

# Hereditary (bi)coreflective subcategories in certain categories of semitopological groups

Veronika Pitrová

Jan Evangelista Purkyně University in Ústí nad Labem

Winter School in Abstract Analysis 2019

- $(G, \circ)$  – group with a topology

# Semitopological groups

- $(G, \circ)$  – group with a topology  
     $\circ : G \times G \rightarrow G$  is separately continuous

- $(G, \circ)$  – group with a topology
  - $\circ : G \times G \rightarrow G$  is separately continuous
  - $\forall g \in G : (g, x) \mapsto g \circ x$   
 $(x, g) \mapsto x \circ g$  are continuous

# Semitopological groups

- $(G, \circ)$  – group with a topology
  - $\circ : G \times G \rightarrow G$  is separately continuous
  - $\forall g \in G : (g, x) \mapsto g \circ x$   
 $(x, g) \mapsto x \circ g$  are continuous
- **STopGr** – the category of all semitopological groups and continuous homomorphisms

# Semitopological groups

- $(G, \circ)$  – group with a topology
  - $\circ : G \times G \rightarrow G$  is separately continuous
  - $\forall g \in G : (g, x) \mapsto g \circ x$   
 $(x, g) \mapsto x \circ g$  are continuous
- **STopGr** – the category of all semitopological groups and continuous homomorphisms
- all maps are continuous homomorphisms

# Semitopological groups

- $(G, \circ)$  – group with a topology
  - $\circ : G \times G \rightarrow G$  is separately continuous
  - $\forall g \in G : (g, x) \mapsto g \circ x$   
 $(x, g) \mapsto x \circ g$  are continuous
- **STopGr** – the category of all semitopological groups and continuous homomorphisms
- all maps are continuous homomorphisms
- every subcategory of **STopGr** is full – subcategories are determined by their classes of objects

# Semitopological groups

- $(G, \circ)$  – group with a topology
  - $\circ : G \times G \rightarrow G$  is separately continuous
  - $\forall g \in G : (g, x) \mapsto g \circ x$   
 $(x, g) \mapsto x \circ g$  are continuous
- **STopGr** – the category of all semitopological groups and continuous homomorphisms
- all maps are continuous homomorphisms
- every subcategory of **STopGr** is full – subcategories are determined by their classes of objects
- every subcategory of **STopGr** is isomorphism-closed



- $\mathbf{A} \subseteq \mathbf{STopGr}$  is reflective in  $\mathbf{STopGr}$ :

- $\mathbf{A} \subseteq \mathbf{STopGr}$  is reflective in  $\mathbf{STopGr}$ :  
 $\forall G \in \mathbf{STopGr} \exists H \in \mathbf{A}, r : G \rightarrow H :$

- $\mathbf{A} \subseteq \mathbf{STopGr}$  is reflective in  $\mathbf{STopGr}$ :

$\forall G \in \mathbf{STopGr} \exists H \in \mathbf{A}, r : G \rightarrow H :$

$\forall H' \in \mathbf{A} \forall f : G \rightarrow H' \exists! \bar{f} : H \rightarrow H'$ , such that the following diagram commutes:

$$\begin{array}{ccc} G & \xrightarrow{r} & H \\ & \searrow f & \downarrow \bar{f} \\ & & H' \end{array}$$

- $\mathbf{A} \subseteq \mathbf{STopGr}$  is reflective in  $\mathbf{STopGr}$ :

$\forall G \in \mathbf{STopGr} \exists H \in \mathbf{A}, r : G \rightarrow H :$

$\forall H' \in \mathbf{A} \forall f : G \rightarrow H' \exists! \bar{f} : H \rightarrow H'$ , such that the following diagram commutes:

$$\begin{array}{ccc} G & \xrightarrow{r} & H \\ & \searrow f & \downarrow \bar{f} \\ & & H' \end{array}$$

- epireflective: every reflection is an epimorphism

- $\mathbf{A} \subseteq \mathbf{STopGr}$  is reflective in  $\mathbf{STopGr}$ :

$\forall G \in \mathbf{STopGr} \exists H \in \mathbf{A}, r : G \rightarrow H :$

$\forall H' \in \mathbf{A} \forall f : G \rightarrow H' \exists ! \bar{f} : H \rightarrow H'$ , such that the following diagram commutes:

$$\begin{array}{ccc} G & \xrightarrow{r} & H \\ & \searrow f & \downarrow \bar{f} \\ & & H' \end{array}$$

