Challenges from the field of new materials: the sublime to the ridiculous?

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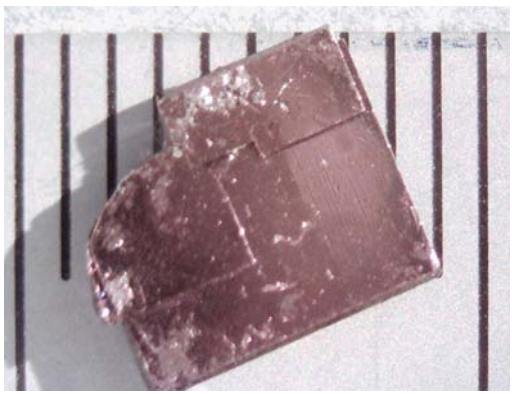
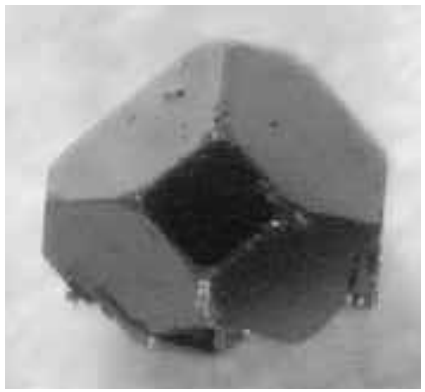
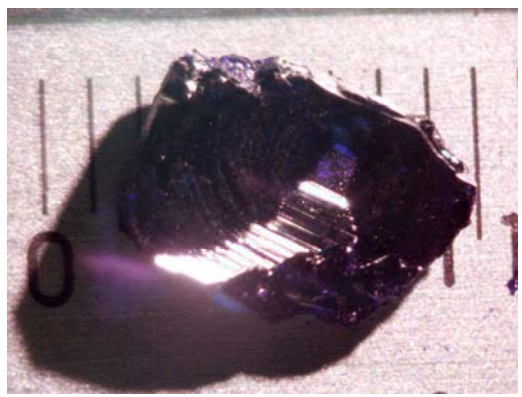


(1) CDW formation



(2) 5d magnetism



(3) Triplet BEC

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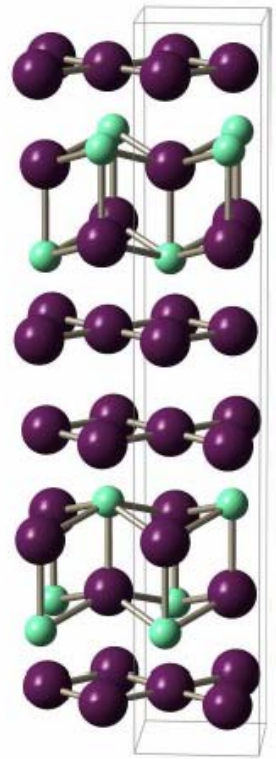
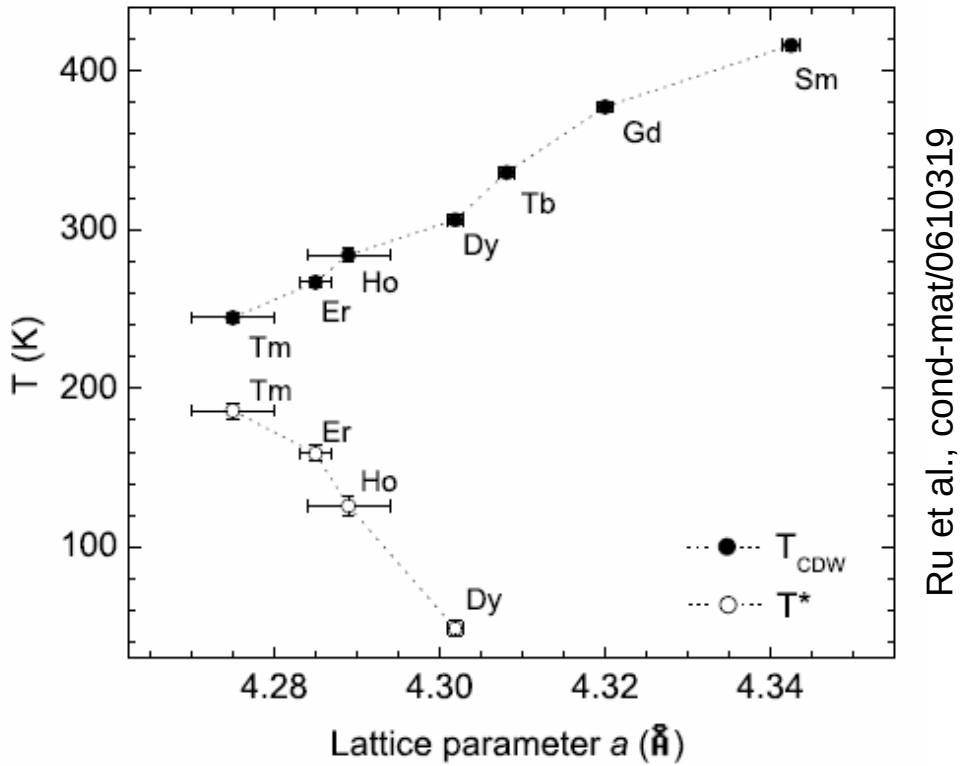
(1) CDW formation

