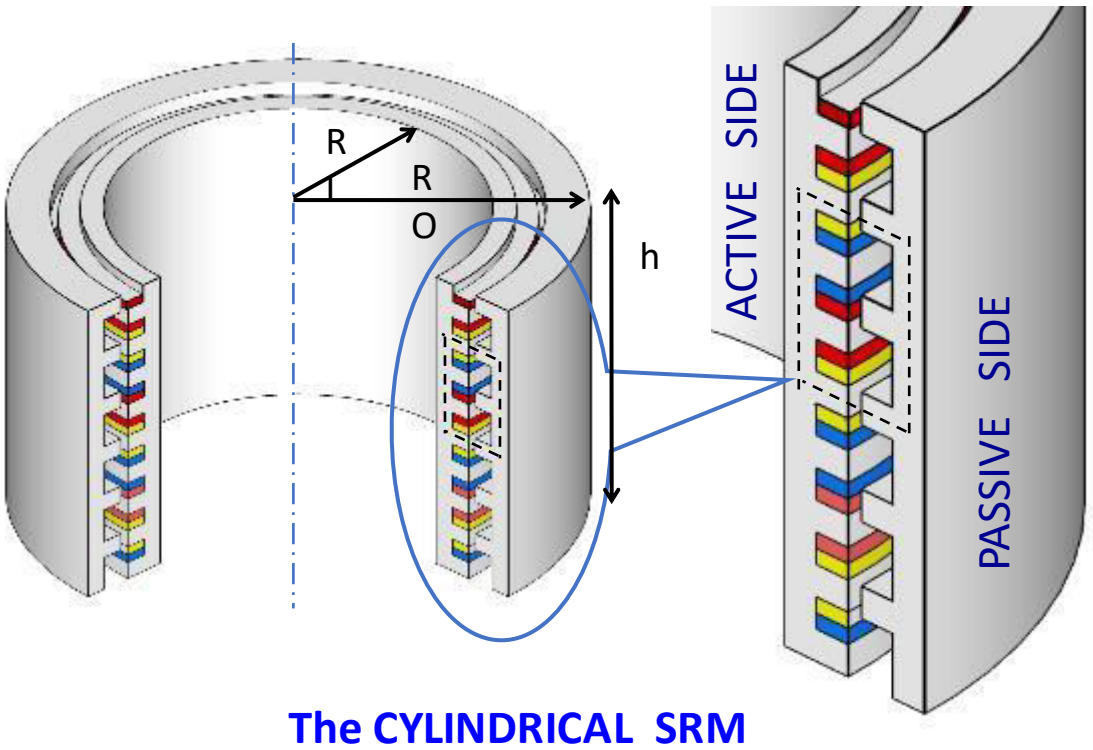
Rectangular & Circular SRMs





The CYLINDRICAL SRM

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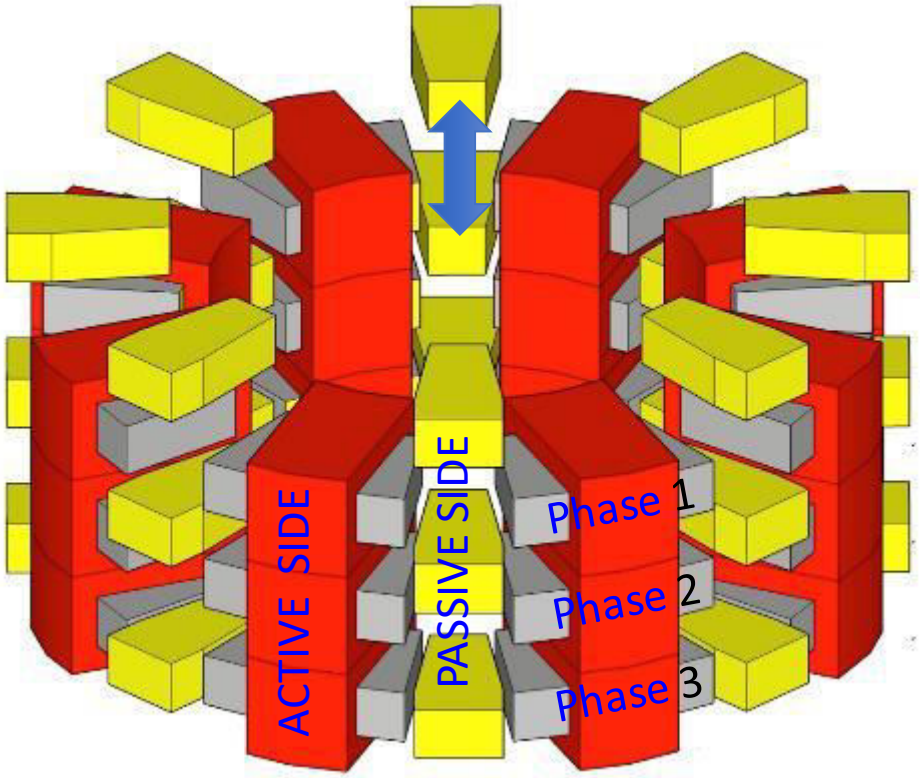
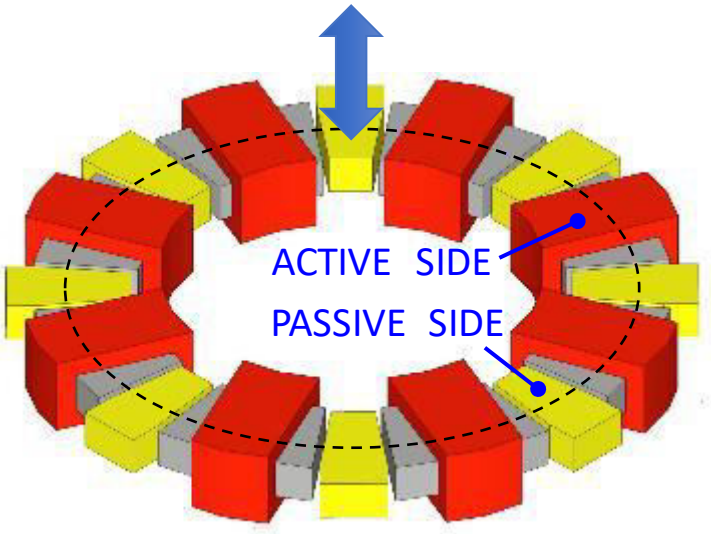
The Azimuthal SRM