- epireflective: every reflection is an epimorphism
- extremal epireflective: every reflection is an extremal epimorphism (quotient map)

- epireflective  $\Leftrightarrow$  closed under the formation of products and subgroups

# Epireflective subcategories of $\mathbf{STopGr}$

- epireflective  $\Leftrightarrow$  closed under the formation of products and subgroups
  - quasitopological groups ( $\mathbf{QTopGr}$ )
  - paratopological groups ( $\mathbf{PTopGr}$ )
  - topological groups ( $\mathbf{TopGr}$ )

# Epireflective subcategories of $\mathbf{STopGr}$

- epireflective  $\Leftrightarrow$  closed under the formation of products and subgroups
  - quasitopological groups ( $\mathbf{QTopGr}$ )
  - paratopological groups ( $\mathbf{PTopGr}$ )
  - topological groups ( $\mathbf{TopGr}$ )
- extremal epireflective  $\Leftrightarrow$  closed under the formation of products, subgroups and semitopological groups with finer topologies



# Epireflective subcategories of **S**TopGr

- epireflective  $\Leftrightarrow$  closed under the formation of products and subgroups
  - quasitopological groups (**Q**TopGr)
  - paratopological groups (**P**TopGr)
  - topological groups (**T**opGr)
- extremal epireflective  $\Leftrightarrow$  closed under the formation of products, subgroups and semitopological groups with finer topologies
  - abelian semitopological groups (**S**TopAb)
  - torsion-free semitopological groups
  - Hausdorff semitopological groups

# Coreflective subcategories

- $\mathbf{B} \subseteq \mathbf{A}$  is coreflective in  $\mathbf{A}$ :

# Coreflective subcategories

- $\mathbf{B} \subseteq \mathbf{A}$  is coreflective in  $\mathbf{A}$ :  
 $\forall G \in \mathbf{A} \exists H \in \mathbf{B}, c : H \rightarrow G :$

# Coreflective subcategories

- $\mathbf{B} \subseteq \mathbf{A}$  is coreflective in  $\mathbf{A}$ :

$\forall G \in \mathbf{A} \exists H \in \mathbf{B}, c : H \rightarrow G :$

$\forall H' \in \mathbf{B} \forall f : H' \rightarrow G \exists! \bar{f} : H' \rightarrow H$ , such that the following diagram commutes:

$$\begin{array}{ccc} H & \xrightarrow{c} & G \\ \bar{f} \uparrow & & \nearrow f \\ H' & & \end{array}$$

# Coreflective subcategories

- $\mathbf{B} \subseteq \mathbf{A}$  is coreflective in  $\mathbf{A}$ :

$\forall G \in \mathbf{A} \exists H \in \mathbf{B}, c : H \rightarrow G :$

$\forall H' \in \mathbf{B} \forall f : H' \rightarrow G \exists! \bar{f} : H' \rightarrow H$ , such that the following diagram commutes:

$$\begin{array}{ccc} H & \xrightarrow{c} & G \\ \bar{f} \uparrow & & \nearrow f \\ H' & & \end{array}$$

- monoreflective: every coreflection is a monomorphism

# Coreflective subcategories

- $\mathbf{B} \subseteq \mathbf{A}$  is coreflective in  $\mathbf{A}$ :

$\forall G \in \mathbf{A} \exists H \in \mathbf{B}, c : H \rightarrow G :$

$\forall H' \in \mathbf{B} \forall f : H' \rightarrow G \exists! \bar{f} : H' \rightarrow H$ , such that the following diagram commutes:

$$\begin{array}{ccc} H & \xrightarrow{c} & G \\ \bar{f} \uparrow & & \nearrow f \\ H' & & \end{array}$$

- monoreflective: every coreflection is a monomorphism
- bicoreflective: every coreflection is a bimorphism (monomorphism and epimorphism)

# Coreflective subcategories in $\mathbf{A}$

- monoreflective  $\Leftrightarrow$  closed under the formation of coproducts and extremal quotients

