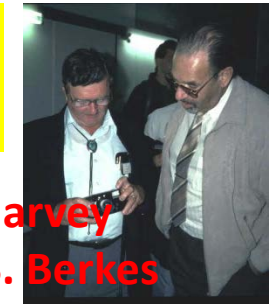

The International Magnetic Measurement Workshop 20
Opening Remarks
Stephane Sanfilippo and the IMMW committee

Outline

- Scope of IMMW's
- Challenge : the example of ultra-low emittance light sources
- IMMW20-introductory remarks including feedbacks of the last IMMW

Spirit of IMMW's

From MMW1 1981 (36 years ago) in Los Alamos…..



A. Harvey
& B. Berkes

…..to IMMW20 2017 in Diamond

A Workshop…

"open to all professionals in the field of magnetic measurements. It consists of presentations by and discussions among the participants concerning current technology in magnetic field measurements. Topics often involve but are not limited to magnets with accelerator applications"

Knud.N.Henrichsen
http://henrichsen.ch/magnet/immw.htm

- *Openness & flexibility*
- *Professionalism & expertise*
- *Discussions and exchanges ("informal discussions")*
- *Magnets , Insertion devices, field measurements, accelerators*

Objectives/ topics

Topics

- *projects and magnetic measurements overview, performance and results*
- *magnetic measurements techniques*
- *Hardware and software related to magnetic measurements*
- *magnetic models*
- *magnetic measurement procedures , calibration and diagnostic tools*
- *survey, alignment and fiducialisation*
- *accuracy limits*

Objectives

- *Information (Status, Progress, challenges)*
- *Exchange and constructive discussions*
- *Training - Tutorials since last IMMW*

To be able to respond to the challenges related to new designs, complex magnet geometries, flexible operating modes, increase efficiency & reduction of operating costs

One example
New generation of Light Sources

4th generation of storage ring light sources;
The search for ultra-low emittance (below 100 ppm)

new generation (> 2015, **MAX IV…**) $\varepsilon_x \approx$ 100...400 pm

Constraints for upgrading the light sources: maintaining the tunnel geometry and the position of the beamlines

Idea : Exploit the $\varepsilon_x \sim \phi^3$ dependence →Multi-bend achromat lattices : ***many small angle bending magnets, many lattice cells, small bend angles***

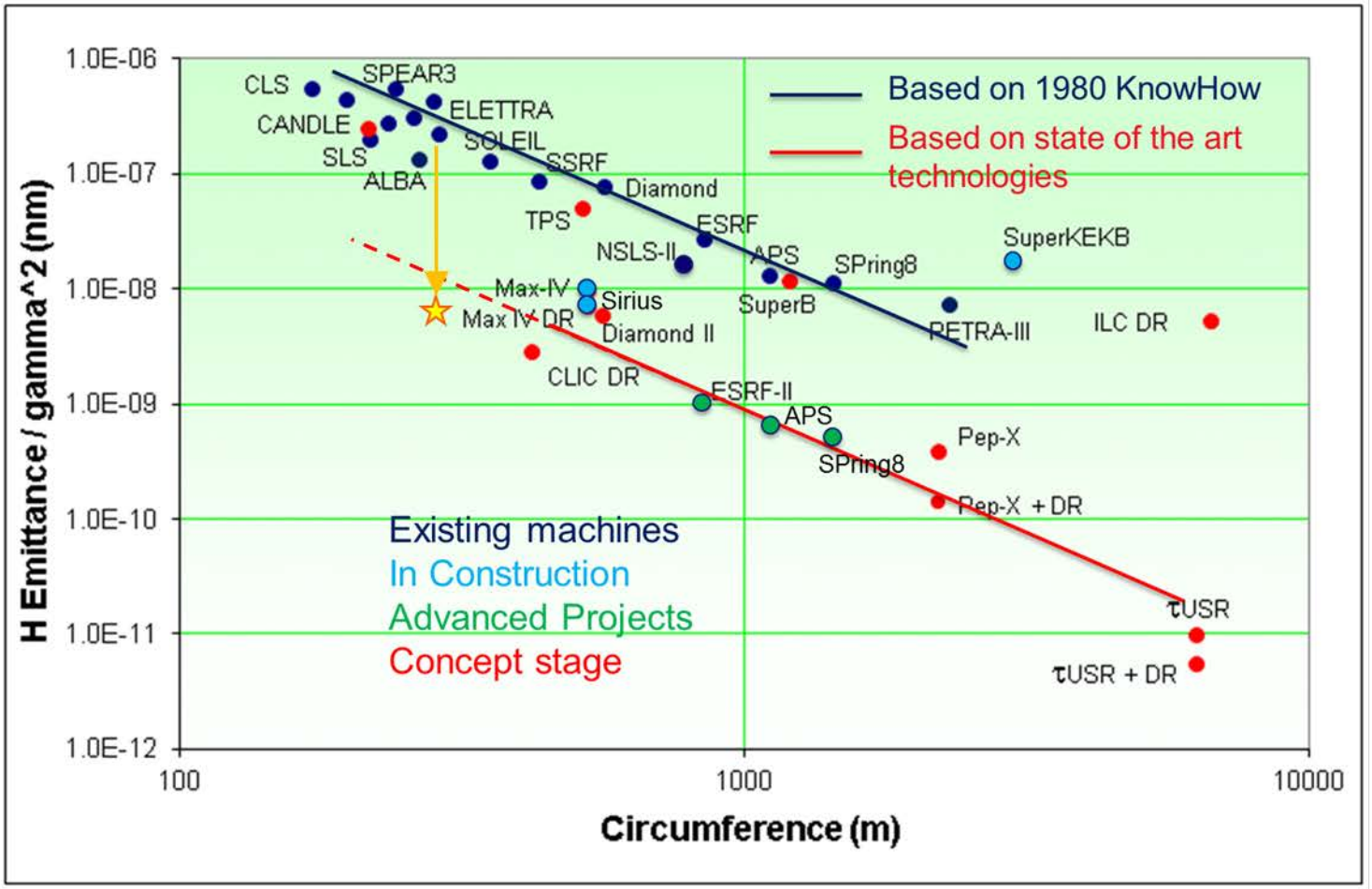
- 2BA→7BA (Taiwan Light Source, ESRF-2, Max-IV, SLS2.0…) , 7BA should have ~40x lower emittance than 2BA