The AZIMUTHAL SRM
(3-Phase Arrangement)



The AZIMUTHAL SRM
(1-Phase)

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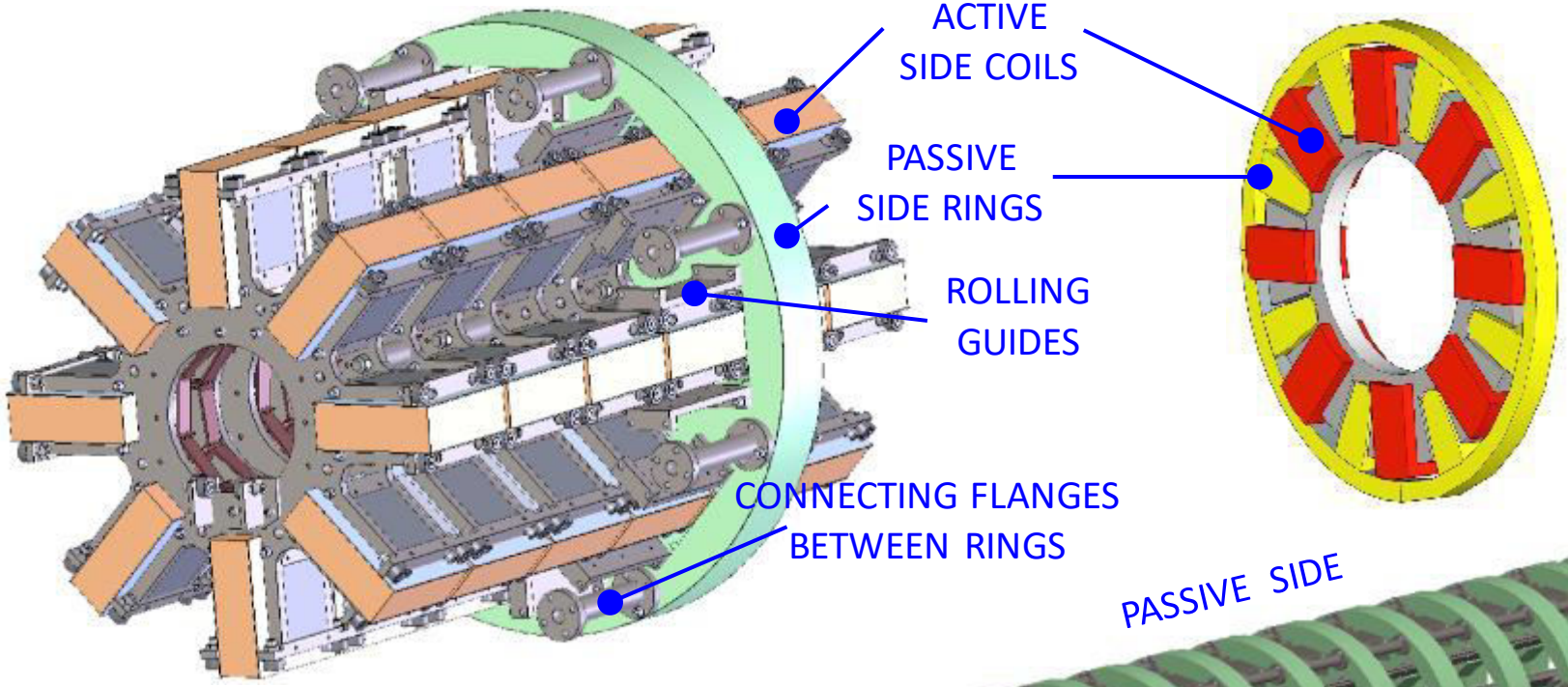
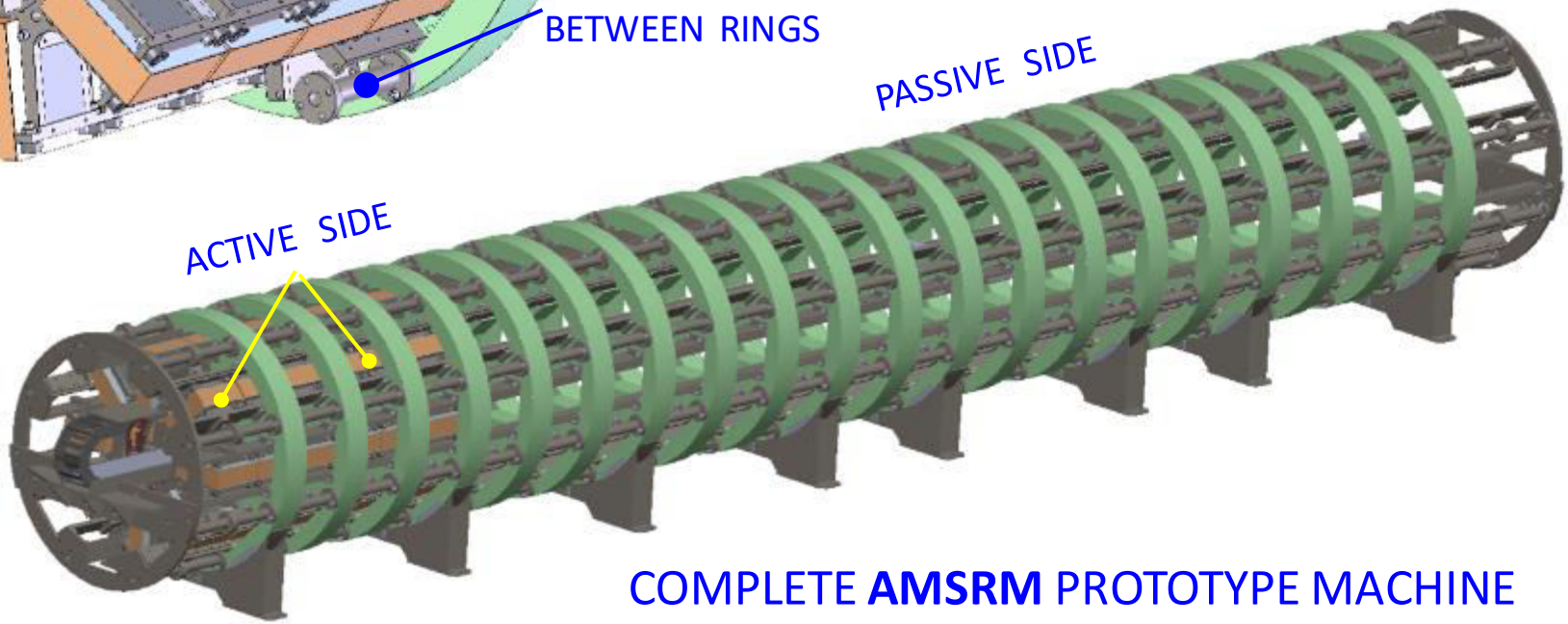
The Azimuthal SRM Prototype Overall Design





