

Concluding Remarks

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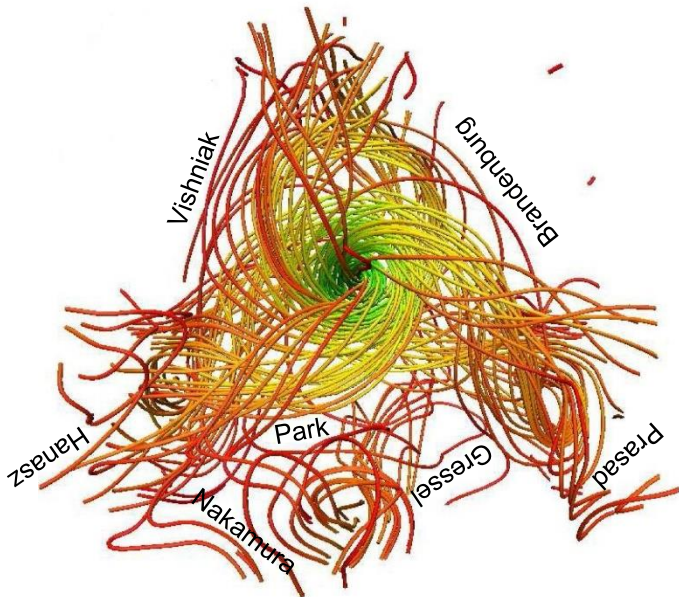
we discussed **magnetic fields**

lab	$10^1 \dots 10^2$ cm	$10^{-1} \dots 10^{-4}$ G
sun	$10^9 \dots 10^{11}$ cm	$10^0 \dots 10^3$ G
magnetars	$10^5 \dots 10^6$ cm	$10^{14} \dots 10^{16}$ G
protostars	$10^{12} \dots 10^{13}$ cm	$10^0 \dots 10^3$ G
molecular clouds	$10^{19} \dots 10^{21}$ cm	$10^{-4} \dots 10^{-1}$ G
Milky Way	$10^{20} \dots 10^{22}$ cm	$10^{-6} \dots 10^{-4}$ G
galaxies	$10^{21} \dots 10^{23}$ cm	$10^{-6} \dots 10^{-5}$ G
radio galaxies	$10^{23} \dots 10^{25}$ cm	$10^{-6} \dots 10^{-5}$ G
galaxy clusters	$10^{23} \dots 10^{25}$ cm	$10^{-6} \dots 10^{-8}$ G
beyond	$> 10^{25}$ cm	$< 10^{-9}$ G

comprising theory, simulations, observations, experiments

the good old dynamo:

- still doesn't work properly; **why?** discussions as tangled as field lines
- one dynamo is understood; **which?** Cary Forest's



good modelling tools

- CR-driven dynamo ([Hanasz, Otmianoswka-Mazur](#))
- fully dynamic galactic dynamo ([Gressel](#))
- strong amplification in grand-design spirals ([Nakamura](#))
- orientation of magn. & material spiral structure ([Chamandy](#))
- significance and role of helicity ([Vishniak, Park, Prasad](#))



new concepts!

discussion: - small-scale turbulence \leftrightarrow large-scale fields

- driving turbulence: alternatives to SNe?

- scales of coherence

- role of galaxy environment

- lab experiments: higher $T_e \rightarrow$ higher R_m

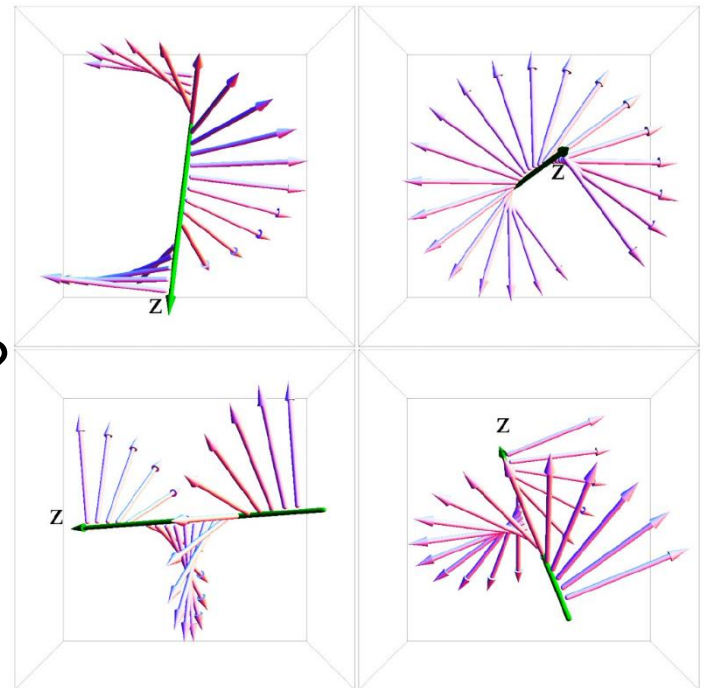
helicity:

