



Towards dissipationless spintronics
—superconducting spin-transport and magnetization control—

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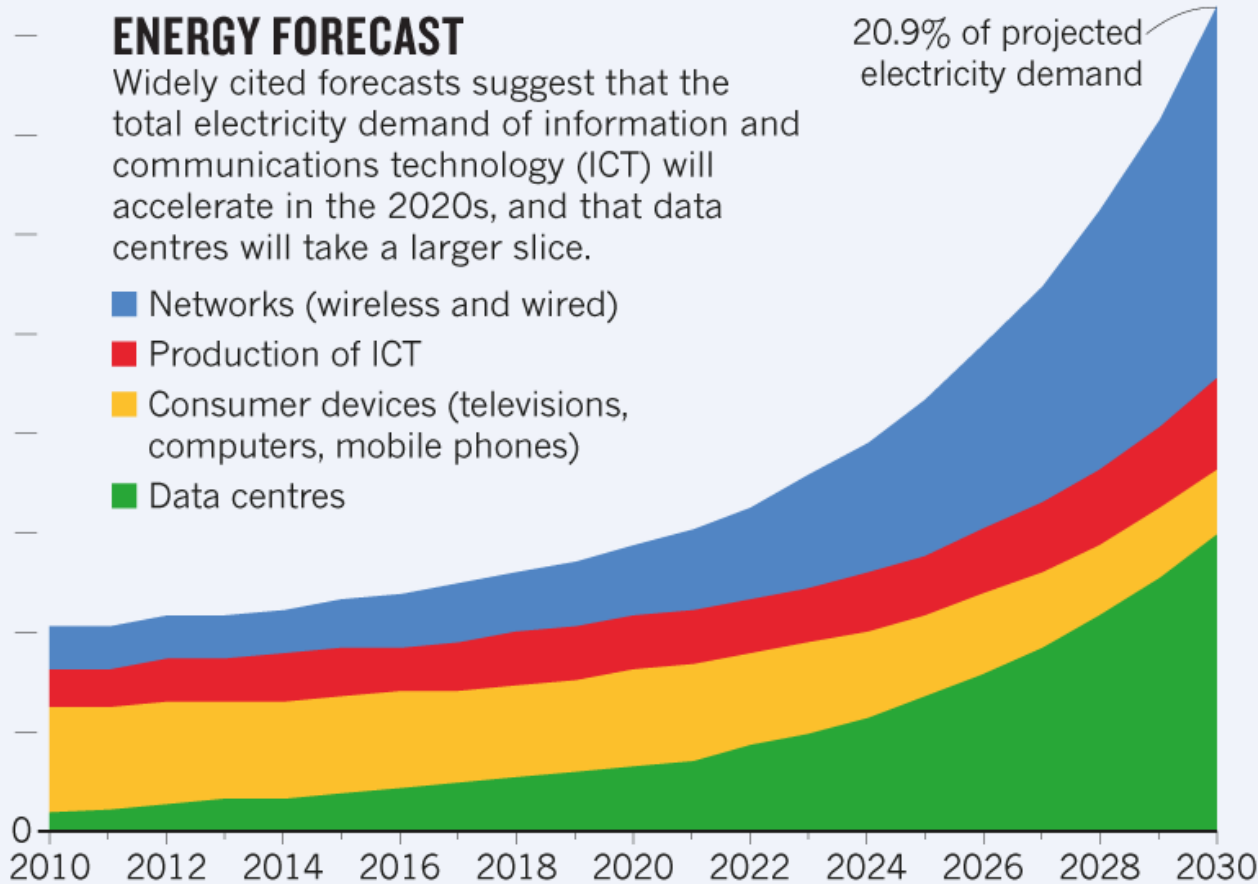
9,000 terawatt hours (TWh)

ENERGY FORECAST

Widely cited forecasts suggest that the total electricity demand of information and communications technology (ICT) will accelerate in the 2020s, and that data centres will take a larger slice.

