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ZooSphere - A tool for automated spheric image capturing and interactive 3D visualization of biological collection objects

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Project **EoS**

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Erschließung **o**bjektreicher **S**pezialsammlungen (**EoS** - Opening of natural history collections that are rich on objects)

Using the entomological collection of the Museum für Naturkunde Berlin as an example

Period: 01.02.2013 – 30.09.2015

Budget: 1,4 Mill (50% in-house)

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Project **EoS**

Three sub projects:

1. Mass digitization
   - 10.000 insect drawers (30% of the insect collection)
   - 10.000 specimens (in total we have about 150.000 type specimens within the entomological collections)
   - www.digicoll.info

2. Spatial visualization of small objects
   - Further development of methods for spheric image capturing

3. Digital preservation of big data, created within the project

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Mass digitization of insect drawers

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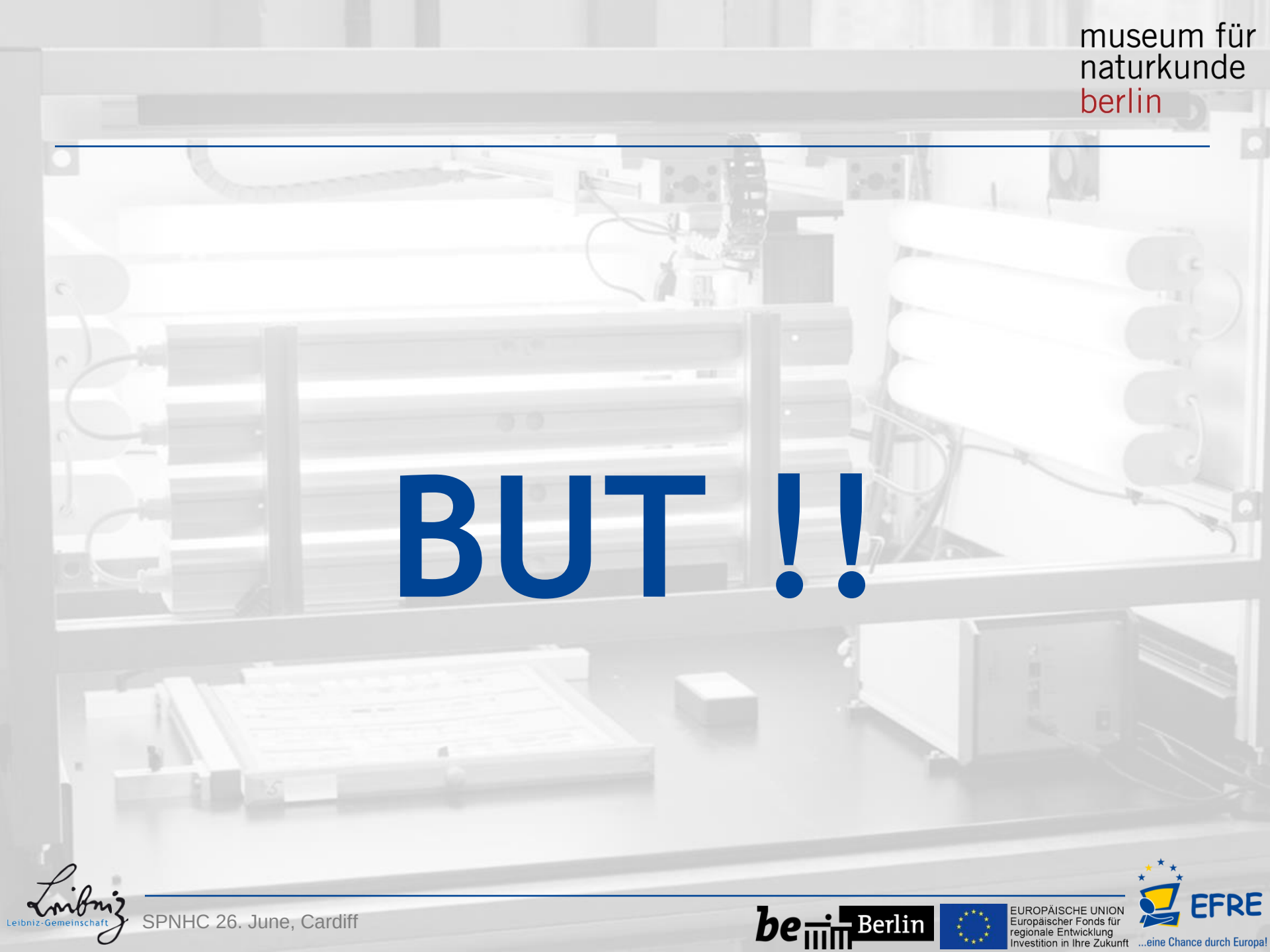
Why digitizing insect drawers ?