- can be measured! ([Brandenburg, Stepanov](#))
solar wind: in-situ
edge-on galaxies: shifted sinc of Burn slab
ISM: RM cross-correlation
- detectability with 1st-order parametrization of PA variation with Faraday depth ϕ ([Horellou, Fletcher](#))

discussion: how really measure it?

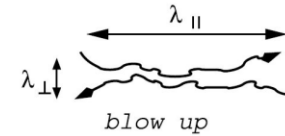
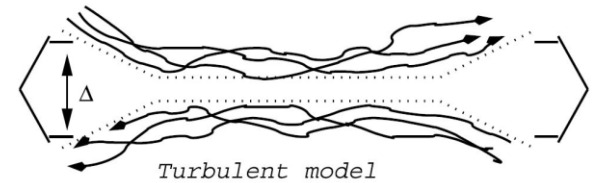
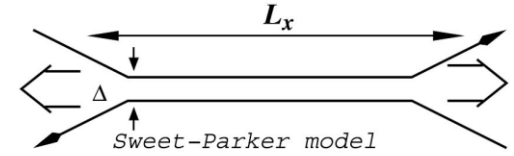
SNRs good targets?

λ^2 coverage adequate?



star formation, turbulence, reconnection:

- reconnection fast with turbulence ([Kowal](#))
- reconnection diffusion ([Santos-Lima](#))
flux problem, rotationally supported
protostellar disks
- do SNe provide turbulence on required
scales? ([Falceta-Goncalves](#))
- asymmetric diffusion ([Beresnyak](#))
- molecular clouds: \vec{B} → strong influence on high-density
regime of power spectrum ([Burkhart](#))
- turbulent scales: RM structure function, polarization gradients;
transsonic, small-scale RM vs. large-scale \vec{B} ([Haverkorn](#))
- \vec{B} -field strengths and gas density ([Basu](#))



extreme stars:

- magnetars: flux conservation not sufficient ([Lyutikov](#))
 \vec{B} prevents quakes
→ bursts are magnetospheric, not crustal
bursts influence earth's ionosphere – wow!!!
- BHXBs: magnetic flux related to accretion rate ([Wang](#))
- ccSNe: Biermann battery to create magnetic field? ([Handy](#))

discussion: can stars have different magnetization,
or take flux solely from molecular cloud?

Milky WAY, and smart / novel techniques:

- RM self-calibration: outwit the ionosphere ([Brentjens](#))
detect moving Faraday screens?
- RM sky: Galactic, extragalactic, source-intrinsic ([Oppermann](#))
- measure \vec{B}_{\parallel} via RM , N_H , EM ([Kothes](#))
- diffuse polarized emission with LOFAR: direction-dependent calibration ([Jelic](#))
- geometry of unresolved sources via poln. spectra ([Schnitzeler](#))
- dust polarization with Planck: high ρ ; $\Psi_{\text{dust}} = \Psi_{\text{stars}}$; $N_H \uparrow \rho \downarrow$
depoln. canals! everything spectacular! ([Bernard](#))
- UV polarimetry: alignment and size distribution of small grains;
opt./IR/UV \rightarrow full \vec{B} ([Hoang](#))

galaxies:

- state of knowledge, crucial input for models (Fletcher)
total, ordered, random field
scale-length and -height
pitch angles and symmetries
- X-shaped \vec{B} in edge-on galaxies: dynamo or wind? (Krause)
CHANG-ES project
- dwarf galaxies: energy input, which dynamo? (Bomans)
strength of \vec{B} , relation to SFR (Chyży)

individual galaxies:

- BH-driven bubble in face-on galaxy? ([Freeland](#))
- M51: high-fidelity LOFAR image! ([Mulcahy](#))
CR propagation, free-free absorption
- M51: tomography, thermal halo ([Mao](#))
- NGC6946, M101: multi- λ studies ([Williams](#), [Sridhar](#))
- IC10: large nonthermal halo, radial \vec{B} -field ([Chyży](#))
- NGC4388: interaction with ICM, AGN, 'fountain or bubble?' ([Damas](#))

discussion: nature of X-shaped magnetic fields?

galaxy groups, clusters, and beyond:

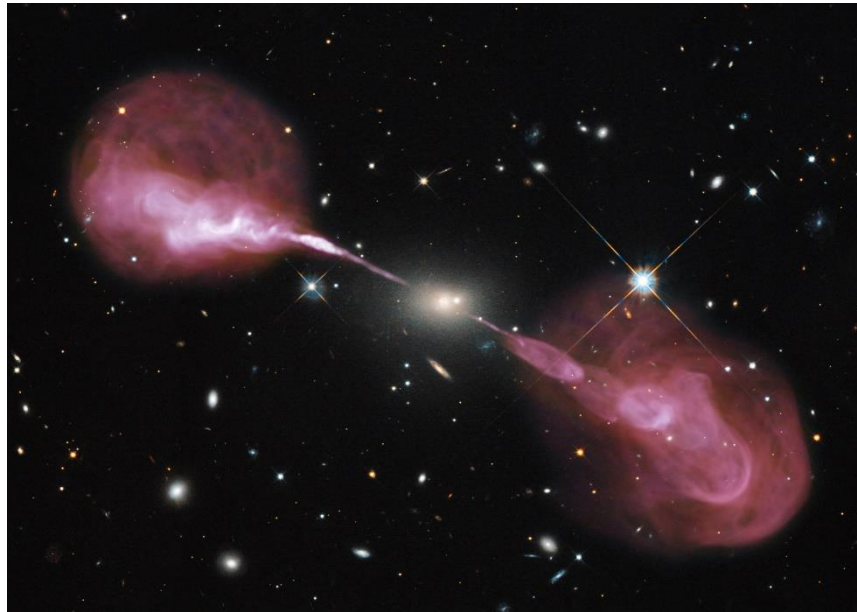
- groups: intergalactic \vec{B} , energy input, which dynamo? ([Urbanik](#))
- HGC92, Arp143, magnetic-field bridges ([Nikiel-Wroczyński](#))
- clusters: what do we know? ([Brunetti](#))
relics & halos, particle acceleration, confinement
halos: hadronic collisions vs. turbulence & stoch. acceleration
LOFAR harvest
- enhanced temperature jumps with $\vec{\nabla}T \perp \vec{B}$ ([Komarov](#))
- LSB galaxy clusters: dynamically young, need to learn more ([Cantwell](#))
- voids, filaments, clusters: origin of \vec{B} , cosmological fields ([Ryu](#))
RM \sim few rad m⁻²
- particle acceleration: $M_{\text{radio}} > M_{\text{X-ray}}$; is DSA correct? ([Takizawa](#))
discussion: DSA, small-scale dynamo, plasma- β

cosmological magnetic fields:

- B-field creation by photo-ionization at EoR ([Durrive](#))