- **Diamond II**: Double Bend Achromat to…
  →the double double bend achromat (DBBA) (x10 less)
  → ***double triple bend achromat (DTBA)*** with 6 bends
  (***Alekou, Bartolini - IPAC2016, Busan, Korea)***

M. Apollonio, Low Emittance Lattice Workshop-2016

This new design → aim: reduction of the emittance to 140 pm (x20 less)

The storage ring generational change



SLS

SLS-2

Emittance scaling

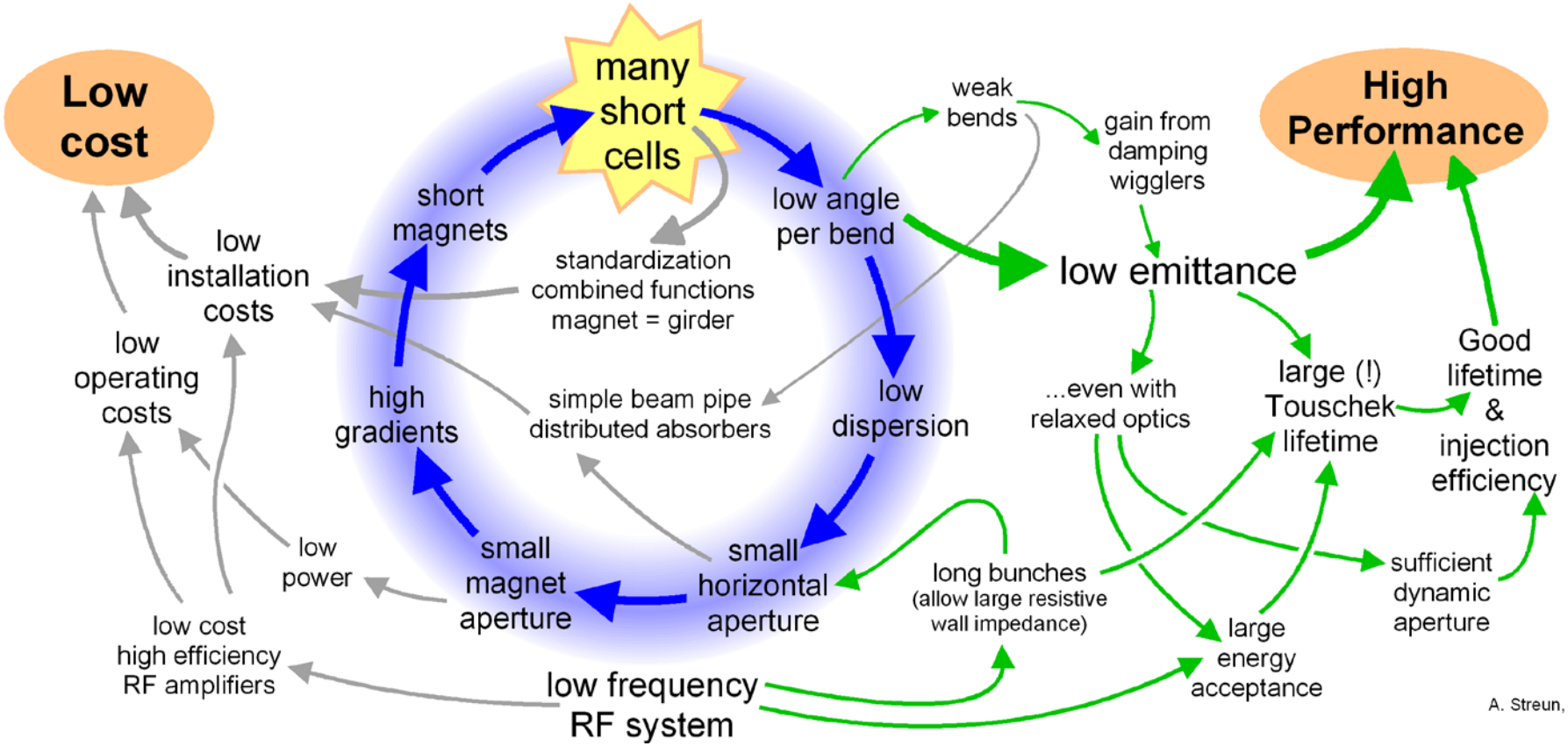
$\varepsilon \propto \gamma^2 C^{-3}$

$\rightarrow$ linear fit

The old (—) and the new (—) generation.

From A. Streun (PSI-2017)

Complex multi-bend achromat optimization cycle



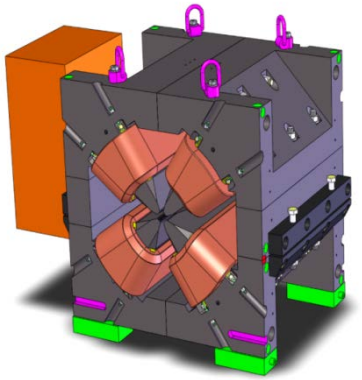
A. Streun (PSI-2017)

⇨ Miniaturization of components until reaching physical or technical limits

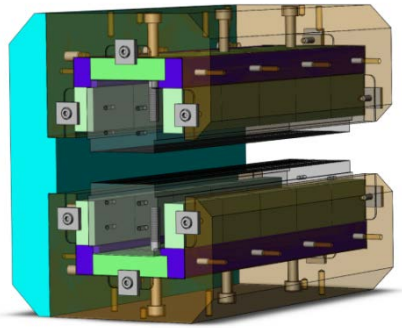
M. Eriksson et al., *Some small-emittance light-source lattices with multi-bend achromats*, NIM A 587 (2008) 221.

MBA Technology

- **small gap/bore** magnets (bore radius *R*)
  - high gradients: 2*n*-pole moment