- Visiting of museums is for scientists not always possible
  - too expensive to visit every relevant museum for the own research
  - too time consuming

➔ Researchers often focus their attention on the larger collections, while institutions with more modest holdings are either overlooked or intentionally ignored

- Important specimens go undiscovered for many years
- Images can also assist a researcher in determining whether type specimens actually have to be borrowed
- Images would enable better planning prior to an actual visit to a collection
- Online data portals is the most effective way to optimize data quality


BUT !!

Limitations of drawer scans

- Metadata not available
- The taxon name labels are not visible from above
- The dorsal view does not show enough characters
- Sustainability - images are outdated quickly
- Size of the animals (resolution of images not good enough for small objects)
- Limitation in depth of focus

What information do we need from single specimens ?

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- Species name
- Metadata (location, date, collector, determinations -> all information from the labels)
- High resolution images from different angles
- Images from internal characters that are important for the determination, e.g. the genitalia

➔ Not possible for all specimens in our entomological collections

➔ Focusing is necessary !

➔ Type specimens (at the MfN about 150.000 entomological types)

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Why focusing on type material ?

- The type specimens are the most important specimens for taxonomic research
- Documentation of collection management/object status

- **Threats:**
- Museum beetles (e.g. *Anthrenus verbasci*)
  - or moths (e.g. *Teneola biselliella*)
- Especially the types are even more in danger by shipping them from the museums to specialists for their taxonomic work

➔ Images are one possibility of preventive conservation

Requirements for the image creation process

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- High quality images
- The digital specimen must be visible from different angles
- Automated image capturing process
- Minimum of human ressources
- The images have to be useful for scientists

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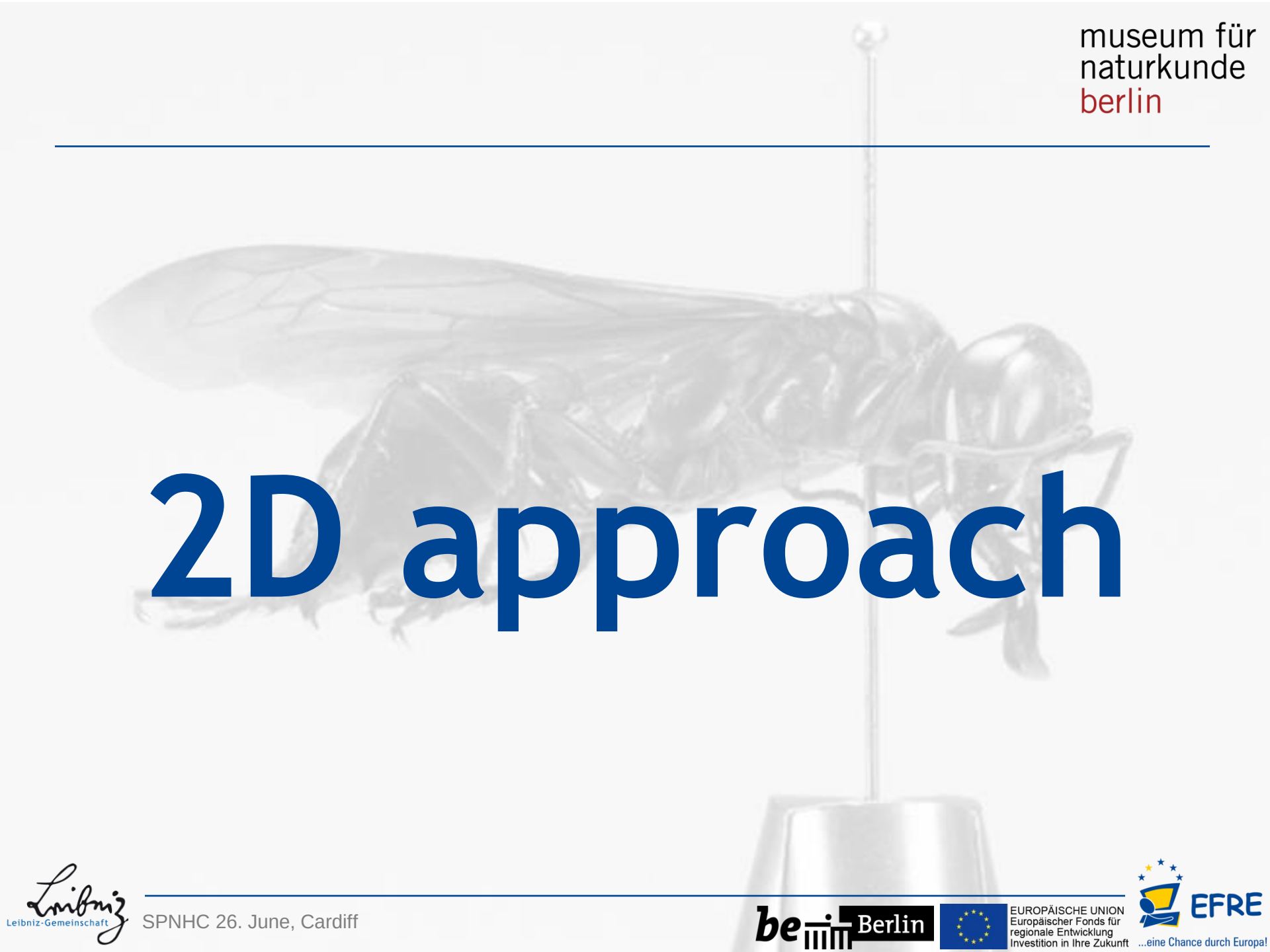