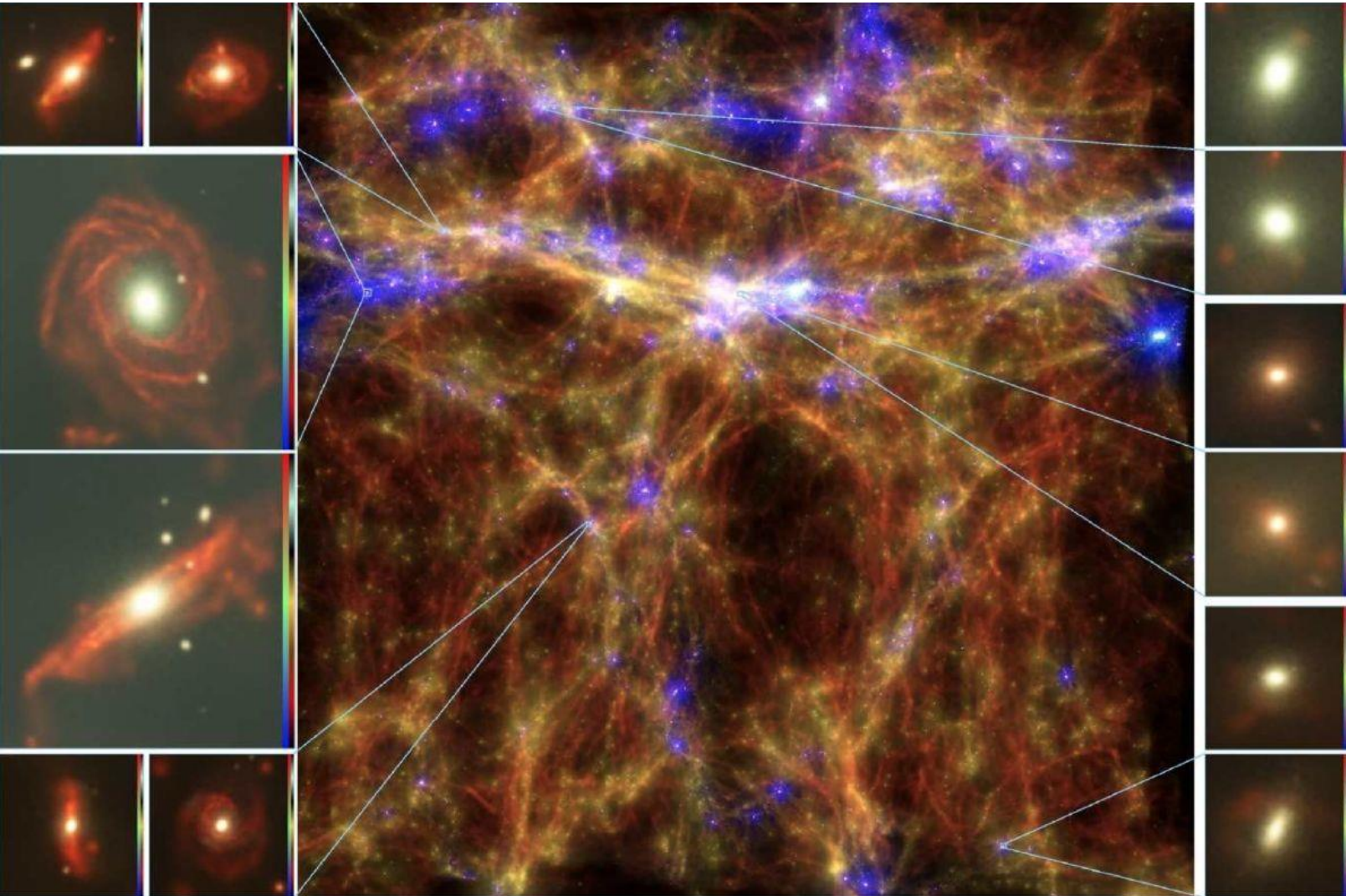
radio galaxies:

- evolutionary sequence: GPS \rightarrow CSS \rightarrow Cyg A \rightarrow GRGs
recurrent activity, duty cycle, energy budget ([Jamrozy](#))
- double-double radio galaxies, misalignments ([Nandi](#))



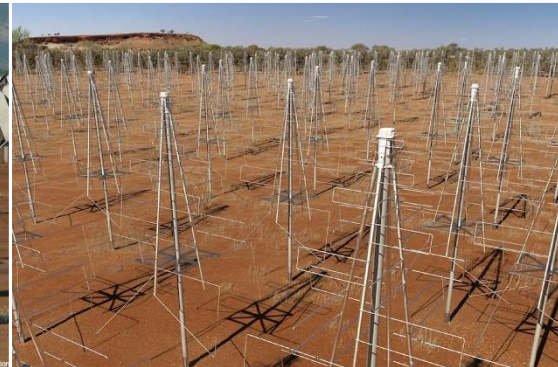
galaxy formation:

- galaxy factory: seeding, amplification, distribution
- observables: e.g. RM (young Beck)



SKA:

- design, sites, time-lines, politics, funding (old Beck)
- science: \vec{B} and EoR, young galaxies: \vec{B} out to $z = 3$
- radio-FIR correlation with z ; \vec{B} and galaxy properties
- small-scale fields
- magnetic arms
- clusters of galaxies: halos & relics
- cosmic web



we had:

- one of the most beautiful cities of Europe
- perfect organisation conference
- a stimulating atmosphere
- lively and fruitful discussions
- very good talks (the salt in the soup)
- no flood