- Electronic instability; IC modulation; FS reconstruction
- Relevance to more strongly correlated materials; “Stripe” vs “checkerboard”
- Synchrotron: intensity & resolution

RTe_3:



Ru et al., PRB **73**, 033101 (2006).



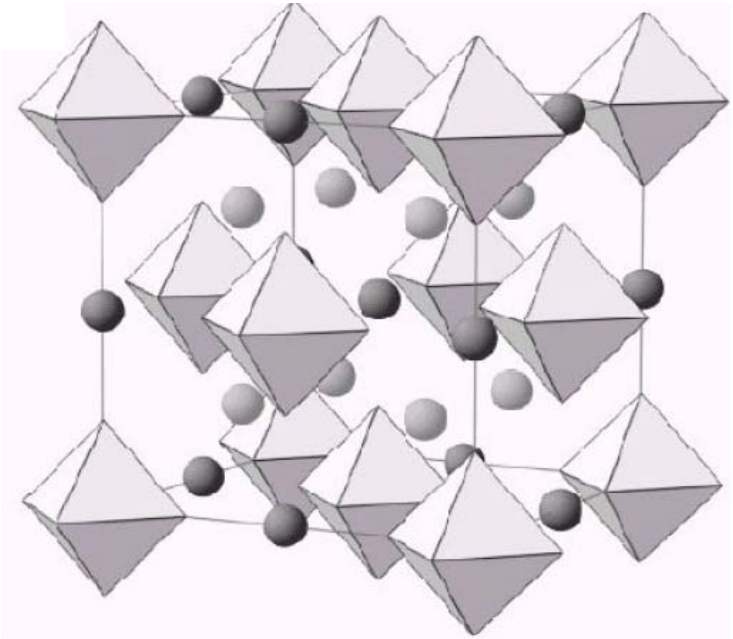
Ru et al., cond-mat/0610319

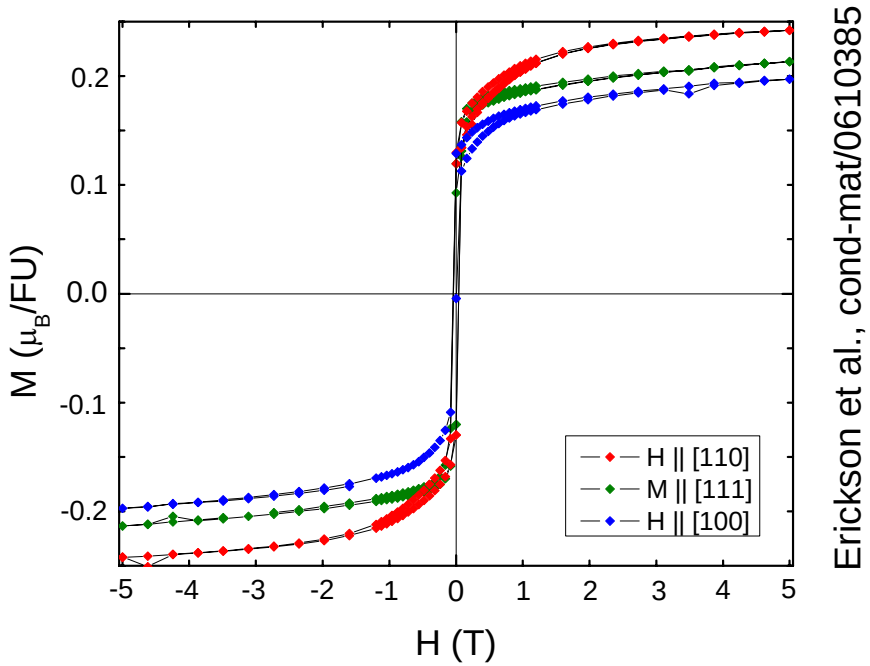
- Huge variation in T_{CDW} – maintaining simple unidirectional q-vector
- T* increases with increasing pressure - counter to all usual expectations
- q vectors? T-dependence? – simple, tractable, “bread & butter” expts