2D approach

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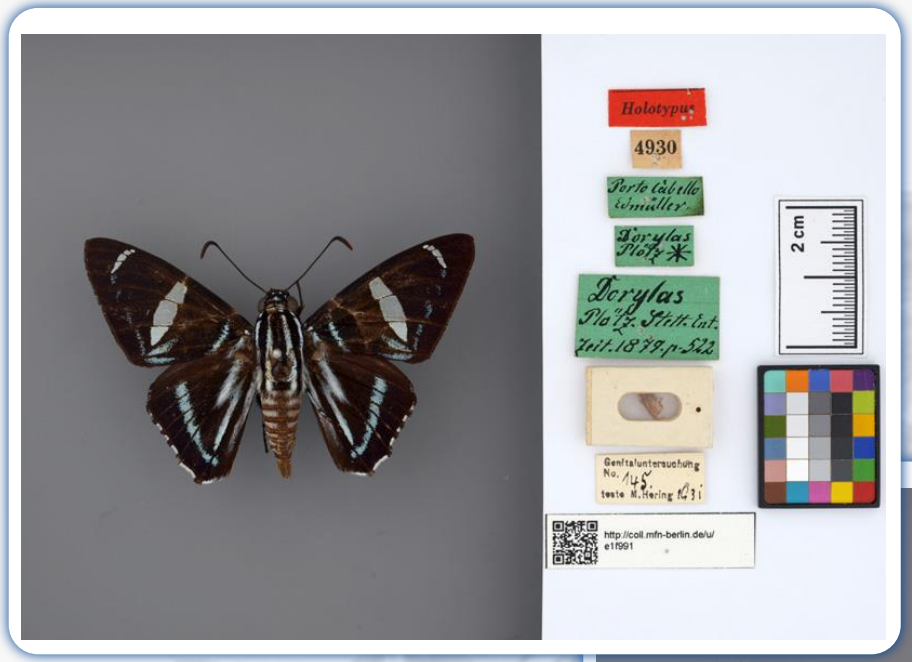
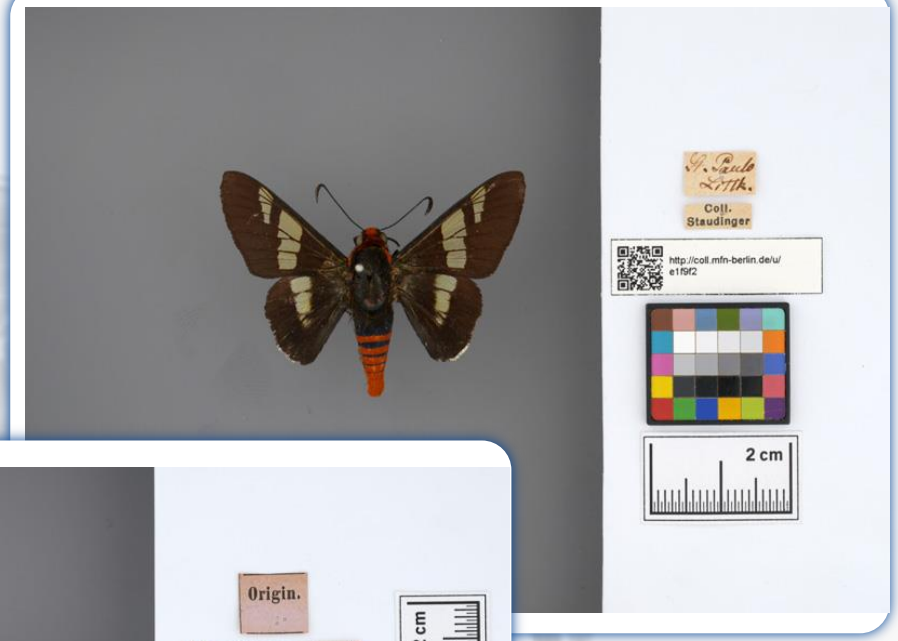
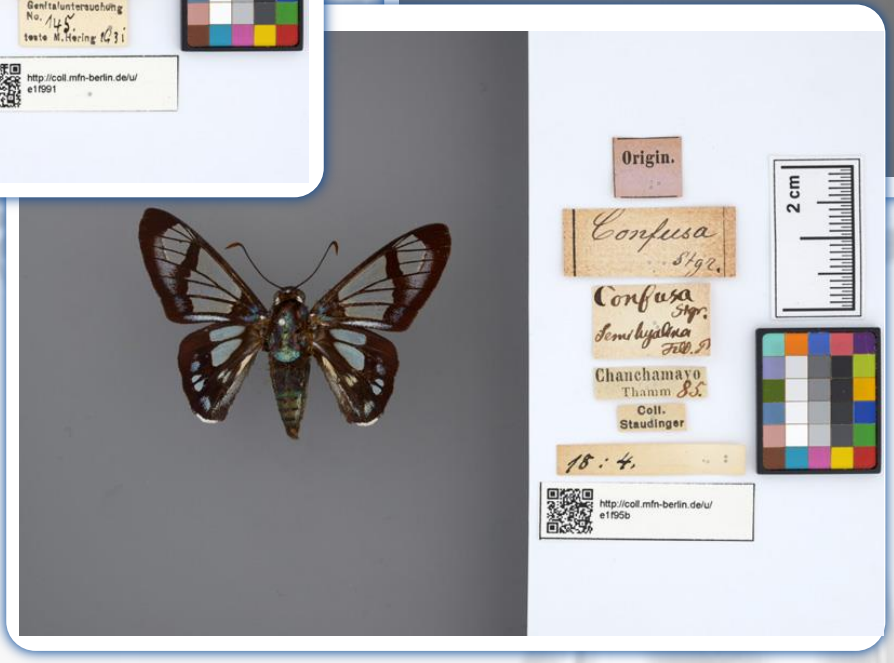
Types of the Hesperiidae (skipper)