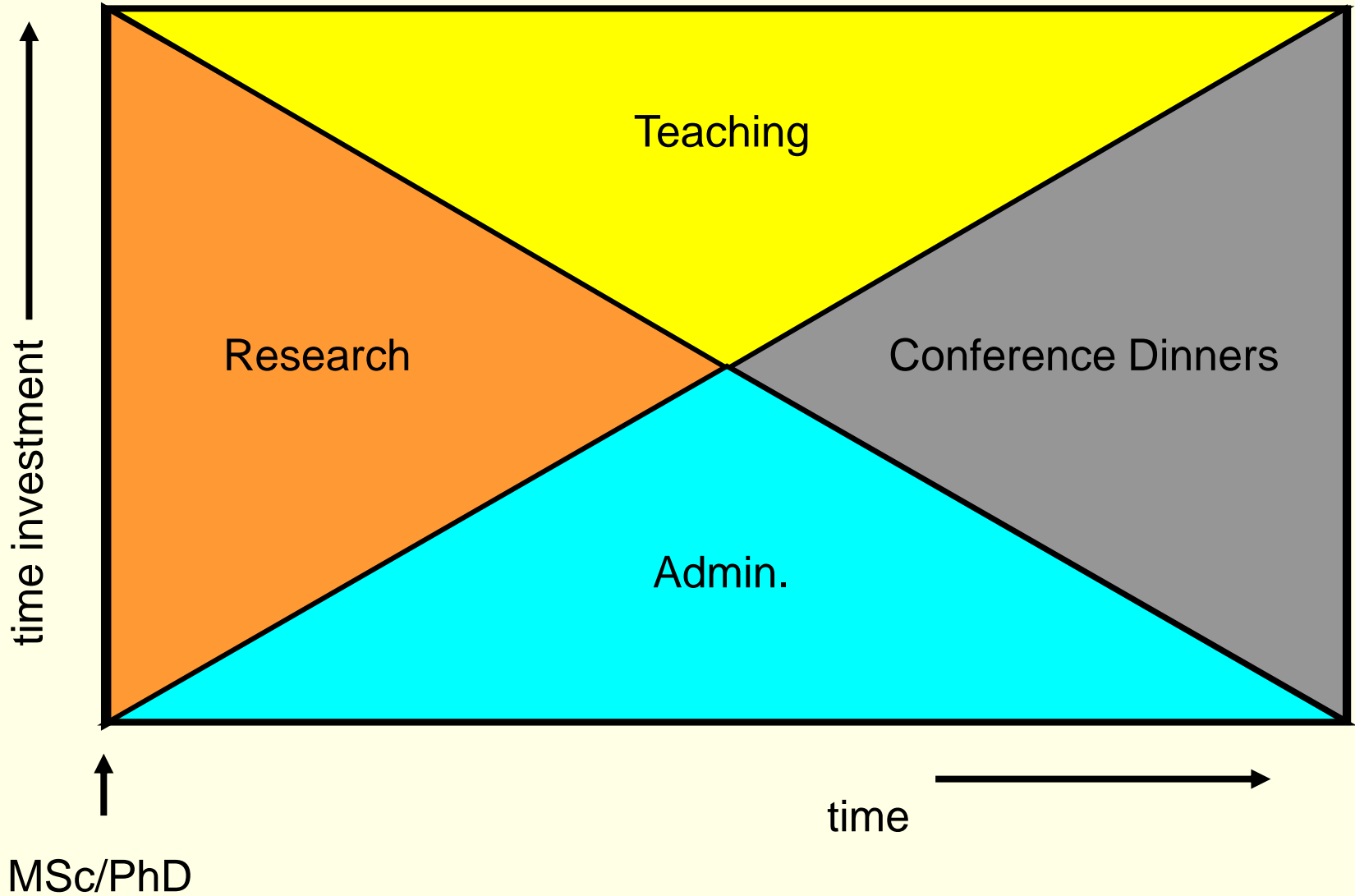


the social part ...

*a superb job by the
LOC!*



Research career



the good old dynamo: 26 years back ...



who's who?

a Very Big thanks to the LOC:

Katarzyna Otmianowska-Mazur

Błażej Nikiel-Wroczyński

Wojciech Jurusik

Natalia Nowak

Marek Urbanik

Krzysztof Chyży