(2) 5d magnetism

- 5d magnetism is relatively unexplored / underexplored
- Interest: interplay between charge, orbital and spin degrees of freedom
- Synchrotron: resolution, intensity & resonant scattering

Ba_2NaOsO_6:



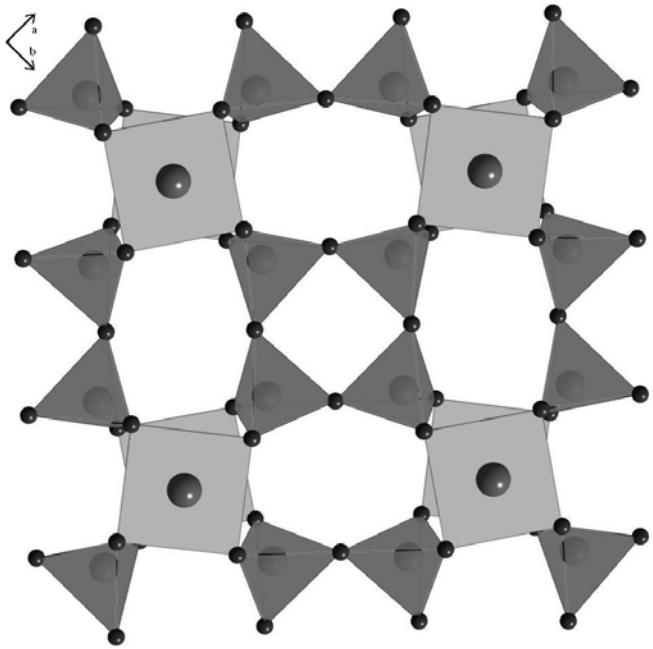


- Origin of ferromagnetism?
- Orbital ordering?
- Requires resonant scattering – far from simple – but tractable experiments