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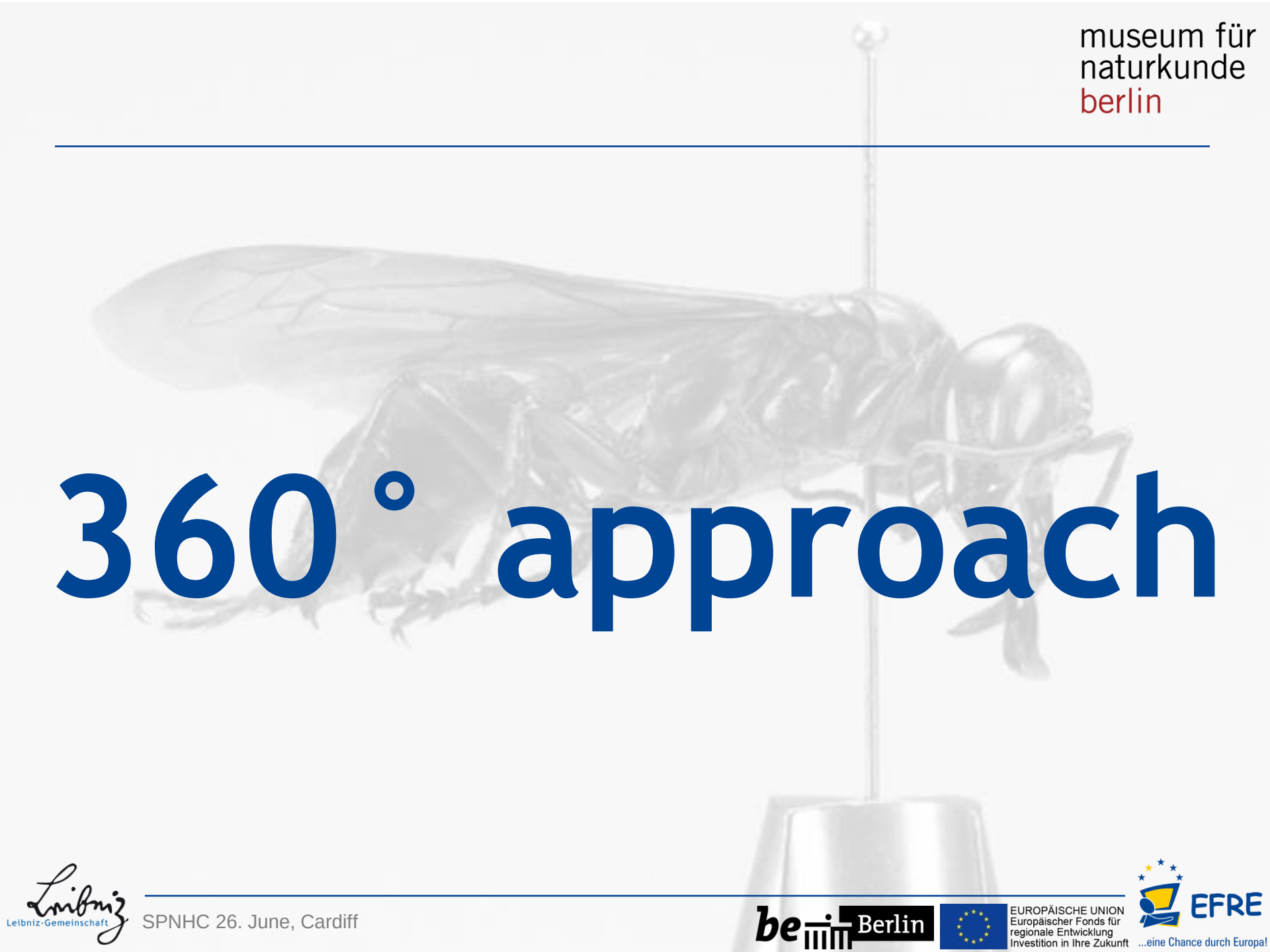