COMPLETE **AMSRM** PROTOTYPE MACHINE

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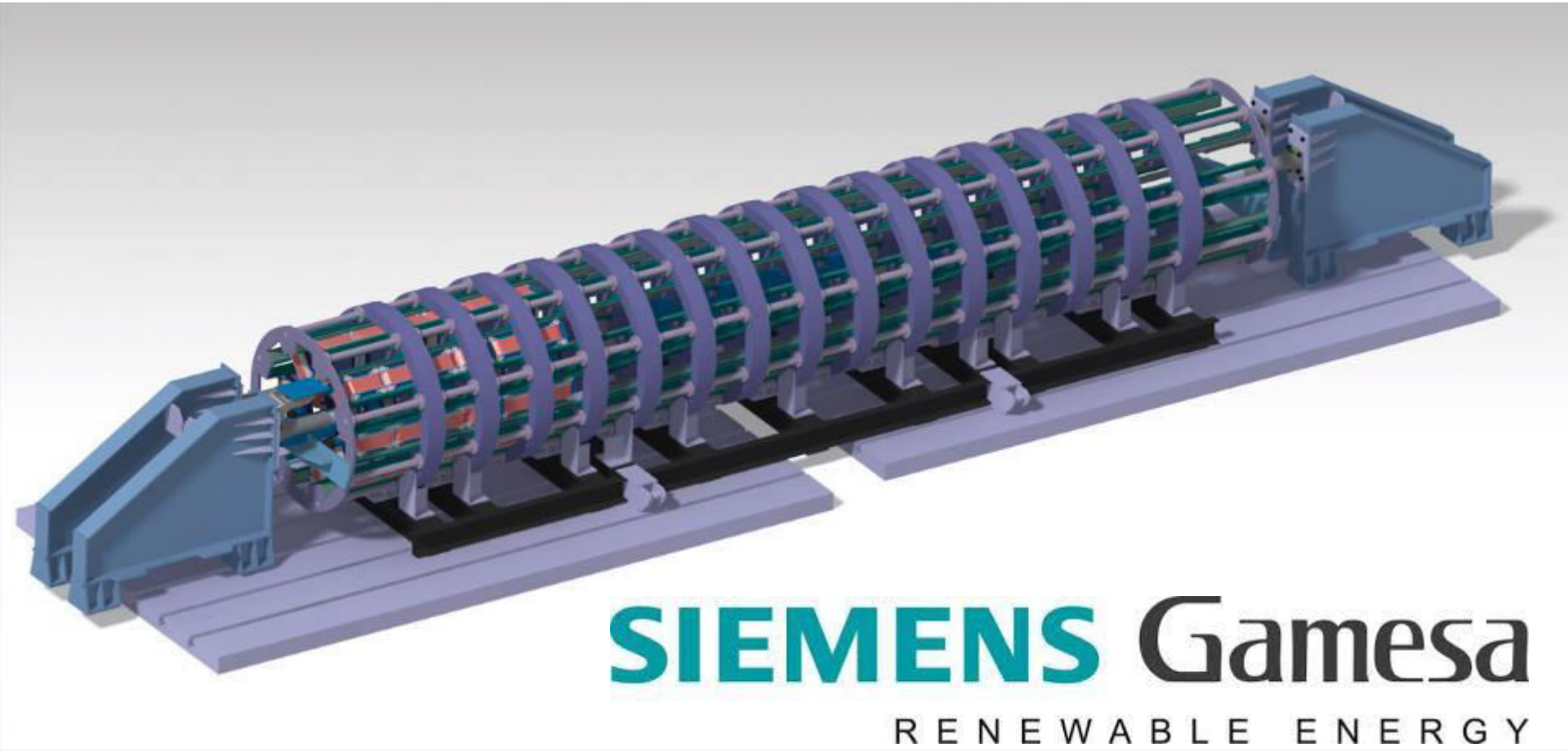