# Coreflective subcategories in $\mathbf{A}$

- monoreflective  $\Leftrightarrow$  closed under the formation of coproducts and extremal quotients
  - extremal quotient:  $G_1 \xrightarrow{q} G_2$



# Coreflective subcategories in $\mathbf{A}$

- monoreflective  $\Leftrightarrow$  closed under the formation of coproducts and extremal quotients
  - extremal quotient:  $G_1 \xrightarrow{q} G_2 \xrightarrow{r} G_3$

- monoreflective  $\Leftrightarrow$  closed under the formation of coproducts and extremal quotients
  - extremal quotient:  $G_1 \xrightarrow{q} G_2 \xrightarrow{r} G_3$
  - coproduct: the most general group from  $\mathbf{A}$  that is generated by the given groups

- monoreflective  $\Leftrightarrow$  closed under the formation of coproducts and extremal quotients
  - extremal quotient:  $G_1 \xrightarrow{q} G_2 \xrightarrow{r} G_3$
  - coproduct: the most general group from  $\mathbf{A}$  that is generated by the given groups
- hereditary: closed under the formation of subgroups

# Coreflective subcategories in $\mathbf{A}$

- monoreflective  $\Leftrightarrow$  closed under the formation of coproducts and extremal quotients
  - extremal quotient:  $G_1 \xrightarrow{q} G_2 \xrightarrow{r} G_3$
  - coproduct: the most general group from  $\mathbf{A}$  that is generated by the given groups
- hereditary: closed under the formation of subgroups
- hereditary coreflective  $\Rightarrow$  monoreflective

# Coreflective subcategories in $\mathbf{A}$

- monoreflective  $\Leftrightarrow$  closed under the formation of coproducts and extremal quotients
  - extremal quotient:  $G_1 \xrightarrow{q} G_2 \xrightarrow{r} G_3$
  - coproduct: the most general group from  $\mathbf{A}$  that is generated by the given groups
- hereditary: closed under the formation of subgroups
- hereditary coreflective  $\Rightarrow$  monoreflective
- coreflective, contains  $r(\mathbb{Z}) \Rightarrow$  bireflective

# Coreflective subcategories in $\mathbf{A}$

- monoreflective  $\Leftrightarrow$  closed under the formation of coproducts and extremal quotients
  - extremal quotient:  $G_1 \xrightarrow{q} G_2 \xrightarrow{r} G_3$
  - coproduct: the most general group from  $\mathbf{A}$  that is generated by the given groups
- hereditary: closed under the formation of subgroups
- hereditary coreflective  $\Rightarrow$  monoreflective
- coreflective, contains  $r(\mathbb{Z}) \Rightarrow$  bireflective  
e.g. **QTopGr** in **STopGr**, **TopGr** in **PTopGr**

Which hereditary coreflective subcategories of  $\mathbf{A}$  are also bicoreflective in  $\mathbf{A}$ ?

Which hereditary coreflective subcategories of  $\mathbf{A}$  are also bicoreflective in  $\mathbf{A}$ ?

- **S**TopGr, **Q**TopGr: every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-indiscrete group is bicoreflective in  $\mathbf{A}$ .



Which hereditary coreflective subcategories of  $\mathbf{A}$  are also bicoreflective in  $\mathbf{A}$ ?

- **S**TopGr, **Q**TopGr: every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-indiscrete group is bicoreflective in  $\mathbf{A}$ .  
Are there other epireflective subcategories of **S**TopGr with this property?

Which hereditary coreflective subcategories of  $\mathbf{A}$  are also bicoreflective in  $\mathbf{A}$ ?

- **S**TopGr, **Q**TopGr: every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-indiscrete group is bicoreflective in  $\mathbf{A}$ . Are there other epireflective subcategories of **S**TopGr with this property?
- What are maximal hereditary coreflective subcategories of  $\mathbf{A}$  that are not bicoreflective in  $\mathbf{A}$ ?

Which hereditary coreflective subcategories of  $\mathbf{A}$  are also bicoreflective in  $\mathbf{A}$ ?

- **S**TopGr, **Q**TopGr: every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-indiscrete group is bicoreflective in  $\mathbf{A}$ . Are there other epireflective subcategories of **S**TopGr with this property?
- What are maximal hereditary coreflective subcategories of  $\mathbf{A}$  that are not bicoreflective in  $\mathbf{A}$ ?
- What is the group  $r(\mathbb{Z})$ ?