360° approach

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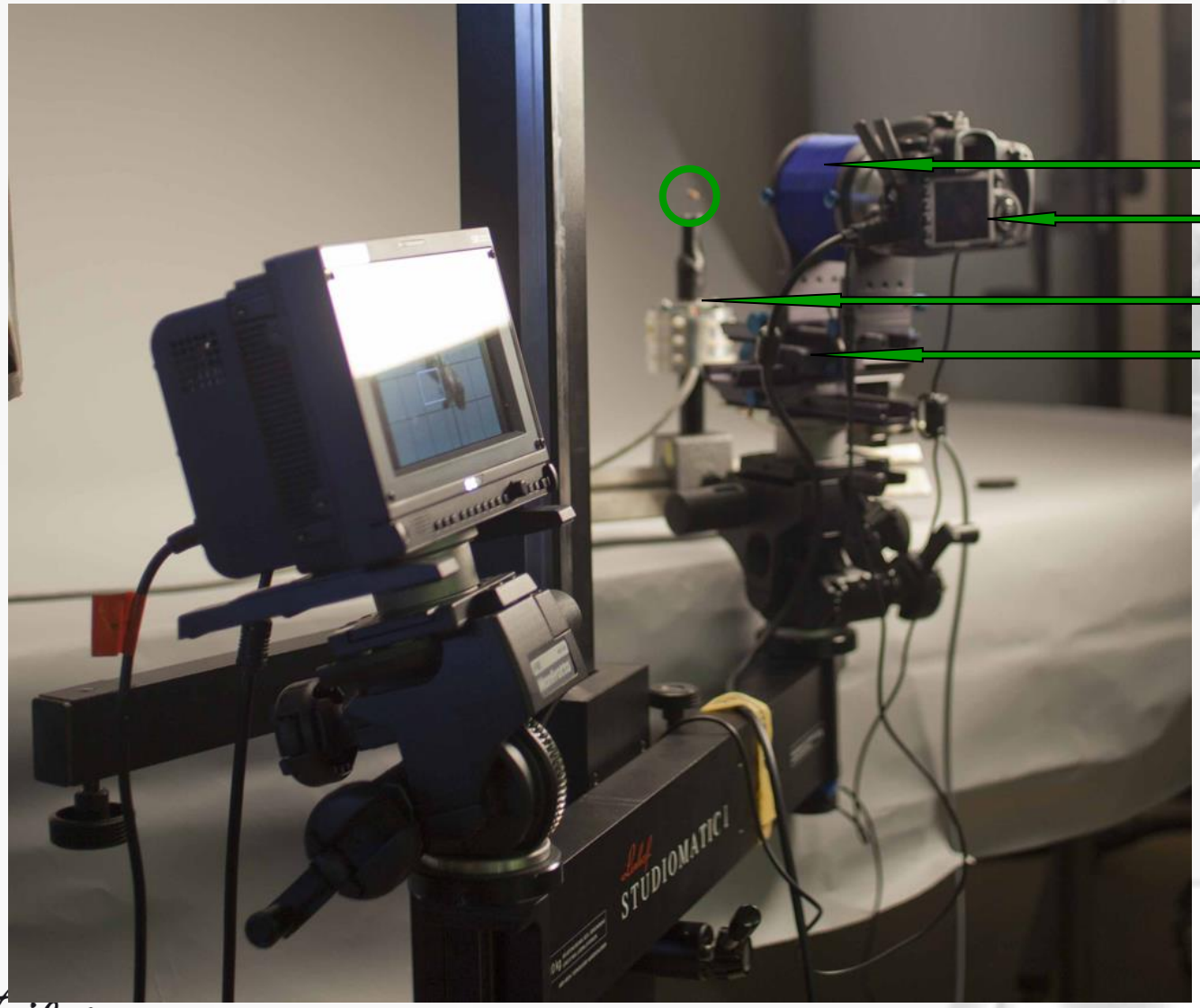
First attempt – 360°