- increasing use of ***permanent magnets***
  - little flexibility required (one energy, one mode)
  - dense lattice: no space for coils
  - save cabeling and electric energy
- new magnet types and high field superbend
  - longitudinal gradient dipoles, octupoles etc.
  - **(highest radiation (peak field) at region of lowest dispersion)**
  - 3.2T peak field permanent magnet NdFeB superbend (Sirius)
  - 6T peak field ***superconducting superbend*** (SLS 2.0)



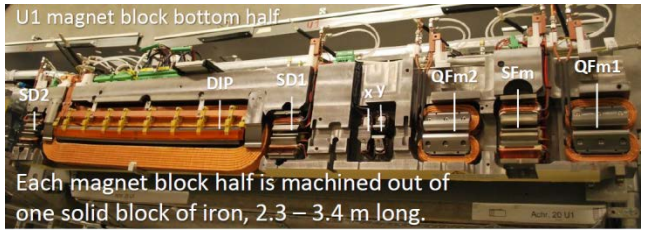
ESRF-EBS quadrupole
90 T/m, R = 12.5 mm



ESRF-EBS permanent magnet dipole

Systems&techniques for :

- **Field quality**
- **Alignment (commissioning tolerances→10 μm….)**
- Combination ***of magnets in blocks*** (Max IV)
- reference surface on girders (ESRF2..)
- Dynamic alignments systems (leveling systems., girder movers…)
- Beam based alignment techniques…



Max IV

Challenges for next magnets & measurements

Future accelerators are very demanding projects,
pushing magnet concepts, designs and materials to their (perceived) limits