Manufacturing the Azimuthal SRM



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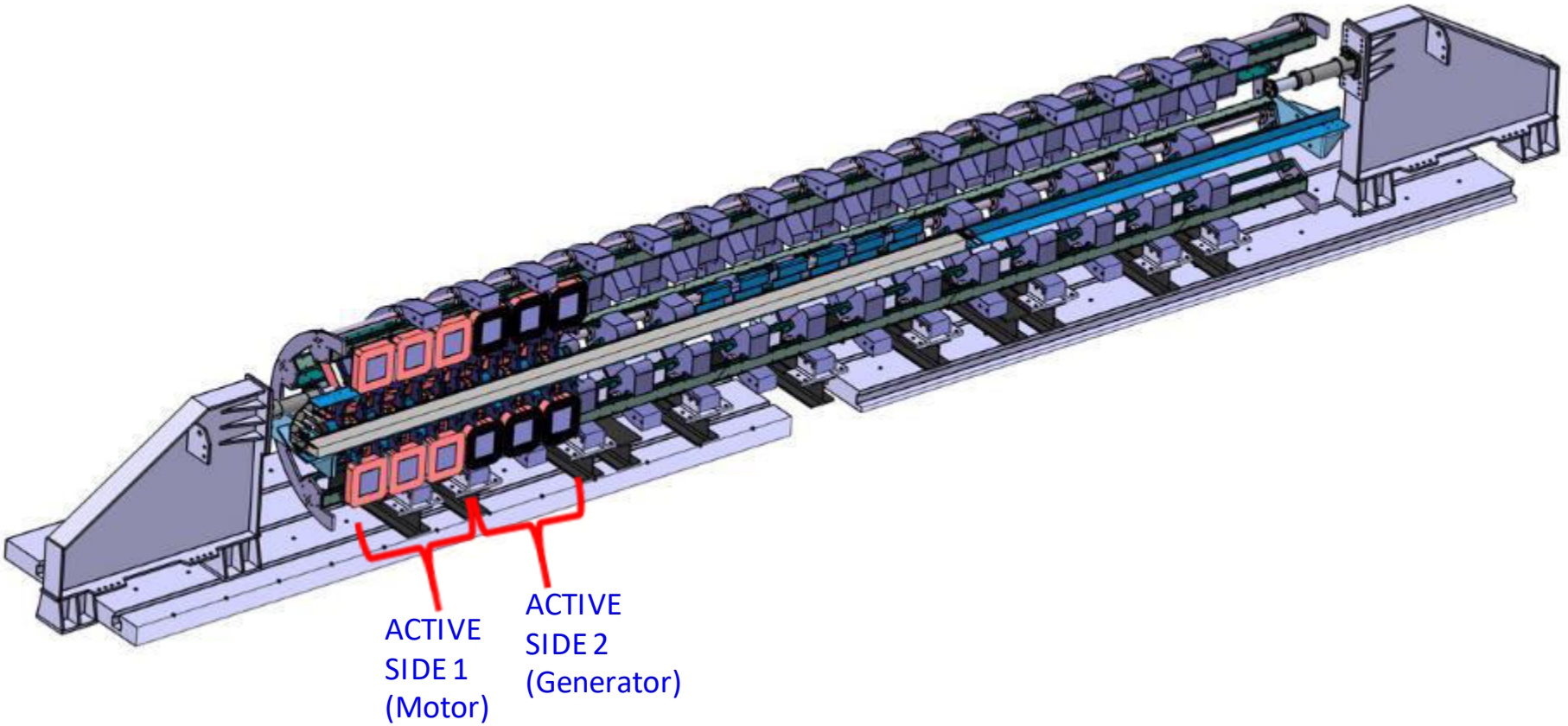
Testing the Azimuthal SRM (I/II)