# The group $r(\mathbb{Z})$

$r(\mathbb{Z})$  can be:

# The group $r(\mathbb{Z})$

$r(\mathbb{Z})$  can be:

- a finite cyclic group  $Z_n$

# The group $r(\mathbb{Z})$

$r(\mathbb{Z})$  can be:

- a finite cyclic group  $Z_n$
- the group of integers with a topology such that  $Z \rightarrow nZ$  is continuous for every  $n \in \mathbb{N}$

# The group $r(\mathbb{Z})$

$r(\mathbb{Z})$  can be:

- a finite cyclic group  $Z_n$
- the group of integers with a topology such that  $Z \rightarrow nZ$  is continuous for every  $n \in \mathbb{N}$
- $\mathbb{Z}$

# The group $r(\mathbb{Z})$

$r(\mathbb{Z})$  can be:

- a finite cyclic group  $Z_n$
- the group of integers with a topology such that  $Z \rightarrow nZ$  is continuous for every  $n \in \mathbb{N}$
- $\mathbb{Z}$
- $Z_n$



# The group $r(\mathbb{Z})$

$r(\mathbb{Z})$  can be:

- a finite cyclic group  $Z_n$
- the group of integers with a topology such that  $Z \rightarrow nZ$  is continuous for every  $n \in \mathbb{N}$
- $\mathbb{Z}$
- $Z_n$
- $Z$  with a topology that is not  $T_0$

# The group $r(\mathbb{Z})$

$r(\mathbb{Z})$  can be:

- a finite cyclic group  $Z_n$
- the group of integers with a topology such that  $Z \rightarrow nZ$  is continuous for every  $n \in \mathbb{N}$
- $\mathbb{Z}$
- $Z_n$
- $Z$  with a topology that is not  $T_0$
- $Z$  with the topology generated by all non-trivial subgroups

$$r(\mathbb{Z}) = \mathbb{Z}$$

- **S**TopGr, **Q**TopGr:

every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-indiscrete group is bicoreflective in  $\mathbf{A}$

$$r(\mathbb{Z}) = \mathbb{Z}$$

- **S**TopGr, **Q**TopGr:

every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-indiscrete group is bicoreflective in  $\mathbf{A}$

hereditary coreflective, not bicoreflective:

- only the trivial group
- all indiscrete groups

$$r(\mathbb{Z}) = \mathbb{Z}$$

- **S**TopGr, **Q**TopGr:

every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**

hereditary coreflective, not bicoreflective:

- only the trivial group
- all indiscrete groups
- **A**: extremal epireflective in **S**TopGr,  $\mathbf{A} \subseteq \mathbf{S}\mathbf{TopAb}$

$$r(\mathbb{Z}) = \mathbb{Z}$$

- **S**TopGr, **Q**TopGr:

every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**

hereditary coreflective, not bicoreflective:

- only the trivial group
- all indiscrete groups

- **A**: extremal epireflective in **S**TopGr,  $\mathbf{A} \subseteq \mathbf{S}\mathbf{TopAb}$

**B**: such groups  $G$  from **A** that no infinite cyclic subgroup of  $G$  is  $T_0$

$$r(\mathbb{Z}) = \mathbb{Z}$$

- **S**TopGr, **Q**TopGr:

every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**

hereditary coreflective, not bicoreflective:

- only the trivial group
- all indiscrete groups

- **A**: extremal epireflective in **S**TopGr,  $\mathbf{A} \subseteq \mathbf{S}\mathbf{TopAb}$

**B**: such groups  $G$  from **A** that no infinite cyclic subgroup of  $G$  is  $T_0$

**B** is the largest hereditary coreflective subcategory of **A** that is not bicoreflective in **A**

$$r(\mathbb{Z}) = \mathbb{Z}_n$$

- **A:** such groups  $G$  that every element of  $G$  is a divisor of  $n$



$$r(\mathbb{Z}) = \mathbb{Z}_n$$

- **A**: such groups  $G$  that every element of  $G$  is a divisor of  $n$   
**A** is extremal epireflective in **STopGr**,  $r(\mathbb{Z}) = \mathbb{Z}_n$

