

# EM pump

A very short literature search

Target videoconference 28.1.2004

# WHY?

- **No moving parts** in contact with target liquid
- **No seals**

**highly reliable**

Problems?

- High slip → high power consumption
- Heating of the liquid by Ohm losses  
→ CRITICAL

Can we reach the desired flow rate? (1cm jet, 1l/s, 20 m/s)

# Existing applications

- Aluminium production
- Testing Pb-Be loops
  - MegaPie
  - ADS
  - spallation source
- Sodium circuit in nuclear facilities
- ...

# MegaPie

- MegaPie: Megawatt Pilot Experiment
  - Spallation source
- LiSoR: **L**iquid metal-**S**olid metal **R**eactions
  - Lead-bismuth:  $<0.3$  l/s,  $<1.5$  bar,  $<2$  m/s
  - Journal of Nuclear Materials 318 (2003) 70–83
- LiSoR like facility at JAERI / KEK

# Mercury Thermal Hydraulic Loop (MTHL) Became Operational in October 1999



Hg-Water  
Heat  
Exchanger

EM  
Pump  
27 L/min

Test  
Section



J.Haines

# Aluminium production



The heart of the LMF system is propelled one way or the other, de

This ability to propel molten al consequently a minimal maintena

The pump, seen here without its water cooling circuit to that found

A range of powers is available, e minute at a velocity of 8m per sec

The 4" pump weighs approxima simple, quick maintenance proced

Various sizes of pump are available in both diameter and also flow rating from 50mm (2 in) as little as 0.1 tonne/min through to 15 tonnes/min.

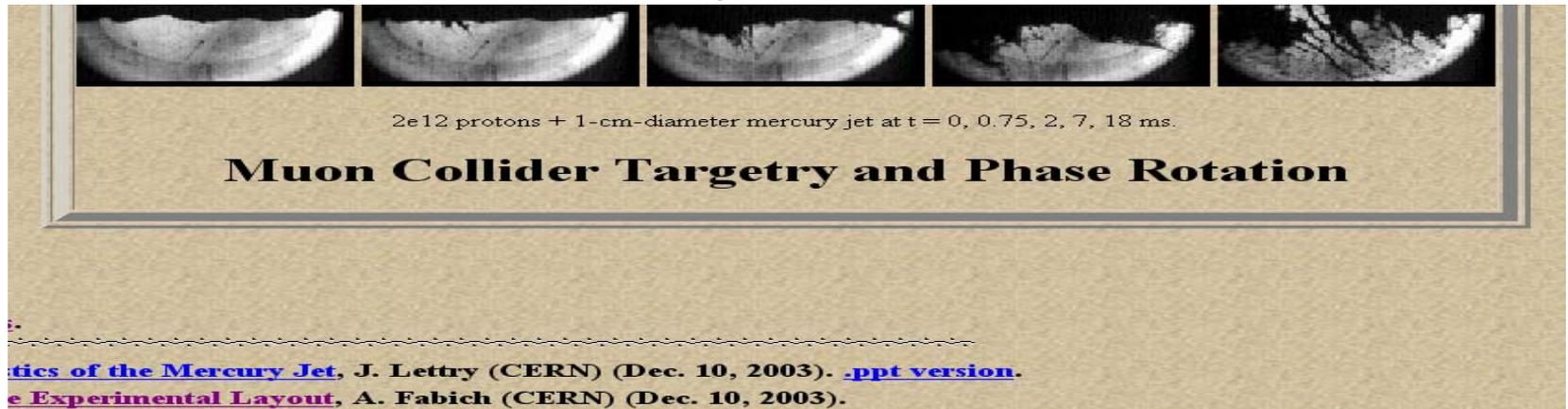
<http://www.emptechnologies.com>

“In mass flow terms the 65kW model can move up to 10 tonnes of aluminium per minute at a velocity of 8m per second.”