The PTO will be tested in a Back to Back configuration in which one of the machines acts as a generator and the other as a motor, both driven by an independent converter.

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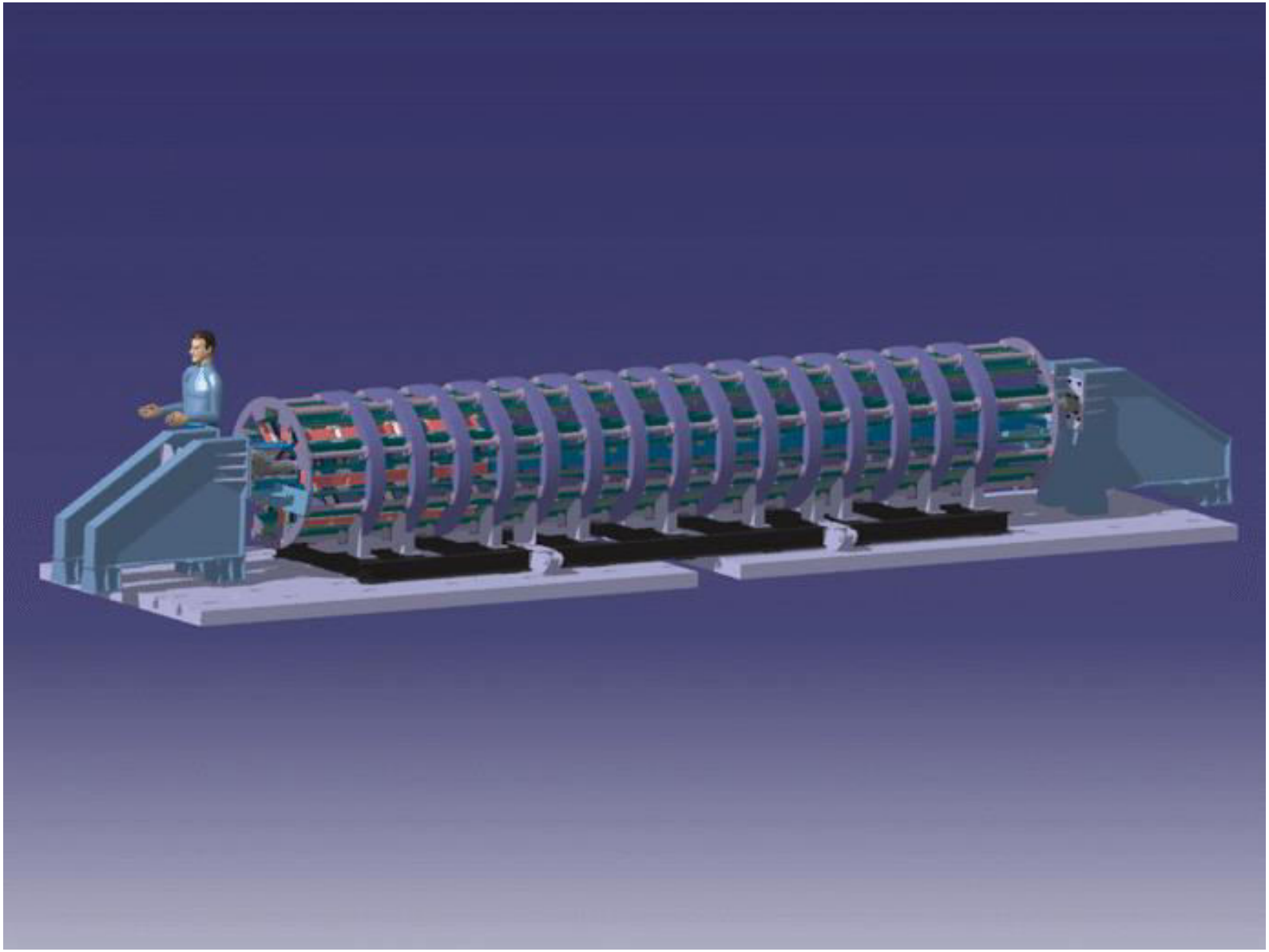
Testing the Azimuthal SRM (II/II)