bellows
camera
turn table
adjustable rail

360°approach

http://360grad.biodiv.naturkundemuseum-berlin.de/

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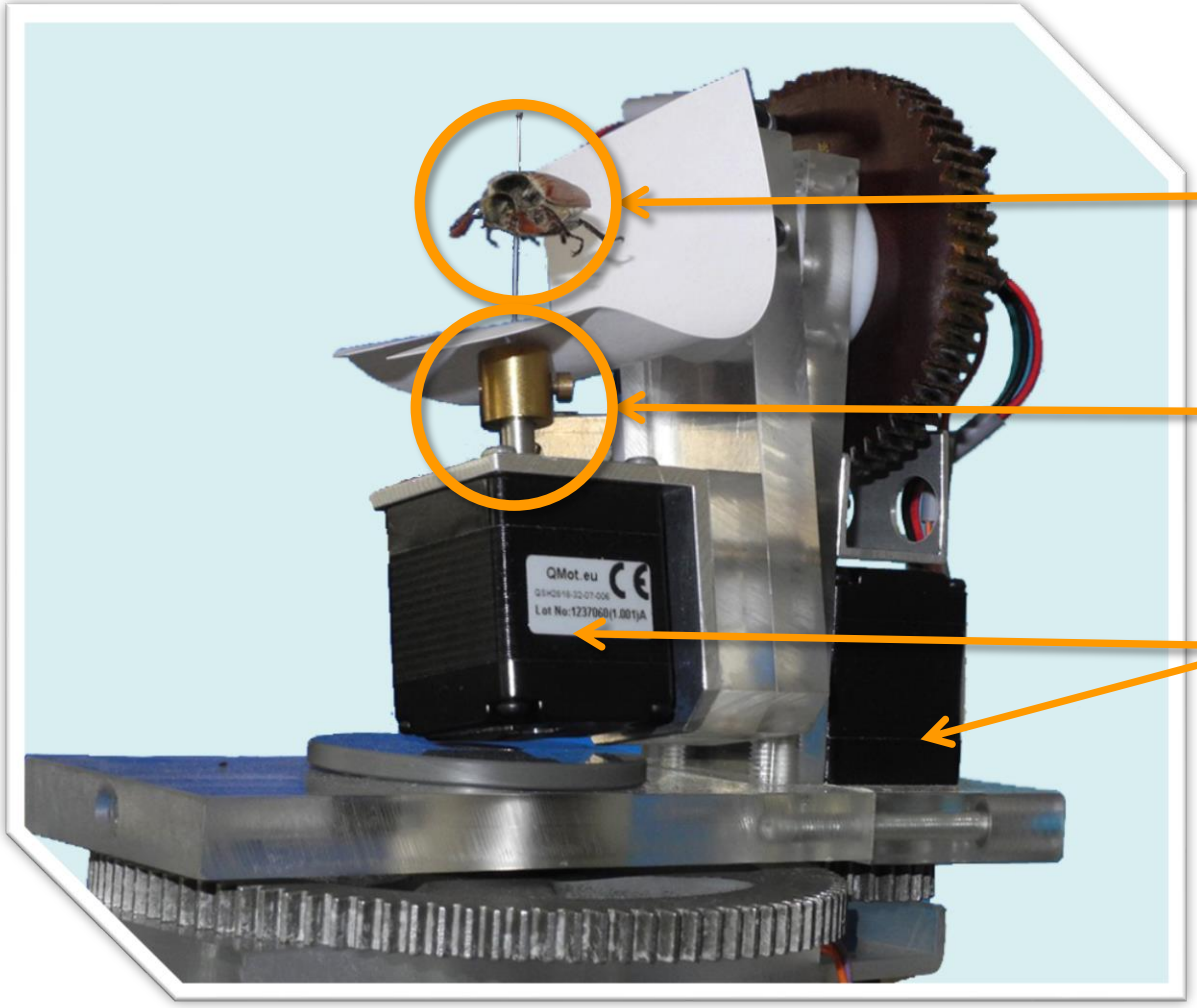
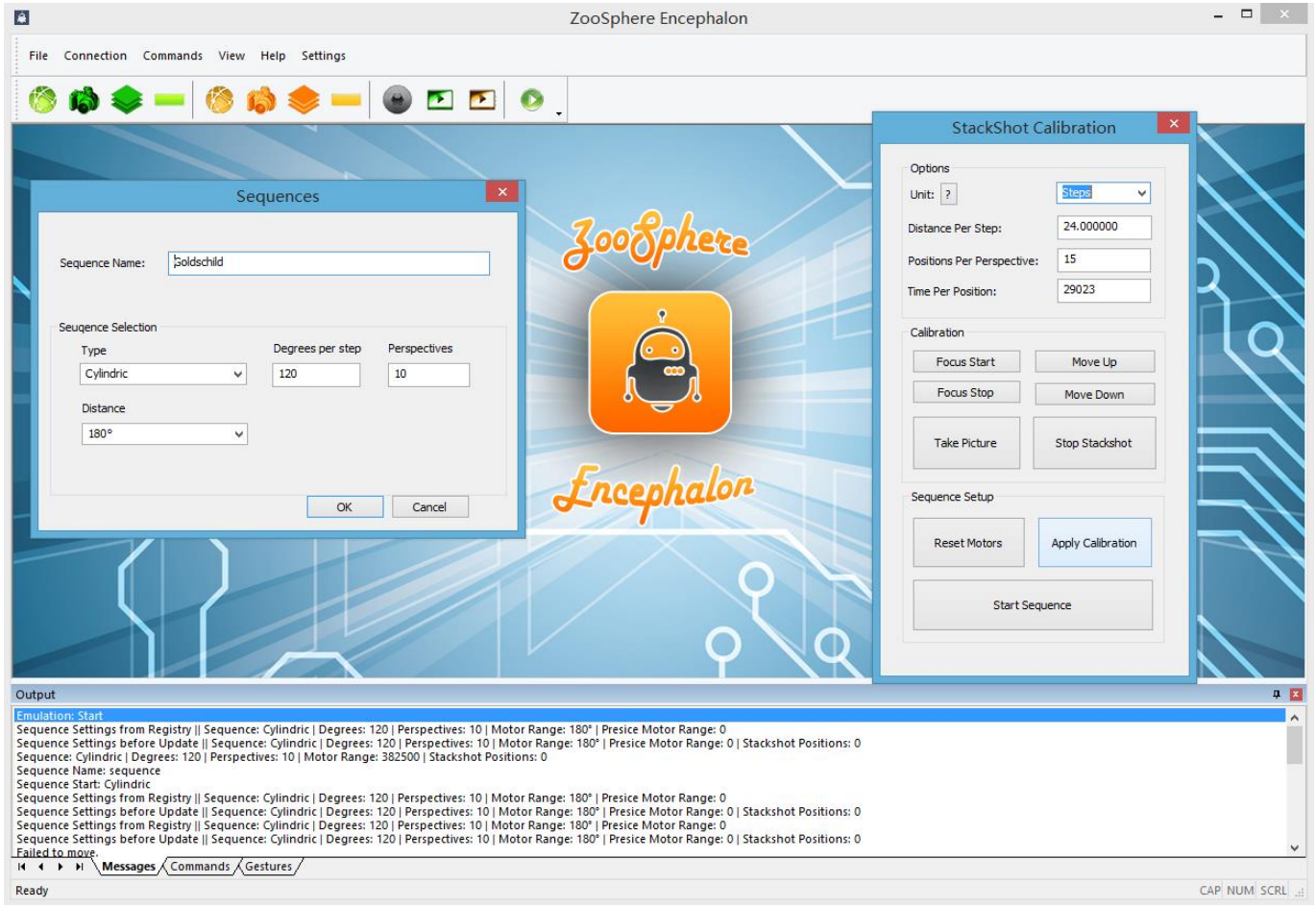
ZooSphere