- Innovative designs and manufacturing process in compact and low-consumption magnets for mechanical stability and energy efficiency
- Methods and devices to measure small gap and curved magnetic elements needed.
- Projects involving very high field magnets (up to 16 T for the FCC), high field superbends, superconducting insertion devices are pursued.
- New fiducialisation procedures in particular for curved gradient dipoles
- Strong synergy is required between:
  - Beam optics & operation teams
  - Magnet designers
  - Magnet manufacturers
  - Cryogenic & vacuum experts
  - Magnetic measurement crew

Some feedbacks since IMMW19

- **Topics:** Include magnetic measurement techniques for fusion applications
  Common points of interest : Radiation hard sensors, large volume field mapping…
  (see presentation of M. Buzio- Wednesday morning)

- **Tutorials**: Positive feedback from the survey among the IMMW19 participants-But each time focalized on one type of measurement technique
  This time : Hall sensors

- **Round table:** Experience repeated in IMMW20, instead of the session summaries

- **Proceedings :** Do we have to produce proceedings for this workshop (on a voluntary base?,


unique opportunity for participants (students) attending only at this event to publish their work (Impact factor?)


keep the workshop format and lighten the workload (editorial work?)

Your feedback is important (discussion in the round table or survey)

Committees: International and local (IMMW20)

International Advisory Committee (2017)

- Marco Buzio (CERN)
- Josep Campmany (ALBA)
- Joel Chavanne (ESRF)
- Joseph DiMarco (FNAL)
- Ching-Shiang Hwang (NSRRC)
- Animesh Jain (BNL)
- Stephane Sanfilippo (PSI)
- Zack Wolf (SLAC)

Heiner Brueck, DESY : Thank you for your support all these years!

Local organizing committee of IMMW20

- Ed Rial (Chair)
- Stephen Milward
- Abolfazl Shahveh
- Zena Patel
- Emma Clarke (Event Manager)

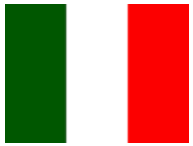
- Frequency :Workshop organized every two years, often linked with the International Conference on Magnet Technology
- Duration : 6 days (since IMMW17-2011)
- Program : Include visits of facilities and magnetic laboratories & culture tours
- Participants: Institutes & University & industrial partners

IMMW20
Delegates & Institutes

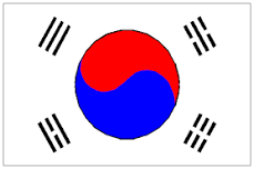

CHINA (3)


FRANCE (5)


GERMANY (8)


Italy (4)


JAPAN (3)


Korea (2)


Romenia (1)


RUSSIAN FEDERATION (4)


SLOVENIA (1)


SPAIN (3)


SWEDEN (4)


SWITZERLAND (11)


TAIWAN (1)


UK (13)


USA (9)

74 participants (close to the record!)
15 Institute Nationalities

IMMW20-Scientific program
A six day event

Day 1 Sunday

- a.m. Tutorials (Hall probe devices and applications)
- p.m. Practical training on magnetic systems

Day 2 Monday

- Overview of activities in laboratories (9 Talks)
- Magnetic alignment (3 Talks)-Tour of Diamond Facility

Day 3 Tuesday

- a.m. Hall probes (4 Talks)
- a.m : Hardware and software (3 Talks)
- p.m Free afternoon-Oxford city centre

Day 4 Wednesday

- a.m : Hardware and software (7 Talks)
- p.m :Application of techniques (3 Talks) & Tour of Jet

Day 5 Thursday

- Measurement reports (10 Talks)
- Tour of Rutherford Lab. + Banquet (evening)

Day 6 Friday

-Rotating coils (3 Talks)

-Round table discussion (chairmen-participants)

42 Talks re-grouped in 6 items

- Tutorials dedicated to Hall devices and applications
- No dedicated session for wire techniques but included in several sessions
- Large session for Hardware and Software
- 1 day session dedicated to measurement reports
- Round table at the end of the workshop
- 3 organized tours (Diamond, JET, ISIS)

End of the workshop : Friday 9 June after Lunch

Sponsors and exhibitors

Sponsors : Thank you for your contribution

Metrolab
Magnetic precision has a name

KYMA

Exhibitions: 5th – 6th June, in the atrium/lobby

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MOTION CONTROLS

Metrolab
Magnetic precision has a name

KYMA

Have a nice & successful Workshop!

"Demain importe plus qu'hier" , P. Mendes France, Député de Grenoble
Colloque Recherche & Enseignement, Caen,1er Novembre 1956

Tomorrow is more important than yesterday