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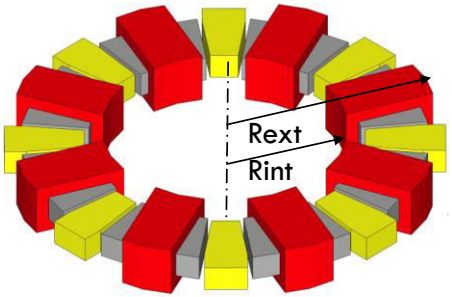
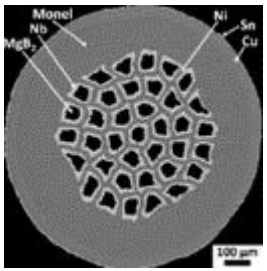
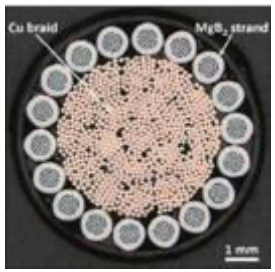
Towards a Superconducting Azimuthal SRM

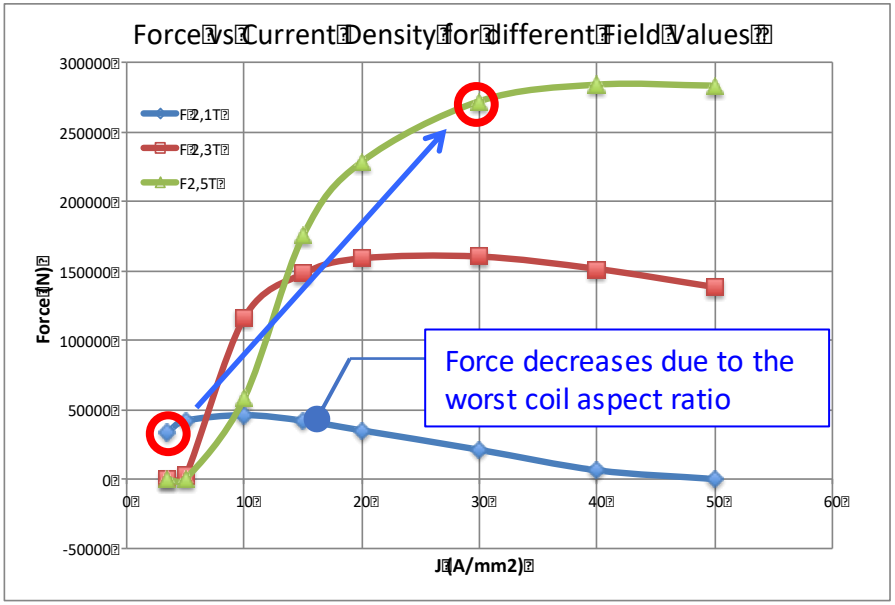


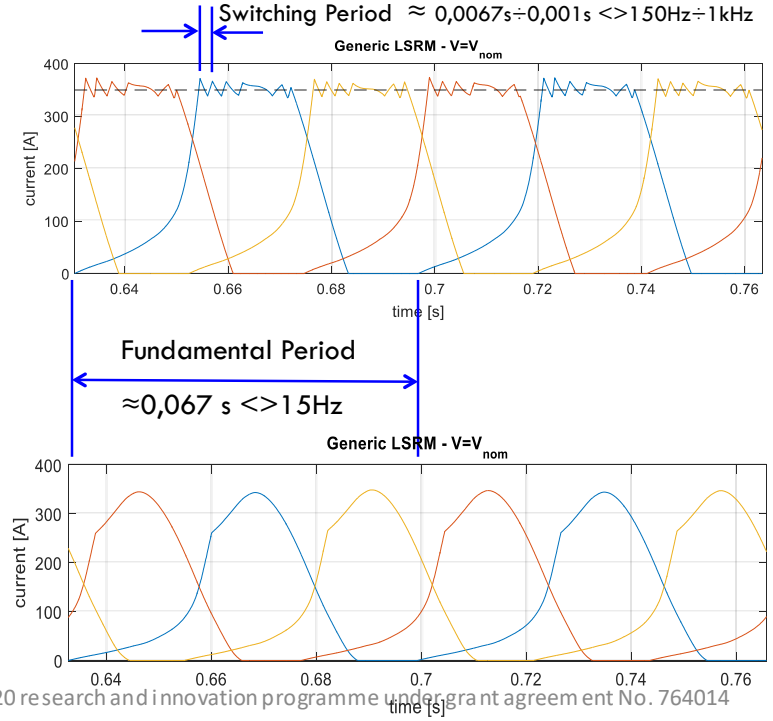




A superconducting version of an AMSRM is theoretically attractive because:

- The machine has only one side with coils and this side can be stationary.
- Increasing the field from 2.1T to only 2.3 T and the current density from 5 Amm^{-2} to 30 Amm^{-2} would mean increasing the force by a factor of 10.
- MgB_2 can be an ideal candidate for the required levels of J & B





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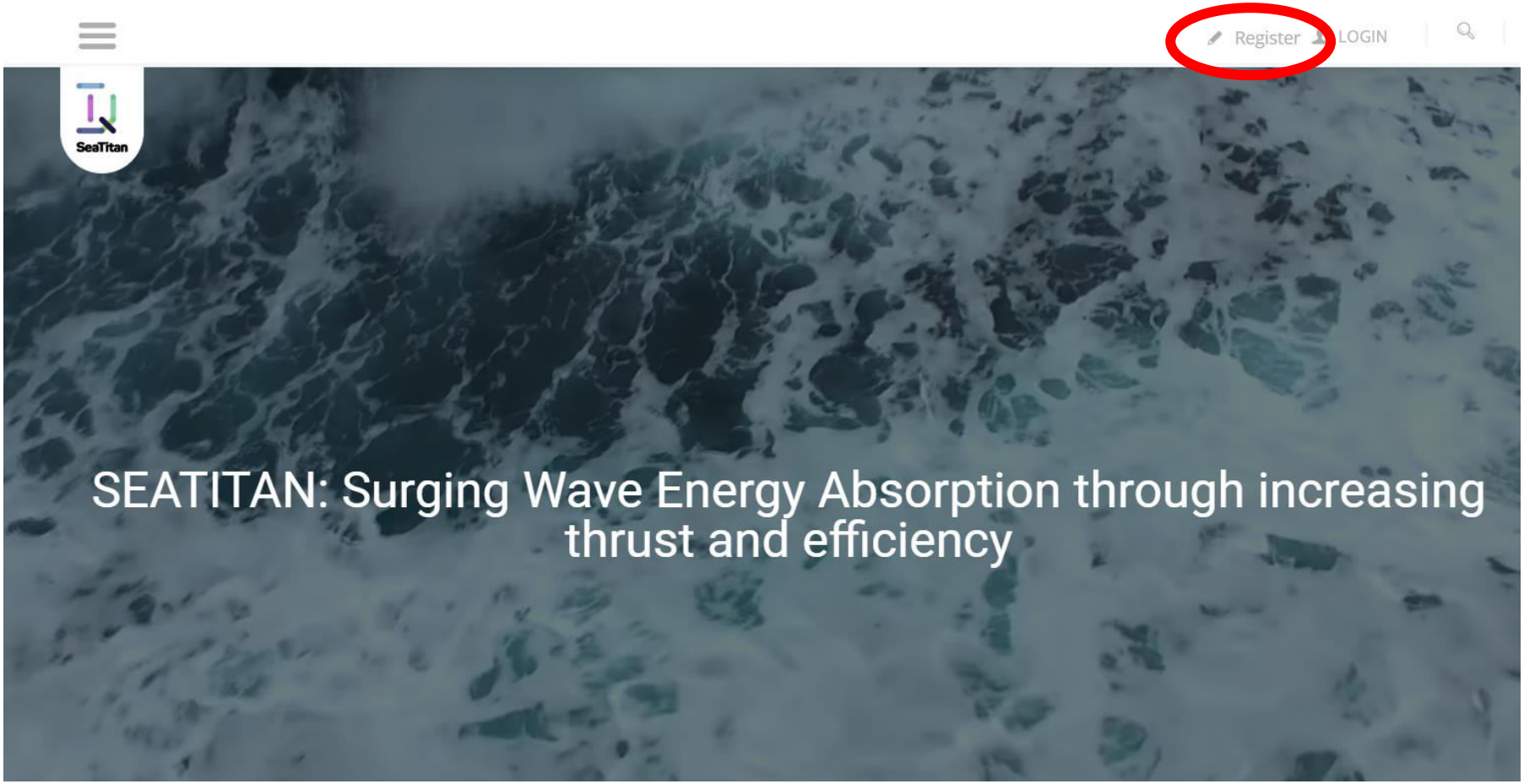
SEA TITAN website https://seatitan.eu/