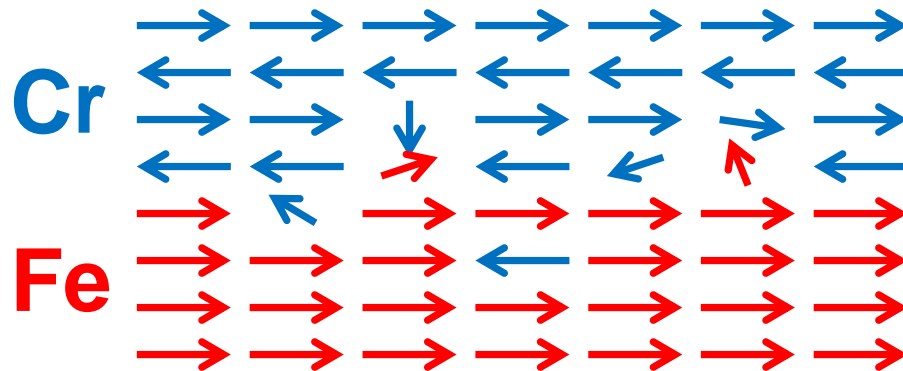
- Networks (wireless and wired)
- Production of ICT
- Consumer devices (televisions, computers, mobile phones)
- Data centres

20.9% of projected electricity demand



Nicola Jones, Nature **561**, 163 (2018).

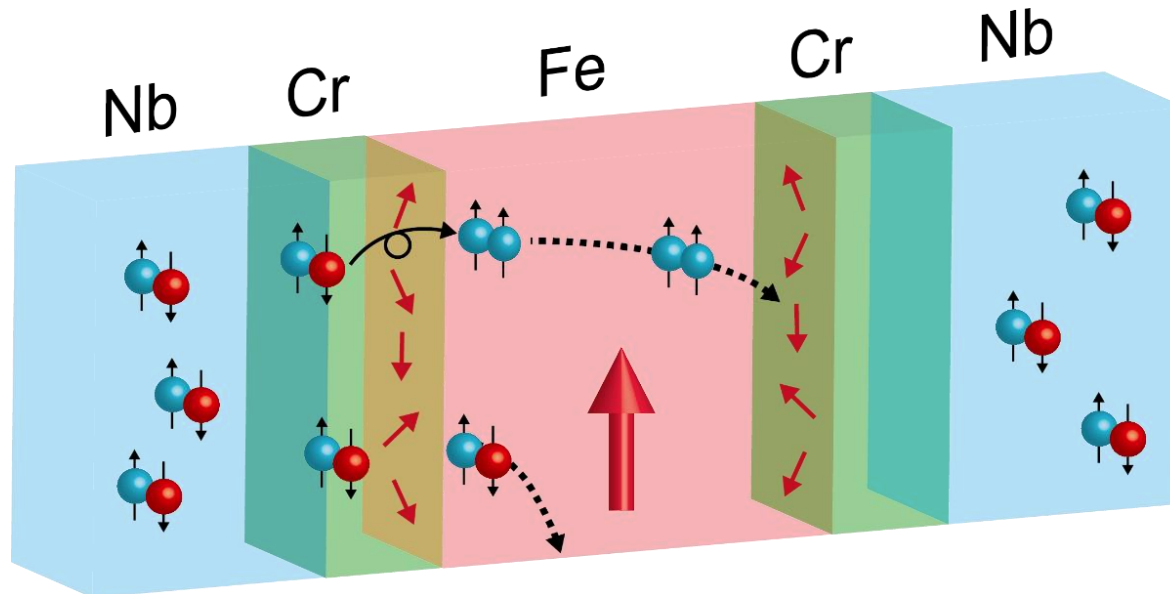
Pair conversion from singlet to spin-aligned triplet