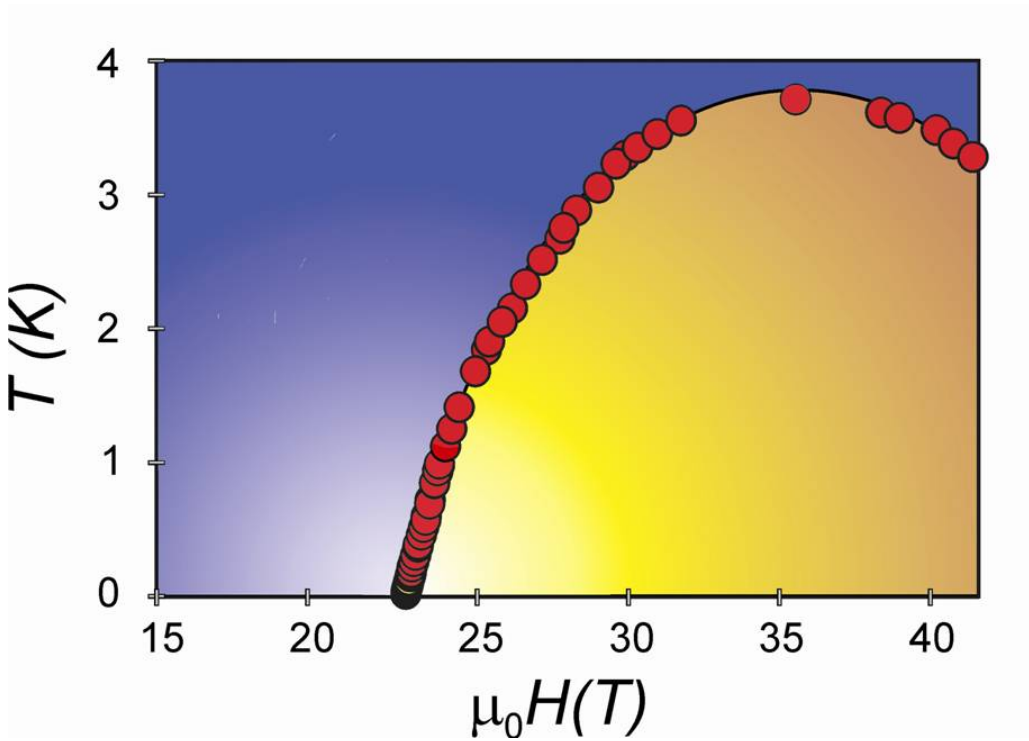
(3) Spin dimer compounds

- Materials based on weakly interacting pairs of spins
- Nature of high-field magnetically ordered state? BEC of triplets?
- Synchrotron: key structural information + access to ordered state?

$BaCuSi_2O_6$:



Samulon *et al.*, PRB **73**, 100407(R) (2006).



Sebastian *et al.*, Nature **441**, 617 (2006).

- X-ray scattering: magneto-elastic coupling? magnetic structure?
- Ridiculous? Not so far fetched… (SNS + NHMFL)
- Synthesis of two user facilities would open many doors to exciting physics…

Scattering needs from our perspective

(1) High temperatures:
- Few hundred C

(2) Low temperatures:
- 4 K

(3) Translator:
- questions → experiments
- train students

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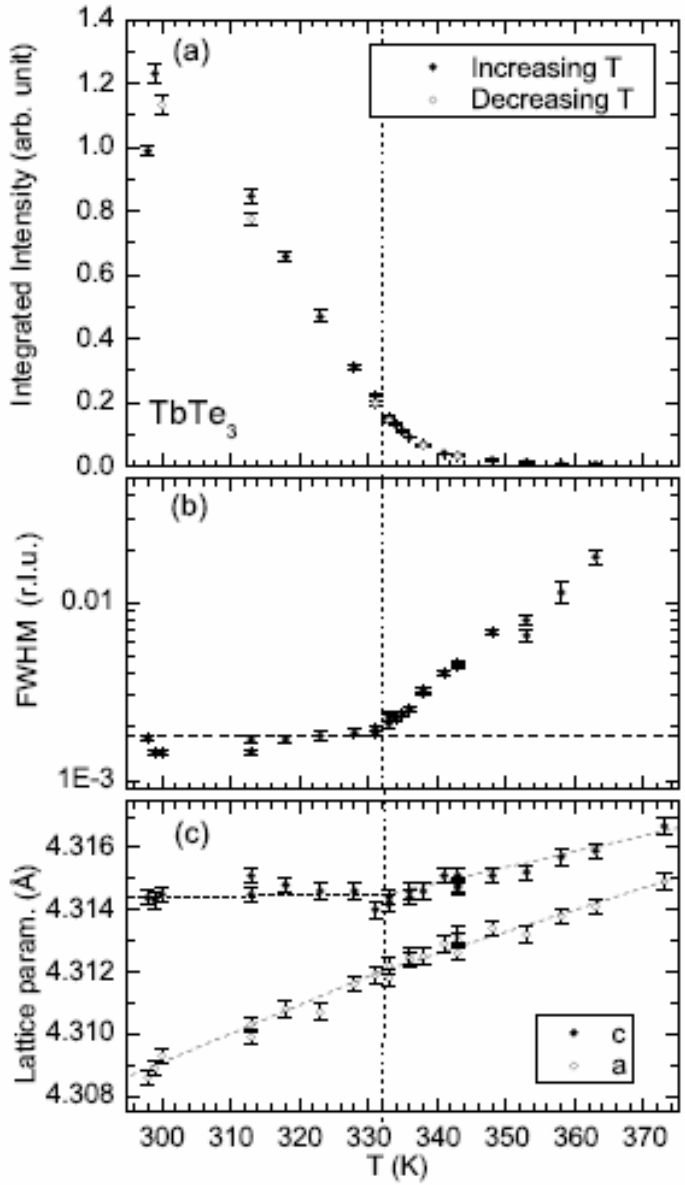

Ru et al., cond-mat/0610319