ZooSphere

- Controlled by a C++ MFC software developed at the MfN



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Some details

- Time for one picture: 2.5 sec per stacking image
- Resolution of the pictures: 24 MegaPixel
- Degree per rotation step: 3° to 6°
- Number of positions: 900 to 1.800
- Number of stacking steps: 10 to 20

➔ In total:

- About 9.000 to 36.000 pictures
- About 7 to 25 hours

http://zoosphere.biodiv.naturkundemuseum-berlin.de/?mode=zoosphere&resolution=1620x1080

Vision for the imaging of single specimens

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- Reduce of loans
- Conserve current state of the specimen for future research
- Protect specimens from different threats
  - Loss by shipping
  - Damage by handling of the specimen
- Facilitate scientific work
- Better, faster and more democratic access to collections and biodiversity than ever before
  - Full scientific access to the valuable material
  - Free online access to all digitized specimens

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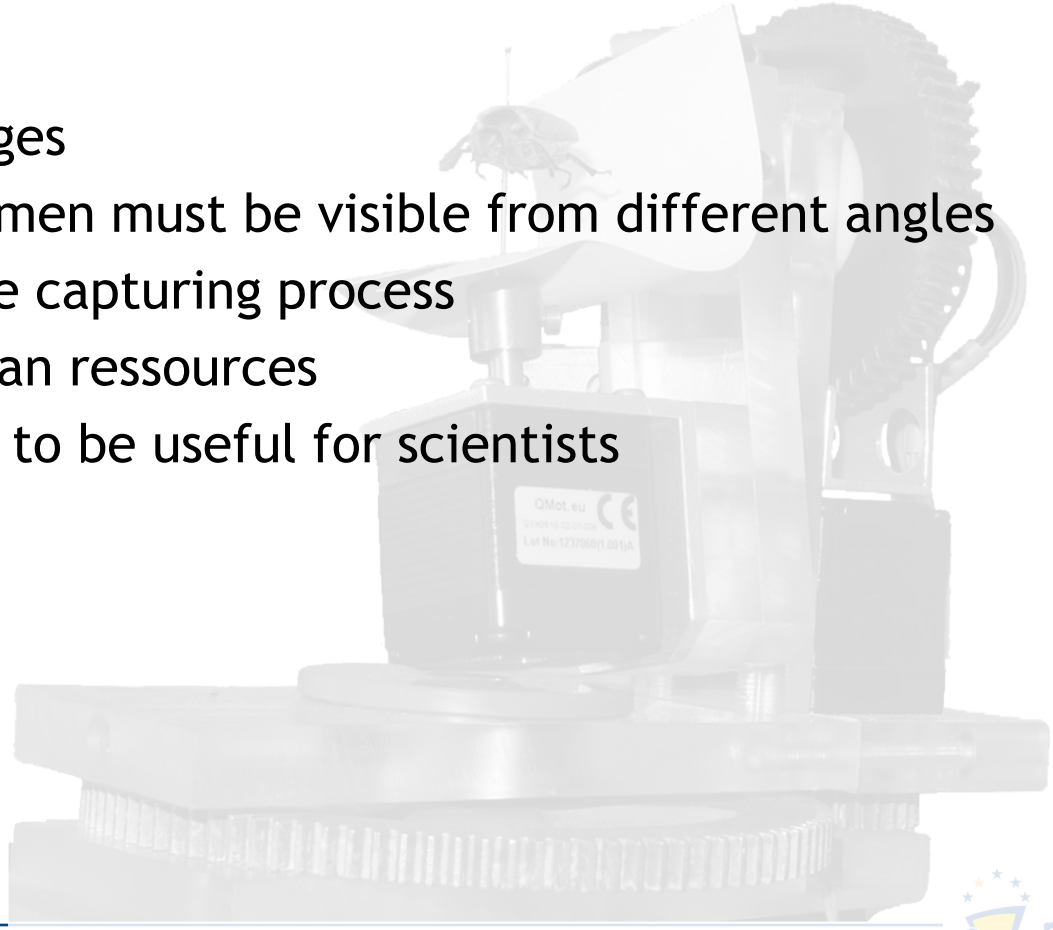
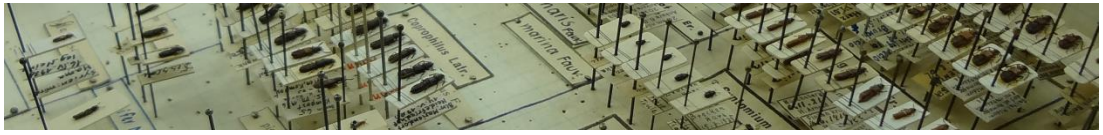


Outlook

The next steps are:

1. Displaying the images in 3D with polarization technology
2. Gesture control of spheric view with Leap Motion technology
3. A spheric ‘ZooSphere’ object in a museum exhibition (*Phasia aurigera* presented as a part of the “Exhibition of Flies” at the MfN – August 2014)
4. Joining the ZooSphere objects with microCT images from internal specimen structures (e.g. neural system or structures necessary for determination of the specimen)
5. Creating 3D models of the specimens from the ZooSphere images

A virtual collection can never replace a real collection of the physical specimens !!



Thanks to:

- Glöckler, Falko
- Graf, Imo
- Pluta, Martin
- Schick, Holger
- Schneider, Hendryk
- Schurian, Bernhard

BMBF (Federal Ministry of Education and Research)

- Verbundvorhaben GBIF-D: Kompetenzzentren innovativer Datenmobilisierung - Teilprojekt 4: Digitale Forschungsinfrastruktur und Dienste für die Bereiche Entomologie und Paläontologie
- Förderkennzeichen: 01 LI 1001 D

ERDF (European Regional Development Fund)

- Effiziente Arbeitsabläufe und innovative Methoden zur Erschließung und dauerhaften Verfügbarmachung objektreicher Spezialsammlungen am Beispiel der entomologischen Sammlung des Museum für Naturkunde Berlin
- Projektnummer: Inno 02- 2013000365

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Many thanks for your attention !