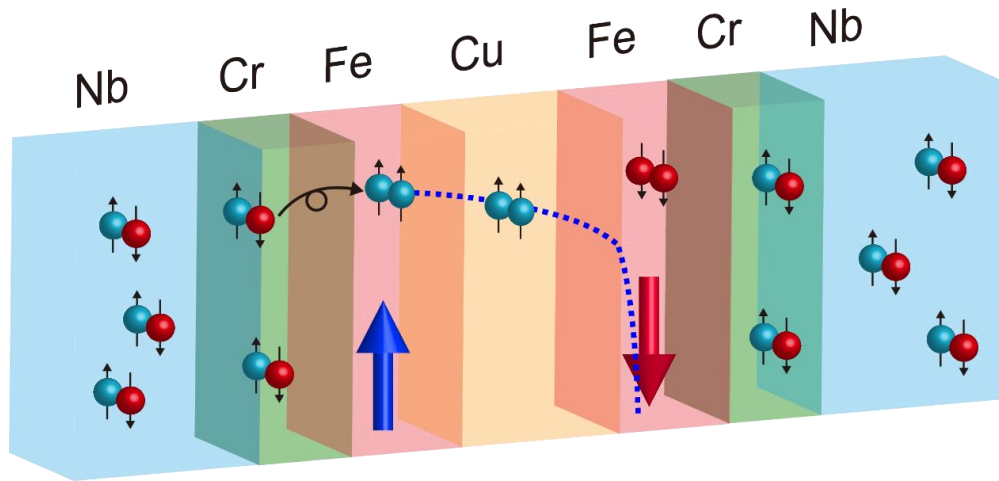
Cr/Fe spin-glass interface

S. K. Burke *et al*, J. Phys. F **13**, 441 (1983).

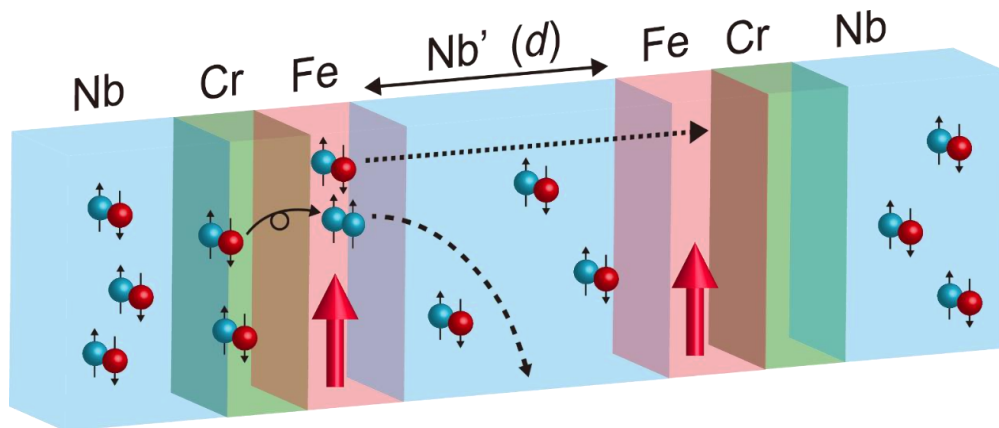
J. Robinson *et al*, PRB **89**, 104505 (2014).



Demonstration of superconducting spin-transport



Antiparallel orientation of the Fe layers blocks triplet pairs



Singlet superconductivity of the central Nb' maintains singlet pairs but blocks triplet pairs

S. Komori *et al.*, arXiv:2006.16654

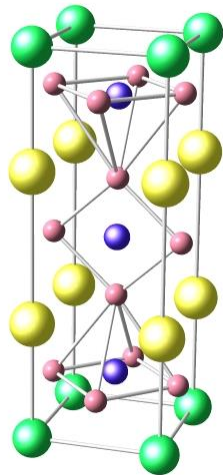
Perspective

problem: spin-aligned triplet supercurrent density $< 10^6$ A/cm²

Oxides can offer materials breakthrough

Spin supercurrents from cuprates

high T_c , high J_c , large Δ



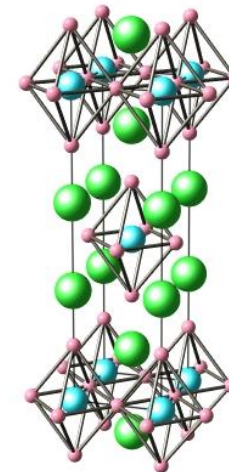
Re123

S. Komori *et al.*, Phys. Rev. Lett., **121**, 077003 (2018)

A. Di Bernardo *et al.*, Nat. Mater., **18**, 1194 (2019)

Intrinsic triplet superconductor

-doesn't require the conversion



Sr₂RuO₄

C. Palomares-Garcia *et al.*,
Comm. Mater., **1**, 23 (2020)



Prof. Jason Robinson



Dr Shahbaz Anwar
S/F oxides



Dr Sachio Komori
Pair conversion



Dr Guang Yang
Non-local spin-valves



Dr Xavier Montiel
S/F Theory



Graham Kimbell
Oxide interfaces



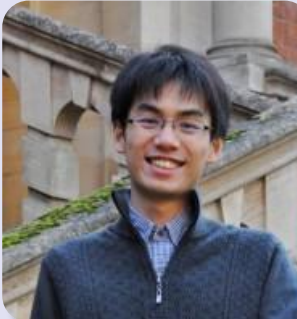
Ben Stoddard-Stones
Quasiparticle injection



Harry Bradshaw
Rare-earth interfaces



Linde Olde Olthof
S/F Theory



Hisakazu Matsuki
Spin-pumping S/F



Lauren McKenzie-Sell
Spin-pumping S/F



James Devine-Stoneman
Triplet spin-mixers