$$r(\mathbb{Z}) = \mathbb{Z}_n$$

- **A**: such groups  $G$  that every element of  $G$  is a divisor of  $n$   
**A** is extremal epireflective in **STopGr**,  $r(\mathbb{Z}) = \mathbb{Z}_n$   
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**

$$r(\mathbb{Z}) = \mathbb{Z}_n$$

- **A**: such groups  $G$  that every element of  $G$  is a divisor of  $n$   
**A** is extremal epireflective in **STopGr**,  $r(\mathbb{Z}) = \mathbb{Z}_n$   
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**
- $r(\mathbb{Z}) = \mathbb{Z}_p$ ,  $p$  is a prime number

$$r(\mathbb{Z}) = \mathbb{Z}_n$$

- **A**: such groups  $G$  that every element of  $G$  is a divisor of  $n$   
**A** is extremal epireflective in **STopGr**,  $r(\mathbb{Z}) = \mathbb{Z}_n$   
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**
- $r(\mathbb{Z}) = \mathbb{Z}_p$ ,  $p$  is a prime number  
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**

$$r(\mathbb{Z}) = \mathbb{Z}_n$$

- **A**: such groups  $G$  that every element of  $G$  is a divisor of  $n$   
**A** is extremal epireflective in **STopGr**,  $r(\mathbb{Z}) = \mathbb{Z}_n$   
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**
- $r(\mathbb{Z}) = \mathbb{Z}_p$ ,  $p$  is a prime number  
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**
- **A**  $\subseteq$  **STopAb**,  $r(\mathbb{Z}) = \mathbb{Z}_n$ ,  $n = p_1^{\alpha_1} \cdots p_k^{\alpha_k}$

$$r(\mathbb{Z}) = \mathbb{Z}_n$$

- **A**: such groups  $G$  that every element of  $G$  is a divisor of  $n$   
**A** is extremal epireflective in **STopGr**,  $r(\mathbb{Z}) = \mathbb{Z}_n$   
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**
- $r(\mathbb{Z}) = \mathbb{Z}_p$ ,  $p$  is a prime number  
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**
- **A**  $\subseteq$  **STopAb**,  $r(\mathbb{Z}) = \mathbb{Z}_n$ ,  $n = p_1^{\alpha_1} \cdots p_k^{\alpha_k}$   
**B<sub>i</sub>**: such groups  $G$  from **A** that if  $H$  is a cyclic subgroup of  $G$  of order  $p_i^{\alpha_i}$  then its topology is strictly coarser than the subspace topology induced from  $r(\mathbb{Z})$

$$r(\mathbb{Z}) = \mathbb{Z}_n$$

- **A**: such groups  $G$  that every element of  $G$  is a divisor of  $n$   
**A** is extremal epireflective in **STopGr**,  $r(\mathbb{Z}) = \mathbb{Z}_n$   
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**
- $r(\mathbb{Z}) = \mathbb{Z}_p$ ,  $p$  is a prime number  
every hereditary coreflective subcategory of **A** that contains a non-indiscrete group is bicoreflective in **A**
- **A**  $\subseteq$  **STopAb**,  $r(\mathbb{Z}) = \mathbb{Z}_n$ ,  $n = p_1^{\alpha_1} \cdots p_k^{\alpha_k}$   
**B<sub>i</sub>**: such groups  $G$  from **A** that if  $H$  is a cyclic subgroup of  $G$  of order  $p_i^{\alpha_i}$  then its topology is strictly coarser than the subspace topology induced from  $r(\mathbb{Z})$   
**B<sub>i</sub>** are maximal hereditary coreflective subcategories of **A** that are not bicoreflective in **A**

$r(\mathbb{Z}) = \mathbb{Z}$ , topology is not  $T_0$

- **$\mathbf{A} \subseteq \mathbf{STopAb}$**   
the closure of  $\{0\}$  in  $r(\mathbb{Z})$  is  $\langle n \rangle$



$r(\mathbb{Z}) = \mathbb{Z}$ , topology is not  $T_0$

- **$\mathbf{A} \subseteq \mathbf{STopAb}$**

the closure of  $\{0\}$  in  $r(\mathbb{Z})$  is  $\langle n \rangle$

- $\langle n \rangle \rightarrow r(\mathbb{Z})$  is an epimorphism: every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-trivial group is bicoreflective in  $\mathbf{A}$