# Literature

- I.R.Kirrilov et al., Tow dimensional model for analysis of cylindrical linear induction pump characteristics: model and numerical results, Energy Conversion management 44 (2003) 2687-2697
- [http://www.fjfi.cvut.cz/con\\_adtt99/papers/Mo-o-b10.pdf](http://www.fjfi.cvut.cz/con_adtt99/papers/Mo-o-b10.pdf)
  - EM pump 50 % efficiency at most
- *linear induction pump, Sodium loop, 7 m3/min*
  - H. Araseki et al. / Nuclear Engineering and Design 227 (2004) 29–50
- *IPUL, RIGA working for ESS, LiSoR*
- <http://mhd.sal.lv/>
  - *High pressure and high flowrate induction pumps with permanent magnets , Magnetohydrodynamics 39, No. 4, 411-418, 2003*
  - *Centrifugal pump basing on rotating permanent magnets, Magnetohydrodynamics 36, No. 2, 157-164, 2000*
- R.Moureau, Magnetohydrodynamics, Kluwer Academic Publishers, 1990
- Pump with em coupling: <http://www.linden-emb.com/Parts/pumps.htm>

# One always ends here



Where you find a link to:

Proposal: Shock wave simulation in liquid ...

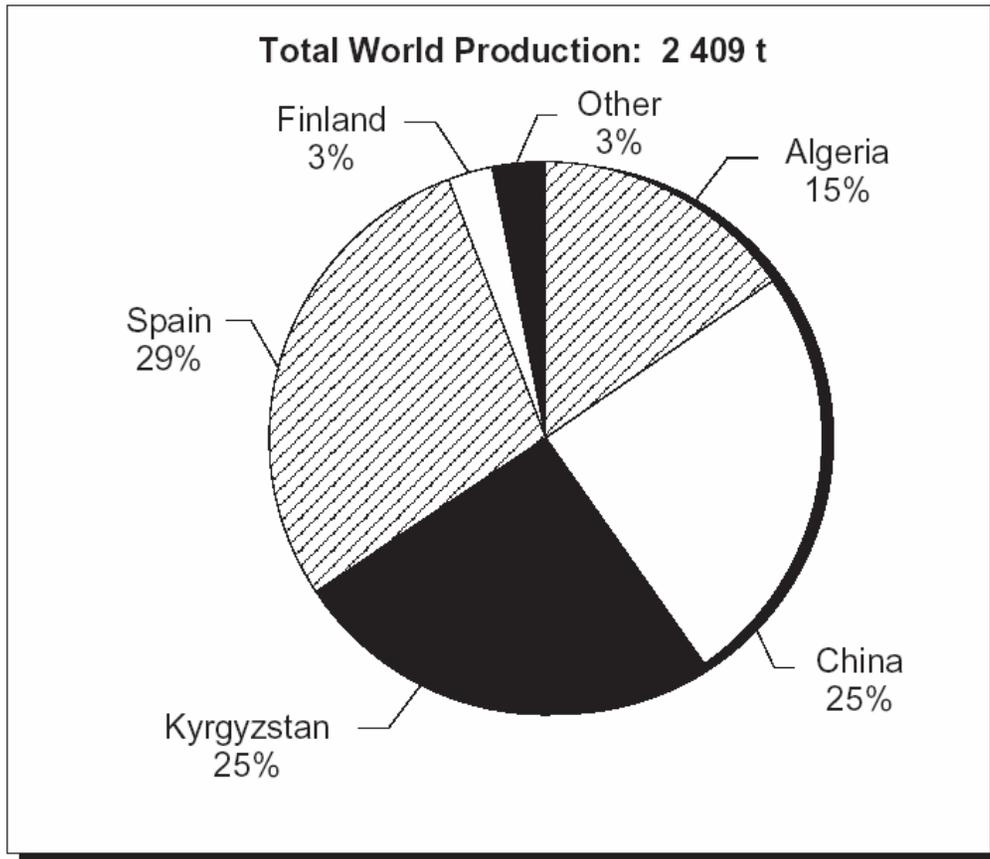
**STC 'Sintez', Institute of Electrophysical Apparatus, St.Petersburg**

<http://www.niiefa.spb.su/>

**Producing EM pumps for 230 m<sup>3</sup>/h Sodium**

**Experts should work on this. We ask them!**

# Mercury production



Year 1997: 2409 ton

Source: International Consultative Group on Nonferrous Metals Statistics.

<http://www.nrcan.gc.ca/mms/cmy/content/1998/38.pdf>

28.1.2004

A.Fabich, CERN

# SNS mercury flow

- mass flow = 340 kg/s
- $v_{\max} = 3.5$  m/s
- centrifugal pump
- Pump power = 56 kW
- [http://puhep1.princeton.edu/mumu/target/Hg\\_issues.PDF](http://puhep1.princeton.edu/mumu/target/Hg_issues.PDF)