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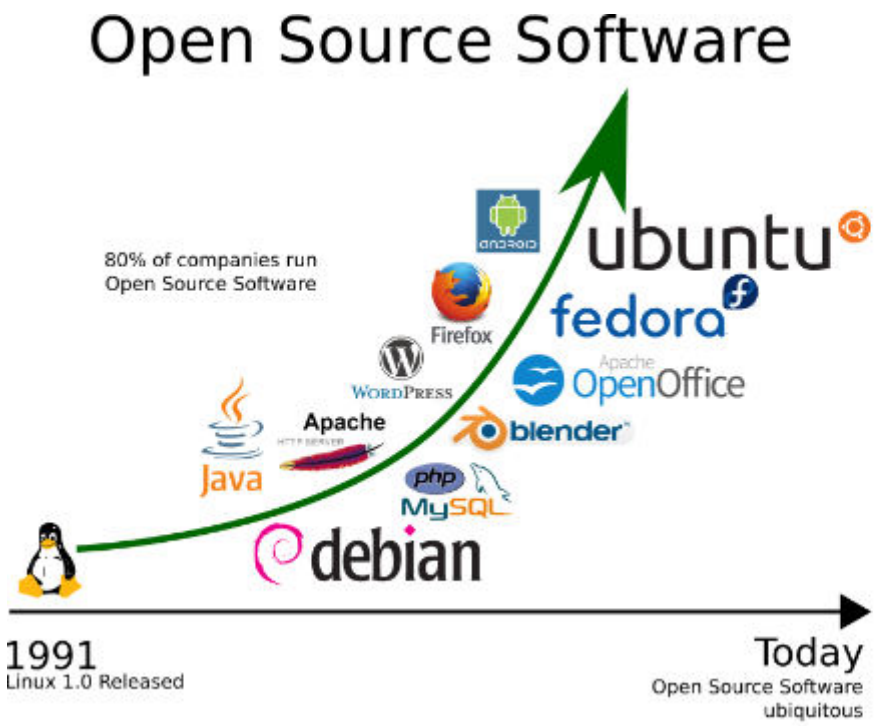
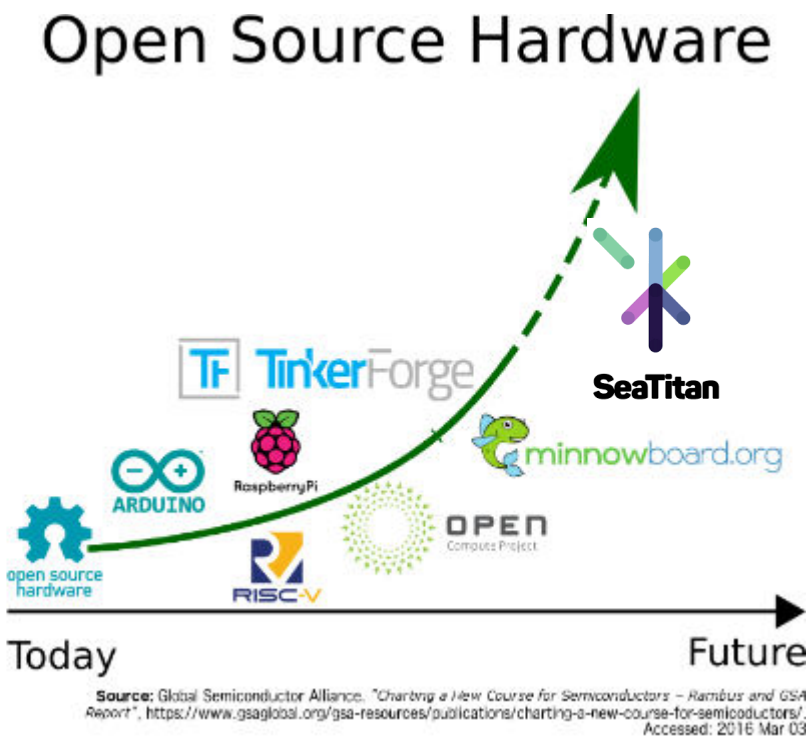
Open Hardware Strategy





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Summary & Conclusions

- Heaving Point Absorbers are consolidated candidates for WECs
- Their capability to harvest energy is increased by hosting high force PTOs
- PTOs must produce a "vector" force (controllable in magnitude & phase)
- In April 2018 started the Sea Titan Project to develop a new concept of PTO based on a linear Switched Reluctance Machine
- This PTO is based on an Azimuthal configuration that saves iron and has a better adaptation to the WEC geometry
- The main deliverable of the Project is a 70 kN, 3ms^{-1} prototype to be tested horizontally at CIEMAT premises
- Calculation and designed is finished and we are now in the fabrication phase
- Additionally, Sea Titan considers the conceptual design of a superconducting version based on Mg B_2

THANK YOU FOR LISTENING!

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