- **$\mathbf{A} \subseteq \mathbf{STopAb}$**

the closure of  $\{0\}$  in  $r(\mathbb{Z})$  is  $\langle n \rangle$

- $\langle n \rangle \rightarrow r(\mathbb{Z})$  is an epimorphism: every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-trivial group is bicoreflective in  $\mathbf{A}$
- $k|n$  is minimal such that  $\langle k \rangle \rightarrow r(\mathbb{Z})$  is an not epimorphism:

- $\mathbf{A} \subseteq \mathbf{STopAb}$

the closure of  $\{0\}$  in  $r(\mathbb{Z})$  is  $\langle n \rangle$

- $\langle n \rangle \rightarrow r(\mathbb{Z})$  is an epimorphism: every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-trivial group is bicoreflective in  $\mathbf{A}$

- $k|n$  is minimal such that  $\langle k \rangle \rightarrow r(\mathbb{Z})$  is an not epimorphism:  
 $\mathbf{B}_k$ : such groups  $G$  from  $\mathbf{A}$  that if  $H$  is an infinite cyclic subgroup of  $G$  then the topology of  $H$  is not finer than the topology of  $\langle k \rangle$

- **$\mathbf{A} \subseteq \mathbf{STopAb}$**

the closure of  $\{0\}$  in  $r(\mathbb{Z})$  is  $\langle n \rangle$

- $\langle n \rangle \rightarrow r(\mathbb{Z})$  is an epimorphism: every hereditary coreflective subcategory of  $\mathbf{A}$  that contains a non-trivial group is bicoreflective in  $\mathbf{A}$

- $k|n$  is minimal such that  $\langle k \rangle \rightarrow r(\mathbb{Z})$  is an not epimorphism:  
 **$\mathbf{B}_k$** : such groups  $G$  from  $\mathbf{A}$  that if  $H$  is an infinite cyclic subgroup of  $G$  then the topology of  $H$  is not finer than the topology of  $\langle k \rangle$   
 **$\mathbf{B}_k$**  are maximal hereditary coreflective subcategories of  $\mathbf{A}$  that are not bicoreflective in  $\mathbf{A}$

$r(\mathbb{Z}) = \mathbb{Z}$ , topology is generated by all non-trivial subgroups

- $\mathbf{A} \subseteq \mathbf{TopAb}$

$r(\mathbb{Z}) = \mathbb{Z}$ , topology is generated by all non-trivial subgroups

- $\mathbf{A} \subseteq \mathbf{TopAb}$   
 $\mathbf{B}_p$  ( $p$  – prime number):

$r(\mathbb{Z}) = \mathbb{Z}$ , topology is generated by all non-trivial subgroups

- **$\mathbf{A} \subseteq \mathbf{TopAb}$**

**$\mathbf{B}_p$**  ( $p$  – prime number): such groups  $G$  from  **$\mathbf{A}$**  that if  $H$  is an infinite cyclic subgroup of  $G$  then there exists  $n \in \mathbb{N}$  such that the subgroup of index  $p^n$  is not open in  $H$

$r(\mathbb{Z}) = \mathbb{Z}$ , topology is generated by all non-trivial subgroups

- **$\mathbf{A} \subseteq \mathbf{TopAb}$**

**$\mathbf{B}_p$**  ( $p$  – prime number): such groups  $G$  from  **$\mathbf{A}$**  that if  $H$  is an infinite cyclic subgroup of  $G$  then there exists  $n \in \mathbb{N}$  such that the subgroup of index  $p^n$  is not open in  $H$

**$\mathbf{B}_p$**  are maximal hereditary coreflective subcategories of  **$\mathbf{A}$**  that are not bicoreflective in  **$\mathbf{A}$**



# Suggestions for further research

- What happens in the case of non-abelian groups?

# Suggestions for further research

- What happens in the case of non-abelian groups?
- What happens when  $r(\mathbb{Z})$  is the group of integers with a topology generated by some of its non-trivial subgroups?

# Suggestions for further research

- What happens in the case of non-abelian groups?
- What happens when  $r(\mathbb{Z})$  is the group of integers with a topology generated by some of its non-trivial subgroups?
- What happens when  $r(\mathbb{Z})$  is the group of integers with a topology that is not generated by its subgroups?

Thank you for your attention.